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# 2017–2018 Minerals Yearbook

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# The Mineral Industry of Brazil

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**Note: In this chapter, information for 2017 is followed by information for 2018.**

Brazil is one of the leading mining countries in the world, producing a wide array of metals, industrial minerals, and mineral fuels. In 2017, Brazil was the world's leading producer of niobium, accounting for 88% of the world's production. It was the second-ranked producer of iron ore, accounting for 18% of world production; the third-ranked producer of asbestos and vermiculite, accounting for 14% each of world production; and the fourth-ranked producer of bauxite, accounting for 13% of world production. Brazil was also the third-ranked producer of talc and pyrophyllite and the second-ranked producer of graphite, accounting for 12% and 10%, respectively, of world production. In 2017, Brazil also ranked third in the world in the production of alumina and magnesium compounds; fourth in the world production of magnesium metal and vanadium; and fifth in the world production of abrasives, beryllium, lime, manganese, silicon, and tantalum. Brazil was also the world's ninth-ranked producer of crude steel, accounting for about 2% of world output, and it was the leading producer of crude steel in South America, accounting for 54% of the region's crude steel production (Instituto Aço Brasil, 2018, p. 10; World Steel Association, 2018, p. 2; Bolen, 2019; Bray, 2019a–c; Corathers, 2019a, b; Flanagan, 2019; Jaskula, 2019; Olson, 2019; Padilla, 2019a, b; Polyak, 2019; Schnebele, 2019; Tanner, 2019; Tuck, 2019a, b; West, 2019).

In 2017, Brazil was the world's 10th-ranked producer of crude petroleum. In South America, it ranked second in crude petroleum reserves (after Venezuela) and third in natural gas reserves (after Venezuela and Peru). Brazil's proven crude petroleum reserves (onshore and offshore) were estimated to be 12.8 billion barrels (Gbbl), and its natural gas reserves were estimated to be 377 billion cubic meters. About 95% of the country's total proven crude petroleum reserves and 82% of its total natural gas reserves were located offshore. In 2017, offshore crude petroleum production accounted for about 95% of the country's total crude petroleum production. The State of Rio de Janeiro accounted for about 68% of total crude petroleum production. Massive pre-salt areas—that is, layers of oil-bearing rock of carbonate composition that are located under thick layers of salt—accounted for 49% of the total crude petroleum production. The pre-salt areas measured about 800 kilometers (km) in length and 200 km in width and were located off the coast of the States of Espirito Santo and Santa Catarina. Government-owned Petróleo Brasileiro S.A. (Petrobras) was the sole participant in Brazil's petroleum and natural gas sectors, playing a significant role in upstream, midstream, and downstream operations (table 3; Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2018a, p. 29, 32, 42, 77, 80; BP p.l.c., 2018, p. 14, 30; Petróleo Brasileiro S.A., 2018).

In 2017, Brazil's nominal gross domestic product (GDP) was about $2 trillion and, based on World Bank data, was ranked as the eighth largest economy in the world. Brazil's nominal GDP increased by about 15% in 2017 compared with that of 2016. In 2017, mineral exports accounted for about 13% of the country's exports (Instituto Brasileiro de Mineração, 2018, p. 88; U.S. Central Intelligence Agency, 2019; World Bank, The, 2019).

## Minerals in the National Economy

Brazil's mineral production in 2017 was valued at $32 billion (representing about 1.5% of the GDP) compared with $24 billion in 2016. This was a decrease in mineral production value of about 40% since its peak of $53 billion in 2011. The increase in 2017 was largely attributed to higher prices and the increase in global demand for various commodities compared with that of 2016. In the second half of the year, about 163,063 workers were employed in the mining sector compared with 166,918 in the second half of 2016. Foreign direct investment (FDI) into Brazil decreased in 2017 to $70.3 billion, down from $73.4 billion in 2016 and below the peak reached in 2011 of $102.4 billion (Departamento Nacional de Produção Mineral, 2017b, p. 2, 6; Economic Commission for Latin America and the Caribbean, 2019, p. 26; Ministério de Minas e Energia, 2019b, p. 2; World Bank, The, 2019).

## Government Policies and Programs

The Ministério de Minas e Energia [Ministry of Mines and Energy] (MME) regulates Brazil's mineral resources through its Departamento Nacional de Produção Mineral [National Department of Mineral Production] (DNPM). The DNPM also inspects mining activity in the country, enforces the Mining Code, and implements the code's legal provisions. Geologic, geophysical, geochemical, hydrologic, and hydrogeologic mapping is performed by the MME's Companhia de Pesquisa de Recursos Minerais [Mineral Resources Research Co.] (CPRM) and includes the dissemination and management of geologic and hydrologic information. The Agência Nacional do Petróleo, Gás Natural e Biocombustíveis [National Agency of Petroleum, Natural Gas and Biofuels] (ANP), which is also part of the MME, has responsibility for regulating activities that integrate the biofuels, crude petroleum, and natural gas industries in the country and for issuing exploration and production licenses (Ministério de Minas e Energia, 2014; 2017a, b; Departamento Nacional de Produção Mineral, 2016).

Brazil's mineral industry is governed by the Mining Code [Decree-law (Act) No. 227 of 1967], which establishes the rights and duties of the holders of mining rights. Public Law No. 5807/13, which was a proposed regulatory framework for mining, continued to be reviewed in 2017. The bill would modify the Mining Code by creating the

Conselho Nacional de Política Mineral [National Mineral Policy Council] to assist the President in strategic decision making on minerals; creating the Agência Nacional de Mineração [National Mining Agency] (ANM), which would replace the DNPM; the new agency would increase the royalties on minerals to a yet-to-be-determined level from their current level of 3% for aluminum, manganese, potassium, and rock salt; 2% for coal, fertilizer, and iron ore; 1% for gold; and 0.2% for carbonates, colored gemstones, noble metals, and precious stones (Ministério de Minas e Energia, 2014; Departamento Nacional de Produção Mineral, 2016; Instituto Brasileiro de Mineração, 2016, p. 8).

Public Law 13.365/2016 was passed in December 2016; the new law made the participation of Petrobras as the exclusive pre-salt operator optional and removed the requirement for Petrobras to hold a minimum 30% stake in all pre-salt projects. The Empresa Brasileira de Administração de Petróleo e Gás Natural–Pré-Sal Petróleo S.A. [Brazilian Company for the Administration of Oil and Natural Gas—Pre-Salt Petroleum S.A.] (PPSA) was created in 2010 to manage new pre-salt crude petroleum reserves and production; PPSA operated under the authority of the MME. The framework also established a development fund to manage Government revenues from pre-salt crude petroleum production and laid out a new production-sharing agreement (PSA) system for pre-salt reserves. Prior to the establishment of Public Law 13.365/2016, Petrobras was to be the sole operator of each PSA and was to hold a minimum 30% stake in all pre-salt projects (Ministério de Minas e Energia, 2017c; WorldOil.com, 2017).

In December 2017, the Government of Brazil enacted law No. 13,540/2017, which changed rules regarding the collection of mining royalties, known in Brazil as Compensação Financeira pela Exploração de Recursos Minerais [Financial Compensation for Mineral Exploitation], or CFEM. Prior to the new law, CFEM taxes were collected based on the mineral product's net sales excluding the sales taxes, transportation costs, and insurance costs; under the new law, taxes are collected based on mineral gross revenue, excluding the sales taxes. The ANM replaced the DNPM and was responsible for setting the guidelines for the implementation of the collection of these royalties. With the new law, CFEM rates were established as follows: a 1% rate for construction aggregates, which included clay, gravel, rocks, sand, and mineral products directly related to the construction sector; 1.5% rate for gold; 2% rate for diamond and other mineral products; 3% rate for manganese, niobium, and rock salt; and 3.5% rate for iron ore, which could be negotiable down to 2% depending on particular circumstances, such as low mineral ore grades, production scale, taxation, and number of employees (Departamento Nacional de Produção Mineral, 2017a; Visconti, 2017).

## Production

In 2017, Brazil reported an estimated 60% increase in the production of tantalum to 200,000 kilograms (kg) from 125,000 kg (revised) in 2016. The following mineral commodities also had significant production increases: ferromanganese, by 47% to 123,470 metric tons (t); graphite (crystalline flake, concentrate), by 46% to 90,000 t (estimated); diamond, by 39% to 255,000 carats (owing to the opening of Lipari Mineração Ltda's Braúna Mine in 2016); niobium content of ferroniobium, by 32% to 58,690 t; silicomanganese, by 22% to 202,520 t; iron content of iron ore, by 19% to 318,587 t; vanadium, by 17% to 5,206 t (owing to higher recovery rates at Canada-based Largo Resources Ltd.'s Maracás Menchen Mine, which was started up in 2016); manganese (gross weight), by 16% to nearly 3.3 million metric tons (Mt); calcite, by 16% to 37.6 Mt; lead (refined, secondary), by 15% to 180,000 t (estimated); niobium, by 15% to 58,137 t; and natural gas liquids, by 14% to 40.5 Gbbl. Other mineral commodities for which production increased in 2017 were ferrochromium (increased by 14%); copper concentrates, ferrosilicon and gold (13% each); gypsum and manganese (12% each); and secondary aluminum, raw steel, and tin (smelted) (10% each). Mineral commodities that reported zero production in 2017 included mined cobalt, nickel carbonate, and uranium. Production of refined cobalt decreased by 89% to 46 t owing mainly to the halt of Grupo Votorantim's Niquelandia and São Miguel Paulista operations in 2016. Several other mineral commodities had significant decreases in production, including primary refined copper, by 48% to 118,300 t; tungsten, by 38% to 200 t (estimated); copper smelter (primary), by 37% to 118,800 t; secondary refined copper, by 36% to 24,800 t; monazite, by 36% to 2,900 t; beryl, by 33% to 80 t; lithium (concentrate), by 32% to 6,000 t (estimated); asbestos, by 24% to 135,000 t (estimated); and phosphate rock ($P_2O_5$), by 24% to 1.6 Mt (estimated). Other mineral commodities for which production decreased in 2017 were lead concentrate, smelted zinc, and vermiculite (decreased by 14% each); tin, metal content (13%); silicon (12%); and mined nickel and phosphate rock (gross weight) (11% each). Data on mineral production are in table 1 (Grupo Votorantim, 2016, p. 17; Largo Resources Ltd., 2017; Lipari Mineração Ltda., 2017, p. 16).

## Structure of the Mineral Industry

In 2017, Vale S.A. was the leading producer of copper, gold, and iron ore in Brazil, and the company had operations throughout the country. Petrobras, which was the sole producer of crude petroleum, had operations both onshore and offshore, and was also the sole operator of Brazil's refineries. Government-owned companies were the majority shareholders in the mineral fuels sector; however, they also played a role in other parts of the mining sector in which the Government held an ownership share (table 2).

Eternit S.A., through its subsidiary Sociedade Anônima Mineração de Amianto S.A., owned Cana Brava, which was the only asbestos operation in the country. Cana Brava was located in Minacu in the State of Goias and had the capacity to produce about 300,000 metric tons per year (t/yr) of asbestos concentrates. Bauxite was produced by Alcoa Aluminio S.A. [which had an annual capacity of 1.1 million metric tons per year (Mt/yr) of bauxite], Alcoa World Alumina Brasil Ltda. (6.6 Mt/yr of bauxite), Companhia Brasileira de Aluminio (3 Mt/yr of bauxite), Mineração Paragominas S.A. (11.4 Mt/yr of bauxite), and Mineração Rio do Norte S.A. (MRN). MRN, which is located in Porto Trombetas in the State of Para, had the largest production capacity at 18.1 Mt/yr of bauxite. Caraiba Metais S.A., which was located in the State of Bahia and 100%

owned by Paranapanema S.A., was the only electrolytic copper producer in the country; it had a production capacity of about 280,000 t/yr. Grupo Votorantim, which was the only producer of zinc in the country, owned two mines (Vazante and Morro Agudo) and two metallurgy operations (Juiz de Fora and Tres Marias) located in the State of Minas Gerais. The Juiz de Fora and the Tres Marias operations had annual production capacities of about 95,000 t/yr and 190,000 t/yr of zinc, respectively. Table 2 is a list of major mineral industry facilities.

## Mineral Trade

Brazil's mineral exports in 2017 were valued at about $24 billion compared with about $17.5 billion in 2016; mineral exports accounted for 11% of the country's total exports of $217.8 billion. The country's major export trade partners were, in descending order of export value, China, which received 22% of Brazil's exports; the United States, 12%; Argentina, 8%; and the Netherlands, 4%. Iron ore accounted for about 60% of the value of mineral exports, followed by copper, 8%; bauxite, 5%; and gold, 4% (Banco Central do Brasil, 2018; Ministério de Minas e Energia, 2019b, p. 10; 2019c).

Brazil's mineral imports in 2017 were valued at about $7.8 billion compared with about $5.4 billion in 2016; mineral imports accounted for 5% of the country's total imports of $150.7 billion. The country's major import trade partners were, in descending order of import value, China, which provided 18% of Brazil's imports; the United States, 17%; and Argentina and Germany, 6% each. Coal accounted for about 46% of mineral imports, followed by potassium, 31%; copper, 11%; and sulfur, 3% (Banco Central do Brasil, 2018; 2019a, b; Ministério de Minas e Energia, 2019b, p. 10; 2019c).

In 2017, the volume of Brazil's exports of crude petroleum increased by 25% to 364 million barrels (Mbbl) from 291 Mbbl in 2016. Brazil produced a total of 956.9 Mbbl of crude petroleum and exported 38% of its production in 2017. Its major crude petroleum export partners were, in descending order of exported barrels received, China, 42%; the United States, 17%; Chile and India, 9% each; Spain, 7%; and Uruguay, 4% (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2019, p. 123).

The value of Brazil's total exports to the United States increased by 15% to about $30 billion from about $26 billion in 2016. Crude petroleum exports to the United States in 2017 were valued at $3.7 billion and accounted for about 13% of the total value of Brazil's crude petroleum exports. Other major mineral-related exports from Brazil to the United States in 2017 were iron and steel mill products valued at $2.2 billion; stone, sand, and cement, $692 million; nonmonetary gold, $630 million; petroleum products, $568 million; fuel oil, $392 million; other nonferrous metals, $285 million; drilling and oilfield equipment, $196 million; coal and related fuels, $170 million; bauxite and aluminum, $151 million; other gemstones, $99 million; and diamond, $30 million (U.S. Census Bureau, 2019b).

Brazil's imports from the United States increased by 24% to $37.3 billion in 2017 from $30.2 billion in 2016. Significant mineral-related imports by Brazil from the United States in 2017 were fuel oil valued at about $5 billion; petroleum products, $2 billion; metallurgical-grade coal, $1 billion; coal and fuels (other), $751 million; natural gas liquids, $717 million; iron and steel products (other), $257 million; crude petroleum, $221 million; and drilling and oilfield equipment, $112 million (U.S. Census Bureau, 2019a).

## Commodity Review

### *Metals*

**Aluminum and Bauxite and Alumina.**—In 2017, aluminum production in Brazil increased by about 1% to 801,700 t. Two operators that produced aluminum in 2017 were Albras Alumínio Brasileiro S.A. (jointly owned by Norsk Hydro ASA of Norway, 51%, and Nippon Amazon Aluminio Co. Ltd. of Japan, 49%), which ran the Barcarena smelter in the State of Para, and Companhia Brasileira de Aluminio S.A. (wholly owned by Grupo Votorantim), which operated the Aluminio smelter in the State of Sao Paulo (table 1).

The Poços de Caldas alumina refinery produced 125,100 t of alumina in 2017 (up from 86,600 t in 2016). The Poços de Caldas bauxite mine, which was operated by Alcoa Alumínio S.A., had a capacity of 1.1 Mt/yr but produced only 408,000 t in 2017. The Sao Luiz alumina refinery produced 369,800 t in 2017 (down from 370,700 t in 2016). The Juruti bauxite mine produced 6.4 Mt (up from about 6 Mt in 2016) (Associação Brasileira do Alumínio, 2018a, b).

Norsk Hydro's Paragominas bauxite mine, which is located in the State of Para in northern Brazil, produced 11.4 Mt of bauxite in 2017 and accounted for 29% of Brazil's total bauxite production of 38.1 Mt. The Barcarena (Alunorte) alumina refinery located in the State of Para produced 6.4 Mt of alumina in 2017 (Associação Brasileira do Alumínio, 2018a, b; Norsk Hydro ASA, 2019, p. 15).

**Copper.**—Vale remained the leading producer of copper concentrates in Brazil in 2017. It produced copper concentrates at its Salobo and Sossego open pit mines located in Carajas in the State of Para. In 2017, the Salobo Mine produced about 193,000 t of copper (an increase of about 10% compared with the 176,000 t produced in 2016); the Sossego Mine produced about 100,000 t of copper (an increase of about 8% compared with the 93,000 t produced in 2016). The increase in production at Salobo could be attributed to the ramping up of operations after the completion of the Salobo II expansion project in 2014, which increased the capacity of the mine to 197,000 t/yr of copper in concentrate from 100,000 t/yr in 2013; Sossego's capacity was 93,000 t/yr of copper in concentrate. Total proven and probable copper ore reserves at Salobo were reported to be 1,193 Mt at an average grade of 0.61% copper; Sossego's reserves were a reported to be 120 Mt at an average grade of 0.68% copper (table 2; Vale S.A., 2019, p. 58, 78).

In 2017, Yamana Gold Inc. of Canada operated the Chapada Mine located in the State of Goias. The production of copper at Chapada was 57,742 t in 2017. The Chapada Mine was a polymetallic mine that produced mostly copper and gold as a byproduct. Copper grades were expected to remain constant through the development of the mine, whereas gold grades were expected to vary (Yamana Gold Inc., 2018, p. 51–52).

**Gold.**—Vale remained a leading producer of gold in Brazil. Total production from its Salobo and Sossego Mines was 12,784 kg, or about 16% of Brazil's total gold production of 79,700 kg; Vale recovered gold as a byproduct from these two copper mines. Salobo's gold production increased by about 9% to 10,762 kg in 2017 from 9,860 kg in 2016. Sossego's gold production decreased by about 3% to 2,022 kg in 2017 from 2,084 kg in 2016. As of yearend 2017, total proven and probable mineral reserves at Salobo was reported to be 1,193 Mt at an average grade of 0.3 gram per metric ton (g/t) gold; and at Sossego, 120 Mt at an average grade of 0.2 g/t gold (Vale S.A., 2019, p. 60, 79).

AngloGold Ashanti Ltd. of South Africa produced gold in Brazil in 2017 through two of its wholly owned subsidiaries, AngloGold Ashanti Córrego do Sítio Mineração (AGA Mineração) and AngloGold Ashanti Serra Grande. The two subsidiaries operated a total of nine gold mines. The combined gold production from these mines increased by 3% to 17,325 kg in 2017 from 16,765 kg in 2016. AGA Mineração was composed of two units, the Cuiaba and the Corrego do Sitio complexes located in the State of Minas Gerais in southeastern Brazil. AGA Mineração produced 13,188 kg of gold in 2017 and was AngloGold's second largest gold-producing subsidiary. AGA Mineração had the lowest production cost of all companies globally at $671 per troy ounce (AngloGold Ashanti Ltd., 2018, p. 111, 121, 125).

Kinross Gold Corp. of Canada wholly owned the Paracatu Mine located in the State of Minas Gerais in southeastern Brazil. In 2017, gold production from Paracatu was 11,196 kg compared with 15,023 kg 2016. The 25% decrease in production was mainly attributed to a temporary shutdown owing to lower-than-average rainfall in the area (Kinross Gold Corp., 2018a, p. 1, 4, 21).

In 2017, Yamana Gold of Canada operated two gold mines in Brazil; they were the Chapada Mine located in the State of Goias and the Jacobina Mine located in the State of Bahia. The Chapada Mine produced 3,728 kg of gold and the Jacobina Mine produced 4,224 kg of gold (Yamana Gold Inc., 2018, p. 51, 57).

**Iron Ore.**—Vale's production of iron ore increased by 5% to 367 Mt in 2017 from 349 Mt in 2016; this accounted for 81% of Brazil's estimated iron ore (gross weight) production of 454 Mt and about 15% of the world's estimated production of 2.4 billion metric tons. Vale produced iron ore from the following four regions (or "systems" as reported by Vale) in the country: the Northern (169.2 Mt), which is located in State of Para; the Southeastern (108.6 Mt) and the Southern (86.4 Mt), which are located in State of Minas de Gerais; and the Midwestern (2.4 Mt), which is located in the State of Mato Grosso do Sul. At the end of 2017, Vale's total proven and probable reserves of iron ore were a reported 17,849 Mt at an average grade of 54% iron (Tuck, 2019b; Vale S.A., 2019, p. 41, 74).

**Iron and Steel.**—Brazil produced 34.8 Mt of raw steel in 2017, which represented a 10% increase compared with the 31.6 Mt of raw steel produced in 2016. In 2017, Brazil was Latin America's leading producer of steel, accounting for 53.5% of the region's steel output; in 2016, Brazil produced 52.4% of the region's steel output. The Brazil Steel Institute, which was an association of the main steelmaking companies in Brazil, comprised 11 local business groups operating 30 mills in the country with a combined installed capacity of 50.4 Mt/yr of raw steel. About 90% of the steel production in the country was concentrated in the States of Espirito Santo, Minas Gerais, and Rio de Janeiro. Brazil's automotive, construction, and manufacturing industries accounted for 78% of the country's apparent consumption of steel products. The apparent consumption of steel products increased by about 5% to 19.2 Mt in 2017 from 18.2 Mt in 2016. The member companies of the Instituto Aço Brasil employed 103,150 people in 2017, which was a decrease of 2% compared with 105,476 employed in 2016 (Instituto Aço Brasil, 2018, p. 5, 10–12, 16; Ministério de Minas e Energia, 2019a, p. 19).

**Manganese.**—Vale produced manganese at the Azul open pit mine located in the State of Para and the Urucum underground mine located in the State of Mato Grosso do Sul. Vale also owned the Morro de Mina open pit mine located in the State of Minas Gerais. Vale produced about 2.2 Mt of manganese ore (gross weight) in 2017 compared with 2.4 Mt of manganese ore in 2016 (table 2; Vale S.A., 2019, p. 46–47).

**Nickel.**—Vale produced nickel at Onça Puma, which was a mining and smelting operation located in the State of Para in northern Brazil. In 2017, production of nickel contained in ferronickel at Onça Puma was 24,700 t compared with 24,100 t in 2016; the production capacity was 27,000 t/yr. In September, Vale suspended operations at Onça Puma owing to a lawsuit brought by the country's Federal Prosecutor's Office against the company. The lawsuit established that mining activities at the Onça Puma nickel operation were negatively affecting the surrounding indigenous communities and contaminating the Catete River. In April 2016, the production of nickel carbonate and electrolytic metal were halted at Niquelandia as Votorantim placed the mine and refineries on care-and-maintenance status. The number for nickel carbonate in table 1 shows the production before the closure (Grupo Votorantim, 2016, p. 17, 22; Vale S.A., 2019, p. 52, 54, 157).

### *Industrial Minerals*

**Cement.**—Cement production decreased by 6.3% to 54 Mt in 2017 from 57.6 Mt (revised) in 2016. In 2017, there were 71 active integrated cement plants in the country that had a total combined installed capacity of 85.7 Mt/yr of cement. In 2017, the leading cement-producing companies included Cimento Nassau, Grupo Votorantim, Holcim Ltd. of the United States, and InterCement Brasil S.A. The country's Southeast Region accounted for about 47% of Brazil's cement production, followed by the Northeast Region (21%), the South Region (16%), the Central-West Region (11%), and the North Region (5%) (table 1; Global Cement, 2017a; Sindicato Nacional da Indústria do Cimento, 2018).

In October the governor of Piaui, which is located in the northeastern part of the country, announced plans to reopen the Itapissuma cement plant. The plant, which was owned by the João Santos Group, had closed in March. According to the company, sales decreased about 80% owing mainly to the country's economic instability. The governor of Piaui was coordinating the sale of the Itapissuma plant to a local business

consortium to speed up the reopening of the plant (Global Cement, 2017b).

**Lithium.**—In December, AMG Advanced Metallurgical Group N.V. (AMG) of the Netherlands announced the construction of a second processing plant to produce lithium concentrate at the existing Mibra Mine in the State of Minas Gerais. The expansion, which was estimated to cost $110 million, was planned to be completed by the end of 2019. The new plant would increase the total processing capacity at the Mibra Mine and double lithium concentrate production to 180,000 t/yr. In addition, the new plant would allow for the production of 272 t/yr of tantalum concentrate. The Mibra Mine had been in operation for about 40 years as a tantalum operation. Total measured and indicated resources at the Mibra Mine were reported to be 20.3 Mt of ore at grades of 4,904 parts per million (ppm) lithium, 1.06% lithium oxide, 278 ppm tantalum, 339 ppm tantalum pentoxide, 51 ppm niobium, and 365 ppm tin (AMG Advanced Metallurgical Group N.V., 2017a, b; 2018).

**Phosphate Rock.**—In August a Brazilian regulator announced the approval of the acquisition of Vale Fertilizantes S.A. by Mosaic Co. of the United States. Mosaic agreed to buy Vale Fertilizantes in December 2016 for a total of $2.5 billion. Through its wholly owned subsidiary Vale Fertilizantes, Vale operated five mines in Brazil: the Araxa, the Patos de Minas, and the Tapira open pit mines, which are located in the State of Minas Gerais; the Cajati open pit mine in the State of Sao Paulo; and the Catalao open pit mine in the State of Goias. Vale Fertilizantes had a capacity to produce 4.8 Mt/yr of phosphate fertilizers and 500,000 t/yr of potash. In 2017, Vale was the leading producer of phosphate rock in Brazil. As of yearend, total reserves at the Tapira Mine were 655.0 Mt at an average grade of 7.6% $P_2O_5$; at the Catalao Mine, the total reserves were 85.5 Mt at an average grade of 10.6% $P_2O_5$; at the Araxa Mine, the total proven and probable reserves were 22.3 Mt at an average grade of 10.6% $P_2O_5$; and at the Cajati Mine, the total reserves were reported as 81.7 Mt at an average grade of 5.2% $P_2O_5$ (Thomson Reuters, 2017; Vale S.A., 2017, p. 22, 78, 79).

### *Mineral Fuels*

**Natural Gas.**—Brazil's gross natural gas production was about 40.1 billion cubic meters in 2017 compared with 37.9 billion cubic meters in 2016. The increase in production was mainly owing to an increase in the production of natural gas from pre-salt areas, which represented about 45% of the total compared with 38% in 2016. Brazil's natural gas operations were concentrated in the States of Rio de Janeiro (46%), Sao Paulo (17%); Amazonas (12%), Espirito Santo (10%), and Bahia (4%). Proven offshore reserves were estimated to be about 369 billion cubic meters. The State of Rio de Janeiro accounted for 61% of total proven natural gas reserves (table 1; Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2018c, e).

**Petroleum.**—In 2017, Brazil's crude petroleum production increased by about 4% to 956.9 Mbbl from 918.7 Mbbl in 2016. The increase in production was attributed to an increase in production of pre-salt areas by 26% to 469.9 Mbbl in 2017 from 372.7 Mbbl in 2016. Brazil's offshore deposits held the vast majority of Brazil's proven reserves, which were estimated to be 12.8 Gbbl. The State of Rio de Janeiro accounted for about 83.5% of the country's total proven reserves, followed by the States of Espirito Santo (7%) and Sao Paulo (4%) (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2018b, d).

By yearend 2017, ANP reported 749 areas under contract, of which 371 fields were in the production stage, 303 blocks were in the exploration phase, and 75 fields were in production development. Of the 371 fields in production, 273 were located onshore and 98 were located offshore. Petrobras was the only contractor in 284 of them, and operator of the consortium of 13 other fields. The locations with the most production of crude petroleum in 2017 were Río de Janeiro (650,854 Mbbl), Espirito Santo (133,869 Mbbl), and Sao Paulo (120,014 Mbbl). The Baleia Ana Field, which is located in the Campos Basin; the Dom Joao Mar and Jandaia do Sul Fields, which are located in the Reconcavo Basin; the Gaviao Azul and Gaviao Caboclo Fields, which are located in the Parnaiba Basin; and the Lapa Field, which is located in the Santos Basin, all started production in 2017. In addition, the FPSO Pioneiro de Libra (Campo da Libra Field) and Petrobras 66 FPSO (Lula Field) started production in 2017 (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2018a, p. 53, 80).

Of the 303 exploratory blocks under concession and in operation, 192 were located onshore, 110 were located offshore, and 1 was located on land and in the sea. Petrobras had a stake in 123 of them, of which 45 were exclusive to Petrobras and another 78 were held in partnership. Other exploratory blocks were operated exclusively by Petra Energia (25 blocks), Rosneft (13 blocks in the Solimoes Basin), Parnaíba Gás Natural (11 blocks in the Parnaiba Basin), and Tog Brasil (10 blocks in the Alagoas Basin and the Reconcavo Basin) (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2018a, p. 53).

Of the total of 75 fields in the development stage, 44 were located onshore and 31 were located offshore. Of the total, Petrobras had 100% of the contracts for 30 fields. Other companies that owned contracts or had consortium or other arrangements with each other and with Petrobras were Alvopetro Energy Ltd. of Canada, BP Energy of the United Kingdom, Chevron Brasil of the United States, Exploration Corp. of Canada, Shell Brasil of the Netherlands, Statoil Brazil of Norway, Total E&P do Brasil of France, and the following locally owned enterprises: Brasil Cranes, Brasoil Manati Exploracao Petrolifera S.A., CNODC Brasil Petróleo e Gás, Dommo Energia, Energizzi Energias do Brasil Ltda., Engepet, Espigão, GeoPark Brasil Exploração e Produção de Petróleo e Gás Ltda., Imetame Energia Ltda., Oeste de Canoas Petróleo e Gás Ltda., Orteng Óleo & Gas S.A., Parnaíba Gás Natural S.A., Petroborn Oleo e Gas S.A., Petrogal Brasil S.A., Petrosynergy Ltda., Queiroz Galvão S.A., Silver Marlin Oil and Gas, Sinochem Petroleo Brasil Ltda., Ubuntu Engenharia e Serviços Ltda., and Vipetro Petróleo S.A. (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2018a, p. 53).

## MINERAL INDUSTRY HIGHLIGHTS IN 2018

### Minerals in the National Economy

In 2018, Brazil's nominal gross domestic product (GDP) decreased to $1.9 trillion, or by about 9% compared with that of 2017. Brazil's mineral production in 2018 was valued at $34 billion (about 1.8% of the nominal GDP), which represented a 6.3% increase compared with production valued at $32 billion in 2017. The increase was attributed to an increase in production and greater overall trading of mineral commodities compared with that of 2017. In the second half of the year, about 164,769 workers were employed in the mining sector compared with 163,063 in the second half of 2017. Brazil's FDI increased in 2018 to $88.3 billion from $70.3 billion in 2017, although this was still below the peak reached in 2011 of $102.4 billion (Departamento Nacional de Produção Mineral, 2018, p. 2, 9–10; Economic Commission for Latin America and the Caribbean, 2019, p. 26; Ministério de Minas e Energia, 2019b, p. 2; World Bank, The, 2019).

Brazil's mineral exports in 2018 were valued at about $25.2 billion compared with $24 billion in 2017; mineral exports accounted for 10.5% of total exports of $239.7 billion. The country's major export trade partners were, in descending order of export value, China, which received 27% of Brazil's exports; the United States, 12%; Argentina, 6%; and the Netherlands, 5%. Iron ore accounted for about 70% of the value of mineral exports, followed by copper, 6%; gold, 5%; and bauxite, 3% (Banco Central do Brasil, 2019a; Ministério de Minas e Energia, 2019b, p. 10; 2019d).

Brazil's mineral imports in 2018 were valued at about $8.4 billion compared with about $7.8 billion in 2017; mineral imports accounted for approximately 5% of total imports of $181.2 billion. The country's major import trade partners were, in descending order of import value, China, which provided 19% of Brazil's imports; the United States, 16%; Argentina, 6%; and Germany, 6%. Coal accounted for about 40% of the top mineral imports, followed by potassium, 37%; copper, 8%; and sulfur, 5% (Banco Central do Brasil, 2019a, b; Ministério de Minas e Energia, 2019b, p. 10; 2019d).

In 2018, the volume of Brazil's exports of crude petroleum increased by 13% to 410 Mbbl from 364 Mbbl in 2017. Its major crude petroleum export partners were, in descending order of export volume, China, 56%; the United States, 12%; Spain, 9%; Chile, 8%; and Uruguay and India, 5% each (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2019, p. 123).

In terms of trade with the United States, Brazil's exports to the United States were valued at $31 billion in 2018 compared with $29.5 billion in 2017, which was an increase of 5%. Brazil's crude petroleum exports to the United States in 2018 were valued at $3.8 billion and accounted for about 12% of the total value of Brazil's exports to the United States. Other major mineral-related exports from Brazil to the United States in 2018 were iron and steel mill products valued at $2.5 billion; petroleum products, $869 million; stone, sand, cement, $602 million; fuel oil, $593 million; nonmonetary gold, $369 million, other nonferrous metals $216 million; coal and related fuels, $158 million; bauxite and aluminum, $156 million; and other gemstones, $108 million (U.S. Census Bureau, 2019b).

Brazil's imports from the United States increased by 6% to $39.6 billion in 2018 from $37.3 billion in 2017. Significant mineral-related imports by Brazil from the United States in 2018 were fuel oil valued at about $4.2 billion; petroleum products, $2.8 billion; metallurgical-grade coal, $1.2 billion; natural gas liquids, $895 million; coal and fuels (other), $786 million; crude petroleum, $635 million; natural gas, $206 million; iron and steel products (other), $102 million; and drilling and oilfield equipment, $84 million (U.S. Census Bureau, 2019a).

### Production

In 2018, the production of lithium was estimated to be 10,000 t, which represented an increase of 67% compared with lithium production in 2017. The increase was mainly attributed to the commencement of lithium production at the Mibra Mine, which was owned by AMG. Production also increased significantly for the following mineral commodities: phosphate rock ($P_2O_5$), by 28% to an estimated 2,000 t; tantalum, by 25% to an estimated 250,000 kg; silicon, by 23% to an estimated 142,000 t; ferrosilicon, by 19% to an estimated 119,000 t; calcite, by 14% to 43 Mt; and silicomanganese, by 13% to 228,690 t. In addition, mineral production increases were reported for primary refined copper, which increased by 12%; primary smelted copper, 11%; phosphate rock (gross weight), 10%; and ilmenite and leucoxene, 10%. Mineral production decreased for refined cobalt, by 83% to 8 t owing mainly to the continuing halt of operations at Grupo Votorantim's Niquelandia and Sao Miguel Paulista facilities since 2016. Production also decreased significantly for the following mineral commodities: rutile, by 56% to an estimated 2,000 t; ferronickel, 39% to an estimated 150,000 t; secondary refined copper, by 38% to 15,300 t; secondary smelted copper, by 38% to 15,300 t; potassium chloride, by 35% to an estimated 320,000 t; potash ($K_2O$), by 34% to 201,181 t; monazite, by 31% to 2,000 t; alumina, by 25% to 8.3 Mt; secondary aluminum, by 25% to 510,000 t; iron ore (metal content), by 22% to 250,000 t; asbestos, by 19% to 110,000 t; primary aluminum by 18% to 659,000 t; and bauxite, by 16% to 32 Mt (table 1; Grupo Votorantim, 2016, p. 17).

### Commodity Review

#### *Metals*

**Aluminum and Bauxite and Alumina.**—In 2018, bauxite production from the Juruti Mine increased by 3% to 6.6 Mt from 6.4 Mt in 2017. Bauxite production from Norsk Hydro's Paragominas Mine, which accounted for 19% of Brazil's total bauxite production in 2018, decreased by 46% to 6.2 Mt from 11.4 Mt in 2017. Together, these two mines produced about 40% of Brazil's bauxite output in 2018. The Poços de Caldas bauxite mine, which had a capacity of 1.1 Mt/yr, produced only 609,000 t in 2018 (table 1; Norsk Hydro ASA, 2017; Associação Brasileira do Alumínio, 2018a, b).

In February 2018, the region of Barcarena in Para State in northern Brazil experienced heavy rainfall that resulted in floods that affected the Hydro Alunorte alumina refinery, which had an annual capacity of 6.4 Mt/yr of alumina. Immediately after

the flooding, the Government ordered the refinery to reduce production by 50% of capacity at the bauxite residue deposit area (DRS1) as a precautionary measure, given concerns of a spill from the facility. As a result, Alunorte's affiliated facilities, Albras and Paragominas, which were partly owned by Hydro, reduced their production by 50%. Production from the Barcarena refinery, which accounted for about 45% of Brazil's alumina output in 2018, decreased by about 42% to 3.7 Mt of alumina from 6.4 Mt of alumina in 2017.

In addition, the Government imposed a ban on Alunorte's use of press filters and on a new bauxite residue deposit area (DRS2), which was under commissioning at the time. The press filters and the DRS2 facility were intended for use as a long-term solution by Alunorte to dispose of bauxite residues from the refinery. The ban was imposed to ensure safety and efficiency in processing waste. In October 2018, Alunorte confirmed that no overflow or contamination was registered at the DRS1 area; as a result, the ban on the DRS2 facility was lifted (table 1; Norsk Hydro ASA, 2017; 2019, p. 15; Associação Brasileira do Alumínio, 2018a, b).

The Poços de Caldas refinery produced 179,700 t of alumina in 2018, which was an increase of 44% from the 125,100 t reported in 2017. The Sao Luiz refinery produced 351,200 t of alumina in 2018, which was a decrease of 5% compared with the 369,800 t produced in 2017 (table 1; Associação Brasileira do Alumínio, 2018a, b).

**Copper.**—In 2018, copper production in Brazil increased by less than 1% to 385,800 t. In October, Vale announced the approval of funds for the Salobo III copper project; the funds were to be used for an expansion to increase the project's processing throughput capacity. The expansion included the addition of a third concentrator line at Salobo. With these improvements, the Salobo III project was expected to have an average copper production capacity of approximately 50,000 t/yr in the first 5 years, 42,000 t/yr in the first 10 years, and 36,000 t/yr throughout the life of mine. The construction of the project was expected to start in 2022 and would take 15 months to complete (Vale S.A., 2019, p. 82).

In 2018, production of copper at Yamana Gold's Chapada Mine was 58,604 t compared with 57,742 t in 2017. As of yearend 2018, the proven and probable copper mineral reserves at the Chapada Mine were 664.6 Mt at a grade of 0.25 g/t copper, which was a 7% increase from that of 2017. The increase in mineral reserves was significant given previous estimates of depletion starting in 2018. The company expected to continue its exploration plan in 2019, which would focus mainly on the Suruca hanging wall and footwall, the Baru NE, and the Corpo Sul deposits (Yamana Gold Inc., 2018, p. 21, 51–52).

**Gold.**—In 2018, AngloGold continued to produce gold in Brazil through two of its wholly owned subsidiaries, AGA Mineração and AngloGold Ashanti Serra Grande. Combined gold production decreased by 11% to 15,365 kg in 2018 from 17,325 kg in 2017. The decrease in production was mainly owing to lower ore grades mined from the sulfide operation at the Corrego do Sitio complex. In addition, greater than average rainfall affected AngloGold Ashanti's gold production performance. At the Serra Grande Mines, less ore was mined in 2018 owing to a delay in receiving the environmental deforestation and waste dump permits. In 2018, AGA Mineração produced 11,322 kg of gold. AGA Mineração was one of AngloGold Ashanti Ltd.'s lowest cost operations with a total cash cost of $723 per troy ounce. Other factors that affected production targets for AngloGold Ashanti in Brazil involved the Cuiaba complex, which had infrastructure limitations and also experienced delays as it tried to resolve a geotechnical issue aimed at improving access to the higher grade ore. The Cuiaba complex comprises of the Cuiaba and the Lamego underground mines and the Cuiaba and Queiroz plants (AngloGold Ashanti Ltd., 2019, p. 68, 71, 92, 96).

In 2018, Kinross's gold production from Paracatu increased by 45% to 16,223 kg from 11,196 kg 2017. In February, Kinross Brasil Mineração (a subsidiary of Kinross), signed an agreement with a subsidiary of the energy company Gerdau S.A. to acquire two hydroelectric powerplants to be located in the State of Goias. The agreement was valued at $253.7 million. Both plants had been in operation since 2010 and had a total installed capacity of 155 megawatts; the plants were expected to supply approximately 70% of Paracatu's future power needs. The plants were expected to secure a long-term power supply to lower production costs over the life of the Paracatu Mine. Total proven and probable mineral reserves at Paracatu as of December 2018 were 591 Mt at an average grade of 0.4 g/t gold; the expected life of the mine was 17 years (Kinross Gold Corp., 2018a, p. 1, 15, 21, 134; 2018b).

In 2018, gold production at Yamana Gold's Chapada Mine was 3,764 kg, which exceeded expectations. The production increase of nearly 1% compared with that of 2017 was owing mainly to higher grades and recoveries as increased ore with higher grade was processed. Planned mine development and scheduled maintenance also contributed to an increase in the costs for the production of gold at the Chapada operation, however. At the Jacobina Mine, production reached 4,501 kg of gold in 2018 compared with 4,224 kg in 2017. The main factors for the increase were higher grades from the Canavieiras Central, Canavieiras Sul, and Joao Belo Mines, which contributed to the higher production and operating earnings. In addition, the operation benefited from ongoing optimization initiatives, which included an advanced control system to enhance plant stability. The company continued to increase productivity and reduce costs by making improvements to the mining, plant processing, maintenance, and supply chain at Jacobina to further increase processing capacity. By yearend 2018, the proven and probable mineral reserves at Chapada were 729.8 Mt at a grade of 0.19 g/t of gold, and those at the Jacobina operation were 27.9 Mt at a grade of 2.34 g/t gold (Yamana Gold Inc., 2018, p. 21, 39, 51–52, 57–58).

**Manganese.**—In 2018, manganese production (gross weight) in Brazil decreased by nearly 7% to 3,058,000 t of manganese. Vale, which mined manganese from the Azul open pit mine, the Urucum underground mine, and the Morro de Mina open pit mine, was the country's leading manganese producer in terms of output. Vale produced about 1.8 Mt of manganese ore in 2018, which was a decrease of 18% compared with the 2.2 Mt of manganese ore produced in 2017 (Vale S.A., 2019, p. 46–47).

**Nickel.**—In 2018, nickel production in Brazil decreased by about 3% to 74,400 t. In November, the Regional Federal Court reaffirmed the decision to suspend nickel mining operations at Vale's Onca Puma nickel mine until the conclusion of various evaluations on the effect of the company's operations in the Catete River and surrounding communities. The court also ordered Vale to pay a monthly compensation to each member of the affected indigenous communities (Vale S.A., 2019, p. 157).

### *Industrial Minerals*

**Cement.**—Cement production decreased by less than 1% to 53.6 Mt in 2018 from 54 Mt in 2017. In 2018, the leading cement-producing companies included Cimento Nassau, Grupo Votorantim, Holcim, and InterCement Brasil S.A. The Southeast Region of the country accounted for about 47% of the country's cement production, followed by the Northeast Region, 20%; the South Region, 17%; the Central-West Region, 11%; and the North Region, 5% (table 1; Global Cement, 2017a; Sindicato Nacional da Indústria do Cimento, 2019).

**Lithium.**—In 2018, lithium production in Brazil increased by nearly 67% to an estimated 10,000 t of lithium. In May, AMG announced the startup and commencement of operations at its AMG Mineração's first lithium concentrate processing plant located at the Mibra Mine. The lithium facility was built at a cost of $50 million and had a designed production capacity of 90,000 t/yr of lithium concentrate (spodumene). Since 2010, AMG had been operating a lithium pilot plant at its Mibra property (AMG Advanced Metallurgical Group N.V., 2018, 2019).

In April, the Government of Minas Gerais, through Codemig Paritipações S.A., announced the purchase of 33% of the shares of Brazilian Lithium Co. (CBL). According to the company, CBL is the only company in the country to produce lithium carbonate and lithium hydroxide. CBL's other properties included the Mina da Cachoeira in Aracuao and a chemical processing plant in Divisa Alegre, both located in the municipality of Jequitinhonha (Brazilian Lithium Co., 2018).

## Reserves and Resources

In 2018, Brazil was among the world leaders in reserves of some mineral commodities. Brazil's estimated share of the world's reserves of niobium amounted to 95%; tantalum, 31%; graphite (natural), 26%; manganese, 18%; rare earths, 18%; nickel, 16%; tin, 15%; iron ore (crude and iron content), 14% each; bauxite, 9%; and titanium (ilmenite), 5% (table 3; Anderson, 2018; Bedinger, 2018; Bray, 2018: Corathers, 2018; Gambogi, 2018; McRae, 2018; Olson, 2018; Polyak, 2018a, b; Tuck, 2018; Departamento Nacional de Produção Mineral, 2019, p. 7).

## Outlook

Brazil's economy was projected to grow by about 1% in 2019, 2% in 2020, and 2.3% in 2024. According to the International Monetary Fund, Brazil's economy could improve as the Government implements social reforms, sustainability of the public debt, tax reforms, trade openness, investment in infrastructure, and easing of monetary policies. According to IBRAM, mineral production in Brazil (excluding the oil and gas sectors) was expected to increase by 11% to reach $38 billion in 2019. The main drivers of this projected increase would include expected increases in global mineral commodity prices, in particular the price of iron ore; the recovery of the construction aggregates sector; the expected increase in the production of manganese; and an increase in mineral trade. IBRAM forecasts an investment of about $28 million in the mining and quarrying sector from 2019 to 2024 (Instituto Brasileiro de Mineração, 2019, 2020; International Monetary Fund, 2019, p. 27, 151).

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TABLE 1

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

| Commodity[2] | | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|
| METALS | | | | | | |
| Aluminum: | | | | | | |
| Bauxite, dry basis | | 36,308,000 | 37,057,000 | 39,244,200 r | 38,072,100 | 32,006,900 |
| Alumina | | 10,404,000 | 10,451,500 | 10,885,500 r | 11,060,600 | 8,258,000 |
| Metal: | | | | | | |
| Primary | | 962,000 | 772,200 | 792,700 | 801,700 | 659,000 |
| Secondary | | 551,000 r | 602,000 r | 622,000 r | 683,000 | 510,000 |
| Total | | 1,510,000 r | 1,370,000 r | 1,410,000 r | 1,480,000 | 1,170,000 |
| Cadmium, refinery, primary[e] | | 200 | 200 | 200 | 200 | 200 |
| Chromium, mine, chromite, ore and concentrate | | 716,951 r | 526,744 r | 426,337 r | 450,000 e | 450,000 e |
| Cobalt: | | | | | | |
| Mine, Co content | | 3,828 | 2,771 r | 852 r | -- e | -- e |
| Refinery, metal | | 1,350 | 1,300 e | 400 r | 46 | 8 |
| Copper: | | | | | | |
| Mine, concentrates, Cu content | | 301,197 | 350,940 r | 338,921 r | 384,542 | 385,800 |
| Smelter: | | | | | | |
| Primary | | 182,800 | 157,800 | 188,500 r | 118,800 | 132,200 |
| Secondary | | 50,500 | 42,400 | 27,000 r | 24,800 | 15,300 |
| Total smelter | | 233,000 | 200,000 | 216,000 r | 144,000 | 148,000 |
| Refinery: | | | | | | |
| Primary: | | | | | | |
| Leaching, electrowon | | 700 e | -- | -- e | -- | -- |
| Other | | 212,385 r | 241,469 r | 225,558 r | 118,300 | 132,200 |
| Secondary | | 23,600 r | 29,000 r | 38,500 r | 24,800 | 15,300 |
| Total refinery | | 237,000 r | 270,000 r | 264,000 r | 143,000 | 148,000 |
| Ferroalloys: | | | | | | |
| Ferrochromium | | 188,682 r | 173,467 r | 150,240 r | 171,531 | 175,061 |
| Ferromanganese | | 110,270 r | 84,160 r | 83,780 r | 123,470 | 117,800 |
| Ferronickel: | | | | | | |
| Gross weight | | 107,243 r | 195,000 r, e | 245,000 r, e | 247,251 | 150,000 e |
| Ni content | | 34,501 r | 54,700 r | 68,600 r | 68,803 | 65,200 |
| Ferroniobium: | | | | | | |
| Gross weight | | 88,100 r | 79,200 r, e | 67,800 r, e | 89,600 | 85,500 |
| Nb content | | 51,737 r | 51,874 r | 44,390 r | 58,690 | 59,000 |
| Ferrosilicon[e] | | 98,000 | 88,300 | 88,300 | 100,000 | 119,000 |
| Silicomanganese | | 214,000 r | 141,540 r | 166,680 r | 202,520 | 228,690 |
| Gold, mine, Au content: | | | | | | |
| Artisanal mines | kilograms | 9,909 | 13,416 r | 23,625 r | NA | NA |
| Large-scale mines | do. | 71,129 | 69,497 r | 70,295 r | 79,717 | NA |
| Total | do. | 81,000 | 82,900 r | 93,900 r | 79,700 | 85,000 |
| Iron ore, mine: | | | | | | |
| Gross weight | thousand metric tons | 411,183 | 430,838 r | 421,358 r | 453,704 | 460,000 |
| Fe content | do. | 261,500 | 275,590 | 268,184 r | 318,587 | 250,000 |
| Iron and steel: | | | | | | |
| Pig iron | do. | 27,016 | 27,803 | 26,129 r | 28,331 | 28,655 |
| Raw steel, excluding castings | do. | 33,912 r | 33,258 r | 31,642 r | 34,778 | 35,407 |
| Lead: | | | | | | |
| Mine, concentrate, Pb content | | 10,978 | 9,440 r | 8,134 r | 7,000 e | 7,000 e |
| Refinery, secondary | | 160,393 | 152,161 r | 156,186 r | 180,000 e | 195,000 e |
| Magnesium, primary, metal[e] | | 16,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Manganese, mine, ore and concentrate:[3] | | | | | | |
| Gross weight | | 2,723,000 | 2,868,000 r | 2,811,000 r | 3,273,029 | 3,058,000 |
| Mn content | | 1,094,000 | 1,243,000 r | 1,198,709 r | 1,343,967 | 1,310,000 |
| Nickel: | | | | | | |
| Mine, undifferentiated or other, Ni content | | 102,000 r | 94,800 r | 86,400 r | 76,800 | 74,400 |

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

| Commodity[2] | | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|
| METALS—Continued | | | | | | |
| Nickel:—Continued | | | | | | |
| Intermediate, carbonate | | 19,958 r | 18,500 r | 6,077 r | -- | 6,000 e |
| Metal, electrolytic | | 19,823 r | 22,650 r | -- r | -- | -- |
| Niobium, mine: | | | | | | |
| Mineral concentrate, Nb content | | 62,055 | 58,852 r | 50,752 r | 58,137 | 59,000 e |
| Pyrochlore concentrate, $Nb_2O_5$ content | | 88,771 | 80,465 r | 80,669 r | 83,166 | 83,000 |
| Rare earths, monazite concentrate | | -- | 1,625 r | 4,525 r | 2,900 | 2,000 |
| Silicon, metal[e] | | 92,300 | 70,000 | 130,000 r | 115,000 | 142,000 |
| Silver, Ag content: | | | | | | |
| Mine | kilograms | 36,700 | 41,300 r | 38,800 r | 39,000 e | 40,000 e |
| Refinery, secondary | do. | 30,400 | 32,000 r | 31,200 r | 31,000 e | 31,000 e |
| Tantalum, mine, mineral concentrate, Ta content | do. | 313,000 r | 268,000 r | 125,000 r | 200,000 e | 250,000 e |
| Tin: | | | | | | |
| Mine, Sn content | | 25,534 | 18,900 r | 19,705 r | 17,081 | 17,000 e |
| Smelter, primary | | 22,334 | 16,531 r | 12,542 r | 13,796 | 12,900 |
| Titanium mineral concentrates: | | | | | | |
| Ilmenite and leucoxene: | | | | | | |
| Gross weight | | 135,500 r, e | 133,300 r, e | 106,400 r | 100,000 e | 110,000 e |
| $TiO_2$ content | | 81,278 | 78,991 r | 63,815 r | 60,000 e | 60,000 e |
| Rutile: | | | | | | |
| Gross weight[e] | | 3,100 r | 3,300 r | 4,500 r | 4,500 e | 2,000 |
| $TiO_2$ content | | 1,834 | 1,984 r | 2,692 r | 2,700 e | 2,700 e |
| Tungsten, mine, concentrate, W content | | 677 r | 432 r | 323 r | 200 e | 200 e |
| Vanadium, V content | | 578 r | 3,254 r | 4,461 r | 5,206 | 5,500 |
| Zinc: | | | | | | |
| Mine, Zn content | | 169,766 | 156,926 r | 158,197 r | 156,348 | 167,250 |
| Smelter, primary | | 246,120 | 270,715 | 284,457 | 245,200 | 246,400 |
| Zirconium, mineral concentrates, gross weight[4] | | 23,659 | 22,647 r | 21,302 r | 21,000 e | 21,000 e |
| INDUSTRIAL MINERALS | | | | | | |
| Asbestos, fiber | | 311,227 r | 232,052 r | 177,677 r | 135,000 e | 110,000 e |
| Barite, beneficiated | | -- | 17,760 | 12,133 r | NA | NA |
| Cement, hydraulic | thousand metric tons | 71,254 | 65,283 | 57,557 r | 54,004 | 53,553 |
| Clay, beneficiated: | | | | | | |
| Bentonite | | 405,169 | 517,607 r | 354,016 r | 350,000 e | 350,000 e |
| Kaolin | | 2,055,000 | 1,802,000 r | 1,737,000 r | 1,700,000 e | 1,700,000 e |
| Diamond, unspecified[5] | thousand carats | 71 r | 32 | 184 | 255 | 251 |
| Diatomite: | | | | | | |
| Crude | | 5,080 | 5,530 r | 16,408 r | 16,000 e | 16,000 e |
| Beneficiated | | 2,822 | 2,830 r | 3,130 r | 3,000 | 3,000 e |
| Feldspar, mine: | | | | | | |
| Crude ore | | 492,469 r | 517,597 r | 486,684 r | 500,000 e | 500,000 e |
| Beneficiated, marketable | | 313,328 r | 456,308 r | 295,778 r | 300,000 e | 300,000 e |
| Fluorspar: | | | | | | |
| Acid grade | | 6,171 r | 5,931 r | 6,290 r | 6,300 e | 6,300 e |
| Metallurgical grade | | 14,428 r | 17,693 r | 11,970 r | 12,000 e | 12,000 e |
| Total | | 20,600 r | 23,600 r | 18,300 r | 18,300 | 18,300 |
| Gemstones: | | | | | | |
| Beryl[e] | | 160 | 100 | 120 | 80 | 80 |
| Quartz crystal, all grades | | 7,163 | 7,036 r | 13,830 r | 14,000 | 14,000 |
| Graphite, crystalline flake, concentrate | | 87,026 | 81,762 r | 61,687 r | 90,000 e | 95,000 e |
| Gypsum, including anhydrite | | 3,471,328 r | 3,161,856 r | 2,674,154 r | 3,000,000 e | 3,000,000 e |
| Lime[e] | | 8,300,000 | 8,300,000 | 8,100,000 r | 8,300,000 | 8,300,000 |
| Lithium, concentrate | | 8,519 | 5,781 r | 8,804 r | 6,000 e | 10,000 e |

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

| Commodity[2] | | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|
| INDUSTRIAL MINERALS—Continued | | | | | | |
| Magnesite: | | | | | | |
| Crude | | 1,634,533 r | 1,860,702 r | 1,802,881 r | 1,800,000 e | 1,800,000 e |
| Beneficiated | | 1,423,210 r | 1,621,425 r | 1,652,424 r | 1,700,000 e | 1,700,000 e |
| Mica | | 10,313 | 11,000 r, e | 10,800 r, e | 10,100 e | 11,000 e |
| Nitrogen, ammonia, N content | | 870,000 e | 1,000,000 e | 1,000,000 e | 1,000,000 e | 1,000,000 e |
| Phosphate rock: | | | | | | |
| Gross weight | thousand metric tons | 6,513 | 6,100 e | 5,850 r | 5,200 e | 5,740 |
| $P_2O_5$ content | do. | 2,521 | 2,100 r | 2,046 r | 1,560 e | 2,000 e |
| Potash: | | | | | | |
| $K_2O$ content | | 311,021 r | 304,018 r | 316,429 r | 306,296 | 201,181 |
| Compounds, potassium chloride | | 492,355 | 481,270 r | 500,917 r | 490,000 e | 320,000 e |
| Salt: | | | | | | |
| Rock salt | thousand metric tons | 1,451 | 1,476 r | 1,410 r | 1,400 e | 1,400 e |
| Sea salt | do. | 6,050 | 6,200 r | 6,100 e | 6,000 e | 6,000 e |
| Total | do. | 7,500 | 7,680 r | 7,510 r | 7,400 | 7,400 |
| Stone, sand and gravel, construction: | | | | | | |
| Sand and gravel | do. | 391,766 | 349,088 r | 312,043 r | 310,000 e | 300,000 e |
| Stone: | | | | | | |
| Crushed | do. | 308,829 | 261,022 r | 236,387 r | 240,000 e | 240,000 e |
| Dimension | do. | 10,130 | 9,500 r | 9,300 r | 9,240 | 9,000 |
| Other, size and shape unspecified, calcite | do. | 34,038 | 29,433 r | 32,469 r | 37,600 | 43,000 |
| Sulfur, byproduct, S content: | | | | | | |
| Metallurgy | | 286,754 | 258,948 r | 260,000 r, e | 260,000 e | 260,000 e |
| Petroleum | | 239,970 | 236,484 r | 240,000 e | 240,000 e | 240,000 e |
| Total | | 527,000 | 495,000 r | 500,000 r, e | 500,000 e | 500,000 e |
| Talc and related minerals: | | | | | | |
| Talc and pyrophyllite | | 531,938 r | 481,687 r | 494,157 r | 500,000 e | 500,000 e |
| Beneficiated | | 164,351 r | 160,864 r | 162,870 r | 160,000 e | 160,000 e |
| Vermiculite, concentrate | | 56,444 | 70,000 r | 58,000 r | 50,050 | 50,000 e |
| MINERAL FUELS AND RELATED MATERIALS | | | | | | |
| Coal, bituminous, beneficiated, marketable | thousand metric tons | 8,845 r | 7,828 r | 6,170 r | 6,000 e | 6,000 e |
| Coke, metallurgical | do. | 9,496 | 9,080 | 9,233 | 9,300 e | 9,300 e |
| Natural gas | million cubic meters | 31,895 | 35,126 | 37,891 | 40,117 | 40,857 |
| Petroleum: | | | | | | |
| Crude, including condensate | thousand 42-gallon barrels | 822,928 r | 889,667 | 918,731 | 956,928 | 944,117 |
| Natural gas liquids | million 42-gallon barrels | 33,475 | 32,671 | 35,407 | 40,526 | 39,182 |
| Refinery: | | | | | | |
| Asphalt | thousand 42-gallon barrels | 20,434 | 12,676 | 13,536 | 14,000 e | 14,000 e |
| Fuel oil | do. | 102,320 | 90,190 | 72,374 | 72,000 e | 72,000 e |
| Gasoline | do. | 189,185 | 169,338 | 174,348 | 175,000 e | 175,000 e |
| Jet fuel | do. | 38,236 | 35,580 | 36,413 | 37,000 e | 37,000 e |
| Kerosene | do. | 38,311 | 35,625 | 36,461 | 37,000 e | 37,000 e |
| Liquefied petroleum gas | do. | 63,218 | 62,252 | 60,778 | 61,000 e | 61,000 e |
| Lubricants | do. | 4,290 | 4,028 | 3,878 | 4,000 e | 4,000 e |
| Naphtha | do. | 31,918 | 28,988 | 19,974 | 20,000 e | 20,000 e |
| Other, solvents | do. | 2,417 | 2,253 | 2,114 | 2,000 e | 2,000 e |
| Total | do. | 490,000 | 441,000 | 420,000 | 422,000 e | 422,000 e |
| Uranium, U content | | 55 e | 40 e | 44 e | -- e | -- |

eEstimated. rRevised. do. Ditto. NA Not available. -- Zero.

[1]Table includes data available through February 13, 2020. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the commodities listed, bismuth, colored gemstones (other than beryls and quartz), leucite, molybdenite, silica (silex), sodalite, sodium compounds, uranium oxide, and other minerals may have been produced, but available information was inadequate to make reliable estimates of output.

[3]Direct sales and (or) beneficiated (marketable product).

[4]Includes baddeleyite-caldasite.

[5]Figures represent officially reported diamond output plus official estimates of output by nonreporting miners.

TABLE 2
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2018

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity[e] |
|---|---|---|---|---|
| METALS | | | | |
| Alumina | | Alcoa Alumínio S.A. (Alcoa Inc., 100%) | Pocos de Caldas, Minas Gerais State (refinery) | 390. |
| Do. | | Alcoa World Alumina Brasil Ltda. (Alcoa Inc., 60%, and Alumina Ltd., 40%) | Sao Luiz, Maranhao State (refinery) | 3,500. |
| Do. | | Alumina do Norte do Brasil S.A. (Norsk Hydro ASA, 91%) | Alunorte refinery, Barcarena, Para State (refinery) | 6,400. |
| Do. | | Companhia Brasileira de Alumínio (Votorantim Group, 100%) | Aluminio City, Sao Paulo State (refinery) | 6,400. |
| Do. | | Novelis do Brasil Ltda. (Hindalco Industries Ltd., 100%) | Ouro Preto, Minas Gerais State (refinery) | 145. |
| Aluminum | | Albras Alumínio Brasileiro S.A. (Norsk Hydro ASA, 51%, and Nippon Amazon Aluminio Co. Ltd., 49%) | Barcarena, Para State (smelter) | 460. |
| Do. | | Alcoa Alumínio S.A. (Alcoa Inc., 100%) | Pocos de Caldas, Minas Gerais State (smelter) | 96. |
| Do. | | Alcoa Alumínio S.A., 60%, and BHP Billiton plc, 40% | Sao Luiz, Maranhao State (smelter) | 447. |
| Do. | | Companhia Brasileira de Aluminio S.A. (Votorantim Group, 100%) | Aluminio City, Sao Paulo State (smelter) | 440. |
| Bauxite | | Alcoa Alumínio S.A. (Alcoa Inc., 100%) | Pocos de Caldas, Minas Gerais State (mine) | 1,100. |
| Do. | | Alcoa World Alumina Brasil Ltda. (Alcoa Inc., 60%, and Alumina Ltd., 40%) | Juruti, Para State (mine) | 6,600. |
| Do. | | Companhia Brasileira de Aluminio S.A. (Votorantim Group, 100%) | Itamarati de Minas, Mirai, and Pocos de Caldas Mines, Minas de Gerais State (mines) | 3,000. |
| Do. | | Mineração Paragominas S.A. (Norsk Hydro ASA, 100%) | Paragominas, Para State (mine) | 11,400. |
| Do. | | Mineração Rio do Norte S.A. (MRN) (Vale S.A., 40%; BHP Billiton plc, 14.8%; Rio Tinto Alcan Inc., 12%; Companhia Brasileira de Aluminio S.A., 10%; Alcoa Aluminio S.A., 8.58%; Alcoa World Alumina, 5%; Norsk Hydro ASA, 5%; Alcoa World Alumina Brasil Ltda, 4.62%) | Porto Trombetas, Para State (mine) | 18,100. |
| Chromite | | Companhia de Ferro Ligas da Bahia (FERBASA) (private, 100%) | Pedrinhas Mine, Campo Formosa, Bahia State | 120 (concentrate). |
| Do. | | do. | Ipueira Mine, Campo Formosa, Bahia State | 48 (concentrate). |
| Cobalt | | Votorantim Metais (Votarantim Group, 100%) | Niquelandia, Goias State (mine)[1] | 2 (ore). |
| Do. | | do. | Niquelandia, Goias State and Sao Miguel Paulista, Sao Paulo (refinery plants)[1] | NA. |
| Copper: | | | | |
| Concentrate | | Mineração Caraíba S/A (Ero Copper Corp., 99.5%) | Jaguarari, Bahia State (3 mines) | 30. |
| Do. | | Vale S.A. (private, 100%) | Sossego Mine, Carajas, Para State | 100. |
| Do. | | do. | Salobo Mine, Carajas, Para State | 200. |
| Do. | | Yamana Gold Inc. (private, 100%) | Chapada Mine, Goias State | 85. |
| Do. | | Avanco Resources Ltd. (private, 100%) | Antas Mine, Carajas, Para State | 15. |
| Refinery | | Caraíba Metais S.A. (Paranapanema S.A., 100%) | Camacari, Bahia State (electrolytic plant)[1] | 280. |
| Do. | | Mineração Caraíba S/A (Glencore plc, 28.5%) | Jaguarari, Bahia State (electrowinning plant)[1] | 5. |
| Ferroalloys | | Vale Manganês S.A. (Vale S.A., 100%) | Barbacena, Minas Gerais State (plant) | 74. |
| Do. | | do. | Ouro Preto, Minas Gerais State (plant) | 65. |
| Do. | | do. | Simoes Filho, Bahia, Mato Grosso do Sul (plant) | 150. |
| Do. | | Minasligas | NA | 60 |
| Do. | | Mineração Taboca SA (Minsur S.A.) | Pitinga Mine, Sao Paulo State | NA. |
| Do. | | Resind Indústria e Comércio Ltda. | Smelter, Sao Joao Del Rei, Minas Gerais State | NA. |
| Gold: | | | | |
| Concentrate | kilograms | Vale S.A. (private, 100%) | Sossego Mine, Carajas, Para State | 3,000. |
| Do. | do. | do. | Salobo Mine, Carajas, Para State | 8,000. |
| Do. | do. | Beadell Resources Ltd. (private, 100%) | Tucano Mine, Amapa State | 6,200. |
| Do. | do. | AngloGold Ashanti Córrego do Sítio Mineração (AngloGold Ashanti Ltd., 100%) | Cuiaba and the Corrego do Sitio complexes, Minas Gerais State (5 mines) | 14,000. |
| Do. | do. | AngloGold Ashanti Serra Grande (AngloGold Ashanti Ltd., 100%) | Serra Grande Mines near Crixas, Goias State (4 mines) | 6,000. |
| Do. | do. | Jaguar Mining Inc. (private, 100%) | Caete Mines, Minas Gerais State (2 mines) | 4,000. |
| Do. | do. | do. | Turmalina Mine, Minas Gerais State | 3,000. |

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2018

(Thousand metric tons unless otherwise specified)

| Commodity | Major operating companies and major equity owners | Location of main facilities | Annual capacity[e] |
|---|---|---|---|
| METALS—Continued | | | |
| Gold:—Continued | | | |
| Concentrate— kilograms Continued | Kinross Brasil Mineração S.A. (Kinross Gold Corp., 100%) | Paracatu Mine, Minas Gerais State | 16,000. |
| Do. do. | Reinarda Mineração Ltda (Troy Resources Ltd.,100%) | Andorinhas Mine, Para State | 1,400. |
| Do. do. | Yamana Gold Inc. (private, 100%) | Chapada Mine, Goias State | 4,000. |
| Do. do. | do. | Jacobina Mine, Bahia State | 4,500. |
| Do. do. | do. | Fazenda Brasileiro Mine, Goias State | 2,000. |
| Do. do. | Avanco Resources Ltd. (private, 100%) | Antas Mine, Carajas, Para State | 300. |
| Refinery | AngloGold Ashanti Córrego do Sítio Mineração (AngloGold Ashanti Ltd., 100%) | Nova Lima, Minas Gerais | NA. |
| Do. | Casa da Moeda do Brasil (Brazil Mint) | Rio de Janeiro, Rio de Janeiro | NA. |
| Do. | Marsam Refinadora de Metais | Sao Paulo, Sao Paulo | NA. |
| Do. | Umicore Brasil Ltda. | Guarulhos, Sao Paulo | NA. |
| Iron ore and steel: | | | |
| Iron ore | Anglo American plc. (private, 100%) | Minas-Rio open pit mines, Minas Gerais State | 26,500. |
| Do. | Companhia Siderúrgica Nacional S.A. (private, 100%) | Casa de Pedra Mine, Congonhas, Minas Gerais State | 21,000. |
| Do. | Itaminas Comércio de Minérios S.A. (private, 100%) | Itaminas mining complex, iron ore mine, Sarzedo, Minas Gerais State | 5,000. |
| Do. | Mineração Usiminas S.A. (Usiminas, 70%, and Sumitomo Corp., 30%) | Quadrilatero Ferrifero, Serro Azul, Minas Gerais State (4 mines) | 12,000. |
| Do. | MMX Sudeste Mineração Ltda. (private, 100%) | Tico-Tico and Ipe Mines, Serro Azul, Minas Gerais State (mines) | 6,000. |
| Do. | do. | Corumba, Mato Grosso do Sul State (mines) | 1,500. |
| Do. | Samarco Mineração S.A. (BHP Billiton Ltd., 50%, and Vale S.A., 50%) | Alegria and Germano Mines, Minas Gerais State (2 mines)[1] | 26,000. |
| Do. | Vale S.A. (private, 100%) | Carajas Mine, Parauapebas, Para State (3 mines) | 130,000. |
| Do. | do. | Carajas Serra Sul S11D Mine, Para State | 90,000. |
| Do. | do. | Itabira, Mariana, and Minas Centrais, Minas Gerais State Centrais (eight mines) | 120,000. |
| Do. | do. | Minas Itabiritos, Vargem Grande, and Paraopeba Mines, Minas Gerais State (11 mines) | 90,000. |
| Do. | do. | Urucum and Corumba Mines, Mato Grosso do Sul State (2 mines). | 6,500. |
| Do. | Zamin Ferrous Ltd., 100% | Amapa Mine, Amapa State | 6,000. |
| Pellets | Companhia Hispano Brasileira De Pelotização S.A. (Vale S.A., 50.9%, and ArcelorMittal Group, 49.1%) | Hispanobras, Espirito Santo State (pellet plant) | 4,300. |
| Do. | Samarco Mineração S.A. (BHP Billiton Ltd., 50%, and Vale S.A., 50%) | Ponta Ubu, Anchieta, Espirito Santo State (3 pellet plants)[1] | 30,500. |
| Do. | Vale S.A. (private, 100%) | Tubarao VIII, Espirito Santo State (pellet plants)[2] | 36,700. |
| Do. | do. | Fabrica, Minas Gerais State (pellet plant) | 4,500. |
| Do. | do. | Sao Luis, Maranhao State (pellet plants)[1] | 7,500. |
| Do. | do. | Vargem Grande, Minas Gerais State (pellet plant) | 7,000. |
| Do. | do. | Cauê Itabiritos, and Conceicao Itabiritos II, Para State (pellet plants) | 43,000. |
| Steel, raw | Gerdau Açominas S.A. (Gerdau S.A., 100%) | Gerdau Acominas Steel Plant, Ouro Branco, Minas Gerais State | 7,600. |
| Do. | Aperam S.A. (private, 100%) | Timoteo, Minas Gerais State (specialty steel) | 900. |
| Do. | ArcelorMittal Tubarão (ArcelorMittal, 100%) | Steel Plant at Grande Vitoria, Espiritu Santo | 7,500. |
| Do. | Companhia Siderúrgica Nacional (private, 100%) | Volta Redonda Steel Plant, Rio de Janeiro State | 5,600. |
| Do. | Usinas Siderúrgicas de Minas Gerais, S.A. (private, 100%) | Iron and Steel Mills at Ipatinga, Minas Gerais State and Cubatao, Sao Paulo | 9,500. |
| Do. | Siderúrgica Norte Brasil S.A (private, 100%) | Siobras Plant, Maraba, Para State | 390. |
| Lead | Votorantim Metais (Votorantim Group, 100%) | Morro Agudo Mine, Paracatu, Minas Gerais State | 13. |
| Lithium | Advanced Metallurgical Group N.V. (AMG), 100% | Mibra Mine, Minas Gerais | 90. |
| Do. | Brazilian Company of Lithium (CBL) (Codemig Paritipações S.A., 67%, and Government, 33%) | Aracuai Mine, Minas Gerais | 10. |

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2018

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity[e] |
|---|---|---|---|---|
| METALS—Continued | | | | |
| Magnesium | | Rima Group | Minas Gerais State (mine) | 22. |
| Manganese | | Vale Manganês S.A. (Vale S.A., 100%) | Morro da Mina, Minas Gerais State | 100. |
| Do. | | Vale S.A. (private, 100%) | Mina do Azul, Carajas, Para State | 1,900. |
| Do. | | Mineração Corumbaense Reunida S.A. (Vale S.A., 100%) | Urucum Mine, Mato Grosso do Sul State | 700. |
| Do. | | Brazilian Manganese Corp. (BMC)-Dutch firm Ferrometals BV, 75%, and Canadian firm Cancana Resources/Meridian, 25% | Espigao Manganese Project (Jaburi and Rio Madeira plants), Rondonia State | 50. |
| Nickel | | Anglo American Niquel Brasil Ltda. (Anglo American plc, 100%) | Barro Alto, Goias State (refinery) | 36 (metal). |
| Do. | | do. | Barro Alto, Goias State (mine) | 3,000 (ore). |
| Do. | | do. | Condemin, Goias State (refinery) | 10 (metal). |
| Do. | | Votorantim Metais (Votorantim Group, 100%) | Fortaleza de Minas, Minas Gerais State (mine)[1] | 19 (nickel matte). |
| Do. | | do. | Niquelandia, Goias State (mine)[3] | 30 (ore, carbonate). |
| Do. | | do. | Niquelandia, Goias State and Sao Miguel Paulista, Sao Paulo (refinery plants)[3] | 25 (electrolytic). |
| Do. | | Vale S.A. (private 100%) | Onca Puma Nickel Mine, Ourilandiado Norte, Para State[2] | 27 (iron-nickel alloy). |
| Niobium (columbium) | | Companhia Brasileira de Metalurgia e Mineração (Moreira Salles Group., 70%) | Araxa, Minas Gerais State (mine) | 150 (ore). |
| Do. | | do. | Araxa, Minas Gerais State (beneficiation plant) | 6,000 (pyrochlore). |
| Do. | | Copebrás S.A. (China Molybdenum Co. Ltd., 100%) | Boa Vista, Goias State (mines) | 9. |
| Do. | | do. | Ouvidor, Goias State (beneficiation plant) | 1,300 (pyrochlore). |
| Silicon metal | | Rima Group | Minas Gerais State (mine) | NA. |
| Do. | | Dow Corning Brazil | NA. | NA. |
| Do. | | LIASA (silicon metal company) | NA. | NA. |
| Do. | | Minasligas | NA. | 40. |
| Silver | kilograms | Yamana Gold Inc. (private, 100%) | Chapada Mine, Goias State | 8,000. |
| Tantalum | metric tons | Mineração Taboca S.A. (Minsur S.A., 100%) | Pitinga Mine, Amazonas State and Fundicion de Pinpora, Sao Paulo State | 120 (concentrate). |
| Do. | do. | AMG Mineração S.A. (Advanced Metallurgical Group N.V. (AMG), 100%) | Volte Grande (Mibra) Mine, Nazareno, Minas Gerais State | 25 (concentrate). |
| Do. | do. | LSM Brazil S.A. [Advanced Metallurgical Group N.V. (AMG)] | Polymetallic plant at Sao Joao Del Rei, Minas Gerais State | NA. |
| Tin | | Estanho de Rondônia S.A. (Companhia Siderúrgica Nacional, 100%) | Santa Barbara (mine) and Ariquemes (smelter) | 3,600 (concentrate). |
| Do. | | Mineração Taboca S.A. (Minsur S.A., 100%) | Pitinga Mine, Amazonas State and Fundicion de Pinpora (smelter), Sao Paulo State | 6,000 (concentrate). |
| Do. | | Coopersanta (part of Coopermetal) | Smelter at Coopersanta, Bom Futuro, Ariquemes, Rondonia State | NA. |
| Do. | | Cooperativa Metalurgica de Rondonia Ltda. (Coopermetal) and subsidiary Coopersanta | Bom Futuro Mine and Smelter at Coopersanta, District of Bom Futuro, Ariquemes Municipality, State of Rondonia | 2. |
| Titanium | | Indústrias Nucleares do Brasil S/A | Polymetallic plant in San Francisco de Itabapoana, Rio de Janeiro State | NA. |
| Do. | | Millenium Inorganic Chemicals Mineração Ltda. (Cristal Global Group, 100%) | Guaju Mine, Mataraca, Paraiba State (mine) | 4,200 (ore). |
| Do. | | do. | Mataraca, Paraiba State (beneficiation plants) | 120 (concentrate). |
| Vanadium | metric tons | Largo Resources Ltd. (private, 100%) | Maracas Menchen Mine, Bahia State | 9,634. |
| Zinc | | Votorantim Metais Zinco S/A (Grupo Votorantim, 100%) | Vazante Mine, Minas Gerais State | 165. |
| Do. | | do. | Morro Agudo Mine, Paracatu, Minas Gerais State | 38. |
| Do. | | do. | Tres Marias Plant, Minas Gerais State | 190 (metal). |
| Do. | | do. | Juiz de For a Plant, Minas Gerais State | 95 (metal). |
| Zirconium, concentrates | | Indústrias Nucleares do Brasil S/A | San Francisco de Itabapoana, Rio de Janeiro State | NA. |
| Do. | | Millenium Inorganic Chemicals Mineração Ltda. (Cristal Global Group, 100%) | Mataraca, Paraiba State (mine) | NA. |
| Do. | | do. | Mataraca, Paraiba State (beneficiation plants) | NA. |

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2018

(Thousand metric tons unless otherwise specified)

| Commodity | Major operating companies and major equity owners | Location of main facilities | Annual capacity[c] |
|---|---|---|---|
| INDUSTRIAL MINERALS | | | |
| Asbestos | Sociedade Anônima Mineração de Amianto S.A. (SAMA) (Eternit Group,100%) | Cana Brava Mine and plant, Minacu, Goias State | 300 (concentrate). |
| Cement | Companhia de Cimento Itambé (private, 100%) | Itambe plant, Balsa Nova, Parana State | 2,800. |
| Do. | Cimento Nacional (Brennand Group, 100%) | Sete Lagoas plant, Minas Gerais State | 1,000. |
| Do. | do. | Plant in Paraiba State | 1,500. |
| Do. | Cimento Nassau (John Santos Group, 100%) | States of Amazonas, Ceara, Espiritu Santo, Maranhao, Para, Piaui, Pernambuco, Rio Grande do Norte, and Sergipe (10 plants) | 7,000. |
| Do. | Cimento Planalto S.A. (private, 100%) | Sobradinho Plant, Brasilia, Distrito Federal State | 1,600. |
| Do. | Cimento Tupi S.A. (private, 100%) | Carandai plant, Minas Gerais State; and Mogi das Cruzes, Sao Paulo State, and Volta Redonda plant, Rio de Janeiro State; | 3,500. |
| Do. | Holcim (Brasil) S.A. (Holcim Ltd., 100%) | Barroso, Cantagalo, Leopoldo, Sorocaba and Vitoria plants, Sao Paulo State | 5,400. |
| Do. | InterCement Brasil S.A. (Camargo Correa S.A., 100%) | States of Alagoas, Bahia, Goias, Minas Gerais, Paraiba, Pernambuco, Sao Paulo, Mato Grosso do Sul, and Rio Grande do Sul (16 plants) | 17,900. |
| Do. | CRH plc. (Irish Cement) | 3 integrated cement plants | 2,300. |
| Do. | João Santos Group | Itapissuma cement plant, Piaui, north east of Brazil | NA. |
| Do. | Lafarge Brasil S.A. (Lafarge S.A., 99.76%) | States of Bahia, Goias, Minas Gerais, Paraiba, Rio de Janeiro, and Sao Paulo (5 plants) | 11,300. |
| Do. | Mizu Cimentos Especiais (private, 100%) | States of Rio de Janeiro, Rio Grande do Norte, Espiritu Santo, Sao Paulo, and Sergipe (6 plants) | 3,000. |
| Do. | Votorantim Cimentos S.A. (Grupo Votorantim, 100%) | Multiple plants, including the following:<br>Barcarena and Primavera plants, Para State<br>Cubatao, Ribeirao Grande, Salto de Pirapora, and Santa Helena plants Sao Paulo State<br>Cantagalo, Sepetiba, Volta Redonda plants, Rio de Janeiro State<br>Campo Grande and Corumba plants, Mato Grosso do Sul State<br>Candiota,Charqueadas, Esteio, and Pinheiro Machado plants, Rio Grande do Sul State<br>Capivari de Baixo, Imbituba, and Itajai plants, Santa Catarina State<br>Caucaia and Sobral plants, Ceara State<br>Cuiaba and Nobres plants, Mato Grosso State<br>Edealina plant, Goias State<br>Itau de Minas plant, Minas Gerais State<br>Laranjeiras plant, Sergipe State<br>Mineradora Ponta da Serra, Ouricuri, and Paulista plants, Pernambuco State<br>Porto Velho plant, Rondonia State<br>Rio Branco do Sul plant, Parana State<br>Sobradinho plant, Distrito Federal State<br>Xambioa, Tocantins State | 35,000. |
| Clay, kaolin | Imerys Rio Capim Caulim S.A. (Imerys Group, 100%) | Processing plant in Barcarena and 2 mines in Ipixuna, Para State | 2,000. |
| Do. | do. | Barcarena, Para State (beneficiation plant) | NA. |
| Do. | CADAM S.A. (KaMin LLC, 100%) | Morro do Filipe Mine in Amapa and a beneficiation port and plant in the town of Munguba | 500. |
| Diamond carats | Lipari Mineração Ltda. (private, 100%) | Brauna open pit mine, in Bahia state | 340,000. |
| Feldspar | AMG Mineração S.A. [Advanced Metallurgical Group N.V. (AMG), 100%] | Volta Grande (Mibra) Mine, Nazareno, Minas Gerais State | 180 (ore). |
| Fluorspar | Mineração Nossa Senhora do Carmo Ltda. (private, 100%) | Cerro Azul, Parana State (2 mines) | 180 (ore). |

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2018

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity[e] |
|---|---|---|---|---|
| INDUSTRIAL MINERALS—Continued | | | | |
| Graphite | | Extrativa Metalquimica S/A (private, 100%) | Maiquinique, Bahia State (mine) | 2 (concentrate). |
| Do. | | JMN Mineração S/A (private, 100%) | Plant at Mateus Leme, Minas Gerais State | 2 (concentrate). |
| Do. | | Nacional de Grafite Ltda. (private, 100%) | Itapecerica, Pedra Azul, Salto da Divisa, Minas Gerais State (3 mines and 3 beneficiation plants) | 90 (concentrate). |
| Gypsum | | Companhia Brasileira de Equipamento (private, 100%) | Codo, Maranhao State, and Ipubi, Pernambuco State (2 mines) | 600 (ore). |
| Do. | | Mineradora São Jorge S.A (private, 100%) | Mines in the municipalities of Ipubi, Ouricuri, and Trindade, Araripe Region, Pernambuco State | 800. |
| Do. | | Votorantin Cimentos (Votorantin Group, 100%) | Mateo, Ceara State (mine) | NA. |
| Lithium | | AMG Mineração S.A. [Advanced Metallurgical Group N.V. (AMG), 100%] | Volta Grande (Mibra) Mine | 90,000. |
| Magnesite | | Indústrias Brasileiras de Artigos Refractories (Ibar) Nordeste S.A. (private, 100%) | Refractory plant at Brumado, Bahia State | NA. |
| Do. | | Magnesita Refratários S.A. (private, 100%) | Refractory plant at Contagem, Minas Gerais | 1,200 (ore). |
| Do. | | Xilolite S.A. (private, 100%) | Refractory plant at Brumado, Bahia State | NA. |
| Phosphate rock, gross weight | | Copebrás S.A. (China Molybdenum Co. Ltd., 100%) | Ouvidor, Goias State (mine) | 1,350 (concentrate). |
| Do. | | Mosaic Co. | Vale Fertilizantes, 5 mines: Araxa, Patos de Minas, and the Tapira open pit mines, located in the State of Minas Gerais; Cajati open pit mine in State of Sao Paulo; and Catalao open pit mine in the State of Goias | 4,800. |
| Do. | | Galvani (Yara, 60%) | Multiple mines in Minas Gerais State | 500. |
| Potash | | Mosaic Fertilizantes Co. | Various mines and production facilities | 500. |
| Quartz | | Rima Group | Mine in Bocaiuva, Minas Gerais State | 250. |
| Sand | | Mineração Jundu | Various mines and production facilities | NA. |
| Vermiculite | | Brasil Minérios Ltda. (private, 100%) | Processing plant in Sao Luiz dos Montes Belos, Goias State | 60 (concentrate). |
| MINERAL FUELS AND RELATED MATERIALS | | | | |
| Coal | | Carbonifera Belluno Ltda. (private, 100%) | Cantao Norte and Lauro Muller Mines, Santa Catarina State | 550. |
| Do. | | Carbonifera Catarinense S.A. (private, 100%) | Bonito and 3G Plano Mines, Santa Catarina State | 700. |
| Do. | | Carbonifera Circiuma S.A. (private, 100%) | Verdinho Mine, Forquilhinha, Santa Catarina State | 2,800. |
| Do. | | Companhia Carbonífera Metropolitana S.A. (private, 100%) | Esperanca and Fontanella Mines, Santa Catarina State | 1,200. |
| Do. | | Copelmi Mineração Ltda. (private, 100%) | Butia, Cachoeira do Sul, and Charqueadas, Rio Grande do Sul State (4 mines) | 3,000. |
| Do. | | Companhia Riograndense de Mineração (Government, 100%) | Candiota Mine and Leao Mine, Rio Grande do Sul State | 5,000. |
| Do. | | Indústria Carbonífera Rio Deserto Ltda. (private, 100%) | Circiuma and Urussanga, Santa Catarina State (2 mines) | 2,600. |
| Natural gas | million cubic meters | Petróleo Brasileiro S.A. (Petrobrás) (Government, 81.4%; private, 11.8%; public, 6.8%) | Offshore and onshore fields in the States of Alagoas, Amazonas, Bahia, Ceara, Espiritu Santo, Rio de Janeiro, Rio Grande do Norte, Sao Paulo, and Sergipe | 41,000. |
| Petroleum | thousand 42-gallon barrels | do. | Offshore and onshore fields in the States of Alagoas, Amazonas, Bahia, Ceara, Espiritu Santo, Parana, Rio de Janeiro, Rio Grande do Norte, Sao Paulo, and Sergipe | 960,000. |
| Petroleum products | do. | do. | Refineries in the States of Amazonas, Bahia, Ceara, Minas Gerais, Parana, Rio de Janeiro, Rio Grande do Sul, and Sao Paulo (15 refineries) | 834,025. |

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2018

[e]Estimated. Do., do. Ditto. NA Not available.
[1]On care-and-maintenance status.
[2]Mining operations have been suspended since September 2017.
[3]On care and maintenace since April 2016

TABLE 3
BRAZIL: RESERVES OF MAJOR MINERAL COMMODITIES IN 2018

(Thousand metric tons unless otherwise specified)

| Commodity[1] | | Reserves |
|---|---|---|
| Asbestos, fiber | | 11,577 |
| Bauxite | | 2,600,000 |
| Chromite, $Cr_2O_3$ | | 507,000 |
| Clay, kaolin | | 7,186,000 |
| Coal, all types | | 32,264 [2] |
| Cobalt, Co content | metric tons | 70,000 |
| Copper, Cu content | | 11,212 |
| Feldspar | | 145,000 |
| Fluorspar ($CaF_2$ content) | | 1,449 |
| Gold, Au content | metric tons | 2,400 |
| Graphite | | 72,000 |
| Gypsum | | 469,000 |
| Iron ore | | 32,644,000 |
| Lead, Pb content | | 74,000 |
| Lithium, Li content | metric tons | 54,000 |
| Magnesite | | 391,000 |
| Manganese, Mn content | | 15,500 |
| Manganese | | 136,492 |
| Natural gas | million cubic meters | 369,432 [3] |
| Nickel, Ni content | | 15,991 |
| Niobium, Nb content | | 16,166 |
| Petroleum, crude | million 42-gallon barrels | 12,800 [3] |
| Phosphate rock, $P_2O_5$ content | | 136,000 |
| Rare earths, rare-earth-element (REE) content | | 21,000 |
| Talc and pyrophyllite | | 45,153 |
| Tantalum, Ta content | metric tons | 33,691 |
| Tin, Sn content | do. | 382,689 |
| Titanium minerals, $TiO_2$ | | 6,145 |
| Uranium, $U_3O_8$ | metric tons | -- [2] |
| Vanadium, V content | do. | 119,000 |
| Vermiculite | | 7,000 |
| Zinc, Zn content | | 2,464 |
| Zirconium, mineral concentrates | | 2,319 |

do. Ditto. -- Zero.
[1]Source: Departamento Nacional de Produção Mineral, Sumário Mineral 2017, v. 37.
[2]Source: Empresa de Pesquisa Energética—Balanço Enegético Nacional 2017.
[3]Source: National Agency of Petroleum Natural Gas and Biofuels, Statistical Mineral Yearbook 2018.