

THE MINERAL INDUSTRY OF SOUTH AFRICA

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The Republic of South Africa holds a major economic and physical presence on the African continent. In 2000, it ranked second after Libya in per capita gross domestic product (GDP) based on purchasing power parity data for 2000 at \$8,500¹ per capita and fifth in population and land area with 43.6 million people and 1,219,912 square kilometers, respectively; by comparison, the land area of South Africa is slightly more than twice the size of Texas. The GDP grew at a rate of 3.1% in 2000; this was its highest growth in 3 years. Of total exports of all goods, which were valued at \$30.8 billion, mineral commodities accounted for about 47%. The minerals industry contributed about 25% to 31% of the GDP, of which 6.5% came from primary mined products and 20% to 25% from value-added processed mineral products, such as aluminum, ferroalloys, and steel. The rand (R), which continued its steady decline relative to the U.S. dollar, reached R7.5 to \$1.00 by yearend 2000 compared with R3.55 to \$1.00 in 1994. The weakness of the rand, however, allowed the mineral sector to remain competitive internationally by helping balance internal rand costs with revenues from dollar-denominated mineral exports; this also contributed to South Africa maintaining a net positive trade balance of \$3.2 billion in 2000 (U.S. Central Intelligence Agency, 2001, South Africa, World Factbook 2001, accessed October 10, 2001, via URL <http://www.odci.gov/cia/publications/factbook/index.html>; U.S. Department of State, 2001, South Africa, Country Commercial Guide, accessed October 10, 2001, via URL <http://www.usatrade.gov/Website/CCG.nsf>).

Mining has been the mainstay of the economy for more than 100 years and has contributed significantly to the industrial development of the country. In the past 10 years, the development of export-oriented value-added processing aluminum, ferroalloys, steel, and titanium industries has become an important component of the mineral economy of South Africa, and has generated more than \$3 billion per year in export earnings. The development of these value-added industries along with an expansion in coal exports and a recent sharp increase in platinum-group metal (PGM) prices have helped compensate for the declining role of gold in the economy. Owing to the high cost of deep gold mining in South Africa and the decline in world market price for gold, gold export earnings have dropped sharply by from \$300 million per year to \$900 million per year since 1994. In 2000, gold exports were only \$3.4 billion compared with slightly more than \$7 billion in 1994. In 2000, for the first time ever, the value of PGM exports (\$3.8 billion) exceeded that of gold exports. The mining and minerals processing through semimanufactured products accounted for more than 500,000 jobs. Employment in

the primary mining sector, however, declined to 437,000 in 1999 from 466,700 in 1998 and from more than 778,000 in 1990 (South Africa Department of Minerals and Energy, 2001, p. 9).

The most important mineral commodities produced in South Africa, in terms of value, were PGMs, gold, coal, ferroalloys (ferrochromium, ferromanganese, ferrosilicon, and ferrovandium), aluminum, steel, titanium, iron ore, diamond, vanadium, and copper. Additionally, important output of metallic commodities included antimony, chromite, cobalt, lead, manganese, nickel, silver, uranium, zinc, and zirconium. Significant industrial minerals production included andalusite (aluminum silicate), aggregate and sand, asbestos, dimension stone, fluorspar, limestone and lime, phosphate rock, sulfur, and vermiculite. South Africa was a major producer and the world's third largest exporter of coal and the largest producer of synthetic liquid fuels and petrochemicals derived from coal. South Africa's well-developed railway and port infrastructure served the domestic minerals industry and those in neighboring countries. In 1999, South Africa produced more than 62 mineral commodities from about 695 mines and quarries, which included about 61 coal mines, and 54 diamond and 53 gold operations.

Government Policies and Programs

The Ministry of Mines and Energy's Department of Minerals and Energy (DME) is the primary Government entity responsible for the establishment and implementation of minerals and energy policy and for oversight of the country's mineral industry. Within the DME are the Mineral Development Branch, which is responsible for regional mineral development, minerals economics (Minerals Bureau), mine rehabilitation, and mining rights; the Energy Branch, which promotes the optimum utilization of energy resources; and the Mine, Health & Safety Inspectorate. A number of parastatal institutions that are associated with the DME include Atomic Energy Corp., the Council for Nuclear Safety, the Council for Geosciences (formerly the Geological Survey of South Africa), the parastatal mineral-research organization Council for Mineral Technology (Mintek); the National Electricity Regulator; the South African Diamond Board; and Central Energy Fund (CEF) (Pty.) Ltd., through which the state's interest in the liquid fuel industry is owned, developed, and managed commercially.

Following 5 years of public and internal Government debate, the DME published its draft Minerals Development Bill, 2000, in the Government Gazette of December 18, 2000. The draft bill was open to public comment until March 31, 2001. This bill will give the state exclusive custodianship of all mineral rights and focused on the freeing up of unexploited mineral rights long held by the major mining houses to provide more

¹Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R6.94=US\$1.00 for 2000 and R6.11=US\$1.00 for 1999.

opportunities in the mining sector for black South African entrepreneurial groups and for foreign investment. The introduction to the bill states, “The fundamental principles which underpins this bill are

“a. mineral resources is the common heritage of all South Africans and belongs collectively to all the peoples of South Africa;

“b. it is a universally recognized right of a state to exercise full and permanent sovereignty over all its natural resources;

“c. public trusteeship of South Africa’s mineral resources;

“d. to redress the results of past racial discrimination and ensure the historically disadvantaged persons participate in the minerals and mining industry and benefit from the exploitation of the nation’s mineral resources; security of tenure for prospecting and mining operations;

“e. environmental protection and sustainable development; and

“f. promotion of local and rural economic development and social upliftment of communities affected by mining.

“The minerals and mining law dispensation proposed in the draft bill is based on the universally accepted principle that mineral resources are part of South Africa’s national patrimony and that the State is the custodian of the nation’s mineral resources. It is from the aforementioned principles that the state derives its entitlements to control, administer, manage access to South Africa’s mineral resources, to grant prospecting rights and mining rights and issue retention permits.

“Therefore, on commencement of the new legislation, prospecting rights, mining rights, retention permits and permission to remove minerals will only be granted by the state. As far as possible the bill reduces ministerial discretion by ensuring that discretionary powers are exercised based on prescribed criteria” (Government of South Africa, December 18, 2000, Mineral development draft bill, Government Gazette, accessed October 1, 2001, at URL <http://www.polity.org.za/govdocs/notices/2000/not4577.html>).

In its initial reaction to the bill, the Chamber of Mines, which represents the largest sectors of the South African mining industry, supported the underlying objectives of the bill but expressed concern over its ability to achieve these objectives without “unintended negative consequences.” The Chamber argued that the bill would undermine fundamental property rights, give excessive discretion to a single person (the Minister of Mines and Energy), offer no right of appeal to the courts, create legislative and regulatory uncertainty, make it more onerous to meet licence requirements, and introduce a royalty system that could put thousands of jobs at risk. The Chamber was concerned over the lack of clarity on compensation for expropriated properties and the impact proposed taxes could have on production costs and the international competitiveness of the industry (Zoli Diliza, February 28, 2001, Industry warns of unintended consequences of new draft mineral development bill, South Africa Chamber of Mines Media Release, accessed June 1, 2001, at URL <http://www.bullion.org.za/bulza/release2001/bill.htm>).

Subject to the enactment of the bill by Parliament, the South African mineral industry operates under the Mining Titles Registration Act, 1967; the Central Energy Fund Act, 1977; the Petroleum Products Act, 1977; the Diamonds Act, 1986; the Electricity Act, 1987; the Mineral Technology Act, 1989; the

Minerals Act, 1991; the Minerals Amendment Act, 1993; the Nuclear Energy Act, 1993; the Liquid Fuels and Oil Repeal Act, 1993; the Mineral and Energy Laws Rationalization Act, 1994 (which repealed the Mining Rights Act of 1967); and the Mine Health and Safety Act, 1996. A 1998 ruling by the Minister of Finance set the corporate tax rate at 35% for all companies entering offshore oil and gas subleases with Soekor E and P (Pty.) Ltd. by the end of 1999.

In February 2000, a mining summit was held among government, labor, and industry leaders and invited nongovernmental and community organizations representatives. The objective of the summit was to seek a common vision for the mining industry and to reach consensus on ways to improve its job creation potential as well as to stabilize employment and develop skills. As an outcome of the meeting, a Sector Partnership Committee was established to develop policy recommendations for several areas, which included mineral promotion, development, and managing cyclical volatility; coordinated and integrated rural development; and employment and human resources development. The Sector Partnership Committee replaces the Gold Crisis Committee, which had been established in 1998; it was modeled after a new advisory board proposed in the bill (South Africa Chamber of Mines, February 2000, Mining industry agreements, accessed June 1, 2001, at URL <http://www.bullion.org.za/bulza/agreements/Mining%20Summit.htm>).

Environmental Issues

Following the consultative national environmental policy process, which was an initiative by the Department of Environmental Affairs and Tourism (DEAT) to review the state of the environment in South Africa, DEAT released its draft white paper on environmental management policy for South Africa in May 1997 (Department of Environmental Affairs and Tourism, July 1997, White paper on environmental management policy, accessed December 12, 1998, at URL http://www.polity.org.za/govdocs/white_papers/envir.html). The white paper confirmed the Constitutional right to a healthy environment and established a policy of sustainable development as the accepted approach to resource management and utilization in South Africa.

The National Environmental Management Act (107 of 1998) (NEMA) created a framework for environmental management in South Africa. It established principles for sustainable development, procedures for coordinating the environmental functions of government, and mechanisms for civil society participation. The NEMA, however, did not deal with the details of coastal management, biodiversity conservation, and integrated pollution and waste management. During 2000, the DEAT began work on a Law Reform Program to amend sections of the NEMA to give effect to the white papers on biodiversity, sustainable coastal development, and integrated pollution and waste management. This legislation will be written as new chapters within the NEMA; the first drafts of the legislation have been scheduled for public comment in 2002.

The NEMA required departments that have an impact on the environment or that have an environmental management function to prepare environmental management plans (EMPs), environmental implementation plans (EIPs), or both. These

plans are submitted to the interdepartmental Committee for Environmental Coordination (CEC) for approval and adoption. During the year under review, the CEC accepted the EIPs and the EMPs from the DME (South Africa Department of Environmental Affairs and Tourism, [2001], Environmental planning and coordination—A connected world, Annual Review 2000-01, accessed October 1, 2001, at URL <http://www.environment.gov.za/Documents/Publications/AnnualReport2000-01/EnvPlanCoord.htm>; South Africa Department of Minerals and Energy, February 23, 2001, Minerals and energy—Environmental management plans, Government Gazette, accessed October 1, 2001, at URL <http://www.dme.gov.za/publications/policydocuments.htm>).

Production

In 2000, South Africa was one of the largest and most diverse minerals producers in the world. As shown in table 1, output levels of more than 60 mineral commodities were mixed. Of the major metal commodities, production increases were significant (14% to 37%) for cobalt, direct reduced iron, iron ore, ferrochromium, manganese, and zirconium and modest (1% to 7%) for ferromanganese, nickel, steel, titanium, and zinc. Production declines of 2% to 6% were noted for aluminum, chromite, copper, gold, lead, PGMs, and silver. In the industrial minerals sector, production of asbestos and diamond increased, and that of fluorite, gypsum, granite, phosphate rock, and salt declined. With the startup of the new Oryx oilfield offshore Mossel Bay in May 2000, oil production increased by 20% to more than 6 million barrels per year.

On a value basis, about 23% of primary mined products and 18% of processed mineral materials were consumed domestically in 1999. More than 70% of coal production went for internal power generation and for value-added synthetic fuel and petrochemicals production. Using South Africa's natural comparative advantage in its mineral resource endowment of chromite, iron ore, manganese, and nickel, these materials were also converted to value-added ferroalloy and steel products for world markets.

Trade

In 2000, the total value of sales of primary minerals, as reported by the DME Minerals Economics Directorate (Minerals Bureau), was \$14.2 billion, of which \$11 billion was exported, compared with \$12.3 billion and \$9.5 billion, respectively, in 1999. For 1999, the total value of all processed mineral materials was \$2.98 billion, of which \$2.43 billion was exported. The major exports by value in 1999 were gold at \$4.09 billion; coal, \$2.84 billion; PGMs, \$2.43 billion; ferroalloys, \$980 million; aluminum, \$687 million; iron ore, \$282 million; vanadium, \$146 million; and copper, \$118 million. Other significant exports, for which individual value data were not provided included diamond, steel, titanium, and zirconium (South Africa Department of Minerals and Energy, 2001).

Listed in declining value order, the majority of primary mineral exports, which included precious minerals, went to European markets followed by the Pacific Rim countries, the Middle East and the Near East, and North America and Central

America with less than 10% each. Exports within Africa accounted for less than 1% of the South African mineral export trade.

Although South Africa was self-sufficient in the vast majority of its mineral needs, some mineral commodities were imported. Significant mineral imports included alumina, coking coal, rough and cut diamonds, certain ferroalloys, magnesite, magnesia, nickel, precious metals, and sulfur. Imports of primary and processed mineral products in 1999 totaled \$1.5 billion with an additional \$2.09 billion in crude petroleum imports reported (South Africa Department of Minerals and Energy, 2001, p. 13-16).

Structure of the Mineral Industry

The South African minerals and energy industries operated on a free-enterprise, market-driven basis. Ownership of mineral rights was held by either the Government or private entities. Mineral rights would revert to the state under terms of the draft Minerals Development Bill, 2000. Government involvement in these sectors was minimal and primarily confined to ownership of the national electric power utility Eskom and the national oil and gas exploration company Southern Oil Exploration Co. (Soekor). The Government also provided additional declining subsidies to the synthetic fuels programs of two parastatals, Mossgas (Pty.) Ltd. and Sasol Limited. Sasol received a subsidy when the derived price of oil, a figure calculated by the Government on a monthly basis, falls below \$16 per barrel.

In South Africa, the bulk of mineral land holdings and production has historically been controlled by five mining investment houses. Since 1994, however, the industry has undergone a major corporate restructuring, or "unbundling," aimed at simplifying a complex system of interlocking ownership that existed in the past, establishing separate core-commodity-focused profit centers, and diversifying and rationalizing nonperforming assets to make the newly restructured companies more competitive internationally. The structure and ownership of the industry as of mid-2001 is shown in table 2.

This period also saw the movement of two major corporate financial headquarters, Anglo American plc and Billiton plc (incorporating the former Gencor Limited), from Johannesburg to London, United Kingdom. Concerned with this trend "in capital flight," the Government blocked the \$3 billion merger of Gold Fields Ltd. with Franco-Nevada Mining Corp. of Canada in September 2000 (Allan Robinson, September 22, 2000, South Africa rejects Franco-Nevada deal, accessed October 1, 2001, at URL <http://www.globetechnology.com/archive/20000922/RGOLD.html>). In mid-2001, however, the Government subsequently approved the \$19 billion takeover of De Beers Consolidated Mines Ltd. (De Beers) by Anglo American (Business Day, May 29, 2001, High Court sanctions buyout of De Beers, Business Day [Johannesburg], accessed October 1, 2001, at URL <http://www.bday.co.za/bday/content/direct/1,3523,858608-6078-0,00.html>).

The Chamber of Mines, whose members represent the majority of coal, gold, and uranium producers, was responsible for a variety of advisory and service functions for mining interests in South Africa. One of its main activities was the annual wage negotiations between member mines and the

Commodity Review

Metals

Aluminum.—Because South Africa has no economically exploitable deposits of bauxite and no alumina production capacity, all alumina feedstock for the production of aluminum metal is imported. Billiton Aluminium South Africa (Pty.) Ltd. was the sole producer of primary aluminum from its Bayside smelter and the newer Hillside smelter at Richards Bay. Effective as of the June 2001 merger of Billiton plc and BHP Ltd. of Australia, the plant will be owned by the new company BHP Billiton Plc. For the fiscal year ending June 30, 2001, the Hillside smelter produced 498,000 metric tons (t) of aluminum metal, and the Bayside smelter, 178,000 t. At Hillside, BHP Billiton was conducting a feasibility study directed at expanding Hillside smelting capacity by another 130,000 metric tons per year (t/yr). An upgrade of the casting house at the Bayside smelter will permit BHP Billiton to produce more value-added products, which will include extrusion ingots, rolling ingots, rods, and rim alloys (BHP Billiton plc., 2001, p. 22-23).

Antimony.—Metorex Ltd. (a subsidiary of Crew Development Corp. of Canada), which operated the Consolidated Murchison mine near Gravelotte in the Northern Province, was South Africa's only producer of antimony (as stibnite concentrate); its output of about 8% of world production made South Africa the second largest producer after China. The mine hoists ore from three shafts—the Athens, the Beta, and the Monarch shafts. Production from the reequipped Beta Shaft resumed in the first quarter of 2001. For the fiscal year ending June 30, 2001, Consolidated Murchison treated 40,000 metric tons per month (t/mo) that averaged 1.10% antimony and 2.2 grams per metric ton (g/t) gold. Recovery rates were 81.47% for antimony and 96.79% for gold. Production was 7,067 t of stibnite concentrates that contained an average of 58% antimony and 1,089 kilograms (kg) of gold. Since large-scale mining began in 1937, the Consolidated Murchison Mine has produced 53,000 t of antimony contained in concentrates and 25.25 t of gold. On June 30, 2001, proved and probable reserves amounted to 1.5 million metric tons (Mt) at 2.2% antimony and 2.8 g/t gold, inclusive of 15% dilution and a mine call factor of 85%. Mineral resources exclusive of reserves total 8.6 Mt at grades of 2.5% antimony and 2.6 g/t of gold (Metorex Ltd., 2001, Our companies—Our operations—Consolidated Murchison Mine, accessed October 18, 2001, at URL <http://www.metorexgroup.com>).

Chromite and Ferrochromium.—Chromite ore production decreased by 3% in 2000 to 6.62 Mt. South Africa was the global leader in chromite ore production and export. Production came from more than 20 mines located within the Bushveld Ultramafic Complex. About 84% of the ore went to supply domestic ferrochrome smelters, and the remainder was exported. Domestic consumption of chromite ore, which was the highest in the world, fed the world's leading ferrochrome industry as well as a major chromium chemicals and refractories industry. Chromite ore sales were valued at about \$155 million

in 2000, of which about \$52 million was export revenue.

For the fiscal year ending June 30, 2001, BHP Billiton's Samancor Group, which was the world's largest integrated ferroalloys producer, produced 3.16 Mt of chromite ore and 908,000 t of chrome alloys. Samancor's operations were organized under two mining centers—Eastern Chrome Mines, which is based at Steelpoort, and Western Chrome Mines, with its mine office at Mooinooi near Rustenburg. The total combined ore reserved exceed 450 Mt, calculated to a depth of 300 meters (m) with production capacity of more than 4 million metric tons per year (Mt/yr). Samancor's total chromite resources exceed 1.8 billion metric tons (Gt) and were expected to support mining activity for more than 200 years at the current (2000) extraction level (BHP Billiton plc., 2001, p. 24; Samancor Group, 2001, Samancor—Chrome—Production process, accessed October 18, 2001, at URL <http://www.samancor.co.za>).

Xstrata AG of Switzerland produced 1.14 Mt of ferrochrome in calendar year 2000; this was a 15% increase compared with that of 1999 from its three smelting operations at Lydenburg, Rustenburg, and Wonderkop. Production of salable chrome ore for the year amounted to 1.9 Mt. The Thorncliffe Mine contributed 855,000 t and met the ore requirements of the Lydenburg smelting operations, which produced nearly 450,000 t of ferrochrome in 2000. Xstrata mines supplied more than 60% of the ore feed required by the its ferrochrome smelters. The balance was purchased from third parties, a major portion of which was obtained from platinum mines in the form of chrome-bearing tailings. Xstrata reported that the use of these tailings, when combined with the its agglomeration technology, continued to provide an extremely competitive source of chrome feed for the production of ferrochrome. The \$28 million development of the Waterval West section of the Townlands chromite ore deposit was delayed by abnormal rains and unforeseen technical difficulties. The surface plant will be commissioned early in 2001, and underground development will be completed by yearend 2001 and will be sufficient to produce 780,000 t/yr of run-of-mine chromite ore.

In June 2000, the company entered into a production joint venture with Samancor to gain access to large quality chrome ore deposits adjacent to its existing Kroondal Mine in the Rustenburg area. The Kroondal Mine infrastructure was being expanded to produce more than 1.2 Mt/yr of run-of-mine production to yield 840,000 t/yr of salable chromite ore. The ore will be available for use by both the joint venture and at Xstrata's Wonderkop ferrochrome furnace. The Samancor and Xstrata joint venture was also building two new furnaces at Wonderkop with a combined capacity of 180,000 t/yr of ferrochrome. Commissioning was scheduled for mid-2001. The new furnaces at Wonderkop will replace the capacity of the two furnaces in Rustenburg that were shut down in the fourth quarter of 2000 for upgrading and to control inventory levels. As of yearend 2000, Xstrata reported proven chromite reserves of 4.4 Mt at a grade of 40.1% Cr₂O₃ and a chrome-to-iron ratio of 1.49; probable reserves of 21.8 Mt at a grade of 39.7% Cr₂O₃ and a chrome to iron ratio of 1.45; and combined measured, indicated, and inferred resources of 332.9 Mt at grades that range from 36.3% to 40.9% Cr₂O₃ and chrome-to-iron ratios of from 1.33 to 1.53 (Xstrata AG, 2001, Annual report for 2000—Review of operations—Metals & minerals—Chrome business

unit, accessed October 18, 2001, at URL <http://www.xstrata.com/reports/2000-en/metals.php>).

In October 2000, Associated Manganese Mines of South Africa Ltd. [a subsidiary of Anglovaal Mining Ltd. (Avmin)] commissioned its new \$30 million Dwarsrivier open pit chrome mine and beneficiation plant located approximately 30 kilometers (km) from Steelpoort and 60 km from Lydenburg. The Dwarsrivier operation will deliver chrome ore to Assmang's chrome alloy smelter in Machadodorp about 150 km from the mine. With the startup of the underground section in late 2001, the mine will produce 1 Mt/yr of run-of-mine chromite ore. This mine is part of a \$173 million capital investment program being undertaken by Assmang Group during the next 3 years. Assmang's ferrochrome capacity was expected to double by the end of 2001 with ore being sourced from the Dwarsrivier chrome-mining complex and with the commissioning of the new 54 megavoltampere furnace and pelletizing plant at Machadodorp Works (Anglovaal Mining Ltd., 2001, Operations—Dwarsrivier—Chrome, accessed October 20, 2001, at URL <http://www.avmin.co.za/operations/dwarsrivier.asp>).

Copper.—Palabora Mining Company Limited (owned by Rio Tinto plc) operated the largest integrated copper complex in South Africa. Production declined by 5% in 2000 because of operating problems with the converter at the copper smelter and as the company began to transition from 80,000-metric-ton-per-day (t/d) open pit mining to 30,000-t/d underground mining, which was scheduled for startup in November 2002. The \$380 million underground development project will extend the life of the mine for another 20 years. During 2000, Palabora treated 25.7 Mt of ore at a grade of 0.58% copper that yielded 388,151 t of copper concentrates that contained 127,548 t of copper. The copper concentrate grade was 32.6%. The Palabora smelter produced 90,727 t of copper anodes, which was down by 11% from 1999; the refinery output declined to 87,683 t of copper cathodes from 100,044 t in 1999. Palabora also produced a variety of other products from the unique carbonatite mineralogy of its deposit; these included 8,526 t of baddeleyite (approximately 70% of world demand), 263 t of nickel sulfate, 139,491 t of sulfuric acid, 86,299 kg of uranium oxide, 208,422 t of 90.65% vermiculite concentrates, and 7,897 t of zirconium dioxide chemicals, as well as 7,804 kg of precious metals contained in refinery tankhouse slimes. The Palabora Mine also generated 240,000 t of byproduct magnetite concentrates at a grade of around 62% iron and 1.6% titanium dioxide, which were either sold to the coal-washing industry or stockpiled for possible future use in a proposed new hot briquetted iron facility in Mozambique (Palabora Mining Company Limited, 2001, p. 48).

O'okiep Copper Co. (Pty.) Ltd. (owned by Metorex Ltd.) operated a copper mine at Nigraoep and a copper smelter at Nababep in the Northern Cape Province. For the fiscal year ending June 30, 2001, O'okiep milled 67,000 t/mo of ore at an average head grade of 1.78% copper. With a 95% smelter recovery rate, blister copper production was 13,000 t/yr. Remaining proved mineral reserves were reported to be 4.9 Mt at a grade of 1.6% copper. Mineral resources exclusive of reserves amounted to 7.0 Mt at a grade of 1.1%. Although a decision was made to begin closing down mining operations in

2002, Metorex was investing more than \$7 million to build a new concentrator at Nababep to retreat the slag dump, which was estimated to have a grade of 1.5% copper. This project should be completed early in 2002 and was expected to run for 7 years (Metorex Ltd., 2001, Our companies—Our operations—O'okiep Copper Co. (Pty.) Ltd., accessed October 18, 2001, at URL <http://www.metorexgroup.com>).

Copper was also produced in small amounts as a byproduct of lead-zinc and platinum mining.

Gold.—In 2000, mine production was nearly 431 t of gold compared with 451 t of gold in 1999 and 989 t of gold during of the historic peak production year of 1970. Gold ore grades steadily declined to 4.5 g/t in 2000 from more than 13.3 g/t in 1970. During this same period, employment in the gold mines declined to 197,500 from 416,800. South Africa remained the world's leading gold producer, although its once-dominant share of total global new mined gold production dropped to about 17% in 1998 from 68% in 1970. The depreciation of the rand has permitted South African gold mines to remain competitive internationally with the industry committing more than \$360 million in new capital expenditures in 2000; this was a 4% increase compared with that of 1999 (Chamber of Mines of South Africa, 2000, South Africa mining industry—Statistical tables—2000—Gold industry data, accessed October 20, 2000, at URL <http://www.bullion.org.za/bulza/publications/Stats2000/StatsTables.pdf>).

Gold production in 2000 was dominated by AngloGold Ltd. (the gold division of Anglo American), which accounted for 37% of mine production; Gold Fields Ltd., 25.7%; Harmony Gold Mining Co., 15.3%; and Durban Roodeport Deeps Ltd., 7.9%.

During 2000, AngloGold's corporate focus was on new gold mine investments in Australia, Mali, and Tanzania. In South Africa, its strategic concentration was on higher profit margin, longer life operations. In line with this strategy, in December, AngloGold reached an agreement in principle to sell the Deelkraal and the Elandsrand Mines to Harmony for \$132 million. AngloGold had three main operational centers in South Africa—the Free State Operations included four underground mines and the Free State surface mines, the Vaal Reefs operations ran four underground mines and a surface mine, and the West Wits Operation included five underground mines and the Western Ultra Deeps Mine. In 2000, production declined to 168,519 kg of gold from 178,690 kg in 1999. AngloGold reported South Africa ore reserves to be 364.1 Mt at a grade of 5.41 g/t gold in addition to measured and indicated resources of 1,558.9 Mt at a grade of 4.0 g/t gold (Anglo American plc, 2001, Reserves and resources, Annual Report 2000, accessed October 24, 2001, at URL <http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html>). Development work on the Moab Khotsang Mine continued during 2000 with completion of the main shaft, which was sunk to 2,400 m; the subvertical shaft had been sunk and equipped temporarily down to 3,310 m. Development of the mine will continue for several years. Total capital costs will be between \$700 million and \$800 million. The high-grade Moab Khotsang deposit contained reserves of 18.5 Mt at a grade of 16.36 g/t gold and resources estimated to be 14.3 Mt at a grade of 26.52 g/t gold for a combined gold content of 681,000 kg (21.9 million troy

ounces). As more in-fill drilling of resource zones was finished, it seems apparent that the mine reserve grade should increase (Anglogold Ltd., 2001, South Africa—Moab Khotsong, Operational Review, accessed October 20, 2001, at URL <http://www.anglogold.co.za/AboutAngloGold/FactSheets/MoabKhotsang.asp>).

Gold Fields operated three gold mining divisions in South Africa—the Dreifontein, the Kloof, and the Free State, which included the Beatrix and St. Helena Mines and the new underground Target development. For the fiscal year ending June 30, 2001, production from Gold Fields' South African operations decreased by 8% to 98,903 kg of gold as the operations were affected by significant seismic activity during the year and were forced to close down high-cost mining areas. For fiscal year 2001, the Dreifontein Division treated 6.55 Mt of ore, which yielded 6.4 g/t gold, for a total output of 42,031 kg of gold compared with 43,497 kg of gold for the year ending June 30, 1999. The Kloof Division treated 3.93 Mt of ore, which yielded 9.6 g/t gold, for a total output of 37,283 kg of gold compared with 43,394 kg of gold in 1999. At the Free State Operations, the Beatrix and Oryx Mines treated 2.81 Mt of ore, which yielded 5.5 g/t gold, for a total output of 15,372 kg of gold compared with 15,268 kg of gold in 1999, and the St. Helena Mine treated 0.92 Mt of ore, which yielded 4.6 g/t gold, for a total output of 4,217 kg of gold compared with 5,475 kg of gold in 1999 (Gold Fields Ltd., 2001, Review of operations, Annual Report 2001, accessed October 20, 2001, at URL http://www.goldfields.co.za/annual_report/ar2001/rev_op/rev_op.htm). As of the end of fiscal year 2000-2001, Gold Fields estimated that on the basis of a gold price of \$270 per troy ounce, measured and indicated mineral resources were 106 Mt at a grade of 17.3 g/t gold, and proved and probable ore reserves were 71.1 Mt at grade of 12.9 g/t gold at Kloof; resources were 140.2 Mt at a grade of 11.2 g/t gold, and reserves were 103.1 Mt at grade of 8.8 g/t gold at Dreifontein; resources were 53.4 Mt at a grade of 8.8 g/t gold, and reserves were 67.8 Mt at grade of 6.52 g/t gold at Free State (Beatrix); and resources were 4.7 Mt at a grade 15.5 g/t of gold, and reserves were 2 Mt at grade of 5.0 g/t gold at Free State (St. Helena) (Gold Fields Ltd., 2001, Resources and reserves, Annual Report 2001, accessed October 20, 2001, at URL http://www.goldfields.co.za/annual_report/ar2001/explor_busdev/def_f_explor_dev.htm).

Since it was spun off from Randgold Resources Ltd. in 1997, Harmony Gold Mining Co. Ltd. has been developing into a major gold mining company that operates and turns around small, high-cost marginal gold operations. Through an aggressive acquisitions policy begun in 1995, Harmony has increased its gold production to 77,759 kilograms per year (kg/yr) from 18,040 kg/yr and since 1996, it has increased its gold reserve base from nearly 249 t (8 million troy ounces) to more than 1,026 t (33 million troy ounces). The reserve base estimates were based on a gold price of \$262 per troy ounce. In addition to a gold mine in Australia and one in Canada, Harmony had five operating divisions in South Africa—the Elandsrand Operations (as of April 2001), the Evander Operations, Freestate Operations, the Kalgold Operations, and the Randfontein Operations. For fiscal year 2001, Freestate treated 5.29 Mt of ore at a recovered gold grade of 4.04 g/t, which yielded 21,344 kg of gold; Evander treated 2.48 Mt of

ore at a recovered gold grade of 5.74 g/t, which yielded 14,252 kg of gold; Randfontein treated 6.28 Mt of ore at a recovered gold grade of 3.58 g/t, which yielded 22,501 kg of gold; for the last quarter of fiscal year 2000-2001, Elandskraal treated 0.7 Mt of ore at a recovered gold grade of 5.41 g/t, which yielded 3,822 kg of gold; and the Kalgold open pit treated 0.96 Mt of ore at a recovered gold grade of 1.60 g/t, which yielded 1,535 kg of gold (Harmony Gold Mining Co. Ltd., 2001, A business approach to mining—Ore reserves statement, Annual Report for 2001, accessed October 22, 2001, at URL <http://www.har.co.za/section2/frames.htm>).

Harmony reported reserves as of June 30, 2001, based on a gold price of \$262 per troy ounce and an exchange rate of R8.00=\$1.00, as follows: Freestate contained measured, indicated, and inferred mineral resources of 570 Mt at a grade of 3.55 g/t, of which proved and probable ore reserves were 44.3 Mt at a grade 4.78 g/t gold; Evander's total resources were 217.4 Mt at a grade of 6.29 g/t gold, of which total reserves were 44 Mt at a grade of 6.05 g/t gold; Randfontein's total resources were 916.3 Mt at a grade of 2.82 g/t gold, of which total reserves were 30.7 Mt at a grade of 5.75 g/t gold; Elandskraal's total resources were 121.7 Mt at a grade of 6.18 g/t gold, of which total reserves were 44.5 Mt at a grade of 7.10 g/t gold; and Kalgold's total resources were 38 Mt at a grade of 1.54 g/t gold, of which total reserves were 7.2 Mt at a grade of 1.91 g/t gold (Harmony Gold Mining Co. Ltd., 2001, Review of operations, Annual Report for 2001, accessed October 22, 2001, at URL <http://www.har.co.za/section2/page25.htm>).

Avgold Ltd. (the gold operating subsidiary of Avmin) was a modest producer of gold from its Eastern Transvaal Consolidated (ETCons) operations, near Barberton, Mpumalanga Province. After the closure of the Loraine Mine, ETCons was restructured to produce around 3,100 kg/yr of gold from three mines. Avgold's principal activity was the \$300 million development of the Target Mine. Target was being developed on a twin decline system by using the infrastructure of the neighboring Loraine gold mine. Construction of the metallurgical plant started during January 2001, and the full production rate of around 10,900 kg/yr of gold was planned from the first quarter 2002. Target has a mine life of at least 13 years with an expected production cost of below \$150 per troy ounce (Avgold Ltd., 2000, Operations—Target, accessed October 20, 2001, at URL <http://www.avgold.co.za/operations>).

Avgold estimated its proven mineral reserves, as of June 30, 2000, to be 4.87 Mt at a grade of 11.47 g/t gold; probable mineral reserves, to be 8.47 Mt at a grade of 3.32 g/t; and total mineral resources, inclusive of reserves, to be 346.2 Mt, at a grade of 6.51 g/t, which contained 2,253 t (72.44 million troy ounces) of gold (Anglovaal Mining Limited, 2000, Mineral resources and reserves, Annual Report for 2000, accessed October 22, 2001, at URL <http://www.avmin.co.za/investor/interim311200.pdf>).

Avgold has completed a comprehensive exploration drilling program within its extensive Paradise lease areas north of the Target Mine. The indicated and inferred total resource of the Paradise area was estimated to contain 429 t (13.8 million troy ounces) of gold at an average grade of 10.02 g/t gold. A prefeasibility study was completed on the Paradise area by year-end 2000, to assess the viability of increasing the Target project's production level from 10,999 kg/yr of gold to 15,550

kg/yr of gold and to extend the mine life from 13 years to more than 40 years (Anglovaal Mining Limited, 2000, Interim report for the half year ended 31 December 2000—Review of operations, accessed October 22, 2001, at URL <http://www.avmin.co.za/investor/interim311200.pdf>).

In April 1999, Placer Dome Inc. of Canada purchased a 50% interest in Western Areas Limited South Deep gold mine development for \$235 million and assumed operating control. With the sale of Randfontein Estates Ltd. to Harmony in 1999, Western Areas had no operating mines and had essentially become a holding company. In January 2000, the joint venture approved a 4-year, \$340 million development plan that would commission the Modular Mill expansion in December 2001, the 2,946-m-deep South Deep Main shaft in July 2002, and the 2,790-m-deep South Deep Vent shaft in July 2004, which would increase the planned production from 135,000 t/mo to 220,000 t/mo of ore for treatment at an average recovered grade of around 8.3 g/t gold. Plans called for an incremental increase in salable production from 10,900 kg/yr of gold in 2000, to 14,300 kg/yr in 2001, to 19,000 kg/yr in 2002, and to 22,000 kg/yr in 2003; during 2000, actual production at the mine was 10,117 kg of gold. Productivity increases will be obtained with the phased change from conventional, labor-intensive reef mining to a minilongwall, bulk mechanized mining, which began in September 2000. This will decrease the size of production panel crews to 9 persons from 12 (South Deep, 2000, Placer Dome Western Areas Joint Venture, Factsheet of South Deep, accessed October 23, 2001, via URL <http://www.southdeep.co.za>).

Placer Dome reported proven and probable ore reserves as of December 31, 2000, at South Deep to be 107.8 Mt at a grade of 8.4 g/t plus additional measured and indicated mineral resources of nearly 70 Mt at a grade of 9.0 g/t and a projected mine life of about 72 years (Placer Dome Inc., 2001, Ore reserves and resources, Financial Results 2000, accessed October 22, 2001, at URL <http://www.placerdome.com/investor/content/financials/download/ar00fr.pdf>).

Iron and Steel.—*Iron Ore.*—In 2000, iron ore production in South Africa increased to 33.7 Mt, gross weight, which contained 20.9 Mt of iron; this was an increase of about 14% compared with that of 1999. Total sales of iron ore in 2000 totaled 33.75 Mt and were valued at about \$438 million; of that total, 68% was exported, and 32% was shipped to domestic steel plants. Iscor Ltd. was South Africa's largest iron ore producer. Its two iron mines, Sishen and Thabazimbi, accounted for more than 80% of the country's total output. The Sishen Mine, which is in the Northern Cape Province, produced about 23 Mt/yr of contained iron ore at a grade of 65% iron, and the Thabazimbi Mine, which is in the Northern Province, 2 Mt/yr of contained iron ore at a grade of about 60% iron. Thabazimbi is a captive mine that supplies lump and fine iron ore to Iscor steel plants at Vanderbijlpark, which is outside of Johannesburg, and at Newcastle, which is in northern KwaZulu-Natal. At Sishen, 80% of iron ore production is railed to Saldanha Bay for export.

The Sishen Mine has commissioned a \$100 million expansion program to increase its production capacity in two phases—from 24 Mt/yr to 30 Mt/yr of iron ore by 2003 and to 38 Mt/yr of iron ore by 2007. Concurrent with the expansion of the operation, the rail and port infrastructure associated with the

Sishen-Saldanha exports will also be upgraded. Because Thabazimbi has a remaining mine life of only between 6 and 8 years, a prefeasibility study on replacing this production by developing the Welgevonden deposit was being conducted; this new mine, which is located some 60 km south of Sishen, contains a high-quality resource of 259 Mt of iron ore suitable for open pit mining (Iscor Ltd., 2001, Operations—Iron ore—Overview, accessed October 22, 2002, at URL <http://www.kumbaresources.com>).

Faced with heavy indebtedness from its steel investments, in March 2001, Iscor announced its intention to unbundle its assets and to spin off its coal, base metals, iron ore, and titanium heavy-minerals assets into the separate mining company Kumba Resources Limited as a wholly owned subsidiary. Iscor would remain as a separate steel company and use funds raised from the spin off of Kumba Resources to help retire more than \$500 million in Saldanha Steel (Pty.) Ltd. debt; Saldanha Steel was a joint venture between Iscor (50%) and Industrial Development Corporation (IDC) (50%). The unbundling was subject to approvals by Government regulatory authorities (Iscor Ltd., 2001, Terms announcement—Announcements—Unbundling Iscor, accessed October 22, 2002, at URL <http://www.iscor.co.za/restructure/index2.asp>; David McKay, March 3, 2001, Iscor to unbundle, ease Saldanha Steel debt, Mining Web, accessed October 22, 2001, at URL <http://m1.mny.co.za/MGFin.nsf/Current/4225685F0043D37A42256A020069A145?OpenDocument>). In a related action in February 2001, Avmin acquired a 13.9% interest in Iscor for about \$82 million (Anglovaal Mining Limited, February 1, 2001, Acquisition by Avmin of a 13.7% interest in Iscor Ltd. and formation of an alliance with IDC, Press Release, accessed October 22, 2001, at URL <http://www.avmin.co.za/mediashop/pressrelease.asp?story=42>).

Iron and Steel.—South African crude steel production increased by 3.9% to 7.02 Mt in 2000. The steel operations of Iscor, which was the largest producer, were set up into two business units. Its flat steel unit operates the steel plant at Vanderbijlpark, which produced 3.4 Mt/yr of steel; this represented 80% of the domestic market and 70% of Iscor's total steel volume. Its long steel unit had four operations located in Newcastle, Kwa-Zulu Natal Province, and in Dunswart, Pretoria, Vereeniging, Gauteng Province; they accounted for total sales of 1.7 Mt/yr of steel, half of which was exported.

Saldanha Steel operated its new steel plant at Vredenburg near Saldanha Bay at full production levels during 2000 for the first year. The \$1.5 billion plant had the capacity to produce 1.25 Mt/yr of hot-rolled coil steel and was the world's first steel minimill to combine the Corex and the Midrex technologies (replacing blast furnace technology) and to be designed as an environmentally clean facility. In May 2001, production rates exceeded 90% of design capacity of 100,000 t/mo. For the financial year ending June 30, 2001, Saldanha Steel reported that sales volumes grew by 60% to 901,000 t of steel. Saldanha Steel began to roll for the first time significant tonnages of 1-millimeter thin-gauge hot-rolled coil, the product for which the plant was designed to give it its international competitive advantage. The 2000-2001 financial year was a difficult one for the company as it faced a 40% drop in hot rolled coil prices, a worldwide steel plant overcapacity, and anticompetition trade

actions to protect their domestic steelmakers by the Canadian and the United States Governments. Forced to adjust its long term price forecast for steel, Saldanha Steel took an “impairment” provision against the carrying value of the company’s assets of approximately \$430 million, offset partially by a \$110 million deferred tax provision [Saldanha Steel (Pty.) Ltd., August 13, 2001, Audited financial results for the year ended 30 June 2001, accessed October 22, 2001, at URL http://www.ssteel.co.za/download/Saldanha_Financial_2001.pdf].

U.S. steel producers were seeking a 54.7% duty on hot-rolled steel shipped by Saldanha Steel, which they claimed had benefited from government subsidies that gave it an unfair edge in the U.S. market. In addition, the U.S. steel producers wanted a 19% dumping duty imposed on the same product line from Saldanha Steel as well as all South African producers, which included Iscor, and Highveld Steel and Vanadium Corp. Ltd. (Highveld), which they contended were charging U.S. customers less than domestic producers [Simon Barber, August 17, 2000, US producers seek 54% duty on SA steel, Business Day (Johannesburg), accessed October 22, 2001, at URL <http://www.bday.co.za/bday/content/direct/1,3523,742139-6078-0,00.html>].

Columbus Stainless [a joint venture among Highveld, IDC, and Samancor (33.3% each)] had production capacity between 500,000 and 600,000 t/yr of cold rolled slab, plate, sheet, and coil depending on the product mix. For 2000, Columbus produced 531,812 t of slab steel, which was a 10.6% increase compared to that of 1999, and saleable production amounted to 433,907 t, which was a 15% increase compared with that of 1999. About 75% of production is exported. Highveld produced 947,588 t of carbon steel in 2000, compared with 797,489 t in 1999 from its plant at Witbank, Mpumalanga Province (Highveld Steel and Vanadium Corp, 2001, Financial information, Annual Report for 2000, accessed October 12, 2001, at URL <http://www.highveldsteel.co.za>).

Lead and Zinc.—During 2000, Anglo American produced 68,100 t of lead and 27,100 t of zinc compared with 73,800 t of lead and 31,200 t of zinc in 1999 from its Black Mountain Mine near Aggeneys, Northern Cape Province. The mine also produced around 10,000 t/yr of copper. Remaining ore reserves at Black Mountain were reported to be 8.1 Mt at a grade of 0.52% copper, 4.05% lead, and 2.36% zinc, and measured and indicated mineral resources, 14.1 Mt at a grade of 0.73% copper, 3.19% lead, and 0.7% zinc. Black Mountain has a remaining mine life of 13 years. Ore reserves at Anglo American’s Gamsberg deposit were reported to be 145.3 Mt at a grade of 6.04% zinc (Anglo American plc, 2001, Reserves and resources, Annual Report for 2000, accessed October 24, 2001, at URL <http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html>). In May 2000, Anglo American announced plans to invest \$110 million in Black Mountain. The major element of the expansion project will be the sinking and equipping of a new vertical shaft from surface to a depth of 1,750 m together with associated underground development. The life of the mine will be extended to at least 2013. The ore body remains open in two directions; management anticipated that further resources will be identified, which would extend the life of the mine beyond 2013 (Anglo American plc, May 16,

2000, Anglo American announces major expansion at Black Mountain mine, Press Release, accessed October 23, 2001, at URL http://www.angloamerican.co.uk/news_detail.asp?news_item_number=63609).

The feasibility study on whether to invest \$850 million to develop the Gamsberg zinc mine, mill, and smelter project that would have the capacity to produce 200,000 t/yr of refined zinc was to have been completed by mid-2000. By yearend, however, Anglo American had yet to commit to the project. The Gamsberg deposit is located 22 km from Black Mountain in Northern Cape Province (Anglo American plc, 2000).

Maranda Mining Co. (Pty.) Ltd. (owned by Metorex) operated the Maranda zinc-copper mine in the southwestern portion of the Murchison Greenstone Belt in the Northern Province. For the fiscal year ending June 30, 2001, Maranda milled at rate of 8,200 t/mo of ore at a head grade of 1.8% copper and 14.6% zinc. Production for the year of metal contained in concentrates was 6,190 t of copper and 22,921 t of zinc. On June 30, 2001, proved and probable reserves were estimated to be 0.3 Mt at a grade of 15.3% Zn and 1.5% Cu, while mineral resources, exclusive of reserves, totaled 0.74 Mt at a grade of 12.7% zinc and 1.6% copper (Metorex Ltd., 2001, Our companies—Maranda Mines, accessed October 18, 2001, at URL <http://www.metorexgroup.com/Maranda.htm>).

Manganese and Ferromanganese.—South Africa dominated the world manganese market as the largest producer of manganese and with approximately 80% of the world’s reserve base of manganese ore. In 2000, the country produced 3.63 Mt, gross weight, of manganese ore and concentrates; these were primarily metallurgical grades that ranged from 30% to more than 48% manganese, which was a 16% increase compared with that of 1999. Billiton’s Samancor Manganese Division produced 2.16 Mt of ore from its Mamatwan open pit and Wessels underground mines near Hotazel and 397,000 t of manganese alloys during the fiscal year ending June 30, 2001. About 40% of Samancor’s manganese ore production was exported to ferroalloy producers worldwide. The remainder was converted into alloys at Samancor’s Manganese Division works at Meyerton, Gauteng Province and into manganese metal by the Manganese Metal Co. Pty. Ltd. The Manganese Division, in turn, exported 85% of its production.

Assmang operated the Gloria and the Nchwaning underground manganese mines in Northern Cape Province. Assmang was investing \$75 million to add a new shaft complex at the Nchwaning III Mine, which was expected to be operational by late 2003. The expanded Nchwaning operation will have a run-of-mine capacity of about 2 Mt/yr of manganese, which could extend its mine life by more than 20 years. Avmin reported total proved manganese reserves of 12.8 Mt at a grade of 44.61% manganese and 7.30% iron at both mines. Measured, indicated, and inferred resources were estimated to be 237 Mt at a grade of 41.24% manganese and 7.98% iron (Anglovaal Mining Ltd., 2000, Mineral resources and reserves, Annual report for 2000, accessed October 22, 2001, at URL <http://www.avmin.co.za/investor/mineralresources.asp>). For 2000, Assmang sales included 1.36 Mt of manganese ore compared with 1.47 Mt in 1999 and 207,000 t of manganese alloys compared with 156,000 t in 1999. Ferromanganese production comes from Assmang plants

at Cato Ridge near Durban and Machadadorp near Middleburg.

Nickel.—South Africa's nickel production was in the form of metal, metal-in-concentrate, and sulfate. Since 1998, the nation's nickel output, which has primarily been produced as a byproduct of PGM and copper processing, has included primary production from the new Nkomati nickel mine. In 2000, domestic sales of nickel, primarily to the stainless steel plants, amounted to about \$171 million; export sales of nickel were valued at more than \$116 million. During 2000, the Nkomati Joint Venture [controlled by Avmin (75%)] milled 189,000 t of ore, that produced 37,104 t of concentrate with an average nickel grade of 10.10%. This resulted in final metal production levels of 3,700 t of nickel and 1,400 t of copper. The mine remained at the lower end of the international cost benchmark. At yearend, the joint venture was evaluating the results of a feasibility study to assess the potential of an openpit expansion to include the large low-grade reserve base in three adjacent ore bodies at the mine (Anglovaal Mining Ltd. 2001, Review of operations—Base metals, Annual Report 2000, accessed October 23, 2001, at URL <http://www.avmin.co.za/annualreport2000/roo-basemetals.asp>).

Platinum-Group Metals.—In 2000, South Africa's production of PGMs, which originated almost exclusively from mines in the Bushveld Complex north of Pretoria, accounted for a dominant share of world production of these commodities, which included rhodium and other PGMs (88%), platinum (74%), and palladium (32%). Additionally, South Africa possessed around 88% of the identified global reserve base of PGMs. In 2000, South Africa produced 206,770 kg of PGMs and exported 198,944 kg valued at \$3.9 billion. Export shipments included 114,459 kg of platinum, 55,818 kg of palladium, 19,427 kg of ruthenium and 12,067 kg of rhodium. The PGM industry employed more than 96,000 workers in 2000.

Since 1997, the global PGM market dynamics, which have been significantly affected by shortfalls in Russian PGM production and exports, have created major incentives for South African producers to expand production. The Bushveld PGM ores are much higher in platinum than the Russian nickel-copper-PGMs ores mined at the Norilsk nickel complex in Siberia, which have a 3:1 palladium-to-platinum ratio. By comparison, 1999 production data from South Africa showed a 0.48 to 1 palladium-to-platinum ratio. As the market leader, South Africa has contributed to moderating the rise in average annual platinum prices by only 139% to \$549.31 per troy ounce in 2000 from \$396.59 per troy ounce in 1997. By comparison, the Norilsk nickel mine in Russia contains ores that are higher in palladium and rhodium and has been the dominant producer of these commodities. Between 1997 and 2000, the disruption of Russian supply has driven up the average annual price of palladium by more than 376% to \$692 per troy ounce and that of rhodium by more than 668% to \$1,990 per troy ounce. A U.S. Geological Survey analysis of industry investment plans shows that more than \$3.5 billion was projected to be spent in South Africa on adding 98,600 kg (3.17 million troy ounces) in new capacity that will bring total PGM production capacity in South Africa to 246,300 kg (7.92 million troy ounces) between 2000 and 2007.

The Anglo American Platinum Corp. Ltd. (Anglo Platinum) was the largest PGM producer in the world at about 37% of global platinum supply, all from South African operations. Anglo Platinum's production came from three operating subsidiaries—Rustenburg Platinum Mines Ltd., Potgietersrust Platinums Ltd., and Lebowa Platinum Mines Ltd. in Northwest and Northern Provinces. Facilities include six mines and three processing plants—the Waterval Smelter complex, the Rustenburg Base Metals Refinery, and the Precious Metals Refinery. Production of the minor platinum-group elements (PGEs) was not reported.

As of December 31, 2000, Anglo Platinum reported total proved mineral reserves of 145.56 Mt at a grade of 5.17 g/t based on four PGEs; probable mineral reserves of 1,349 Mt, at a grade of 4.8 g/t based on four PGEs; and indicated mineral resources of 1,624 Mt, at a grade of 5.34 g/t based on four PGEs (Anglo American Platinum Corp. Ltd., 2001, Mining operations—Combined ore reserves, Annual Report 2000, accessed October 24, 2001, at URL

http://www.angloplatinum.com/for_invest/fi_annual_rep/ar_00/amplats_ar_2000/minoprev/def_minop.htm). Grades are reported as the total grams per metric ton of from three to five PGEs, which include platinum, palladium, rhodium, ruthenium, and osmium, in order of importance. These resources were being used as a base to expand production to 108,862 kg (3.5 million troy ounces) of platinum by 2006. Capital expansion investment for 2000 was \$193 million with more than \$450 million projected for 2001. Major expansion projects included the following:

- Completion of the \$173 million Bakofeng-Rasimone Mine by the first quarter of 2002. The mine is designed to treat 2.4 Mt/yr of ore that will yield 7,776 kg/yr of platinum. The mine life will be 25 years.
- The \$22 million Amandelbult Mine UG2 expansion was completed in 2000. Amandelbult will treat 720,000 t/yr of ore that will yield 2,239 kg/yr of platinum. The mine life will be 80 years.
- The \$12 million Lebowa Middlepunt Hill expansion was completed in 2000. Middlepunt Hill will treat 660,000 t/yr of ore that will yield 1,089 kg/yr of platinum. The mine life will be 8.5 years.
- Development of the new Maandagshoek Mine at a capital cost of \$195 million by the third quarter of 2002 will add 5,039 kg/yr of new platinum production during a 30-year mine life with potential for expansion.
- The Waterval project will invest \$190 million to expand UG2 mining at the Rustenburg section to produce 12,286 kg/yr for more than 30 years. Completion is expected by the end of 2002.
- The \$60 million UG2 expansion project at the Union section will expand production to 2,923 kg/yr of platinum for more than 30 years by the first quarter of 2003.
- A new converter process will be installed at the Waterval Smelter to increase capacity and to reduce sulfur dioxide emissions. With a capacity of 72,000 t/mo of converter matte, the plant will be able to treat material that contains 33,000 t/yr of nickel, which equates to around 124,400 kg/yr of platinum. Capital cost will be around \$160 million with completion scheduled for 2004.
- In February 2001, Anglo Platinum authorized construction of a new \$145 million smelting complex at Pietersburg in the

Northern Province. The plant will be designed to treat 650,000 t/yr of concentrates with completion expected in 2002 (Anglo American Platinum Corp. Ltd., 2001, Business development review, Annual report for 2000, accessed October 24, 2001, at URL http://www.angloplatinum.com/for_invest/fi_annual_rep/ar_00/amplats_ar_2000/default.htm).

In 2000, Impala Platinum Holdings Limited (Implats), which was the second largest producer in South Africa, held majority interests in the Impala Platinum operations, in the Canadian junior mining company Platexco Inc., and Barplats Mines Ltd. as well as minority interests in Aquarius Platinum Ltd. and the Two Rivers Platinum (Pty) Ltd. joint venture (Avmin, 55%; Implats, 45%). Implats operated 13 shafts within the Merensky and UG2 Reefs, a concentrator, smelter, an enhanced precious metals refinery, and a base metals refinery. For the financial year ending June 30, 2001, Implats produced 58,381 kg of refined PGMs, of which 31,166 kg was platinum; there was a 2% decrease from that of the previous financial year. The decrease was attributed to delays in commissioning of the new concentrator circuit for UG2 plant expansion. The smelter upgrade, which comprised two new converters, the enhanced acid plant and a new 38 megawatt (MW) furnace, was completed during the year. These expansions were the first step in Implats' plans to expand production at a rate of 10% per year.

Implata planned on investing \$486 million between 2000 and 2004 to maintain its in-house capacity at the 31,110 kg/yr level until 2030. The phased projects, which were designed to access more than 112 Mt of ore reserves, include five decline shafts and a vertical shaft to link in with the No. 12 shaft. Future expansions also included the Winnaarshoek project, which Implats acquired with the \$136 million takeover of Platexco in December 2000. The \$230 million Winnaarshoek project included development of the Platexco property along with adjacent land acquired in a mineral rights swap with Amplats. Production was expected to begin in 2002 with full production of 5,443 kg/yr of PGMs expected by 2004. Barplats Crocodile River Mine was brought into production during December 2000. By March 2001, the mine was operating at the planned rate of 75,000 t/mo of ore designed to produce 1,555 kg/yr of platinum at a capital cost of \$40 million.

The Two Rivers joint venture acquired the PGM rights to the Dwars Rivier farm, near Lydenburg, for \$70 million in May 2001 and planned on investing an additional \$60 to \$85 million to bring into production at least 3,110 kg/yr of PGMs by 2004 (Business Day, May 30, 2001, Avmin, Implats in R551m platinum deal, accessed October 24, 2002, at URL <http://www.bday.co.za/content/direct/1,3523,858927-6079-0,00.html>; Impala Platinum Holdings Limited, 2001, Chief executive officer's review, Annual report for 2001, accessed October 24, 2002, at URL http://www.implats.co.za/annual_report/2001/chief_executive_officers_review.html; Impala Platinum Holdings Limited, 2001, Review of operations, Annual report for 2001, accessed October 24, 2002, at URL http://www.implats.co.za/annual_report/2001/impala_platinum.html).

A detailed breakdown of Implats PGM ore reserves was presented in its 2001 annual report (Impala Platinum Holdings Limited, 2001, Reserves and resources, Annual Report for 2001, accessed October 24, 2002, at URL http://www.implats.co.za/annual_report/2001/reserves_and_

[resources.html](#)).

Lonmin plc, which is the third largest PGM producer in the world, operated three mines, a smelter, a base-metals smelter, and a precious metals refinery. During 2000, the company divested its nonmining interests and restructured itself as a focused PGM producer. For the financial year ending September 30, 2000, Lonmin mined and treated 9.7 Mt of ore with an average yield of 4.19 g/t PGMs. The upward trend in production continued with refined output at 20,521 kg of platinum, 9,122 kg of palladium, and 2,762 kg of rhodium. Proven mineral reserves were reported to contain 80,870 kg (2.6 million troy ounces) of five PGEs plus gold and probable mineral reserves 244,785 kg (78.7 million troy ounces) of five PGEs plus gold. Expansion projects underway in 2001 included a new incline shaft at the Eastern Platinum Mine, a new Karee-B concentrator, two new vertical shafts at the Eastern Platinum and the Karee Mines, and construction of a new smelter furnace. The company announced plans in 2000 to increase production by 43% within a 7 year period to 27,060 kg/yr of platinum at a capital cost of \$550 million, which they expect to cover from cash flow (Lonmin plc, 2000, Review of operations—Platinum, Annual Review 2000, accessed October 24, 2001, at URL http://www.lonmin.com/files/Lonmin2000_Annual_Review.pdf).

Aquarius Platinum Ltd. of Australia had interests in the Kroondal Mine and the Marikana and the Everest South PGM projects in North West Province, which they planned to develop so that 15,550 kg/yr of platinum could be produced by 2003. Kroondal Platinum Mines Ltd. [controlled by Aquarius (55%) and Implats (45%)] commissioned its \$56 million Kroondal PGM mine in mid-1999. During its first full year of operation in 2000, Kroondal produced 1,533 kg of platinum, 707 kg of palladium, and 236 kg of rhodium, all in concentrates, which were sold to Implats for refining. Bulk mining methods were employed to keep productivity high and operating cost low. Reserves were sufficient for 14 years of operation at this rate. Measured reserves in two seams were reported to be 2.6 Mt, at a grade of 5.8 g/t PGEs, and indicated reserves, to be 13.3 Mt, at a grade of 6.3 g/t PGEs. Kroondal Platinum entered a 50-50 joint venture with Anglo Platinum's Rustenburg Division to expand Kroondal production to 15,550 kg/yr of PGMs, which would include 9,330 kg/yr of platinum, by 2002 with a contribution of adjacent Rustenburg UG2 mineral rights. Following a favorable feasibility study in 2000, Aquarius decided to begin development of the Marikana project in 2001 on the basis of a UG2 resource of 21.36 Mt at a grade of 4.41 g/t PGMs. The \$70 million development will produce 4,980 kg/yr of PGMs in concentrates containing 2,924 kg of platinum, 1,483 kg of palladium, and 529 kg of rhodium that will be sold to Implats. At the Everest South project, exploration drilling in the UG2 Reef has identified an undiluted resource of 36.3 Mt, at a grade of 4.7 g/t PGMs. A feasibility study on developing Everest South will be conducted during 2001. Aquarius Platinum reported total resources to be 95.4 Mt at a grade of 4.8 g/t PGMs at all three properties (Aquarius Platinum Ltd., 2001, Kroondal platinum mine and projects—Marikana and Everest South, 2000 Annual Review, accessed October 24, 2001, at URL <http://www.aquariusplatinum.com/documents/A00.pdf>).

Northam Platinum Ltd. (Northams) operated the Northam Mine and processing plant near Anglo Platinum's Amandelbult

section. The economic empowerment company Mvelaphanda Platinum Ltd. held a 22.5% interest in Northams, and Anglo Platinum held a 20% interest. During the year ending June 30, 2001, Northams treated 1.9 Mt of ore that yielded 5.4 g/t of three PGEs plus gold. Production included 8,725 kg of three PGEs plus gold in concentrates, 1,625 t of nickel, and 827 t of copper. Sales were reported to be 5,235 kg of platinum, 2,475 kg of palladium, 414 kg of rhodium, and 183 kg of gold. Construction of the concentrator for the UG2 expansion project was completed in November 2000 and commissioned in January 2001 (Northam Platinum Ltd., 2001, Operational review, 2001 Annual Report, accessed October 24, 2001, at URL http://www.northam.co.za/annual_report/2001/review_of_ops.html). Northams reported resources on the Merensky Reef to be proved and probable reserves of 38.1 Mt at a mill head grade of 5.7 g/t PGMs and measured and indicated resources of 55.6 Mt at an in-situ grade of 7.3 g/t PGMs. UG2 Reef assets were estimated to be proved and probable reserves of 21.8 Mt, at mill head grade of 3.8 g/t PGMs and measured and indicated resources of 71 Mt at an in-situ grade of 4.7 g/t PGMs (Northam Platinum Ltd., 2001, 2001 Resources and reserves, Annual Report, accessed October 24, 2001, at URL http://www.northam.co.za/annual_report/2001/resources_and_reserves.html).

SouthernEra Resources Ltd. began development of the \$86 million Voorspoed section of its Messina Platinum Mine in 2000; completion was expected in early 2003. The mine was scheduled to produce 4,945 kg/yr of four PGEs plus gold, which will include 2,147 kg/yr of platinum, 1,697 kg/yr of palladium, 551 kg/yr of ruthenium, 263 kg/yr of rhodium, and 123 kg/yr of iridium. Additional byproduct credits will include 170 kg/yr of gold, 1,860 t/yr nickel, 1,111 t/yr copper, and 30 t/yr cobalt. A mine life of more than 50 years was expected. A second ore body, the Doornvlei section, held potential for future expansion of the Messina Mine (SouthernEra Resources Limited, 2001, The Messina platinum project, accessed October 25, 2001, at URL <http://www.southernera.com/messina.htm>). Total resources identified by the end of 2000 for the Messina project at the Doornvlei, the Voorpoed, and the Zebediela ore bodies and reported as five PGEs plus gold included measured resources of 26.4 Mt at a grade of 6.3 g/t, indicated resources of 15.2 Mt at a grade of 5.81 g/t, and inferred resources of 45 Mt at a grade of 5.3 g/t (SouthernEra Resources Limited, 2001, Report of operations—Messina platinum project, Annual report for 2000, accessed October 25, 2001 at URL <http://www.southernera.com/SUFannual2000.pdf>).

Other companies active in PGM exploration and development projects during 2000 included African Minerals Ltd., a private affiliate of Ivanhoe Capital Corporation, Anooraq Resources Corp.'s Platreef project (<http://www.hdgold.com/arqstart.htm>), Cluff Mining PLC. (<http://cluff-mining.com>), Pan Palladium Ltd. (http://www.minesite.com/companies/pan_palladium.htm), Pinnacle Resources Inc. (<http://www.pnrr.net>), and Thabex Exploration Ltd. (<http://www.thabex.com>).

Titanium and Zirconium.—Globally, South Africa ranked second in titanium production and third in titanium exports in 2000. Richards Bay Minerals (owned jointly by Rio Tinto and BHP Billiton) produced ilmenite, rutile, and zircon from beach sands north of Richards Bay. Richards Bay Minerals was the

trading name for two registered companies—Richards Bay Iron and Titanium (Pty) Ltd (RBIT) and Tisand (Pty) Ltd. Tisand is responsible for the dune mining operation and mineral separation. RBIT, which is responsible for the smelting and beneficiation process, produced an 85% titanium dioxide slag from ilmenite concentrates at the Richards Bay smelter as well as low-manganese pig iron. The flow sheet for the operation was available on the company Web site accessible at URL <http://www.richardsbayminerals.co.za>. The Richards Bay operation was the largest titanium mineral producer in the country with production in the range of 1 Mt/yr of titanium dioxide slag.

Namakwa Sands Limited operated a heavy-mineral sand mine at Brand-se-Baai and a mineral separation plant at Koekenapp, which is located 340 km northwest of Cape Town, and a smelter at Vredenburg, which is near the export harbor at Saldanha Bay. Production in 2000 was up about 30% from 1999 and included 112,700 t of titanium chloride slag, 106,800 t of zircon, 71,600 t of pig iron, 27,200 t of titanium sulfate slag, and 23,200 t of rutile. Remaining resources at Namakwa Sands at yearend 2000 were 761 Mt at a grade of 3% ilmenite, 0.5% zircon, and 0.25% rutile (Anglo American plc, 2001, Reserves and resources, Annual Report for 2000, accessed October 20, 2001, at URL <http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html>).

Titaniferous magnetite also was recovered at the Phalaborwa carbonatite as a byproduct of copper and phosphate rock production. Titaniferous slag was produced from Mapoch Mine magnetite ores at Highveld's Witbank steel plant. Iscor's Heavy Minerals business unit (60%) in partnership with Ticom Ltd. of Australia (40%) was proceeding with development of its \$275 million Heavy Minerals project which will consist of a mine and a concentrator at Hillendale and a mineral separation plant and a smelter at Empangeni, both are near the Richards Bay deep-sea port in the KwaZulu-Natal Province. The project design calls for production of 550,000 t/yr ilmenite, 250,000 t/yr of titanium slag, 145,000 t/yr pig iron, 100,000 t/yr zircon, and 40,000 t/yr rutile by 2005 (Iscor Ltd, 2001, Locations—Hillendale and Empangeni, accessed October 23, 2001, at URL <http://www.iscor.co.za>).

Zirconium was produced as a zircon byproduct of mining at the Richards Bay and the Namakwa Sands mineral sands operations. Palabora produced 70% of the world's baddeleyite, which is a zirconium sulfate mineral used in specialized applications in the ceramics, refractory, and tanning industries and in kidney dialysis machines. During 2000, Palabora mined 8,526 t of baddeleyite compared with 7,486 t in 1999. Production of zirconium sulfate tetrahydrate was 1,769 t, and that of grade 5, which is a milled baddeleyite, 2,497 t (Palabora Mining Company Limited, 2001).

Vanadium and Ferrovandium.—South Africa was the world's largest producer and exporter of vanadium. Vanadium was produced from titaniferous magnetite mined from the Bushveld Complex. The largest producer was Highveld Vanadium and Chemicals. From calendar years 1999 to 2000, Highveld's production of vanadium slag increased by 22% to 70,372 t and of ferrosilicon, by 2% to 55,629 t (Highveld Steel and Vanadium Corp. Ltd., 2001, Group salient information, Annual Report 2000, accessed October 30, 2001, at URL

<http://www.highveldsteel.co.za/Financial/Files/Highveld.pdf>.

Xstrata, which was the second largest South African producer of vanadium, acquired both Rhombus Vanadium Holdings Ltd. and Vanadium Technology (Pty.) Ltd. (Vantech) in 1997. Although Xstrata produced 20% more vanadium pentoxide in 2000, it struggled with low world market prices and reduced sales and revenues, which were offset by higher chrome revenues. During 2000, 27,781 t of vanadium pentoxide and 1,070 t of ferrovanadium were produced (Xstrata AG, 2001, Financial review, Annual Report 2000, accessed October 25, 2001, at URL http://www.xstrata.com/reports/2000-en/financial_review.php).

Industrial Minerals

South Africa produced about 30 different industrial minerals from 530 mines and quarries, about half of which were devoted to aggregate and sand production. The industrial minerals sector was a significant contributor to total mineral sales. In 2000, the value of total sales of industrial minerals produced decreased by 3% in rand terms and by more than 13% in dollar terms to \$602 million, compared with \$696 million in 1999. Approximately 68% of those sales was on the domestic market. In terms of sales, the three dominant industrial mineral commodities were aggregate and sand, limestone and dolomite, and phosphate rock. The largest domestic consumers of South Africa's industrial minerals were the building and construction, metallurgical, and agricultural sectors. Total export earnings for industrial minerals were than \$194 million in 2000. Granite and norite dimension stone accounted for 47% of industrial mineral exports; the other major export commodities were, by value, vermiculite, phosphate rock, andalusite, and asbestos (Duval, Luitingh, and Ratabala, 2001).

Cement.—The expected 3% to 4% growth in demand for cement failed to materialize in 2000; this followed a weak year for residential building and for large civil engineering projects, aggravated by serious floods early in the year. Domestic sales of cement were 7.9 Mt in 2000, essentially the same as those of 1999 but 1 Mt less than those of 1997. The major consuming provinces were Gauteng (34.3%), Kwa-Zulu Natal (15.4%), and Western Cape (13.8%). Export sales of cement to the neighboring states of Botswana, Lesotho, Namibia, and Swaziland declined slightly by 1.2% to 1.09 Mt in 2000 (Cement and Concrete Institute of South Africa, 2001, Market review 2000, Cement and Concrete Review, accessed October 16, 2001, at URL http://www.cnci.org.za/annual_review_2000/market_review.htm).

Diamond.—Rough diamond production increased by 9% in 2000 to 10.8 million carats. As in years past, mines owned by De Beers dominated the sector with more than 90% of the total production. Total diamond production for De Beers' South African operations in 2000 amounted to 10.29 million carats recovered from 23.3 Mt of material treated. The Venetia Mine, which was the largest De Beers operation, recovered 4,497,756 carats with a revenue of \$55 per carat; the Finsch Mine, 1,925,059 carats at \$50 per carat; the Premier Mine, 1,782,420 carats at \$46 per carat; the Namaqualand Mine, 809,928 carats at \$159 per carat; the Kimberley Mine, 568,639 carats at \$76

per carat; the Marsfontein Mine, 436,191 carats at \$165 per carat; the Koffiefontein Mine, 151,498 at \$228 per carat, and the Oaks Mine, 116,048 carats at \$165 per carat. Recovered diamond grades varied considerably within the De Beers operations during 2000—with 122 carats per 100 metric tons recovered at Venetia, 82.2 carats per 100 tons at Marsfontein, 62.6 carats per 100 tons at Premier, 54.7 carats per 100 tons at the Oaks, 45.8 carats per 100 tons at Finsch, 16.2 carats per 100 tons at the Kimberley Mine, 13.2 carats per 100 tons at the Namaqualand Mine, and 6.9 carats per 100 tons at the Koffiefontein Mine (De Beers Consolidated Mines Ltd., 2001, Review of operations—Mining and recovery, Annual Report for 2000, accessed October 20, 2001, at URL <http://www.debeersgroup.com/dbInvestor/AR2000/AR2000ReviewOfOperations.pdf>). At Kimberly, De Beers was examining the feasibility of extending the life of the Dutoitspan Mine by 6 years by replacing its 40-year-old treatment plant with newer, more efficient technology, that would permit recovery from old surface dumps and previously uneconomic underground reserves.

During 2000, SouthernEra Resources Ltd. of Canada announced plans to develop its third diamond mine the Klipspringer; completion is expected by 2004. The underground development will produce 160,000 carats per year at a capital cost of \$7 million. On the basis on a minable reserve of 3.6 Mt at an average recovered grade of 47 carats per 100 tons, valued at \$100 per carat, the Klipspringer project will have a mine life of more than 13 years. Ore will be treated at SouthernEra's existing dense-medium separation plant at Klipspringer (SouthernEra Resources Ltd., August 24, 2000, Positive feasibility study completed for Klipspringer diamond project, Press Release, accessed October 24, 2001, at URL http://www.southernera.com/News_Releases/nr000824.htm).

Fluorspar.—In 2000, the two main producers of fluorspar were Vergenoeg Mining Company (Pty.) Ltd. (owned by Metorex) and Witkop Fluorspar Mine (Pty.) Ltd. [owned by the Australian company South Africa Land & Exploration Company (Sallies)]. Also during 2000, International Metal Processing of South Africa reopened the old Buffalo Fluorspar Mine, which was expected to produce more than 120,000 t/yr of acid-grade fluorspar (International Metal Processing, 2001, The Buffalo plant—Fluorspar, accessed October 11, 2001, at URL <http://www.intmetals.com/BuffaloPlant.htm>).

The open pit Vergenoeg Mine, which is located 70 km north-northwest of Pretoria, milled 51,000 t/mo of ore at a head grade of 38% calcium fluoride. Production was approximately 16,400 t/yr of metallurgical-grade fluorspar and 103,600 t/yr of acid-grade fluorspar. As of June 30, 2001, mineral reserves were reported to be 4.6 Mt at grade of 36.8% calcium fluoride (CaF₂) plus mineral resources of 151 Mt (Metorex Ltd., 2001, Our companies—Vergenoeg, accessed October 18, 2001, at URL <http://www.metorexgroup.com/Vergenoeg.htm>).

Sallies purchased the Witkop Mine from Phelps Dodge Corp. of the United States for \$12 million in 1999. Capacity from four quarries and a flotation plant was 140,000 t/yr of acid-grade fluorspar. A feasibility study was underway to examine the potential for doubling capacity to 240,000 t/yr of fluorspar. Resources at the Witkop Mine and the nearby Buffelshoek Farm deposit were reported for Witkop as measured reserves of 14 Mt

at a grade of 15% CaF₂ at a stripping ratio of less than 2 to 1 and indicated resources of 3.5 Mt at a stripping ratio of 2 to 1. The Buffelshoek deposit had measured reserves of 7.5 Mt at a grade of 18% CaF₂ at a stripping ratio of less than 2 to 1 and indicated resources of 9 Mt at a grade of 15% CaF₂. Inferred resources at depths of 50 to 200 m, which were currently uneconomic to mine underground in 2000, have been estimated to be around 750 Mt, which made the Witkop deposit one of the largest fluorspar deposits in the world (Jansen, 2001).

Vermiculite.—The major producer was the Vermiculite Operations Division of Palabora, which extracted vermiculite from the pyroxenite units of the mineralogically diverse Phalaborwa Carbonatite Complex. The company reported vermiculite concentrate production of 208,422 t at a grade of 90.65% vermiculite in 2000; this represented about 75% of reported world supply.

Mineral Fuels

Coal.—Following platinum and gold, coal was one of the most important sectors of the mineral economy of South Africa. South Africa remained the fifth largest coal-producing country in the world and the third largest coal exporter. Production and export levels continued on an upward trend in 2000. About 55 mines produced 222.9 Mt of coal valued at \$2.84 billion; of this total, 68.6 Mt valued at \$1.57 billion was exported primarily through the Richards Bay Coal Terminal (RBCT). Export destinations for South African coal were in order of importance Europe, Asia and the Middle East, Africa, and South America. The RBCT was undertaking a major investment program to increase the Richards Bay port coal export capacity progressively to 81 Mt/yr by 2010. More than 80% of saleable coal production was controlled by three companies—Ingwe Coal Corp. Ltd. (36%), Anglo American Coal Corp. Ltd. (24%), and Sasol Mining (Pty.) Ltd. (21%). In 2000, 162.8 Mt of coal was consumed domestically. The majority of domestic sales went to electricity (93.36 Mt) and industry (51.51 Mt). South Africa's coal reserves were mainly bituminous with relatively high ash content (about 45%) and low sulfur content (about 1%). Three fields—Highveld, Waterberg, and Witbank—hold 70% of total recoverable reserves. Several areas, which included parts of the Waterberg Field, were identified as having potential for future coal bed methane development (U.S. Energy Information Administration, 2000, South Africa—Energy, Country Analysis Brief, accessed February 17, 2000, at URL <http://www.eia.doe.gov/emeu/cabs/safrica.html>). The estimate of recoverable coal reserves of 55.3 Gt was last calculated in 1987. The DME was conducting a new evaluation of coal resources and reserves to be based on guidelines from the United Nations Economic Commission for Europe Standards and Proposals. The new evaluation will also include an assessment of the recovery of usable energy from coal discard dumps. In 1998 alone, 62 Mt of discard coal was generated.

Petroleum and Natural Gas.—Soekor controlled all offshore oil and gas prospects. In 2000, the ORCA, which is a floating production, storage, and off-loading (FPSO) vessel, produced more than 6.6 million barrels of 42° API crude petroleum from the Oribi Field, which was commissioned in

1997, and the newly commissioned (May 2000) Oryx Field. The ORCA, which operated about 140 km offshore from the town of Mossel Bay, was producing at a rate of 25,000 barrels per day (bbl/d) of crude petroleum; 10,000 bbl/d came from the Oryx Field. Seventeen kilometers to the west, Soekor discovered oil and gas in five wells drilled in the Sable Field; field development studies suggested the potential to produce 40,000 bbl/d from the Sable Field. Soekor was seeking to lease the Sable Field to a major contractor, which would supply a new FPSO and operate the oilfield [Soekor E and P (Pty.) Ltd., 2001, Oil production, accessed October 16, 2001, at URL <http://www.soekor.co.za/produce.htm>].

Mossgas, which used natural gas to produce synthetic motor fuel at its plant at Mossel Bay, produced natural gas from several offshore fields under mining leases from Soekor. The F-A Field, discovered by Soekor in 1984 and situated 85 km south of the town of Mossel Bay, was producing at an average rate of 5.49 million cubic meters per day of natural gas and 9,500 bbl/d of condensate. The E-M gasfield, which is situated 50 km west of F-A, was commissioned by Mossgas in September 2000. Combined with several other smaller fields in the area, gas resources were sufficient to supply Mossgas until 2008. Separate 91-km pipelines convey gas and condensate to the Mossgas synfuels plant where petrol, diesel, and kerosene were produced at a rate of 36,000 bbl/d of finished product [Soekor E and P (Pty.) Ltd., 2001, Exploration—Oil and gas discoveries, accessed October 16, 2001, at URL <http://www.soekor.co.za/explore.htm>].

Synthetic Fuels.—South Africa had a highly developed synthetic fuels industry, that took advantage of the country's abundant coal resources and offshore natural gas and condensate in Mossel Bay. The two major players were Sasol (coal-to-oil and chemicals), which was the world's largest manufacturer of oil from coal, and Mossgas (natural-gas-to-petroleum products). Sasol had the capacity to produce 150,000 bbl/d, and Mossgas, 45,000 bbl/d. The Government ended Sasol's \$150 million per year subsidy in July 1999; the subsidy was to protect it against cheaper imported crude oil. Sasol's coal liquefaction plants were located at Secunda (oil) and Sasolburg (petrochemicals). Started by the Government in the 1950s to help reduce South Africa's dependence on imported oil, the company was privatized in 1979. In the coal liquefaction plants, coal is first gasified, then turned into a range of liquid fuels and petrochemical feedstocks. During 2000, Sasol initiated plans to replace coal with natural gas as the feedstock for its conversion process. Sasol estimated that the switch to natural gas, which will entail the construction of a 893-km pipeline to transport gas from the Pande and the Temane gasfields in Mozambique to Sasolburg and Secunda, could be completed within 3 years. In October 2000, Sasol and the Mozambican Government signed three accords that allow for construction of the pipeline and transport of the natural gas out of Mozambique. Sasol was also granted the rights to explore for additional hydrocarbons in the area around the Pande and the Temane gasfields. A regulatory framework for the project was agreed upon in December 2000. Construction on the \$500 million pipeline was expected to begin in June 2001 (U.S. Energy Information Administration, December 2000, South Africa—Energy, Country Analysis Brief, accessed

October 17, 2001, at URL <http://www.eia.doe.gov/emeu/cabs/safrica.html>).

Reserves

South Africa's mineral reserves are large and varied and reflect the country's complex geology. A detailed description of the geology and mineral resources of South Africa was updated by the Council for Geosciences in 1998 (Wilson and Anhaeusser, 1998). The bulk of South Africa's mineral production is from the northern half of the country. Table 3 lists the reserve base for a number of South Africa's major minerals. Although data for many of the minerals listed are incomplete for the world, South Africa's reserves appear to rank among the top five countries and would rank first in the world for andalusite, chromite, gold, manganese, PGMs, and vanadium.

Infrastructure

The country has a well-developed and extensive road and railroad infrastructure that served not only South Africa but also the surrounding region. Roadways totaled 331,265 km, of which 137,475 km was paved. Railroad infrastructure totaled 21,431 km, of which 9,087 km was electrified. Portnet maintained the largest and most efficient commodity export harbors in sub-Saharan Africa, most of which handled minerals, notably Cape Town, Durban, East London, Mossel Bay, Port Elizabeth, Richards Bay, and Saldanha Bay. In addition to fulfilling the requirements of South Africa itself, the country's ports also served as outlets for such landlocked countries as Botswana, Lesotho, Swaziland, Zambia, and Zimbabwe. South Africa was also a regional supplier of electricity and petroleum products, two of a number of examples of the dependence of neighboring countries on South Africa's infrastructure and transportation networks.

Richards Bay handled more than half the volume of cargo among South African ports. The RBCT had a coal export capacity of about 68 Mt/yr out of a total bulk cargo port capacity of 75 Mt/yr. A second coal export facility was being built at South Dunes near Richards Bay to handle an additional 12 Mt/yr of coal exports. Coal exports through Durban and the Mozambican port of Maputo were only a fraction of those through the RBCT. Durban's port facilities were designed mainly for small consignments of high-quality lump bituminous coal and anthracite that cannot be properly handled at Richards Bay.

Eskom had a nominal capacity of 41,298 MW, predominantly from coal-fired sources, with a small percentage of electricity being generated from nuclear sources, and operated more than 306,100 km of power lines (Eskom, 2001, Key statistics, Annual Report for 2000, accessed October 22, 2001, at URL <http://www.eskom.co.za/annreport01/home.htm>). South Africa maintained 931 km of pipeline for the distribution of crude oil, 1,748 km for petroleum products, and 322 km for natural gas.

Outlook

South Africa is endowed with one of the richest and diverse concentrations of mineral resources on Earth and has, in terms

of size and value, one of the top 10 mining and mineral-processing industries in the world. Contributing to more than 25% of the country's GDP, the minerals sector is expected to continue to play an important role in the economy for many years to come. The Government is successfully balancing the needs to focus policy initiatives and budget resources on redressing social and economic inequities in the country with the need to maintain economic and labor policies which allow South African exports to remain competitive in global markets. As a sign of confidence in the future of South Africa, domestic and foreign mineral investors have announced plans to commit more than \$10 billion to develop or expand new mining and value-added mineral processing capacity between 2000 and 2007. These planned investments, however, are subject to internal and external forces that could delay or constrict actual implementation. Internally, the impact of the high rate of HIV/AIDS in the country on the able-bodied skilled and semiskilled work force between 15 and 49 and on the resulting increasing direct and indirect labor costs to industry are of concern to investors. Externally, the weak global economy is impacting negatively on demand and prices of mineral commodities and are making many projects marginally economic to continue. Increased attention was being given to environmental issues, which are also factors in projects that require financing from international lending institutions. By mid-2000, evidence indicated that many companies were beginning to rethink the timing of future investments, particularly in ferrous and base-metal projects. These factors make it even more critical for the South African Government to maintain the investment policies and economic incentives that will allow South Africa to compete for investment with the other major mineral-export-oriented-countries, such as Australia and Canada.

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Major Sources of Information

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Major Publications

Chamber of Mines of South Africa:
Annual Report.
Statistical Tables, annual.
Department of Mineral and Energy Affairs, Annual Report.
Mineral Economics Directorate (Minerals Bureau):
South Africa's Mineral Industry, annual.
Operating Mines and Quarries and Mineral Processing Plants
in the Republic of South Africa, various periodic
directories.
Mineral Production and Sales Statistics, monthly.

TABLE 1
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000
METALS					
Aluminum metal, primary	569,600	673,043	677,000	689,230 r/	676,000
Antimony concentrate: 3/					
Gross weight	8,860	5,888	7,316	9,100	7,076
Sb content (58% Sb)	5,137	3,415	4,243	5,278	4,104
Chromite, gross weight:					
44% to 48% chromic oxide thousand tons	1,862	2,279 r/	2,329	2,447	2,261
Less than 44% chromic oxide do.	3,216 r/	3,883 r/	4,151	4,370	4,360
Total do.	5,078 r/	6,162 r/	6,480	6,817	6,621
Cobalt:					
Mine output, Co content e/	350	465	435	450	580
Refinery output	247	318	296	306	397
Copper:					
Mine (company output), Cu content	152,595	153,058	164,000	144,263	137,092
Metal:					
Smelter	148,400	163,600	152,300	149,300 r/	140,000
Refined, primary	116,000	130,200	125,600	134,500	126,100
Gold, primary kilograms	496,846	491,680	465,100	451,300	430,778
Iron and steel:					
Ore and concentrate:					
Gross weight thousand tons	30,830	33,225	32,965	29,512	33,707
Fe content do.	19,115	20,600 e/	20,438	18,442	20,900
Metal:					
Pig iron do.	6,876	6,192	5,650 r/	4,587 r/	4,573
Direct-reduced iron do.	900	1,120	1,070	1,260 r/	1,530
Ferroalloys, electric arc furnace:					
Chromium ferroalloys do.	1,478	1,940	2,025	2,155	2,526
Ferromanganese do.	562	525 e/	542 r/	527 r/	530
Ferrosilicon do.	87 r/	102	108	106	100
Ferrovanadium e/ do.	1	5	6	6	6
Silicomanganese e/ do.	212 r/	266 r/	265 r/	267 r/	270
Silicon metal do.	29	34	33	36	34
Steel:					
Crude do.	7,999	8,311	7,679 r/	6,830 r/	7,019
Stainless	334	439	430	450 r/ e/	436
Lead:					
Concentrate, Pb content	88,613	83,114	84,128	80,191	75,262
Smelter, secondary	32,200	43,000	50,000	55,000	53,000
Manganese:					
Ore and concentrate, gross weight:					
Metallurgical:					
More than 48% manganese thousand tons	1,845	1,809	1,734	1,876	2,047
45% to 48% manganese do.	86	84	12	12	302
40% to 45% manganese do.	118	116	218	235	235
30% to 40% manganese do.	1,133	1,111	1,049	970	1,029
Total do.	3,182	3,120	3,013	3,093	3,613
Chemical, 35% to 65% manganese dioxide do.	58	33	31	29	22
Grand total do.	3,240	3,153	3,044	3,122	3,635
Metal, electrolytic e/ do.	39	40	40	40	40
Nickel:					
Mine output, concentrate, nickel content e/	33,861	34,830	36,679	36,200	36,616
Metal, electrolytic	27,861 r/	28,830 r/	29,039	28,345 r/	29,616 e/
Platinum-group metals: e/					
Platinum kilograms	105,440	115,861	116,483	121,304	114,459
Palladium do.	52,560	55,675	56,608	58,164	55,818
Rhodium do.	11,200	11,664	11,633	12,752	12,067
Other e/ 4/ do.	19,436	13,404 r/	15,229 r/	24,259 r/	24,426
Total do.	188,636	196,604 r/	199,953 r/	216,479 r/	206,770
Silver do.	168,689	144,000 r/	144,482 r/	151,959 r/	144,232
Titanium: e/					
Ilmenite concentrate thousand tons	2,100	2,240 r/	2,300	1,851 r/	2,000
Rutile concentrate do.	115	123	130	100 r/	100
Total do.	2,220 r/	2,360 5/	2,430	1,950 5/	2,100

See footnotes at end of table.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000
METALS--Continued					
Titanium--Continued: e/					
Titaniferous slag 6/ thousand tons	1,000	1,100	1,100	1,100	1,120
Uranium oxide	1,706	1,324	1,138	1,084 r/	1,015
Vanadium, vanadium metal content	17,095	16,103	18,954	17,612	18,021
Zinc:					
Concentrate:					
Gross weight e/	142,000	132,000	129,000	129,200 r/	116,100
Zn content	76,853	71,062	69,630	69,733	62,703
Metal, smelter, primary	101,100	108,500	107,400	108,000 r/	116,000
Zirconium concentrate (baddeleyite and zircon)	260,000 e/	265,000	265,000	219,000 r/	253,000
INDUSTRIAL MINERALS					
Aluminosilicates:					
Andalusite	233,728	251,203	236,200	136,900	182,674
Sillimanite	--	--	65	--	--
Asbestos:					
Chrysotile	51,776	49,754	27,195	18,700	18,910
Crocidolite	5,344	232	--	--	--
Total	57,120	49,986	27,195	18,700	18,910
Barite	7,428	2,071	610	2,844 r/	1,628
Calcite	13,749	2,886	2,764	2,800 e/	2,800 e/
Cement, hydraulic, sales thousand tons	9,000	9,797 r/	9,581 r/	9,008 r/	8,991
Clays:					
Attapulgite	14,318	9,349	7,800	7,067	7,337
Bentonite	48,076	75,500	48,382	50,700	85,187
Fire clay	101,452	89,600	143,500	121,000	135,079
Flint clay, raw and calcined	113,645	91,700	82,787	88,600	47,256
Kaolin	191,900	164,400	138,300	122,400	98,897
Brick clay, local sales thousand tons	2,919	4,137	3,518	3,249	--
Diamond, natural:					
Gem e/ thousand carats	4,400	4,500	4,700	4,400	4,745
Industrial e/ do.	5,556	5,586	6,051	5,622	6,060
Total do.	9,956	10,086	10,751	10,022	10,805
Feldspar	53,644	68,100	56,400	59,300	66,774
Fluorspar:					
Acid-grade	202,018	201,000	222,000 r/	203,280 r/	197,855
Ceramic-grade e/	--	4,000	--	--	--
Metallurgical-grade	10,000	2,000	15,000 r/	14,000 r/	14,500
Total	202,018	207,000	237,000 r/	217,280 r/	212,355
Gemstones, semiprecious, tiger's eye kilograms	18,650	64,300	87,200	80,000 e/	80,000 e/
Gypsum, crude	340,688	396,900	485,749	513,760 r/	413,105
Industrial or glass sand (silica) thousand tons	2,173	2,463	2,223	2,170	2,138
Lime do.	1,650	1,585	1,523	1,920	1,351
Magnesite, crude	71,358	76,699	74,300	74,000	74,000 e/
Mica, scrap and ground	1,515	1,423	1,556	1,010	708
Nitrogen, N content of ammonia	769,800	752,400	722,800	784,800	560,200
Perlite	1,300	403	400 e/	400 e/	400 e/
Phosphate rock:					
Gross weight thousand tons	2,655	2,732	2,739	2,957 r/	2,779
Phosphorus pentoxide content e/ do.	1,036	1,066	1,068	1,153 r/	1,083
Pigments, mineral, natural:					
Ochers	484	186	122	118	550
Oxides	159	98	64	98	80
Total	643	284	186	216	630
Salt	253,403	322,442	356,059	365,255	346,447
Sodium sulfate, natural	46,947	49,071	48,613	53,400	49,712
Stone, n.e.s.:					
Dimension:					
Granite and norite 7/	708,700	804,300	669,363	782,000	648,818
Marble 7/	1,696	--	--	--	--
Slate	37,800	11,000	23,547	24,500	24,952

See footnotes at end of table.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000
INDUSTRIAL MINERALS--Continued					
Stone, n.e.s.--Continued:					
Crushed and broken:					
Limestone and dolomite thousand tons	22,038	22,214	19,754	19,030	15,881
Nepheline syenite	137,706	114,201	11,500 e/	--	--
Quartzite thousand tons	8,515	8,500	10,203	8,360	7,965
Shale:					
For cement do.	338	334	279	304	303
For aggregate and sand do.	3 r/ 5/	3 r/ 5/	4 r/ 5/	3 r/ 5/	7
Total do.	3,338	3,334	3,986	2,850	7,661
Aggregate and sand, n.e.s. do.	20,792	32,971	33,803	29,344	29,118
Sulfur:					
S content of pyrite (53.45%) do.	184 r/	167 r/	152 r/	141 r/	146
Byproduct:					
Metallurgy e/ do.	19 r/	47 r/	122 r/	126 r/	100
Petroleum do.	232 r/	256 r/	178 r/	139 r/	202 e/
Total do.	435	470 r/	452 r/	406 r/	448
Talc and related materials:					
Talc	9,700	12,600	11,300	7,900	5,600
Pyrophyllite (wonderstone)	8,837	10,610	11,500	13,277	11,989
Vermiculite	196,000	211,000	221,300	217,800	208,835
MINERAL FUELS AND RELATED MATERIALS					
Coal (salable product):					
Anthracite thousand tons	2,465	1,997	2,101	1,930	1,618
Bituminous do.	202,531	217,272	222,283	221,541	221,272
Total do.	204,996	219,269	224,384	223,471	222,890
Natural gas million cubic meters	980	1,756	1,560	2,039	2,088
Petroleum: 8/					
Crude thousand 42-gallon barrels	--	3,744	6,549	5,493	6,606
Refinery products:					
Liquefied petroleum gases do.	3,285	3,650 r/	3,650 r/	3,650 r/ e/	3,650 e/
Gasoline do.	66,795	67,525 r/	67,525 r/	67,000 r/ e/	67,000 e/
Jet fuel do.	10,220	11,315 r/	12,410 r/	12,000 r/ e/	12,000 e/
Kerosene do.	6,935	6,205 r/	7,300 r/	7,000 r/ e/	7,000 e/
Distillate fuel oil do.	49,275	39,785 r/	55,115 r/	55,000 r/ e/	55,000 e/
Residual fuel oil do.	25,550	19,345 r/	24,090 r/	24,000 r/ e/	24,000 e/
Lubricants (including greases) e/ do.	3,000	3,650 r/	3,650 r/	3,650 r/ e/	3,650 e/
Other e/ do.	7,950	10,585 r/	8,760 r/	8,700 r/ e/	8,700 e/
Total 9/ do.	173,010	162,060 r/	182,500 r/	181,000 r/ e/	181,000 e/

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

1/ Table includes data available through September 2001.

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

3/ Data are for the year ending June 30 of that stated.

4/ Difference between total production reported by Minerals Bureau and platinum, palladium, and rhodium supplies (shipments) reported in Johnson and Matthey Annual Platinum Review. Includes ruthenium and iridium production plus excess platinum, palladium, and rhodium inventory.

5/ Reported figure.

6/ Except for about 45,000 metric tons per year of slag derived from titaniferous magnetite by Highveld Steel and Vanadium Corp. Ltd., titaniferous slag is all from the smelting of ilmenite and likely represents most of that mineral's production, for which data are unavailable.

7/ Converted from reported cubic meters using 1 cubic meter=2.7 metric tons.

8/ In addition, Sasol produces about 67 million barrels per year of synthetic liquid petroleum fuels from coal.

9/ Excludes refinery fuel and losses.

TABLE 2
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	BHP Billiton Aluminium South Africa (Pty.) Ltd. (BHP Billiton plc., 100%)	Bayside smelter at Richards Bay	175.
Do.	do.	Hillside smelter at Richards Bay (planned expansion by 2003)	500+ increase to 650.
Andalusite	Rhino Minerals (Pty.) Ltd. [Mircal South Africa (Pty.) Ltd., 100%.	Rhino Mine near Thabazimbi	120.
Do.	do.	Havercroft Mine at Penge, north of Steelpoort	60.
Do.	Samrec Pty. Ltd. of France (private, 100%)	Annesley Mine at Penge, 50 kilometers north of Steelpoort	75.
Do.	do.	Andalusite Refractories Mine at Groot Marico, 60 kilometers west of Rustenburg	12.
Do.	do.	Krugerspost Mine near Lydenburg	50.
Do.	Hoogenoeg Andalusite (Pty.) Ltd.	Hoogenoeg Mine 60 kilometers northeast of Potgietersrust	15.
Antimony	Consolidated Murchison Mine Ltd. [Metorex Pty. Ltd., 34.3%, Crew Development Corp. (Canada), 3.3%]	50 kilometers west of Palabora	7 antimony concentrate, 1,000 kilograms gold byproduct.
Asbestos	Kaapsehoop Asbestos Pty. Ltd.	New Amianthus Mine in Mpumalanga.	NA (chrysotile).
Do.	African Chrysotile Asbestos Ltd.	Msauli Mine near Barberton (closed)	NA (chrysotile).
Do.	Anglo Dutch Exploration & Mining Co. (Pty.) Ltd.	Stella Mine east of Barberton (closed)	NA (chrysotile).
Do.	Griqualand Exploration and Finance Corp.	Kuruman Mine (closed in 1998)	NA (crocidolite).
Cement	Anglo Alpha Ltd. (Holderbank; Anglovaal Industries Ltd.)	Dudfield kiln near Lichtenburg and grinding mill at Roodepoort	1,830.
Do.	do.	Ulco kiln 60 kilometers northwest of Kimberly	1,615.
Do.	Lafarge South Africa Ltd. [Lafarge (France)]	Lichtenburg kiln in North West Province	2,400
Do.	do.	White's kiln	200.
Do.	Natal Portland Cement Co. (Pty.) Ltd. (co-owned by Anglo Alpha, Lafarge, and Pretoria Portland Cement companies)	Simumu plant 125 kilometers southwest of Durban and grinding mills at Durban and Newcastle	1,500.
Do.	Pretoria Portland Cement Co. Ltd. (Barlow Rand Group, 60.3%)	De Hoek, Dwaalboom, Herculese, Jupiter, Slurru, Riebeeck West, and Port Elizabeth kilns	5,500 (combined), clinker.
Chromite	Samancor Ltd. (BHP Billiton plc., 60%, Anglo American plc, 40%)	Eastern Chrome Mines in Steelpoort Valley, Mpumalanga Province; includes Lannex, Groothoek, Jagdlust, Mooihoek, Tweefontein, and Steelpoort mines	2,200 run-of-mine ore.
Do.	do.	Western Chrome Mines in Northern Province; includes Elandsdrift, Mooinooi, Ruighoek, and Waterkloof-Millsell mines	1,800 run-of-mine ore.
Do.	Chromecorp Holdings Ltd. (Xstrata Ag, 100%)	Kroondal Mine east of Rustenburg	1,260 ore; 880 concentrate.
Do.	do.	Wonderkop Mine east of Rustenburg	720 ore; 400 concentrate.
Do.	do.	Chrombronne Mine near Rustenburg	576 ore; 432 concentrate.
Do.	do.	Purity Mine near Rustenburg	360 ore; 252 concentrate.
Do.	Hernic Ferrochrome Pty. Ltd., [South African Chrome and Alloys Ltd.; EL Daniel (Germany); Nittetsu Shoji (Japan)]	Hernic Chrome Mine near Brits, North West Province, and Mooinooi Mine near Rustenburg	NA.
Do.	Bayer Pty. Ltd.	Rustenburg Chrome Mine	NA.
Do.	Lavino South Africa (Pty.) Ltd. (Anglovaal Minerals Ltd., 51%; Middle Witwatersrand, 49%)	Grootboom Mine near Lydenburg	500 ore.
Do.	Dilokong Chrome Mine (Pty.) Ltd. (Mining Corp. Ltd., 100%)	Dilokong Mine near Lydenburg	480 ore.
Do.	Associated Manganese Mines of South Africa Ltd.; (Anglovaal Minerals Ltd., 50.2%; Associated Ore and Metal Corp., 45.2%)	Dwarsrivier Mine	1,000 run-of-mine ore.
Coal	Amcoal Colliery and Industrial Operations Ltd. [Anglo American plc. (52%)]	Eight collieries: Arnot, Bank, Goedeboom, Kriel, New Denmark, New Vaal, SA Coal Estates, and Vryheid Coronation in Mpumalanga and KwaZulu-Natal Provinces	52,000 anthracite and bituminous.
Do.	Ingwe Coal Corp. Ltd. (BHP Billiton Plc, 100%)	Ten collieries in Mpumalanga and KwaZulu-Natal Provinces	59,000 anthracite and bituminous.
Do.	Duiker Mining Ltd., (Glencore International AG, 100%)	Duiker and Tavistock collieries (six mines, include Tweefontein and Spitzkop collieries).	20,000.
Do.	Duvha Opencast Services (Pty.) Ltd. (Rand Mines Ltd., 71%)	Duvha colliery 18 kilometers southeast of Witbank	11,000 bituminous.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity	
Coal--Continued:	Kangra Group Pty. Ltd.	Savamore, Springlake, Taaboschpruit, and Welgedacht collieries	4,300 bituminous and steam.	
Do.	Sasol Mining (Pty.) Ltd. (Sasol Limited, 100%)	Sigma colliery and two mines 75 kilometers south of Johannesburg (closed end 1999).	5,500 bituminous.	
Do.	do.	Secunda collieries and six mines 75 kilometers south of Witbank	43,000 bituminous.	
Do.	Iscor Mining (Iscor Ltd., 100%)	Grootegeluk Mine 120 kilometers north of Thabazimbi	12,000 steam coal, 2,000 coking coal, 450 metallurgical coal.	
Do.	do.	Leeuwpaan colliery in Mpumalanga Province	1,250 steam coal.	
Do.	do.	Durnacol Mine at Dannhauser, 40 kilometers south of Newcastle	530 coking coal.	
Do.	do.	Tshikondeni Mine in Venda, about 100 kilometers southeast of Messina	410 coking coal.	
Do.	Anglovaal Minerals Ltd. (100%)	Dortfontein Colliery	700.	
Do.	do.	Forzando Colliery	1,350.	
Do.	Newcoal [Eyesizwe Coal (Pty.) Ltd., 80%; Anglo Coal, 11%; Ingwe Coal Corp. Ltd., 9%]	Matla, Arnot underground, Glisa, and New Clydesdale collieries	18,000	
Do.	Kuyasa Mining (Pty.) Ltd.	Ikhewezi Mine near Delmas	350.	
Do.	Gold Fields Coal Ltd	Greenside and New Clydesdale collieries	3,000.	
Do.	Anker Holdings B.V. (Netherlands)	Elandsfontein, Golfview, Van Oudshoornstrom, and Woestalleen collieries.	5,000. e/	
Do.	Wakefield Coal Division, [Metorex Pty. Ltd., 40.07% (Canada)]	Leeufontein and Side collieries in Witbank coalfield	1,300 steam.	
Copper	Palabora Mining Co. Ltd. (Rio Tinto plc, 46.4%; Anglo American plc./De Beers, 29%)	Palabora open pit mine and plant at Palabora	130 metal in ore.	
Do.	do.	(Switch to underground mining in 2002)	Reduce to 75 metal in ore.	
Do.	do.	Smelter at Phalaborwa	140 anodes.	
Do.	do.	Refinery at Phalaborwa	125 cathodes.	
Do.	O'okiep Copper Co. (Pty.) Ltd. [Metorex (Pty.) Limited, 89%]	Nigrampoep copper mine near Nababeep, Northern Cape Province.	15 copper in concentrates.	
Do.	do.	O'okiep smelter at Nababeep	42 blister.	
Do.	Black Mountain Mineral Development Co. (Pty.) Ltd. (Anglo American plc, 100%)	Black Mountain Mine near Aggeneys, 100 kilometers northeast of O'okiep	5 copper in concentrate.	
Do.	Maranda Mining Co. [Metorex (Pty.) Limited, 29.1%]	Maranda zinc-copper mine in Murchison Range in Northern Province	1.6 copper metal.	
Diamond	thousands	De Beers Consolidated Mines Ltd. (Anglo American plc, 29%)	Finsch Mine 100 kilometers west of Kimberly	2,500. e/
Do.	do.	do.	Kimberley Mines at Kimberly	800. e/
Do.	do.	do.	Koffiefontein Mine 70 kilometers south of Kimberly	200. e/
Do.	do.	do.	Marsfontein	500. e/
Do.	do.	do.	Namaqualand Mines 50 kilometers north of Port Nolloth	800. e/
Do.	do.	do.	The Oaks	120. e/
Do.	do.	do.	Premier Mine 70 kilometers east of Pretoria	1,800. e/
Do.	do.	do.	Venetia Mine 150 kilometers north of Potgietersrust	5,000. e/
Do.	do.	SouthernEra Resources Ltd. (Canada)	Klipspringer Mine near Potgietersrust in Northern Province	1,000.
Do.	do.	Benguela Concessions Ltd.	Several marine operations along Namqualand coast. Moonstone mining ship	40.
Do.	do.	Trans Hex Group Ltd.	Baken deposit on Orange River, Hondklip Bay, So Ver, Reuning, and Komagass mines and three marine operations off Northern Province	200.
Do.	do.	Trivalence Mining Corp. of Canada, (100%)	Palmietgat kimberlite mine	50
Fluorspar		Vergenoeg Mining Co. (Pty.) Ltd. [Metorex Pty. Ltd., 70%; Minerale y Productos Derivados SA (Spain), 30%]	Vergenoeg Mine 75 kilometers north of Pretoria	125 acid grade fluorspar, 10 metallurgical grade fluorspar.
Do.		Witkop Fluorspar Mine (Pty.) Ltd. [South Africa Land & Exploration Co. (Sallies) (Athlone International (Australia), 100%]	Witkop Mine 250 kilometers west of Johannesburg	140 acid-grade fluorspar (expand to 280 by 2002).

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners		Location of main facilities	Annual capacity
Fluorspar--Continued:	Van den Heever Fluorspar Works		Van Den Heever Mine 120 kilometers west of Johannesburg	50 metallurgical grade fluorspar. e/
Gold	tons	AngloGold Ltd. (Anglo American plc, 100%)	Vaal River Operations, includes Great Noligwa (ex-Vaal Reefs Shaft 8), Kopanang (Vaal Reefs #9, and Tau Lekoa (Vaal Reefs #10) underground mines; Vaal River surface operations; and Moab Khotsong development	60 gold.
Do.	do.	do.	Ergo Operations--slimes dam reprocessing	11 gold.
Do.	do.	do.	Free State Operations, includes Bambanani (President Steyn #4), Tshepong (Freegold #2), Matjhabeng (ex-Western Holdings), and Joel, underground mines and Free State surface operations	48 gold.
Do.	do.	do.	West Wits Operations, includes Tau Tona (ex-Western Deeps-East), Savuka (ex-Tau Tona and ex-Western Deeps-East), Savuka (ex-Western Deeps-West), Mponeng (ex-Western Deeps-South) underground mines	42 gold.
Do.	do.	do.	Western Ultra Deep Levels project	12 gold by 2003.
Do.	do.	Gold Fields Ltd.	Beatrix, Driefontein, Kloof, Oryx, St. Helena, and Target mines west and southwest of Johannesburg	125 gold (South African operations only).
Do.	do.	Harmony Gold Mining Co. Ltd.	Free State Operations, shafts include Harmony 2 and 4; Merriespruit 1, 7, and 3; Virginia, Unisel, Masimong 4 and 5; Brand 2, 3, and 5; Central, Saaiplaas and Virginia metallurgical plants; and Central refinery	26.5 gold.
Do.	do.	do.	Deelkraal and Elandsrand mines	20 gold.
Do.	do.	do.	Evander Operations, includes six shafts and Leslie, Kinross, and Winkelhaak metallurgical plants	12.5 gold.
Do.	do.	do.	Randfontein Operations, includes Cooke 1, 2, and 3 shafts and No. 4 and Doornkop shafts and metallurgical plants and Doornkop South Reef development	24.9 gold.
Do.	do.	do.	Lindum open pit operations	(included in Randfontein).
Do.	do.	do.	Kalgold open pit, heap leach, and carbon-in-leach operation at Mafikeng, Northwest Province	3.2 gold.
Do.	do.	Avgold Ltd. (Anglovaal Mining Ltd., 60.1%)	Eastern Transvaal Consolidated Division (Sheba, Fairview, and New Consort Mines) near Klerksdorp	2.8 gold.
Do.	do.	do.	Target Mine (full production by early 2002)	10.9 gold by 2002.
Do.	do.	Durban Roodeport Deep Ltd.	Blyvoorruitzicht and Doornfontein section	6.3 gold.
Do.	do.	do.	Buffelsfontein section	5.5 gold.
Do.	do.	do.	Hartebeestfontein section	15.5 gold.
Do.	do.	do.	Crown section--tailings retreatment	4.1 gold.
Do.	do.	do.	Argonaut Deep project (on hold)	60 million troy ounces.
Do.	do.	Western Areas Ltd. (JCI Gold, 50%; Placer Dome Inc., 50%)	Western Areas	6 gold.
Do.	do.	do.	South Deep project	11.7 gold by 2002.
Do.	do.	Rand Refinery Ltd.	Germiston, Gauteng Province	1,200 refined gold.
Iron and steel:				
Iron ore	IsCOR Ltd.		Sishen Mine at Sishen	27,000 ore, to 32,000 by 200
Do.	do.		Thabazimbi Mine at Thabazimbi	2,900 ore.
Do.	Highveld Steel and Vanadium Corp. Ltd. (Anglo American plc, 74%)		Mapochs Mine at Roossenekal, 60 kilometers west of Lydenburg	3,000 titaniferous and vanadiferous magnetite ore.
Do.	Associated Manganese Mines of South Africa Ltd. (Anglovaal Minerals Ltd., 50.2%)		Beeshoek Mine near Postmasburg	4,500 ore.
Ferroalloys 2/	Samancor Chrome Division (BHP Billiton plc, 60%, Anglo American plc, 40%)		Ferrometals plant at Witbank (six furnaces) (two furnaces at 110,000 capacity closed in 1999); F1 and F2 20-megawatt furnaces (80,000 metric tons per year) closed August 2000	450 ferrochromium.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Iron and steel--Continued			
Ferroalloys--Continued: 2/	Samancor Chrome Division (BHP Billiton plc, 60%; Anglo American plc, 40%)	Tubatse Ferrochrome plant at Steelpoort (six furnaces)	340 ferrochromium.
Do.	do.	Middelburg Ferrochrome plant 35 kilometers east of Witbank (three furnaces)	235 ferrochromium.
Do.	do.	Palmiet Ferrochrome plant at Krugersdorp, 30 kilometers west of Johannesburg (three furnaces)	120 ferrochromium.
Do.	do.	Bathlako Ferrochrome plant at Ruighoek, northwest of Rustenburg	20 ferrochromium.
Do.	Chromecorp Holdings Ltd., (Xstrata AG, 100%)	Rustenburg (six furnaces)	400 ferrochromium.
Do.	do.	Lydenburg (four furnaces)	350 ferrochromium.
Do.	do.	Wonderkop (four furnaces)	320 ferrochromium.
Do.	do.	Rustenburg slag retreatment plant	25 ferrochromium.
Do.	do.	Wonderkop slag retreatment plant	20 ferrochromium.
Do.	do.	Silicon Technology plant at Ballengeich, KZN	55 ferrosilicon.
Do.	Samancor and Xstrata Joint Venture (BHP Billiton plc, 50%; Xstrata AG, 50%)	Wonderkop furnace (mid-2001 start up)	180 ferrochromium.
Do.	South African Chrome and Alloys Ltd.	Elandsdift and Horizon Chromite Mines; proposed new ferrochrome smelter planned	150 ferrochromium. (150-170 ferrochromium).
Do.	Hernic Ferrochrome Pty. Ltd. [South African Chrome and Alloys Ltd; EL Daniel (Germany); Nittetsu Shoji (Japan)]	Plant near Brits (two furnaces)	260 ferrochromium.
Do.	Feralloys Ltd. (Associated Manganese Mines of South Africa Ltd., 100%)	Machadodorp plant (three furnaces) 80 kilometers east of Middelburg	150 ferrochromium, 175 by 2000.
Do.	Cato Ridge Alloys Ltd. (Associated Manganese Mines of South Africa Ltd., 50%; Mizushima Ferroalloy Co. Ltd., 40%; Sumitomo Corp., 10%)	Cato Ridge 75 kilometers west of Durban	245 ferromanganese.
Do.	Samancor Manganese Division, (BHP Billiton plc, 54.6%; Anglo American plc, 28.9%; private, 16.5%)	Metalloys Ltd. plant at Meyerton (nine furnaces), 50 kilometers south of Johannesburg; can switch between FeMn and SiMn	530 high-carbon ferromanganese, 200 silicomanganese.
Do.	Advalloy (Pty.) Ltd. (BHP Billiton/Samancor, 50%; Japan Metals & Chemicals Co., 35%; Mitsui & Co. Ltd., 15%)	Furnace at Samancor's Meyerton Plant	75 low-carbon and high carbon ferromanganese.
Do.	Manganese Metal Co. (Pty.) Ltd. (Samancor Ltd.)	Plants at Krugersdorp and Nelspruit	44 electrolytic manganese.
Do.	Transalloys Division (Highveld Steel and Vanadium Corp. Ltd., 100%)	Witbank	50 medium-carbon ferromanganese.
Do.	do.	do.	175 silicomanganese.
Do.	tons ASA Metals (Pty.) Ltd. (Eastern Asia Metal Investment Co. Ltd., 60%; Northern Province Development Corp., 40%)	Plant near Pietersburg, Northern Province (associated with Dilokong Chrome)	50 ferrochrome.
Do.	Rand Carbide Division (Highveld Steel and Vanadium Corp. Ltd., 100%)	Plant at Witbank, Mpumalanga Province	58 ferrosilicon.
Do.	tons Vametco Minerals Corp. (Strategic Minerals Corp., USA, 100%)	Smelter near Brits	5,250 ferrovanadium.
Steel	Iskor Ltd.	Vanderbijlpark Works	3,200 flat products.
Do.	do.	Newcastle Works	2,000 profile products.
Do.	do.	Vereeniging Works	450 specialty steels. e/
Do.	Highveld Steel and Vanadium Corp. Ltd. (Anglo American plc, 74%)	Witbank	1,000 cast billets, blocks, and slabs.
Do.	Saldanha Steel (Pty.) Ltd. (Iskor Ltd., 50%; Industrial Development Corp., 50%)	Hot-rolled steel coil plant at Saldanha Bay	1,200.
Do.	Columbus Stainless (Samancor, 33.3%; Highveld Steel and Vanadium Corp. Ltd., 33.3%; Industrial Development Corp., 33.3%)	Stainless steel plant at Middelburg	500.
Do.	Scaw Metals Division, Anglo Operations Ltd.	Germiston plant, Johannesburg	500 speciality castings and rolled products.
Do.	Duferco Steel Processing Ltd.	Cold-rolled slab steel at Saldanha Bay	400.
Do.	Davsteel Division, Cape Gate Pty. Ltd.	Vanderbijlpark plant at Gauteng	400 rebar, wire rod, and other shapes.
Do.	Cape Town Iron & Steel Works (Pty.) Ltd. (CISCO)	Kuilsrivier plant at Cape Town	180 rebar.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners		Location of main facilities	Annual capacity
Manganese	Associated Manganese Mines of South Africa Ltd., (Avmin Ltd., 50.2%)		Gloria and N'Chwaning Mines near Black Rock, 70 kilometers north of Sishen	1,500 ore.
Do.	Samancor Ltd. (BHP Billiton plc, 60%; Anglo American plc, 40%).		Mamatwan open pit mine and ore sintering plant near Hotazel	2,200 ore, of which 1,100 sintered ore.
Do.	do		Wessels underground mine near Hotazel	1,200 ore.
Do.	Manganese Metal Co. Pty. Ltd. (Samancor Ltd., 100%)		Electrolytic plant, Nelspruit, Mpumalanga	26 manganese metal.
Do.	do.		Electrolytic plant, Krugersdorp, Gauteng	18 manganese metal.
Do.	Metmin (Metorex Pty. Ltd., 100%)		Open pit mine in North West Province (used as catalyst for extracting uranium from gold).	24 manganese dioxide.
Nickel	Nkomati Joint Venture (Anglovaal Mining Ltd., 75%; Anglo American plc, 25%)		Nkomati Mine in Mpumalanga Province	15 nickel in concentrate.
Petroleum, thousand crude 42-gallon barrels	Soeker (Government, 100%)		Oribi Field 140 kilometers southwest offshore from Mossel Bay	9.1.
Do.	do.	do	Oryx Field	1.8. e/
Do.	do.	do	Sable Field (in development in 2000-2001)	14.6.
Do.	do.	Mossgas [Government (through Central Energy Fund), 100%]	Nine wells in Mossel Bay	3.5.
Do.	do.	Shell and BP Refineries Pty. Ltd. (Shell South Africa, 50%; BP p.l.c., 50%)	Sanref refinery in Durban	60 crude.
Do.	do.	Caltex Oil SA Pty. Ltd. (private, 100%)	Refinery in Cape Town	41 crude.
Do.	do.	National Petroleum Refiners of South Africa Pty. Ltd. (Sasol Ltd., Total SA)	Natref Refinery in Secunda, 100 kilometers southeast of Johannesburg	32 crude.
Do.	do.	Engen Ltd., 62%	Engen Refinery in Durban	38 crude.
Phosphate	Phosphate Development Corp. Ltd. (Foskor Ltd.) (Industrial Development Corp., 100%)		Foskor Mine and plant at Phalaborwa	2,900 phosphate rock. 3/
Platinum-group metals	kilograms	Anglo American Platinum Corp. Ltd. (Anglo Platinum) (Anglo American plc, 100%)	Rustenburg section near Rustenburg, Rustenburg underground and open pit mines (New Waterval UG2 mine by 2002); adding 12,285 kilograms per year platinum capacity by 2002	24,000 platinum metal, 10,260 palladium metal, 1,650 rhodium metal.
Do.	do.	do.	Rustenburg mill	9,000,000 tons per year ore.
Do.	do.	do.	Union section, 50 kilometers south of Thabazimbi	9,850 platinum metal, 4,540 palladium metal, 1,470 rhodium metal.
Do.	do.	do.	Union mill	4,000,000 tons per year ore.
Do.	do.	do.	Amandelbult section, 50 kilometers south of Thabazimbi iron ore mines	17,700 platinum metal, 8,150 palladium metal, 6,500 rhodium metal.
Do.	do.	do.	Amandelbult mill	6,000,000 tons per year ore.
Do.	do.	do.	Lebowa Platinum (Atok) Mine, 70 kilometers east of Potgietersrust	2,520 platinum metal, 1,100 palladium metal, 150 rhodium metal.
Do.	do.	do.	Lebowa Platinum mill	1,000,000 tons per year ore.
Do.	do.	do.	Potgietersrust Platinum Mine (30 million metric tons per year low grade ore mined, most of which is stockpiled for future use)	5,160 platinum metal, 5,500 palladium metal, 350 rhodium metal.
Do.	do.	do.	Potgietersrust Platinum mill	3,100,000 tons per year ore.
Do.	do.	do.	Bafokeng Rasimone Mine in Northern Province opening in 2000, full capacity by 2002	7,776 platinum-group metals
Do.	do.	do.	Bafokeng Rasimone mill	2,400,000 tons per year ore.
Do.	do.	do.	Waterval Mine	12,285 platinum-group metal
Do.	do.	do.	Total Amplats mill capacity	23,800,000 tons per year ore.
Do.	do.	do.	Waterval mill	4,800,000 tons per year ore.
Do.	do.	do.	Waterval smelter	50 converter matte.
Do.	do.	do.	Rustenburg Base Metals Refiners Refinery	25 nickel plus refined copper and cobalt and precious metals concentrates.
Do.	do.	do.	Precious Metals Refinery (total Amplats capacity)	70,000 platinum metal, 34,000 palladium metal, 6,500 rhodium metal.
Do.	do.	Anglo Platinum and African Rainbow Minerals	Maandagshoek Mine (full capacity by 2003)	5,000 platinum metal.
Do.	do.	do.	Maandagshoek mill (to treat UG2 ore)	2,400,000 tons per year ore.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Platinum- group metals--Continued:	Impala Platinum Ltd. [Impala Platinum Holdings Ltd. (Implats), 100%]	13 mine shafts, concentrator, and smelter near Rustenburg, North West Province	15,000,000 tons per year ore.
Do.	do.	Enhanced Precious Metals Refinery near Springs, Gauteng Province	62,200 platinum, 18,000 palladium, 4,600 rhodium.
Do.	do.	Reopening Crocodile River Mine in 2001	1,555 platinum; 930 other platinum-group metals.
Do.	do.	Platexco properties, including Winnaarshoek Deposit adjacent to Implats Clapham, Forrest Hill and Dreikop properties, plus Platexco Mokopane and Septre properties	6,220 platinum-group metals
Do.	Lonmin Platinum (Lonmin Plc., 73%; Impala Platinum Holdings Ltd., 27%)	3 mines (Eastern Platinum, Karee, and Western Platinum) near Rustenburg	37,324 platinum-group metals in concentrates; 10 million tons per year ore.
Do.	do.	Smelter	Matte, 6,000 grams per ton platinum-group metals.
Do.	do.	Base Metals Refinery	Copper and nickel sulfate, and platinum-group metal concentrates.
Do.	do.	Precious Metals Refinery at Western Platinum, 20 kilometers east of Rustenburg	20,600 platinum, 9,330 palladium, 2,800 rhodium.
Do.	Northam Platinum Ltd. (Mvelaphanda Platinum, 22.5%; Anglo Platinum, 20%)	Northam Mine 20 kilometers south of Thabazimbi	13,000 platinum.
Do.	do.	Northam mill (treats Merensky ore)	1,800,000 tons per year ore.
Do.	do.	New mill in 2001 (to treat UG2 ore)	900 ore.
Do.	do.	Northam Refinery	5,910 platinum.
Do.	Kroondal Platinum Mines [Aquarius Platinum Ltd., (Australia), 45%; Implats, 15%]	Kroondal Minel, 10 kilometers east of Rustenburg (opening in 2000)	3,110 platinum, 1,555 palladium, 467 rhodium.
Do.	do.	Kroondal mill	1,200,000 tons per year ore
Do.	Aquarius Platinum Ltd. (Australia), (Implats, 25%)	Marikana Mine 20 kilometers southeast of Rustenburg (feasibility study in 2000)	4.665 platinum planned.
Do.	do.	Marikana mill	1,540,000 tons per year ore
Do.	do.	Everest South deposit feasibility study in 2001	5,440 platinum-group metals planned.
Do.	Messina Holdings Ltd. (SouthernEra Resources Ltd., 70.4%) (purchased from Implats in 1999)	Messina platinum deposit near Klipspringer diamond mine, Northern Province, 2003 startup	2,176 platinum, 1,681 palladium, 247 rhodium.
Do.	East Daggafontein Ltd. (Mvelaphanda Platinum, 100%)	Tailings dump retreatment operation at East Daggafontein	NA.
Pyrophyllite	Alpha Ltd.	Idwala Industrial Minerals plant and Witpoort Quarry	NA.
	Wonderstone Ltd., (The Associated Ore & Metals Corp. Ltd.)	Pyrophyllite (wonderstone) Mine in North West Province	NA.
Do.	G&W Base and Industrial Minerals Pty. Ltd.	Masala Mine at Mpumalanga	NA.
Salt	Salt is mined/extracted from 4 seawater and 50 salt-pan brine operations	Operations are distributed throughout the country with the greatest concentration within a major inland saltpan around the border of the Free State and Northern Cape Provinces	400.
Silicon	Silicon Smelters (Pechiney, 77%, Samancor, 23%)	Near Pietersburg, Northern Province (three submerged arc furnaces)	40 silicon.
Synthetic fuels	Sasol Ltd. (Government, 100%)	Coal-to-oil plant at Secunda and a coal-to-petrochemical plant at Sasolburg	54.8.
Do.	Mossgas [Government (through Central Energy Fund), 100%]	Natural-gas-to-petroleum products plant at Mossel Bay	16.4.
Titanium:			
Titanium concentrates	Richards Bay Minerals trading for Tisands (Pty.) Ltd. and Richards Bay Iron and Titanium (Pty.) Ltd. (Rio Tinto plc, 50%; BHP Billiton plc, 50%)	Opencast operations near Richards Bay	1,280 ilmenite concentrate, 125 rutile concentrate. e/
Do.	Namakwa Sands Ltd. (Anglo Operations Ltd, a subsidiary of Anglo American plc, 100%)	Opencast mine near Brand-se-Baai and mineral separation plant at Koekenaap, 300 kilometers northwest of Cape Town	540 ilmenite concentrate, 42 rutile concentrate.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Titanium slag	Richards Bay Iron and Titanium (Pty.) Ltd./Richards Bay Minerals (Rio Tinto plc)	Smelter at Richards Bay	1,000 titania slag.
Do.	Namakwa Sands Ltd. (Anglo Operations Ltd., a subsidiary of Anglo American plc, 100%)	Smelter at Vredenberg, Saldanha Bay area	230 titania slag (by 2000), 120 pig iron.
Do.	Highveld Steel and Vanadium Corp. Ltd.	Steel plant at Witbank	48 titania slag. e/
Uranium	tons AngloGold Ltd. (Anglo American plc, 60%; De Beers, 40%)	Vaal River operations near Klerksdorp	2,000 uranium oxide (900 at 2000 output). e/
Do.	do. Durban Roodepoort Deep Ltd.	Hartebeestfontein Mine and plant 5 kilometers southeast of Klerksdorp	400 uranium oxide (less than 200 at 2000 output). e/
Do.	do. Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	160 uranium oxide. e/
Vanadium	do. Highveld Vanadium and Chemicals (Anglo American plc through Highveld Steel and Vanadium Corp. Ltd.)	Mapochs Mine near Lydenburg	25,000 vanadium pentoxide. e/
Do.	do. do.	Highveld steel plant in Witbank	17,000 vanadium pentoxide.
Do.	do. do.	Highveld Vantra plant in Witbank	8,000 vanadium pentoxide.
Do.	do. Vametco Minerals Corp. (Strategic Minerals Corp., USA, 100%)	Krokodilkraal Mine and plant near Brits	5,000 vanadium pentoxide. e/
Do.	do. Transvaal Alloys Pty. Ltd., (Highveld Steel and Vanadium Corp., 100%)	Wapadskloof Mine and plant 60 kilometers northeast of Middelburg	2,250 vanadium pentoxide. e/
Do.	do. Vanadium Technology (Pty.) Ltd., [Xstrata AG (nee Sudelektra Holding AG), Switzerland, 100%]	Kennedy's Vale (ex-Vansa Vanadium) Mine and plant near Lydenburg	5,900 vanadium pentoxide, 1,500 ferrovandium.
Do.	do. Rhombus Vanadium Holdings Ltd. (Xstrata AG, 100%)	Ba-Mogopa Mine and Usko plant	13,500 vanadium.
Vermiculite	Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	230 concentrate. e/
Do.	Natkruit Vermiculite Mine Pty. Ltd., (Verimex Trading Pty. Ltd.)	Mine near Soutpansberg, Northern Province	22 concentrate, (closed March 1999).
Zinc	Zinc Corp. of South Africa Ltd. (Zincor) (Iscor Ltd., 100%)	Struisbult Springs zinc refinery at Springs, southeast of Johannesburg	120 zinc.
Do.	Black Mountain Mineral Development Co. (Pty.) Ltd. (Anglo American plc, 100%)	Black Mountain Mine near Aggeneys, 100 kilometers northeast of Okiep	26 zinc in concentrate.
Do.	Maranda Mining Co. (Pty.) Limited (Metorex Ltd. 29.1%)	Maranda zinc-copper mine in Murchison Range in Northern Province	15 zinc metal in concentrates, 6 copper metal in concentrates.
Do.	Pering Mine (Pty.) Ltd. (BHP Billiton plc., 100%)	Pering Mine in Northern Cape Province (phased closure 1999-2001)	27 zinc in concentrate, 6 lead in concentrate.
Zirconium	Tisand (Pty.) Ltd./Richards Bay Minerals	Opencast mines near Richards Bay	300 zircon concentrate.
Do.	Namakwa Sands Ltd. (Anglo Operations Ltd, a subsidiary of Anglo American plc, 100%)	Opencast mine near Brand-se-Baai and mineral separation plant at Koekenaap	140 zircon concentrate.
Do.	Palabora Mining Co. Ltd.	Palabora Mine and plant at Palabora	14 baddeleyite. e/
Do.	do.	Zirconium basic sulfate plant at Palabora	8 zirconium basic sulfate (1999).
Do.	Phosphate Development Corp. Ltd. (Foskor Ltd.) (Industrial Development Corp., 100%)	Plant at Palabora	3 baddeleyite. e/
Do.	do.	Fused zirconia plant	6 synthetic zirconia.

e/ Estimated. NA Not available.

1/ Based on information available, as of October 2001.

2/ Depending on market demand, furnace capacity can switch between ferrochromium and ferromanganese.

3/ Most of Foskor's phosphate output is from phosphate concentrates supplied by the neighboring Palabora copper mine.

TABLE 3
SOUTH AFRICA: RESERVE BASE OF MAJOR
MINERALS IN 2000 1/

(Million metric tons unless otherwise specified)

Commodity	Reserve base
Andalusite 2/	50.8
Antimony thousand tons	250
Chromium, ore	3,100
Coal, recoverable	34,980
Cobalt 3/ thousand tons	15
Copper	13
Diamond 4/ million carats	1,127
Fluorspar	36
Gold thousand tons	35.9
Iron ore, Fe content	1,500
Lead	3
Manganese	4,000
Natural gas billion cubic meters	85
Nickel 3/	11.8
Petroleum million barrels	29.4
Phosphate rock, concentrates	2,500
Platinum-group metals thousand tons	62.8
Silver do.	10
Titanium	146
Uranium 5/ thousand tons	218.3
Vanadium	12
Vermiculite	80
Zinc	15
Zirconium	14.3

1/ Metallic minerals are contained metal.

2/ Includes the aluminosilicate, sillimanite.

3/ Minerals Bureau estimates as of December 31, 1997.

4/ De Beers reserves and resource data only.

5/ Recoverable at a cost of less than \$80 per kilogram.

Sources: Chamber of Mines Online Statistical Tables 1999, accessed at URL <http://www.bullion.org.za/bulza/publications/Stats/MinRes.pdf>. Minerals Bureau estimates as of December 31, 1999. U.S. Energy Information Administration, Country Analysis Briefs, South Africa, December 2000, accessed at URL <http://www.eia.doe.gov/emeu/cabs/safrica.html>.