

THE MINERAL INDUSTRY OF

GHANA

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The Republic of Ghana covers an area of 238,540 square kilometers within West Africa and supported a population of around 19.9 million in mid-2001. During 2001, the economy continued to be affected by a high level of indebtedness, a high rate of inflation, weak international prices for its major exports (cocoa, gold, and timber), and high international prices for its major imports of petroleum products, chiefly diesel fuel for the mining sector. Ghana was the second largest gold producer in Africa after South Africa, the third largest African producer of aluminum metal and manganese ore, and a significant producer of bauxite and diamond. Production of major mineral commodities is listed in table 1. In addition, a number of industrial minerals, which included clays (kaolin), dimension stone, limestone, salt, sand and gravel, and silica sand, were produced on a small scale (Barning, 1997, p. 1).

The Ghana Ministry of Finance reported that the real gross domestic product (GDP) grew at a rate of 4.0% in 2001 compared with 3.7% in 2000; inflation declined to 25% from 40% in 2000; the Ghanaian cedi (C) leveled off at an average rate of C7,062 to the dollar for 2001 after having depreciated by more than 160% against the U.S. dollar from its 1999 average to the end of 2000. Ghana's external debt totaled \$6.2 billion; during 2001, the Government applied for relief under the World Bank's Heavily Indebted Poor Countries initiative. For 2001, the country had an \$800 million merchandise trade deficit, which was based on total exports of \$1.98 billion and total imports of \$2.78 billion. The principal exports were gold (\$634.4 million), cocoa (\$378 million), and timber (\$169.2 million). Gold export revenues, which were based on an average price of \$273 per troy ounce of gold for 2001, declined by 21% from those of 2000, but were forecast to increase significantly in 2002 as the world gold price moved up to the \$300- to \$325-per-troy-ounce range in early 2002 (Ghana Ministry of Finance, 2002¹).

Other mineral commodity exports in 2001 included manganese (\$25.2 million), diamonds (\$18.5 million), and bauxite (\$12.7 million). Ghana's main processed mineral commodity export was primary aluminum, which was toll-refined by Volta Aluminum Co. Ltd. (Valco) from imported alumina. On the basis of the average price of aluminum of \$1.54 per kilogram (\$0.70 per pound) in 2001, aluminum production of 162,000 metric tons (t), most of which was exported, was valued at about \$249 million. Petroleum imports were valued at \$550 million and accounted for 18% of total merchandise imports during 2000. Other mineral- or mining-related imports included alumina for aluminum production; clinker, gypsum, and limestone for cement production; fertilizers; and sodium cyanide for gold leaching.

Government Policies and Programs

¹References that include a section twist (§) are found in the Internet References Cited section.

Legislation that affects mining and mineral exploration in Ghana includes the Minerals and Mining Law, 1986 (PNDCL 153), as amended by the Minerals and Mining (Amendment) Act, 1994 (Act 475); the Additional Profits Tax Law, 1985 (PNDCL 122); the Minerals Commission Law, 1986 (PNDCL 154); and the Minerals (Royalties) Regulations, 1987 (LI 1349). The 1986 mining law had been instrumental in attracting more than \$4 billion in foreign investment to the Ghanaian mining industry through the end of 2000. Act 475 has reduced the 45% general mining corporate tax rate to 35%, which is the same as that imposed on other industries. The Petroleum (Exploration and Production) Law, 1984 (PNDCL 84), sets out the policy framework and describes the role of institutional participants, namely the Ministry of Mines and Energy, which regulates the industry. Ghana National Petroleum Corp. (GNPC), which is empowered to undertake petroleum exploration and production on behalf of the Government, is authorized to enter joint ventures and production-sharing agreements with commercial organizations; GNPC was established under the GNPC Law of 1983 (PNDCL 64). The regulation of artisanal gold mining is set forth in the Small-Scale Gold Mining Law, 1989 (PNDCL 218). The Precious Minerals Marketing Corporation Law, 1989 (PNDCL 219), set up the Precious Minerals Marketing Corp. (PMMC) to promote the development of small-scale gold and diamond mining in Ghana and to purchase the output of such mining either directly or through licensed buyers. Concerned with the dropoff in investment in the mining sector since 1999, the Ministry of Mines was preparing draft legislation, which will be submitted to Parliament in mid-2002, to revise PNDCL 153 to enhance Ghana's international competitiveness.

The Ministry of Mines and Energy oversees all aspects of the Ghanaian mineral economy and is the grantor of mineral and energy exploration and mining leases. Within the Ministry, the Minerals Commission has responsibility for administering the Mining Act, recommending mineral policy, promoting mineral development, advising the Government on mineral matters, and serving as a liaison between industry and the Government. The Ghana Geological Survey Department conducts geologic studies, and the Mines Department has authority in mine safety matters. All mine accidents and other safety problems also must be reported to the Ghana Chamber of Mines, which is the private association of operating mining companies. The Chamber also provides information on Ghana's mining laws to the public and negotiates with the mine labor unions on behalf of its member companies.

Structure of the Mineral Industry

Through privatization programs during the 1990s, the Government greatly reduced its once-dominant stake in cement and gold companies. It has maintained a controlling interest in Ghana Consolidated Diamonds Ltd., GNPC, and state-run Tema Steel Co.

Efforts to attract foreign investment in recent years have brought in a wide range of companies from Australia, Canada, Ireland, South Africa, the United Kingdom, and the United States, which held controlling interests in most of the mines in Ghana (table 2). Chiefly owing to weak gold markets, new investment in the foreign mining sector was limited in 2000 and 2001. Kaiser Aluminum & Chemical Corp. (Kaiser) of the United States maintained its longstanding 90% interest in the Valco aluminum smelter and was the major consumer of hydroelectric power generated by the state-owned Volta River Authority (VRA).

Commodity Review

Metals

Aluminum and Bauxite.—Valco's smelter at Tema Harbor was majority owned and operated by Kaiser (a wholly owned subsidiary of Kaiser Aluminum Corp.). Valco continued to deal with fluctuating operating levels, which resulted from the amount of power that it has been allocated by the VRA under a contract agreement that is valid until 2017. VRA power allocations have been restricted by droughts and low water levels in the Akosombo Dam. During 2000 and 2001, Valco operated an average of four potlines, or at an average 81% of capacity. Each potline represented approximately 20% of the plant's 200,000-metric-ton-per-year (t/yr) aluminum capacity. Owing to power shortages, Valco expected to operate only three potlines during 2002. In late 2000, Valco and the VRA reached an agreement that would provide for sufficient power to operate at least four of Valco's five potlines in 2001 and at least three and one-half potlines thereafter. By March 2002, however, the Parliament had yet to approve the agreement, and Kaiser was going to seek remedies from the Government. In its 2001 annual report, Kaiser announced that it filed for voluntary bankruptcy in United States courts because of liquidity and cash flow problems in late 2000 and early 2001. The company stated, however, that they did not expect the Valco operations to be affected because it had received authority from the bankruptcy court to fund Valco's cash requirements in the ordinary course of business (Kaiser Aluminum & Chemical Corp., 2002§).

Ghana Bauxite Co. Ltd. (GBC), which was majority owned by Alcan Aluminum Ltd. of Canada, operated the country's only bauxite mine at Awaso, which has been in production since 1941. As a result of recent investment and equipment upgrading in 2001, GBC increased production by 42% to 715,455 t/yr of salable bauxite.

Gold—Of the 11 major gold mines in operation in Ghana in 2001, the 5 largest accounted for a total of nearly 83% of the recorded gold output of the country—the Obuasi (24%), the Tarkwa (24%), the Damang (13.8%), the Bibiani (11.5%), and the combined Iduapriem/Teberebie Mine (9.3%). Gold production, by mine, from 1997 to 2001 is listed in table 3.

In 2001, Ashanti Goldfields Co. Ltd.'s corporate gold production from six mines in Ghana, Guinea, Tanzania, and Zimbabwe totaled 49,253 kilograms (kg), of which approximately 62% was from operations in Ghana compared with 66% in 2000. The decline from Ghana's total share in Ashanti's production was due to the closure of the high-cost Obuasi surface mining and leaching operations in Ghana, the opening of its 50% owned Geita Mine in Tanzania during 2000,

and the closure of the Ayanfuri Mine in Ghana in 2001. Ashanti's liquidity position improved in 2001 as it continued to restructure and pay down its debt that resulted from large hedging losses in late 1999. During 2001, outstanding debt was reduced to \$325.9 million from \$365.7 million in 2000. In January 2002, the company announced plans to restructure \$218.6 million in debt by refinancing \$164 million in loans and by converting nearly \$55 million to equity through the issuance of new shares. Combined with the increased cash flow from the Geita Mine, the company was returning to profitability (Ashanti Goldfields Co. Ltd., 2002, p. 18).

Production decreased by 7.5% at Ashanti's Bibiani Mine and by 18% at the Obuasi Mine following shutdown of surface operations at the latter in 2000. Exploration at the Obuasi Mine during 2001 intersected high-grade gold mineralization that included sections which assayed from 20 to 66 grams per metric ton (g/t) gold below the 1,520-meter (5,000-foot) level; this suggested the significant potential of the mine, which has been in production since 1897. With the acquisition of additional ore reserves from the Teberebie Mine, Ashanti increased the life expectancy of the Iduapriem Mine and increased production in 2001 by 23% to 6,380 kilograms per year (kg/yr) of gold. Ashanti announced plans to expand the capacity at Iduapriem/Teberebie during 2002 by upgrading the carbon-in-leach (CIL) plant to treat 4 million metric tons per year (Mt/yr) of ore from its present capacity of 2.9 Mt/yr of ore.

The expansion project will include a new semiautogenous grinding (SAG) mill, the conversion from CIL to carbon-in-pulp (CIP), and installation of a new primary crusher and overland ore conveyor from the Teberebie pits. At Bibiani, ore grades continued to exceed the reserve model. Metallurgical recovery, however, decreased to 83.7% from 86.7% in 2000 as more refractory ore was treated. A feasibility study was being conducted to evaluate the possible development of a trackless underground mine to access deeper ore resources at Bibiani. During 2001, a small deposit at Mpesetia was acquired that contained 933 kg of gold reserves, which will be trucked to Bibiani for treatment. At the end of 2001, Ashanti reported measured and indicated resources of 206.6 million metric tons (Mt) at an average grade of 4.2 g/t gold, of which underground measured and indicated resources at Obuasi accounted for 57.3 Mt at a grade of 10.1 g/t gold, at its four mines in Ghana. The total reported measured and indicated resources estimates represented more than 867 t or nearly 28 million ounces of contained gold. As of December 31, 2001, reported proved and probable ore reserves at its four mines in Ghana were 114.8 Mt at an average grade of 4.18 g/t gold, of which underground proved and probable reserves at Obuasi accounted for 42.3 Mt at a grade of 8.0 g/t gold (Ashanti Goldfields Co. Ltd., 2002, p. 22).

On the basis of Gold Fields Ltd. quarterly reports for calendar year 2001, the Tarkwa open pit heap-leach operation mine processed 14.55 Mt of ore that yielded an average of 1.13 g/t gold and a total of 16,393 kg of gold compared with 11,272 kg of gold for calendar year 2000. This 45% increase in production was attributed, in part, to the integration of Teberebie crushing and heap leach assets into Tarkwa operations during 2001 (Gold Fields Ltd., 2002§).

Gold Fields reported the following resources and reserves at its Tarkwa Mine, as of June 30, 2001, based on a gold price of \$285 per troy ounce and a cutoff grade of 0.5 g/t gold and including the recently acquired Teberebie resources. Near-surface measured, indicated, and inferred resources above a

cutoff grade of 5 g/t of gold at Tarkwa were estimated to be 340.4 Mt of ore at an average grade of 1.6 g/t gold for a total resource of 530,840 kg of contained gold, of which proven and probable reserves were estimated to be 131.2 Mt at an average grade of 1.6 g/t gold for a total resource of 213,430 kg of contained gold (Gold Fields Ltd., 2001\$).

In January 2002, Gold Fields completed the purchase of 90% of Abooso Goldfields Ltd. and its adjacent Damang Mine from Ranger Minerals Ltd. of Australia for approximately \$31 million and 4 million shares of Repadre Capital Corp. of Canada stock, which was valued at Canadian \$3.40 per share at the time of the agreement. The acquisition will add an additional 7,776 kg/yr of gold to Gold Fields' production capacity. The ownership of Gold Fields (Ghana) Ltd. and Abooso will be Gold Fields Ltd. of South Africa, 71.1%; Repadre, 18.9%, and the Government, 10%. As of June 30, 2001, Damang had resources of about 94,000 kg (3.03 million ounces) and reserves of about 47,000 kg (1.53 million ounces). Gold Fields planned a detailed exploration of the area between the two mines (Gold Fields Limited-Repadre Capital Corporation, 2002).

Production shown in table 3 for Damang was for calendar years 1998 to 2001. For Ranger Minerals' financial year that ended June 30, 2001, however, Abooso had milled 4.54 Mt of ore at an average grade of 2.42 g/t gold to yield 10,017 kg of gold on the basis of a 91.2% recovery rate. The 7% decrease in gold output from that of the 2000 financial year was attributed to a 2-week shutdown of the mill for maintenance. Revised mineral resources estimates as of June 30, 2001, which were based on a cutoff grade of 1.1 g/t for primary ore and 0.5 g/t for oxide ore was 41.6 Mt at an average grade of 2.26 g/t gold. The measured and indicated component of the mineral resource was estimated to be 30 Mt at an average grade of 2.23 g/t gold. Additional material that might be added to the identified resources had been located at several nearby deposits, such as the Kesi-Lima pits and the Rex prospect and in the Tomento-Amoanda areas. Pit optimization studies for the Damang resource, which were based on a gold price of \$300 per ounce, projected an end of mining in 2006, with completion of processing of then-remaining stockpiles 2 years later (Ranger Minerals Ltd., 2001).

Resolute Amansie Ltd., which was owned by Resolute Ltd. of Australia, operated the Obotan gold mine and CIL plant. Obotan is located near Manso-Nkran, which is 47 kilometers (km) west of Obuasi. With the depletion of near-surface oxide ore at the Adubiaso Hill section of the mine, Resolute Amansie installed a new secondary/tertiary crusher to treat harder primary ore found during 2000. With the operations main ore source at the Nkran pit nearing completion and the satellite deposit at Adubiaso proving erratic, gold production at Obotan for calendar year 2001 was 3,447 kg; this was a decrease of 19% from that of 2000 (Resolute Ltd., 2001).

In July 2001, Resolute agreed to purchase Abore Mining Company Limited (AMC) from Leo Shield Exploration Ghana Ltd. of Australia for "\$2.5 million cash payable on settlement plus an additional amount related to gold production from the Abore Mine of \$7.50 per ounce on gold produced, plus 25% of the amount by which the average spot price of gold per ounce for a month exceeds \$265 for the number of ounces produced in that month." The Abore gold deposit, which is located about 20 km north of Resolute's Obotan Mine, had a proved and probable reserve of 2.26 Mt at a grade of 1.9 g/t gold as of March 2000. Resolute intended to begin mining at Abore immediately and to treat the ore at its Obotan Mill. This will

deliver an expected 3,110 kg/yr of production and extend the life of operations at Obotan by approximately 12 months (Resolute Ltd., 2001).

Satellite Goldfields Ltd., which was owned by Glencar Mining plc. of Ireland through its Wassa Holdings Ltd. subsidiary, operated the Wassa gold open pit heap-leach project, which is about 35 km northeast of Tarkwa. In February 2001, the company announced plans to sell the mine as a going concern. Following poor metallurgical gold recovery from its heap-leach operations since the Wassa project was commissioned in 1999, recoveries in late 2000 and early 2001 began reaching levels projected at the time of the initial capital investment on a relatively consistent basis. The accumulated shortfall in production together with the continuing low gold price, however, meant that the project was unable to meet all its current scheduled debt repayments. Mining operations continued at reduced levels at Wassa until the end of October 2001 when they were suspended. Stacking of stockpiled ore was completed by the end of that month, and the operation has continued on a leaching only basis at the mine since then. During the first 10 months of the year, 2.1 Mt of ore at an average grade of 1.6 g/t was stacked. Gold production for 2001 was more than 2,182 kg of gold. In November 2001, Glencar announced that subject to completion of its due diligence and arrangement of finances, Golden Star Resources Ltd. of the United States would purchase the Wassa Mine. Golden Star intended to replace the leaching pads with a CIL plant to improve metallurgical recoveries. The sale was expected to be completed in July 2002 (Glencar Mining plc, 2002, p. 3-5).

During 2001, in addition to its proposed acquisition of the Wassa Mine, Golden Star continued to consolidate its resource position along the Ashanti structural trend. It increased its interest in Bogosu Gold Ltd. (BGL) to 90% from 70% by buying out its minority partner Anvil Mining NL of Australia. BGL operated the Bogosu Mine and CIL plant, which were located between Dunkwa and Prestea. In May 2001, Golden Star acquired the surface rights to the Prestea area from Prestea Gold Resources Ltd. (PGR) and Barnato Exploration Ltd. (Barnex) of South Africa. Initially, BGL was to acquire the surface mining rights and a 35% interest in PGR from PGR for a payment of \$4 million. In March 2002, however, the agreement was restructured as a joint venture between BGL and PGR, with BGL increasing its interest in PGR to 45% for an additional \$0.5 million payment. PGR retained its rights to the old Prestea underground mine below a depth of 200 m. On June 29, 2001, the Government granted Golden Star a new 30-year mining lease that covered surface mining rights in the Prestea area, which was adjacent and to the southwest of the Bogosu Mine. In September 2001, surface mining at the Bueschem deposit, which is located in the northern part of the Prestea area, began. Ore will be shipped to the Bogosu CIL plant for processing. In a separate agreement with Barnex, Golden Star acquired its option to the Prestea property in exchange for Golden Star shares that were valued at about \$3.3 million and payment to Barnex of a royalty of \$6.00 to \$16.80 per ounce, tied to the prevailing gold price, on the first 3,110 kg (1 million ounces) of gold produced at the Bogosu/Prestea operation. Oxide reserves at the known Prestea surface deposits were sufficient to supply ore to the Bogosu CIL plant through 2006. Following that, BGL was looking into a \$30 million investment to install a bio-oxidation (BIOX) plant to treat sulfide ore reserves. As of December 31, 2001, measured and indicated mineral resources for the combined Bogosu/Prestea property

were 28.5 Mt at a grade of 3.14 g/t gold, of which probable mineral reserves were 19.1 Mt at grade of 2.97 g/t. Of the 89,375 kg of gold contained in the mineral resources, approximately 18% was in oxide and transitional ores and the remainder in primary and refractory ores (Golden Star Resources Ltd., 2002, p. 4-7).

Akrokeri-Ashanti Gold Mines Inc. (AAGM) of Canada owned 85% of Bonte Gold Mines Limited (Bonte) and 90% of Jeni Gold Mining Limited (Jeni); both were Ghanaian subsidiaries. Gold was produced from alluvial mining of old flood plain and terrace sediments. Bonte's Esaase deposit was mined out by 1997, and operations shifted to the Jeni River property. During 2001, production by Bonte decreased slightly by 4% to 2,031 kg of gold as a result of an unexpected loss of fine-grained gold fractions in the sluice system. Extensive testing of Bonte Mine's processing plant indicated that a combination of Knelson concentrators and cyclones would solve the fine-grained gold recovery problem. The new concentrators were expected to be commissioned in April 2002, and completion of the cyclone upgrade was completed by June 2002. As of December 31, 2000, the Bonte reserves consisted of 2.8 million cubic meters of proven reserves that contained 3,255 kg of gold and 4.7 million cubic meters of probable reserves that contained 3,942 kg of gold. Bonte continued to evaluate the economic potential of 4 million cubic meters of gold-bearing gravels identified at the Jeni property during 2000 (Akrokeri-Ashanti Gold Mines, Inc., 2002a§).

In early 2000, AAGM completed its acquisition of a 90% interest in the Goldenrae Mining Company. The Goldenrae deposit, which is located west of Kibi, was mined for 15 months in the early 1990s and then closed. The Goldenrae property had two mining leases and a fully operational floating processing plant with the capacity to produce 780 kg/yr of gold. The two Goldenrae leases contain a stated proven and probable reserve estimated to be 4,043 kg of gold. An adjacent prospecting licenses for which AAGM has been granted an option has a stated reserve of 2,177 kg of gold. AAGM was evaluating the potential for reopening operations at Goldenrae during 2002 (Akrokeri-Ashanti Gold Mines, Inc., 2002b§).

In a major acquisition, Newmont Mining Corp. of the United States announced in November 2001 its plans to acquire Normandy Mining Ltd. of Australia and Franco-Nevada Mining Corp. Ltd. of Canada, which held a 20% interest in Normandy. The resulting company will be the largest gold producer [248,830 kg/yr (8 million ounces per year)] and holder of gold reserves [301,700 kg (97 million ounces)] in the world (Newmont Mining Corp., 2001). The acquisition was completed in February 2002. Its major holding in Ghana was Normandy's Yamfo-Sefwi project, which was located in the Yamfo-Sefwi greenstone belt in west-central Ghana near Sunyani and Kenyasi about 60 km east of the border with Côte d'Ivoire. Newmont lumped Yamfo-Sefwi mineral resources in the "other" category in its 2001 annual report. Normandy, however, had previously (as of June 30, 2000) reported mineral resources to be 42.2 Mt of measured resources at a grade of 2.3 g/t gold, 16.8 Mt of indicated resources at a grade of 2.2 g/t gold, and 16.7 Mt of inferred resources at a grade of 2.0 g/t gold. Normandy also held a 42.3% joint-venture interest in Moydow Mines International Inc.'s adjacent Area E (Ntotoroso) property where inferred resources were reported to be 14 Mt at a grade of 2.6 g/t gold. The two deposits have a combined gold content of 205,600 kg (6.61 million ounces). Normandy's 2000 feasibility study on the Yamfo-Sefwi project estimated that

capital costs of \$152 million would be required to develop 15 pits at Bosumkese, Kenyase, Subenso, and Yamfo and a treatment plant with an initial capacity of 3.5 Mt/yr, which would process oxide (40%) and sulfide (60%) ore. The plant flowsheet incorporated primary crushing, SAG, and ball milling followed by a CIL circuit. A feasibility study to incorporate Moydow's Ntotoroso deposit, which was based on toll processing of Ntotoroso ore at the Yamfo-Sefwi treatment plant and an increase in plant capacity to 5 Mt/yr of ore, was expected to be completed by mid-2001 (Normandy Mining Ltd., 2000, p. 15-17). In July 2001, Rank Mining Ltd., which was a 50-50 joint venture between Normandy and Moydow, was granted a 30-year Mining License on the Ntotoroso project (Moydow Mines International Inc., 2001). In its report for the third quarter of 2001, Moydow indicated that it would defer any decision on the development of these properties until the Newmont takeover of Normandy was completed.

Chirano Gold Mining Ltd., which was owned by Red Back Mining NL of Australia (95%), continued exploration drilling and feasibility studies during 2001 at its Chirano property, which was adjacent to the GBC bauxite mine at Awaso. In early 2001, Ashanti made an offer to buy Chirano, which was rejected by Red Back as too low. Ashanti was seeking the Chirano ore as feed for its nearby Bibiani plant, which was located 17 km to the north. The plant will run out of mine feed in late 2003. Subject to locating stand-alone financing or negotiating a better offer from Ashanti, Red Back concentrated on expanding the gold resource base with further exploration at Chirano in 2001. Revised indicated mineral resources, which were based on 1-g/t cutoff, a gold price of \$300 per ounce, and a 92% recovery, were reported to be 15.8 Mt at a grade of 2.3 g/t gold in seven prospects along 4 km of the Chirano Shear Zone at Akota North, Akota South, Obra, Paboase, Sariehu, Suraw, and Tano. Additional inferred mineral resources were estimated to be 5.66 Mt at a grade of 2.1 g/t gold. A 2001 prefeasibility study indicated a potential for developing a small project that would produce 3,515 kg/yr for 6.6 years at a capital cost of \$32 million (Red Back Mining NL, 2002, p. 4).

In other gold exploration activity, the Canadian joint venture of St. Jude Resources Ltd. and Fairstar Explorations Inc. continued work on its Hwini-Butre and South Benso concessions. The Hwini-Butre concession had a reported indicated mineral resource of 4.25 Mt at a grade of 4.11 g/t gold and an inferred mineral resource of 1.72 Mt at a grade of 3.01 g/t gold. Gold mineralization has been at the adjacent South Benso Concession, and further exploration will be conducted on this property during 2002 (St. Jude Resources Ltd., 2002, p. 10). Marine Mining Corp., which was a Canadian junior exploration company, held a 10,000-square-kilometer marine concession offshore for precious metal, industrial mineral and aggregate exploration. The 240-km-long by 40-km-wide concession runs approximately from Winneba to just past Axim and covers the offshore extensions of the Ashanti and the Kibi-Winneba structural belts and their drainage systems.

Manganese.—Ghana Manganese Company Limited's Nsuta-Wassaw open pit mine near Tarkwa was the only producer of manganese ore in Ghana. During 2001, production of manganese ore decreased by 9% to 813,329 t of manganese ore from 895,669 t in 2000 (table 1). The metal content of the manganese carbonate ore was between 32% and 34% manganese. Reinvestment in new equipment and rehabilitation of the export railroad from Nsuta to Takoradi Harbor have

allowed the company to double manganese exports since 1997.

Industrial Minerals

Cement.—Ghana Cement Works Ltd. (Ghacem) operated the country's only two clinker grinding plants at the port cities of Takoradi and Tema. Each plant had the capacity to produce 1.2 Mt/yr of cement by using imported clinker, gypsum, and limestone. During 1999, Heidelberg Zement AG of Germany acquired a 94.5% interest in Ghacem from Scancem International AG of Norway (60%) and the Government. The company operated essentially as a monopoly but has faced increasing competition from cement imports from Togo since 1999. During 2000 and 2001, Ghacem operated at about 80% of capacity. The mining industry accounts for about 10% of cement consumption, chiefly as a binder in gold heap-leach pads and CIL plants.

Diamond.—The majority of diamond was recovered by artisanal miners from alluvial and raised terrace gravel workings in the Birim Valley. On the basis of sales to the Precious Metals Marketing Corporation in 2001, artisanal output was reported to be 870,490 carats with an average sales value of \$21.26 per carat. Production from Ghana Consolidated Diamonds Ltd.'s Akwatia placer diamond mine was not available for 2001. Akwatia is located about half way between Accra and Kumasi and was the only formal operating diamond mine in Ghana.

Other Industrial Minerals.—Carmeuse Lime Products (Ghana) Ltd., which was owned by Carmeuse S.A. of Belgium, operated out of Sekondi and produced limestone and lime, as well as seashells, which were supplied to Ashanti for use in its BIOX gold-treatment plant at Obuasi. An estimated 20,000 to 30,000 people were involved in the small-scale production of industrial minerals, which included kaolin, limestone, salt, and sand and gravel.

Mineral Fuels

In 2001, GNPC produced an estimated 9,000 barrels per day (bbl/d) of crude oil from the Saltpond and the Tano oilfields. On the basis of exploration during the past 30 years, the offshore fossil fuel potential was the greatest for natural gas; no gas, however, was being produced. Several companies, which included Hunt Oil Co. of the United States in the Cape Three Points Southwest deepwater block and Nuevo Energy Co. of the United States (75%) and SK Corp. of Korea (25%) in the Cape Three Points East block and the Accra-Keta block, were exploring for offshore oil and gas during 2001. In July 2001, Nuevo abandoned its exploration well and relinquished its Accra-Keta block. Dana Petroleum plc of the United Kingdom held the rights to the Cape Three Points West block and the West Tano Contract Area. Dana announced the discovery of oil with a flow rate of 1,000 bbl/d on the West Tano Contract Area in March 2000 and was evaluating its commercial development potential during 2001. Other U.S. companies that were active in offshore exploration included Devon Energy Corp. in the offshore Volta River block and Andarko Petroleum Corp. in the Keta block. GNPC announced its plans for the Tano Fields Development and Power Project, which would add about 260 megawatts of additional electric power generation capacity fueled by offshore natural gas resources; this would be

accomplished by developing the Tano gasfields and distribution infrastructure at a cost of up to \$500 million (U.S. Energy Information Administration, 2001§).

Ghana's only petroleum-refining facility was the 45,000-bbl/d Tema oil refinery located outside of Accra. It was operated by Tema Oil Refinery (TOR) (a subsidiary of GNPC). The company primarily processed imported Bonny Light/Brass River crudes from Nigeria and produced a variety of refined products for domestic consumption and export. Unfavorable exchange rates and increased petroleum prices and imports weakened the ability of TOR to import oil. By March 2001, its debt had increased to \$350 million, which presented another economic problem to the newly elected Government (U.S. Energy Information Administration, 2001§).

In a major example of West African regional cooperation and coordinated economic planning, a plan was approved in August 1999 to construct the West Africa Gas Pipeline (WAGP), which would use Nigerian natural gas that has been flared to help solve the long-term energy needs of the neighboring states of Benin, Ghana, and Togo. By using Nigeria's more than 1.1 trillion cubic meters of natural gas reserves, a consortium led by Chevron Nigeria Ltd. committed to build the WAGP by 2002. The \$400 million project will involve the construction of an 800-km offshore gas pipeline from the Niger Delta to the west coast city of Effuasi, Ghana. The pipeline will supply an initial amount of 120 million cubic feet per day of gas to existing and planned powerplants in Benin, Ghana, and Togo. Cooperators in the WAGP Project included Nigerian National Petroleum Corporation, GNPC, Shell Petroleum Development Company, Société Togolese de Gaz, and SA Société Béninoise de Gaz (Chevron Nigeria Ltd., 1999§). Construction of the WAGP, which was originally scheduled to begin in 2001, has been delayed until engineering and environmental studies will be completed. A more extensive review of the energy sector is available at the U.S. Energy Information Administration Web site at URL: <http://www.eia.doe.gov/emeu/cabs/ghana2.html>.

Outlook

Despite a favorable political and investment climate, the prospects for continued development of the key mining sector of the Ghanaian economy were threatened by weak commodity prices, particularly for gold, and by high energy costs between 1999 and 2001. Weak gold and cocoa prices have reduced the foreign exchange generation capacity of the country and slowed the strong economy growth of the late 1990s. The return of the gold price to more than \$300 per ounce in early 2002 held promise for the revitalization of the gold sector, although a number of the small- and medium-sized gold mines were faced with depleting mineral resources and a limited remaining mine life. Owing to periodic droughts, domestic energy supply, especially hydroelectric power, has been a problem particularly for the aluminum industry and the expanding needs of the gold industry. Although new gas-fueled powerplant developments will help mitigate this problem, the long-term solution of Ghana's energy problems rested with implementation of the WAGP.

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TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/	1997	1998	1999	2000	2001
Aluminum:					
Bauxite, gross weight	504	442	355	504	715
Metal, smelter, primary	152	56	104	142	162
Arsenic, trioxide 3/	4,577	5,000 e/	7,000	-- e/	--
Cement, hydraulic 4/	1,700 e/	1,630	1,870	1,950	1,900
Diamond:					
Gem e/	664	649	544	736	700
Industrial e/	166	160	136	184	170
Total 5/	830	809	680	920 e/	870
Gold 6/	54,662	72,541	79,946	72,080	68,699
Manganese:					
Ore, processed	437	537	639	896	813
Mn content e/	149	172	204	287	260
Petroleum:					
Crude	2,600	2,190	2,190	2,555 r/	3,285
Refinery products: e/					
Liquefied petroleum gas	350	-- 7/	-- r/ 7/	625	625
Gasoline	3,300	1,460 7/	1,825 r/ 7/	5,850	5,850
Jet fuel	350	365 7/	365 r/ 7/	625	625
Kerosene	1,100	730 7/	730 r/ 7/	1,950	1,950
Distillate fuel oil	2,500	1,460 7/	2,190 r/ 7/	4,450	4,450
Residual fuel oil	700	1,460 7/	2,190 r/ 7/	1,250	1,250
Other including refinery fuel and losses	700	1,825 7/	730 r/ 7/	1,250	1,250
Total	9,000	7,300 7/	8,030 r/ 7/	16,000	16,000
Salt e/	50	50	50	50	50
Silver, content of exported dore e/	2,730 r/	3,630	3,950	6,100 r/	1,945
Steel, secondary, rebar e/	75 r/	75	75	75	75 e/

e/ Estimated; estimated data are rounded to no more than three significant digits. r/ Revised. -- Zero.

1/ Table includes data available through July 2002.

2/ In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are produced as are limestone and lime for processing of some gold ore and salt. Output of these commodities is not reported and information is inadequate to make reliable estimates of output levels.

3/ Bogosu Gold Ltd.'s gold ore roaster closed in 1996. Ashanti Goldfields Co. Ltd.'s Obuasi roaster closed in June 2000.

4/ All from imported clinker.

5/ Production, in thousand carats, includes that of Akwatia Mine (1997--300 (estimated); 1998--252; 1999--205; 2000--233; 2001--nil. Remainder are artisanal sales to the Precious Metals Marketing Corp. Estimates of unreported artisanal production not included.

6/ Does not include estimate of smuggled or undocumented production.

7/ Reported figure.

TABLE 2
GHANA: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	thousand metric tons	Volta Aluminum Co. Ltd. (Valco) (Kaiser Aluminum & Chemical Corp., 90%; Reynolds Aluminum Co., 10%)	Aluminum smelter at Tema	200.
Bauxite	do.	Ghana Bauxite Co. Ltd. (Alcan Aluminum Ltd., 80%; Government, 20%)	Bauxite mine at Awaso	1,000.
Cement	do.	Ghana Cement Works Ltd. (Heidelberg Zement AG of Germany, 94.5%)	Clinker grinding plant at: Takoradi	1,200.
Do.	do.	do.	Tema	1,200.
Diamond	thousand carats	Ghana Consolidated Diamonds Ltd. (Government, 100%)	Placer mine at Akwatia, in Birim Valley	360.
Gold	kilograms	Ashanti Goldfields Co. Ltd. [Depositary Nominee, Inc. (Ashanti), 36.1%; Lonmin, Plc., United Kingdom, 31.5%; Government, 19%; other private, 13.4%]	Obuasi underground mine (Surface mines closed mid-2000)	17,000.
Do.	do.	do.	Iduapriem/Teberebie Mine	9,000.
Do.	do.	do.	Bibiani Mine	5,000.
Do.	do.	do.	Ayanfuri Mine (closed early 2001)	1,800.
Do.	do.	Ashanti total capacity in Ghana		31,000.
Do.	do.	Abosso Goldfields Ltd. (Gold Fields Ltd., 71.1%; Repadre Capital Corp., 18.9%; Government, 10%)	Damang Mine near Tarkwa (acquired from Ranger Minerals Ltd. January 2002)	9,000.
Do.	do.	Prestea Gold Resources Ltd. (acquired by former Presta employees in 1999; underground rights below 200 meters)	Prestea underground mine (closed September 1998)	1,100.
Do.	do.	Bogosu Gold Ltd. (Golden Star Resources Ltd., 90%; Government, 10%)	Open pit mine at Bogosu (oxide mining phasing out in 2001)	3,100.
Do.	do.	do.	Prestea surface rights (acquired from Barnato Exploration Ltd. and Prestea Gold Resources Ltd. in 2001)	
Do.	do.	Bonte Gold Mines Limited (Akrokeri-Ashanti Gold Mines, Inc., Canada, 85%; Government, 10%; Buosiako Co. Ltd., Ghana, 5%)	Placer mine at Jeni River, about 40 kilometers southwest of Kumasi	1,100.
Do.	do.	Gold Fields (Ghana Ltd.) (Gold Fields Ltd., 71.1%; Repadre Capital Corp. of Canada, 18.9%; Government, 10%)	Tarkwa open pit mines and heap leach (Full capacity planned by 2003)	17,000.
Do.	do.	Prestea Sankofa Gold Ltd.	Prestea tailings retreatment operation	650.
Do.	do.	Resolute Amansie Ltd. [Resolute Ltd. (Australia), 90%; Government, 10%]	Obotan Mine 40 km northwest of Obuasi. Acquired Abore mine in 2001	3,100.
Do.	do.	Satellite Goldfields Ltd. [Wassa Holdings Ltd., 90% (of which Glencar Mining plc. of Ireland holds 66%); Government, 10%]	Wassa Mine, 30 km northwest of Tarkwa (Offered for sale to Golden Star Resources Ltd. in 2001)	3,730.
Limestone and lime		Carmeuse Lime Products (Ghana) Ltd. (Carmeuse SA of Belgium)	Sekondi	NA.
Manganese ore	thousand metric tons	Ghana Manganese Company Limited (Government, minority interest)	Open pit mine at Nsuta-Wassaw in Western Region	650 (processed ore).
Steel	do.	Ferro Fabrik	Steel mill at Tema (secondary)	20 (rod, rebar, and wire).
Do.	do.	Tema Steel Co., (subsidiary of Ghana Industrial Holdings Co.), (Government, 100%)	do.	25 (rebar).
Do.	do.	Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%)	do.	30 (rod, rebar, and wire).
Petroleum, crude	thousand barrels	Ghana National Petroleum Corp. (Government, 100%)	Saltpond and Tano Fields	3,500.
Petroleum products	do.	Tema Oil Refinery Limited (Government, 100%)	Refinery at Tema	16,500 (crude input).

NA Not available.

TABLE 3
GHANA: GOLD PRODUCTION BY COMPANY AND MINE

(Kilograms)

Company	Mine	1997	1998	1999	2000	2001
Abosso Goldfields Ltd.	Damang, open pit	--	8,421	9,446	9,881	9,420
Ashanti Goldfields Co. Ltd.	Ayanfuri, open pit 1/	1,807	1,440	1,382	1,130	358
Do.	Bibiani	--	4,719	8,146	8,513	7,871
Do.	Iduapriem/Teberebie, open pits 2/	4,560	4,828	5,092 r/	5,191	6,380
Do.	Asikam, alluvial (Midras Mining Ltd.) 3/	--	233	34	--	--
Do.	Obuasi, underground (open pit closed 2000)	26,687	27,537	23,113	19,937	16,437
AGC Total		33,054	38,757	37,767	34,771	30,688
Barnex (Prestea) Ltd.	Prestea, underground and surface rights 4/	1,011	600	894	--	--
Bogosu Gold Ltd. 5/	Bogosu, open pit	3,464	3,813	4,058 r/	3,379	2,735
Bonte Gold Mines Limited	Esaase and Jeni River, placer	879	1,093	1,515 r/	2,134	2,031
Dunkwa Continental Goldfields Ltd.	Dunkwa, placer	118	37	1	--	--
Gold Fields (Ghana) Ltd.	Tarkwa, underground	1,672	1,670	1,269	--	--
Do.	Tarkwa, open pit, 1998 startup	--	2,522	6,806	11,272	16,392
Obenemasi Gold Mines Ltd.	Konongo/Obenemasi, open pit	176	--	--	--	--
Precious Minerals Marketing Corp. 6/	Artisanal workings	3,331	1,873	2,302 r/	1,968	1,446
Prestea Sankofa Gold Ltd.	Prestea Sankofa, tailings 7/	626	467	373	371	--
Resolute Amansie Ltd.	Obotan, open pit	2,151	5,411	4,230 r/	4,199	3,447
Satellite Goldfields Ltd.	Wassa, open pit, 1999 startup 8/	--	--	2,712 r/	3,266	2,182
Teberebie Goldfields Ltd. 9/	Teberebie, open pit	8,180	7,877	8,573	839	--
Grand total		54,662	72,541	79,946	72,080	68,341

r/ Revised. -- Zero.

1/ Closed in early 2001.

2/ Includes production from Teberebie for 2001.

3/ Sold by Ashanti Goldfields Co. Ltd. in 1999 and closed in 2000.

4/ Surface rights acquired by Golden Star Resources Ltd. from Barnex (Prestea) Ltd. (Western Areas Ltd. of South Africa) in 2001 to be used to extend life of the adjacent Bogosu Mine. Prestea Gold Resources Ltd. will retain rights to old Prestea underground mine.

5/ Acquired by Golden Star Resources Ltd. (U.S.), 70%, and Anvil Mining NL (Australia), 20%, in 1999. Golden Star acquired Anvil's 20% interest in 2001.

6/ Includes 8 to 110 kilograms per year byproduct gold from Ghana Consolidated Diamonds Ltd.'s Akwatia Mine. Includes gold purchases from small-scale miners by Miramex and other licensed buying authorities.

7/ Acquired by Ashanti in purchase of SAMAX, Inc. in 1998; sold in 1999. Included in Ashanti's total for 1998.

8/ Acquired by Golden Star Resources Ltd. from Glencar Mining plc. and Moydow Mines International Inc. in November 2001 and placed on care and maintenance pending reappraisal.

9/ Acquired by Ashanti (ore reserves) and Gold Fields (heap leach facilities) from Pioneer Group Inc. in mid-2000.

Sources: Ghana Minerals Commission, Ghana Chamber of Mines, and company reports.