

THE MINERAL INDUSTRY OF

GHANA

By George J. Coakley

The Republic of Ghana covers an area of 238,540 square kilometers (km²) on the coast of West Africa and supported a population of approximately 20.4 million in 2002. Ghana is primarily an agricultural economy; this sector accounted for about one-third of the gross domestic product (GDP) and more than 50% of the labor force. Formal mining and quarrying accounted for about 25% of the GDP and employed about 14,000 workers, or less than 1% of the labor force. 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. 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 GDP, which was based on purchasing power parity for 2002, was \$42.5 billion with an estimated real growth rate of 5.8%. GDP per capita was estimated to be \$2,100 (U.S. Central Intelligence Agency, 2003¹). Following a more than 160% depreciation against the U.S. dollar from its 1999 average to the end of 2000, the Ghanaian cedi (C) has stabilized somewhat, and declined by only 10% to C7,947 for 2002 from an average rate of C7,062 to the U.S. dollar for 2001. Overall inflation declined to 14.8% in 2002 from 32.9% in 2001.

Government Policies and Programs

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 Investment Promotion Act, 1994 (Act 478); the Additional Profits Tax Law, 1985 (PNDCL 122); the Minerals Commission Law, 1986 (PNDCL 154); the Minerals (Royalties) Regulations, 1987 (LI 1349); and the Environmental Protection Agency Act, 1994 (Act 490), and the Environmental Assessment Regulations, 1999, and as amended 2002. 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 Corporation (GNPC), which is empowered to undertake petroleum exploration and production on behalf of the Government,

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

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 was 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 sector 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 the Government and industry. 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.

Production and Trade

Production of major mineral commodities is listed in table 1. Of the major mineral commodities, bauxite, gold, and manganese saw modest increases that ranged from 1% to 5% for 2002, and aluminum and diamond production dropped 19% and 12%, respectively. Despite the significant increase in the gold price, gold production was constrained by the depletion of some mine resources and the restructuring of several operations. Between 1999 and 2002, bauxite and manganese production increased by 93% and 78%, respectively; both benefited from an injection of new capital and the rehabilitation of the railroad lines from Akwatia and Nsuta to the export harbor at Takoradi. The decline in aluminum is directly related to the shortage of hydropower available to the smelter at Tema.

For 2002, the country had a \$1.1 billion merchandise trade deficit, which was based on total exports of \$1.87 billion and total imports of \$2.97 billion. The increased cost of imported petroleum products negated the increased commodity prices for cocoa and gold. The principal exports were gold (\$689

million), cocoa (\$463 million), and timber (\$182 million). Total mineral exports accounted for \$915 million, or 49% of all merchandise export trade. Gold export revenues were based on an average sales price of \$309 per troy ounce of gold for 2002 compared with export revenues of \$618 million and an average gold price of \$272 per troy ounce in 2001. Other mineral commodity exports in 2002 included primary aluminum (\$158 million), manganese (\$32 million), diamond (\$21 million), and bauxite (\$15 million). Petroleum imports were valued at \$508 million and accounted for 19% of total merchandise imports during 2002. 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 (Dordogne, 2003§; International Monetary Fund, 2003§). According to the Ghana Minerals Commission (2003§), approximately 7% of gold production, which was valued at \$48.9 million, and 72% of diamond production, which was valued at \$16 million, came from artisanal mining. Mining, quarrying, and associated support services provided \$38.4 million in Government revenues, of which \$19.3 million came from royalties and nearly \$3 million from income and corporate taxes.

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. As listed in table 2, most major mining activity is now privately owned and operated.

The increase in the gold market price to about \$350 per ounce during 2002 was expected to stimulate new exploration and development in this sector during the next few years. Kaiser Aluminum & Chemical Corp. of the United States maintained its longstanding 90% interest in Volta Aluminum Co. Ltd.'s (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 2002, Valco operated at an average 66% of capacity. Each potline represented approximately 20% of the plant's 200,000 metric-ton-per-year (t/yr) aluminum capacity. During 2002 and 2001, Valco operated an average of three and four potlines, respectively. The amount of power made available to Valco by VRA depended in large part on the level of the lake that is the primary source for

generating the hydroelectric power used to supply the smelter. The level of the lake is primarily a function of the level of annual rainfall and the alternative (non-Valco) uses of the power generated as directed by VRA. As of February 28, 2003, the lake level was at a 10-year low. During late 2000, Valco, the Government of Ghana, and VRA reached an agreement, which was subject to Parliamentary approval, that would provide sufficient power for Valco to operate at least three and one-half of its five potlines through 2017. Parliamentary approval, however, was not received, and in March 2002, the Government reduced Valco's power allocation, which forced Valco to curtail one of its four operating potlines. In January 2003, Valco's power allocation was further reduced, which resulted in the curtailment of two additional operating potlines. As of February 28, 2003, Valco was operating only one of its five potlines. No assurances could be given, however, that Valco would continue to receive sufficient power to operate the one potline. The company met with the Government and VRA and anticipated that such discussions would continue in respect of the current and future power situations. Valco had objected to the power curtailments and expected to seek appropriate compensation from the Government. In addition, Valco and Kaiser filed for arbitration with the International Chamber of Commerce in Paris against the Government and VRA (Kaiser Aluminum & Chemical Corp., 2003§).

Ghana Bauxite Co. Ltd. (GBC), which was majority owned by Alcan Aluminum Ltd. of Canada, operated the country's only bauxite mine at Awaso; the mine has been in production since 1941. GBC produced a gibbsite form of bauxite that was marketed for chemical uses rather than for conversion to alumina. As a result of recent investment and equipment upgrading in 2001 and 2002, GBC increased production by 36% to 683,654 t/yr of bauxite in 2002 compared with that of 2000 (Ghana Minerals Commission, 2003§).

Gold.—With mine closures and consolidation of the industry, two companies accounted for about 80% of gold production during 2002. Ashanti Goldfields Co. Ltd. accounted for 43.4% of gold production from its Bibiani, Iduapriem/Teberebie, and Obuasi Mines, and Gold Fields (Ghana) Ltd. accounted for 37.2% of gold production from its Tarkwa and newly acquired Damang Mines. Gold production from 1998 to 2002 is listed in table 3.

In 2002, Ashanti's corporate gold production from six mines in Ghana, Guinea, Tanzania, and Zimbabwe totaled 50,447 kilograms (kg), of which approximately 59% was from operations in Ghana compared with 62% in 2001. Increased production at Obuasi was offset by 4% and 10% declines in output at the Bibiani Mine and the combined Iduapriem/Teberebie operation, respectively. Lost production at the Iduapriem/Teberebie Mine was attributed to a fire and maintenance problems at its carbon-in-leach (CIL) plant. With the successful refinancing of its outstanding debt during 2002 and its highest earnings level in 5 years, Ashanti was in a position to focus its capital resources on new exploration and development with a concentration on the area around its existing operations. Its debt level was reduced to \$257 million from \$326 million during the year. Major projects

included exploration of the Obuasi deep levels mineralization and expansion of the processing plant at Iduapriem, which was to be completed in 2003. The potential for reserves in the Obuasi Deeps was being evaluated down to 3,000 meters (m), which was some 1,500 m below the base of the current mine infrastructure. Ashanti mined 2.42 million metric tons (Mt) of ore at a grade of 7.48 grams per metric ton (g/t) from underground operations at Obuasi and 368,000 metric tons (t) at a grade of 2.71 g/t from a new open pit operation at the Homasi concession, which is located 16 kilometers (km) to the north of Obuasi. The Oxide Treatment Plant was recommissioned to process the Homasi ores; this yielded 727 kg of gold in 2002. The Sulfide Treatment Plant, which used the BIOX (bio-oxidation) process, treated 2.35 Mt of underground ore at a grade of 7.53 g/t to yield 14,661 kg of gold. The balance of Obuasi production (1,315 kg of gold) came from the retreatment of tailings (Ashanti Goldfields Co. Ltd., 2003).

Production at the Bibiani Mine was affected by harder ore and lower metallurgical recoveries. Bibiani treated 2.56 Mt of ore at a grade of 3.72 g/t gold to yield 7,540 kg of gold. A feasibility study to evaluate the possible development of a trackless underground mine to access deeper ore resources at Bibiani was completed during the year. Bibiani also began mining the small Mpasetia deposit, which is located northeast of the Bibiani concession; the ore was trucked to Bibiani for processing. Expansion of the CIL plant at Iduapriem/Teberebie Mine to treat 4.5 million tons per year (Mt/yr) of ore from its present capacity of 2.8 Mt/yr of ore was expected to be completed early in 2003. The expansion was expected to increase production capacity to about 8,800 kilograms per year (kg/yr) of gold. Gold production during 2002 included 4,595 kg from the CIL plant and 1,166 kg from heap-leach operations (Ashanti Goldfields Co. Ltd., 2003).

At the end of 2002, Ashanti reported measured and indicated resources at its three mines in Ghana of 191.6 Mt at an average grade of approximately 4.4 g/t gold, of which underground measured and indicated resources at Obuasi accounted for 96.7 Mt at a grade of 7.1 g/t gold. The total reported measured and indicated resources estimates represented more than 852 t, or about 852,200 kg (27.4 million ounces) of contained gold. As of December 31, 2002, reported proved and probable ore reserves at its three mines in Ghana were 121.2 Mt at an average grade of approximately 3.96 g/t gold, of which underground proved and probable reserves at Obuasi accounted for 60.8 Mt at a grade of 6.1 g/t gold (Ashanti Goldfields Co. Ltd., 2003, p. 26).

On January 24, 2002, Gold Fields completed the purchase of 90% of Abosso Goldfields Ltd. and its adjacent Damang Mine from Ranger Minerals Ltd. of Australia for approximately \$213 million. The acquisition will add about 9,000 kg/yr of gold to Gold Fields' production capacity until the expected end of its mine life in 2006. Following the purchase, Gold Fields bought down Abosso's 420,000-ounce gold hedge position to retain its corporate position of not participating in gold hedging. Gold Fields and Abosso will be owned by Gold Fields Ltd. of South Africa (71.1%), Repadre Capital Corporation of Canada (18.9%), and the Government (10%) (Gold Fields Ltd., 2002§).

According to Gold Fields Ltd.'s quarterly reports for calendar year 2002, the Tarkwa open pit and heap-leach operation processed 15.13 Mt of ore that yielded an average of 1.07 g/t

gold and a total of 16,283 kg of gold compared with 16,393 kg of gold for calendar year 2001. For the 11 months (February-December) that it owned the Damang Mine in 2002, Gold Fields Ltd. reported milling 4.3 Mt of ore that yielded 8,874 kg of gold (Gold Fields Ltd., 2003a§).

Gold Fields Ltd. reported the following mineral resources and reserves as of June 30, 2003, based on a gold price of \$325 per troy ounce. At Tarkwa, resources were estimated to be 472 Mt at a grade of 1.5 g/t, of which reserves were 232 Mt at a grade of 1.3 g/t gold. At Damang, resources were 27.9 Mt at a grade of 1.7 g/t, of which reserves were reported to be 17.3 Mt at a grade of 1.7 g/t gold. Contained gold in the combined mines amounted to 74,120 kg (23.83 million ounces) of resources and 33,436 kg (10.75 million ounces) of reserves (Gold Fields Ltd., 2003b§).

Resolute Amansie Ltd., which was owned by Resolute Ltd. of Australia, operated the Obotan gold mine and CIL plant. The depleted Obotan Mine was closed at the end of 2001, with production extended by 1 year at the Abore Mine, which Resolute acquired from Leo Shield Exploration Ghana Ltd. of Australia in July 2001. Ore from the Abore gold deposit, which is located about 20 km north of Resolute's Obotan Mine, was shipped to the Obotan mill and CIL plant for treatment. In 2002, 3,118 kg of gold was recovered from Abore prior to its closure. The Obotan CIL plant was sold to Golden Star Resources Ltd. of the United States.

Golden Star was positioning itself to become the third largest gold producer in Ghana through its acquisitions of the Bogosu (1999) and Prestea (2001) Mines and, in September 2002, of a 90% interest in the Wassa Mine. The Wassa gold open pit and heap-leach project, which is located about 35 km northeast of Tarkwa, was acquired from Satellite Goldfields Ltd., which was owned by Glencar Mining plc. of Ireland through its Wassa Holdings Ltd. subsidiary. The acquisition funding arrangements for Wassa allowed Golden Star "to: (i) acquire, at a discount of 27.5%, approximately \$2.2 million of the \$4 million debt facility put in place to fund the initial acquisition payment, and (ii) convert 100% of the \$5 million debt facility put in place to fund the deferred purchase payment into a gold production linked payment. The gold production payment will be equal to \$8 per ounce on future production from Wassa, up to a cap equal to \$5.5 million" (Golden Star Resources Ltd., 2002§).

Because gold recovery was very poor at the Wassa heap-leach operation, the operation was closed in 2002. Golden Star will convert it to a CIL processing plant to retreat the heap-leach material and reopen the mine in 2004 at a rate of 2,333 kg/yr of gold; this will increase production to 4,666 kg/yr in 2005.

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 and 90% of Goldenrae Mining Co.; both were Ghanaian subsidiaries. During 2002, the 29% decline in production by Bonte at its Jeni River alluvial

mining operation to 1,432 kg of gold was attributed to delays in construction of its new gold recovery system, which came onstream in September, and an extended harsh rainy season. As of December 31, 2002, the Bonte Mine had proven and probable reserves of 1,220 kg plus additional explored material of 1 million cubic meters that contained 866 kg of gold. The company expected to add to its reserves through additional exploration in 2003. Goldenrae held two mining leases (Kwabeng and Pameng) west of Kibi, which held proven and probable reserves of 4,043 kg of gold, and three surrounding prospecting leases, one of which had a reported reserve of 2,177 kg of gold. The average grade of the reserves ranged from 0.74 to 0.77 gram per cubic meter. The Goldenrae property had a fully operational floating processing plant with the capacity to produce 780 kg/yr of gold (Akrokeri-Ashanti Gold Mines, Inc. 2003§).

In February 2002, Newmont Mining Corp. of the United States completed its acquisition of Normandy Mining Ltd. of Australia and Franco-Nevada Mining Corp. Ltd. of Canada, which held a 20% interest in Normandy. Its major holdings in Ghana were Normandy's Yamfo-Sefwi project, which was located in the Yamfo-Sefwi greenstone belt in west-central Ghana near Kenyasi and Sunyani about 60 km east of the border with Côte d'Ivoire, and Akyem, which was an exploration property west of Kibi. Newmont had an 85.6% equity interest in the Yamfo-Sefwi project, which was renamed the Ahafo Project, where its share of reserves were reported to be 102,640 kg (3.3 million ounces). Newmont held an 85% interest in the Akyem Project and reported the first reserve calculation to be 49,770 kg (1.6 million ounces) of equity gold. The company budgeted \$5 million for 2003 to expand reserves and to evaluate development options for both projects. A development decision was expected by yearend 2003 (Newmont Mining Company, 2003§). As part of the Normandy acquisition, Newmont also acquired a 42.3% joint-venture interest in Moydow Mines International Inc.'s adjacent Area E (Ntotoroso) property. Negotiations between Newmont and Moydow for Newmont to acquire the remaining shares in the Ntotoroso property continued into 2003.

Chirano Gold Mining Ltd., which was owned by Red Back Mining NL of Australia (95%), was working on the development of the Chirano property, which is located adjacent to the GBC bauxite mine at Awaso. A bankable feasibility study was expected to be completed by March 2003. The study was based on proven and probable gold reserves estimated at a \$300 per ounce gold price and a 0.8 g/t cutoff at 16.1 Mt at a grade of 2.1 g/t gold. Open pit optimization and gold price sensitivity studies show that the measured, indicated, and inferred resources changed from 16.1 Mt at a grade of 2.2 g/t at a \$300 per ounce gold price to 25.8 Mt at a grade of 2 g/t at a \$400 per ounce gold price. The feasibility study was based on treating 2 Mt/yr of ore from several deposits at a central CIL plant. Although the Chirano property is located primarily (80%) within the Tano Suraw Productive Forest Reserve, the Government granted Red Back a mining lease for the Chirano project in February 2003 following an environmental impact review (Red Back Mining NL, 2003a, b).

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 was located at the adjacent South Benso Concession, and further exploration was conducted on this property during 2002 (St. Jude Resources Ltd., 2002§).

Marine Mining Corp., which was a Canadian junior exploration company, held a 10,000 km² marine concession offshore for precious metals, industrial minerals, and aggregate exploration. The 240-km-long by 40-km-wide concession ran approximately from Winneba to just past Axim and covered the offshore extensions of the Ashanti and Kibi-Winneba structural belts and their drainage systems. During 2002, Marine Mining received an Environmental Protection Agency permit to conduct offshore exploration operations and was preparing two land sites to receive and process samples. The company was seeking additional financing to pursue exploration and dredging operations (Marine Mining Inc., 2003§).

Manganese.—Ghana Manganese Company Limited's (GMC) Nsuta-Wassaw open pit near Tarkwa was the only producer of manganese ore in Ghana. During 2002, production of manganese ore increased by 5% to 1.14 Mt of manganese ore compared with 1.08 Mt in 2001. The metal content of the manganese carbonate ore was between 32% and 34% manganese. Investment in new equipment and rehabilitation of the export railroad from Nsuta to Takoradi Harbor allowed the company to increase manganese production by 160% between 1997 and 2002. During 2002, GMC added to their mining fleet, which now included seven articulated dump trucks and three off-highway trucks.

Industrial Minerals

Cement.—Ghana Cement Works Ltd. (Ghacem), which was controlled by Heidelberg Zement AG of Germany (94.5%), operated the country's only two clinker-grinding plants at Takoradi and Tema. Each plant had the capacity to produce 1.2 Mt/yr of cement by using imported clinker, gypsum, and limestone. The mining industry accounted for about 10% of cement consumption chiefly as a binder in gold heap-leach pads and CIL plants.

Diamond.—The majority (72%) of diamond production was recovered by artisanal miners from what was long thought to be alluvial and raised gravel terraces in the Birim Valley. On the basis of sales to the Precious Metals Marketing Corporation in 2002, artisanal output was reported to be 693,493 carats with an average sales value of about \$23 per carat. The only commercial production, which amounted to 267,778 carats in 2002, came from Ghana Consolidated Diamonds Ltd.'s (GCD) Akwatia placer diamond located about half way between Accra and Kumasi. The Divestiture Implementation Committee reopened bidding for the privatization of GCD; completed

bids will be due by September 30, 2003. Available reserves distributed over 240 km² along the Brim River valley were estimated to be 14 million carats of proven reserves at an average grade of 1 carat per cubic meter, 4.6 million carats of probable reserves, and 30 million carats of possible reserves in addition to associated fine gold (Divestiture Implementation Committee, undated§). Recent fieldwork by researchers from the New Mexico Institute of Mining & Technology found evidence to support the conclusion that Akwatia is a residual, not alluvial, deposit with the diamond-bearing soils weathered in-place. The soils show no sign of transport and grade into diamond-bearing bedrock of actinolite/tremolite schist with a composition that resembles komatiite or boninite-type volcanic rocks, which are coeval or intruded into Proterozoic Birimian metasediments. Akwatia is one of the oldest known diamond deposits in the world (Canales and Norman, 2003§).

Other Industrial Minerals.—Carmeuse Lime Products (Ghana) Ltd., which was owned by Carmeuse S.A. of Belgium, operated out of Sekondi and produced limestone, lime, and 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 2002, GNPC produced an estimated 7,000 barrels per day (bbl/d) of crude oil from the Saltpond and 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 yet being produced. The U.S. Energy Information Administration (EIA) reported petroleum reserves at yearend 2002 to be 16.2 million barrels and natural gas reserves to be 23.8 billion cubic meters. According to the EIA, Saltpond Offshore Producing Ltd. (SOPL), which was owned by Lushann-Etermit of the United States (60%) and the GNPC (40%), began redevelopment of the Saltpond offshore oilfield and gasfields, which had been shut down since 1985. Redevelopment of Saltpond may include the building of a pipeline to take associated gas from field to shore for domestic use. Dana Petroleum plc of the United Kingdom announced on October 18, 2002, that a second well on the West Tano block had been successful. Drilling of several prospects in the deepwater portions of the block will begin in late 2003. In August 2002, Devon Energy Corp. of the United States and EnCana of Canada signed an agreement with GNPC to explore for hydrocarbons offshore southeastern Ghana in the Keta Basin. The companies will invest \$56 million in seismic research and exploration drilling. Devon intended to test drill on the Keta block by mid-2003. Vanco Energy Co. of the United States also signed an exploration agreement with the Government in August 2002. Vanco Energy said it planned to invest \$30 million to explore for oil on the Cape Three Points Deepwater block. In August 2002, Ghana signed production agreements with First Oil Expro Ltd. of the United Kingdom for the development

of its Tano (North and South) offshore oilfields and natural gasfields. Gas from the fields will power turbines mounted on barges in the Effasu Lagoon. North Tano will be developed first and could supply 736 million cubic meters per day to Effasu, where a gas-processing plant will be built adjacent to the 134-megawatt (MW) power-generation barge by the end of 2003. South Tano is farther offshore, in deeper water, and will come onstream later. When onstream, gas deliveries will rise to 1.7 billion cubic meters per day, and generating capacity at Effasu/Mangyea is expected to increase to 270 MW. The South Tano field should also boost oil production from both fields to 3,000 bbl/d (U.S. Energy Information Administration, 2003§).

Outlook

The gold sector was going through a transitional phase of mine closures and corporate consolidations, which was expected to last through 2005; as a result, production dropped to as low as 60 t/yr of gold. Stimulated by rising gold commodity prices and the infusion of new capital by AngloGold, Newmont, and Golden Star Resources over the next several years, gold production is expected to increase to 83 to 84 t/yr by 2009; this could consolidate Ghana's position as the second largest producer in Africa. Recent reinvestment and rehabilitation of bauxite and manganese mining operations and the proposed privatization of the State diamond mining company suggested that the mining sector would be a significant component of the economy for at least the next decade. Although still in early development stages, the development of offshore natural gas resources and the completion of the West African Gas Pipeline will be key longer term factors in supplying the energy needed to support increased industrial development in Ghana, which will reduce dependency on high-cost petroleum imports and on erratic hydroelectric power supply.

References Cited

- Ashanti Goldfields Co. Ltd., 2003, Annual report 2002: Accra, Ghana, Ashanti Goldfields Co. Ltd., March, 72 p.
- Barning, Kwasi, ed., 1997, Industrial mineral resources of Ghana: Ghana Minerals Commission, 94 p.
- Golden Star Resources Ltd., 2002, Annual report—2001: Denver, Colorado, Golden Star Resources Ltd., March, 90 p.
- Red Back Mining NL, 2003a, Chirano gold project—Ore reserve statement, announcement: Perth, Australia, Red Back Mining NL, January 16, 2 p.
- Red Back Mining NL, 2003b, Chirano gold project Ghana—Mining lease approval and debt finance, announcement: Perth, Australia, Red Back Mining NL, February 14, 2 p.

Internet References Cited

- Akrokeri-Ashanti Gold Mines, Inc., 2003, Annual report 2002, accessed July 31, 2003, at URL http://www.aagm.com/documents/AAGM_AR02.pdf.
- Canales, D.G., and Norman, D.I., 2003 (November 3), The Akwatia diamond field, Ghana, West Africa—Source rocks, accessed November 22, 2003, at URL http://gsa.confex.com/gsa/2003AM/finalprogram/abstract_63618.htm.
- Divestiture Implementation Committee, [undated], Privatisation of state-owned enterprises—Ghana Consolidated Diamonds Limited, accessed November 11, 2003, at URL <http://www.mincomgh.org/DIC%20GCD%20AD.pdf>.

Dordogne, C. K., 2003 (April 23-25), Ghana, Country Report, accessed September 22, 2003, at URL <http://www.chass.utoronto.ca/link/meeting/ctryrep/ghana0304.htm>.

Ghana Minerals Commission, 2003, Production statistics, accessed April 9, 2003, at URL http://www.mincomgh.org/facts_and_fig/production_stats.html.

Gold Fields Ltd., 2002, Quarterly results for quarter ended 31 March 2002, accessed May 5, 2002, at URL http://www.goldfields.co.za/Investor/Quarterly_Reports/FY_2002/March_2002/pdf/gf_march02_qrt.pdf.

Gold Fields Ltd., 2003a, Quarterly history (.xls)—Quarterly results for quarter ended 30 June 2003, accessed October 22, 2003, at URL http://www.goldfields.co.za/Investor/Quarterly_Reports/FY_2003/June_2003/default_excel.htm.

Gold Fields Ltd., 2003b (September 8), Section 5. Mineral reserves and resources, Annual Report for the Financial Year Ending June 30, 2003, accessed August 28, 2003, at URL http://www.goldfields.co.za/Investor/Annual_Reports/FY_2003/gf_ar03/ar_03/pdf/section5.pdf.

Golden Star Resources Ltd., 2002 (September 16), Golden Star completes acquisition of Wassa, Press Release, accessed September 20, 2002, at URL <http://www.gsr.com/News/091602/htm>.

International Monetary Fund, 2003 (May), Ghana—Selected issues and statistical appendix, Country Report No. 03/134, accessed September 9, 2003, at URL <http://www.imf.org/external/pubs/cat/longres.cfm?sk=16556.0>.

Kaiser Aluminum & Chemical Corp., 2003 (March 31), Form 10-K for 2002 to U.S. Securities and Exchange Commission, accessed July 22, 2003, at URL <http://www.sec.gov/Archives/edgar/data/54291/000005429103000003/0000054291-03-000003-index.htm>.

Marine Mining Inc., 2003 (March 5), Marine mining at the PDAC, Press Release, accessed January 5, 2004, at URL <http://marinemining.com/news/news.html>.

Newmont Mining Corp., 2003 (March 5), Annual report, accessed November 30, 2003, at URL <http://www.newmont.com/en/investor/releases/media/newmont/2002NEM-10KWrap.pdf>.

St. Jude Resources Ltd., 2002, Quarterly and yearend report for the three months and nine months period ended October 31, 2002, accessed November 30, 2003, at URL http://www.stjudegold.com/pdf/SJD_QuarterlyRptOct31_2002.pdf.

U.S. Central Intelligence Agency, 2003, Ghana, World Factbook, accessed September 3, 2003, at URL <http://www.cia.gov/cia/publications/factbook/geos/gh.html#Econ>.

U.S. Energy Information Administration, 2003 (June), Economic Community of West African States, Country Analysis Briefs, accessed August 1, 2002, at URL <http://www.eia.doe.gov/emeu/cabs/ghana.html>.

Major Sources of Information

Environmental Protection Agency—Ghana

Executive Director
P. O. Box M.326
91 Starlets Road
Accra, Ghana
Telephone: 233-21-664697/8
Fax: 233-21-662690
E-mail: epaed@africaonline.com.gh
Internet: <http://www.epa.gov.gh>

Geological Survey Department

P.O. Box M 80
Accra, Ghana
Telephone: 233-21-228093

Ghana Chamber of Mines

P.O. Box 991
Minerals House #10
6th Street, Airport
Accra, Ghana
Telephone: 233-12-760652 or 761893
Fax: 233-12-760653
E-mail: chamine@ghana.com
Internet: <http://www.ghanachamines.com>

Ghana National Petroleum Corp.

Petroleum House
Private Mail Bag
Tema, Ghana
Telephone: 233-22-206020 or 204654
Fax: 233-22-232039 or 206088
E-mail: gnpc@ghana.com
Internet: <http://www.gnpc.com.gh>

Minerals Commission

P.O. Box M 248
Plot #9, Switchback Road
Residential Area—Cantonments
Accra, Ghana
Telephone: 233-21-771318 / 773053 / 772783
Fax: 233-21-773-324
E-mail: mincom@mincomgh.org
Internet: <http://www.mincomgh.org>

Mines Department

P.O. Box 3634
Accra, Ghana
Telephone: 233-21-776802
Fax: 233-31-24344 (Takoradi office)

Ministry of Mines and Energy

P.O. Box 40
Stadium, Accra, Ghana
Telephone: 233-21-667151-3, 667090
Fax: 233-21-668262

Precious Minerals Marketing Company Ltd.

Diamond House, Kinbu Road
P.O. Box M. 108
Accra, Ghana
Telephone: 233-21-664931-4
Fax: 233-21 662586
E-mail: pmmc@ghana.com
Internet: <http://www.pmmcghana.com>

Other Publication

Kesse, G.O., 1985, The mineral and rock resources of Ghana: Rotterdam, A.A. Balkema, 610 p.

TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES ¹

(Thousand metric tons unless otherwise specified)

Commodity ²	1998	1999	2000	2001	2002
Aluminum:					
Bauxite, gross weight	442	355	504	678 ^r	684
Metal, smelter, primary	56	137	137 ^r	144 ^r	117
Arsenic, trioxide ³ metric tons	5,000 ^e	7,000	-- ^e	--	--
Cement, hydraulic ⁴	1,630	1,870	1,950	1,900	1,900
Diamond:					
Gem ^e thousand carats	760 ^r	545	700 ^r	936 ^r	770
Industrial ^e do.	163 ^r	137	178 ^r	234 ^r	193
Total ⁵ do.	823 ^r	682	878 ^r	1,170 ^r	963
Gold ⁶ kilograms	72,541	79,946	72,080	68,699	69,707
Manganese:					
Ore, processed	384 ^r	639	896	1,077 ^r	1,136
Mn content ^e	123 ^r	204	287	344 ^r	363
Petroleum:					
Crude thousand 42-gallon barrels	2,190	2,190	2,555 ^r	3,285	3,300 ^e
Refinery products: ^e					
Liquefied petroleum gas do.	--	--	-- ^{r,7}	--	625
Gasoline do.	1,460	1,825	2,190 ^{r,7}	2,190	5,850
Jet fuel do.	365	365	730 ^{r,7}	730	625
Kerosene do.	730	730	365 ^{r,7}	365	1,950
Distillate fuel oil do.	1,460	2,190	2,555 ^{r,7}	2,555	4,450
Residual fuel oil do.	1,460	2,190	1,825 ^{r,7}	1,825	1,250
Other including refinery fuel and losses do.	1,825	730	730 ^{r,7}	730	1,250
Total do.	7,300	8,030	8,390 ^{r,7}	8,390	16,000
Salt ^e	125 ^r	125 ^r	150 ^r	68 ^r	99
Silver, content of exported dore kilograms	3,630 ^e	3,950 ^e	6,101 ^r	1,945 ^r	2,129
Steel, secondary, rebar ^e	75	75	75	75	75

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^rRevised. -- Zero.

¹Table includes data available through December 2003.

²In 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.

³Ashanti Goldfields Co. Obuasi roaster closed in June 2000.

⁴All from imported clinker.

⁵Production, in thousand carats, includes that of Akwatia Mine: 1998--252; 1999--205; 2000--233; 2001--300 (estimated); and 2002--268. Remainder are artisanal sales to the Precious Metals Marketing Corp. Estimates of unreported artisanal production not included.

⁶Does not include estimate of smuggled or undocumented production.

⁷Reported figure.

Sources: Ghana Minerals Commission and company reports.

TABLE 2
GHANA: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

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	181.
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.	Tema	1,200.
	do.	Diamond Cement Ghana Ltd.	Cement plant at Aflao uses imported clinker	900.
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.	Iduapriem/Teberebie Mine	9,000.
	do.	do.	Bibiani Mine	5,000.
	do.	Ashanti Goldfields total capacity in Ghana		31,000.
	do.	Bogosu Gold Ltd. [Golden Star Resources (U.S.), 90%; Government, 10%]	Bogosu/Prestea open pits. (Oxide ore until 2007, then sulfides. Prestea acquired 2001)	2,800.
	do.	do.	Wassa Mine, 30 km northwest of Tarkwa (closed 2001; acquired by GSR in 2002)	2,300.
	do.	Bogosu Gold Ltd. [Golden Star Resources (U.S.), 54%; Prestea Gold Resources Ltd., 36%; Government, 10%]	Prestea underground mine (acquired 2002; temporarily closed in early 2002)	1,100.
	do.	Bonte Gold Mining Ltd. (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.	Gold Fields Ghana Ltd. (Gold Fields of South Africa Ltd., 71.1%; Repadre Capital Corp. of Canada, 18.9%; Government, 10%).	Tarkwa open pit mines and heap leach	17,000.
	do.	do.	Damang Mine near Tarkwa	9,000.
	do.	Resolute Amansie Ltd. [Resolute Ltd. (Australia), 90%; Government, 10%]	Obotan Mine 40 km northwest of Obuasi (mine depleted, closed in 2002)	3,100.
	do.	Newmont Mining Corp.	Ahafo (Yamfo-Sefwi) deposit near Kenyasi	NA
	do.	do.	Ntoroso deposit near Kenyasi	NA
	do.	do.	Akyem deposit west of Kibi	NA
	do.	Red Back Mining NL	Chirano deposit, near Awaso	4,040. ^e
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	1,200.
Salt	do.	Panbros Salt Industry Ltd.	Salt pan at Mendskrom, near Accra (2002 plans to expand to 200,000 t/yr)	200.
	do.	Quality Salt Industry Ltd. (Closed in 1994, seeking new investors in 2002)		NA
	do.	Elmina Salt Producers Association	Artisanal salt pan mining near Elmina	NA
Steel	do.	Ferro Fabrik	Steel mill at Tema (secondary)	20 (rod, rebar, and wire).
	do.	Tema Steel Co., subsidiary of Ghana Industrial Holdings Co. (Government, 100%)	do.	25 (rebar).
	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 (Government, 100%)	Refinery at Tema	16,425.

^eEstimated. NA Not available.

TABLE 3
GHANA: GOLD PRODUCTION BY COMPANY AND MINE

(Kilograms)

Company	Mine	1998	1999	2000	2001	2002
Ashanti Goldfields Co. Ltd.	Ayanfuri, open pit, depleted in 2001 ¹	1,440	1,382	1,130	358	--
Do.	Bibiani	4,719	8,146	8,513	7,871	7,540
Do.	Iduapriem/Teberebie, open pits ²	4,828	5,092 ^r	5,191	6,380	5,760
Do.	Asikam, alluvial (Midras Mining Ltd.) ³	233	34	--	--	--
Do.	Obuasi, underground (open pit closed 2000)	27,537	23,113	19,937	16,437	16,709
Ashanti Goldfields total		38,757	37,767	34,771	30,688	30,009
Barnex (Prestea) Ltd.	Prestea, underground and surface rights ⁴	600	894	--	--	--
Bogosu Gold Ltd. ⁵	Bogosu, open pit	3,813	4,058 ^r	3,379	2,735	3,669
Bonte Gold Mines Ltd.	Esaase and Jeni River, placers	1,093	1,515 ^r	2,134	2,031	1,432
Dunkwa Continental Goldfields Ltd.	Dunkwa, placer	37	1	--	--	--
Gold Fields (Ghana) Ltd.	Tarkwa, underground	1,670	1,269	--	--	--
Do.	Tarkwa, open pit, 1998 startup	2,522	6,806	11,272	16,392	16,283
Do.	Damang, open pit ⁶	8,421	9,446	9,881	9,420	9,680
Gold Fields total		12,613	17,521	21,153	25,812	25,963
Precious Minerals Marketing Corp. ⁷	Artisanal workings	1,873	2,302 ^r	1,968	1,446	4,880
Prestea Sankofa Gold Ltd.	Prestea Sankofa, tailings ⁸	467	373	371	--	--
Resolute Amansie Ltd.	Obotan, open pit	5,411	4,230 ^r	4,199	3,447	--
Do.	Abore Mine (operated 2002 only)	--	--	--	--	3,118
Satellite Goldfields Ltd.	Wassa, open pit, 1999 startup ⁹	--	2,712 ^r	3,266	2,182	--
Teberebie Goldfields Ltd. ¹⁰	Teberebie, open pit	7,877	8,573	839	--	--
Grand total		72,541	79,946	72,080	68,341	69,097

^rRevised -- Zero.

¹Closed in early 2001.

²Includes production from Teberebie for 2001.

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

⁴Surface 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 adjacent Bogosu Mine. Prestea Gold Resources Ltd. will retain rights to old Prestea underground mine.

⁵Acquired 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.

⁶Acquired in January 2002 from Ranger Minerals Ltd. To be integrated into Tarkwa operation in 2003.

⁷Includes 8 to 110 kilograms per year of byproduct gold from Ghana Consolidated Diamonds Ltd.'s Akwatia Mine. Includes gold purchases from small scale miners by Miramex and other licensed buying authorities.

⁸Acquired by Ashanti in purchase of SAMAX, Inc. in 1998; sold in 1999. Included in Ashanti's total for 1998.

⁹Acquired by Golden Star Resources Ltd. from Glencar Mining plc. and Moydow Mines International Inc. in November 2001 and placed on care and maintenance pending appraisal.

¹⁰Acquired 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.