

THE MINERAL INDUSTRY OF ZAMBIA

By George J. Coakley

Zambia is a landlocked country, is bordered by seven southern African neighbors, has an area of 752,614 square kilometers, and in 2003, had a population of 10.4 million. For 2003, the per capita gross domestic product (GDP) based on purchasing power parity was estimated to be \$800.¹ During 2003, the economy had a GDP real growth rate of 4.0%, and inflation increased to 21.4% by yearend from 16% in 2002. Mining and quarrying accounted for 2.8% of the GDP at current prices in 2003; mine expansions and startups increased employment to 53,900 compared with 39,900 in 2002. In 2003, the International Monetary Fund reported total merchandise exports to be \$1.1 billion, of which copper exports were valued at \$601 million and cobalt, at \$109 million compared with \$510 million and \$50 million, respectively, in 2002. Metal sector imports accounted for about 15% of total merchandise imports of almost \$1.4 billion (U.S. Central Intelligence Agency, 2003²; International Monetary Fund, 2004³). The mining sector was dominated by copper and cobalt production. Zambia ranked 2d in the world as a producer of cobalt and 11th for copper and was one of the top producers of gem-quality emerald in 2003. Gemstones, mostly emerald, also recorded significant earnings; an even larger amount may have bypassed official channels. Besides copper and cobalt, Zambia produced a variety of industrial mineral commodities and coal. The most recent mineral production statistics are listed in table 1.

Government Policies and Programs

The Investment Act of 1993 established the Zambia Investment Center as a one-stop support facility for investors and offers incentives to investors in the mining sector. The Act, as amended in 1996, regulates, for example, investment incentives and investment guarantees. Investment is protected by the Securities Act (for the stock exchange) and the Investment Act against compulsory acquisition. No investment can be expropriated unless Parliament has passed an act that relates to the compulsory acquisition of that property. In the event of expropriation, the 1993 Investment Act, as amended, guarantees full compensation at market value and free transfer of the funds in the currency in which the investment was made. In December 1994, the Government announced that it would no longer participate in exploration or become a shareholder in a mining company and would limit its functions to regulatory or promotional activities.

The approval of the Companies Act by Parliament in 1994 brought Zambia's company law in line with modern British company law. The subsequent passing of the Mines and Minerals Act (No. 31) on September 13, 1995, was aimed

¹Where necessary, values have been converted from Zambian kwacha (K) to U.S. dollars (US\$) at the rate of K4,734=US\$1.00 for 2003 and K4,307=US\$1.00 for 2002.

²References that include a section mark (§) are found in the Internet References Cited section.

at attracting risk capital, technology, and entrepreneurial efforts to the mining sector. This Act officially put in place a mineral policy that called for a privatization program to encourage private development and diversification of the mining sector. It committed the Government to the promotion of small-scale mining; to the development of gemstone mining and liberalization of gemstone marketing facilities; to the diversification of mining through development of industrial, ferrous, and energy minerals; to the reduction of ecological damage arising from mining; and to the promotion of local value-added processing of Zambia's mineral raw materials. The law covers all mineral commodities and treats large-scale, small-scale, and gemstone operations separately as to mineral rights (prospecting and mining authorizations). Export of radioactive minerals, such as monazite, is illegal without special Ministerial approval. The law also gives the Government leeway in negotiating individualized contracts with investors. Among other provisions are secure title to mining rights with provision to assign the right to other parties and to market products, international arbitration, exemption from import duties and sales taxes on material at least for an initial period of exploration and development, and royalty charges of 3% for large-scale mining license holders on the "net back value" of minerals free-on-board less transport and smelting and refining costs.

By 2000, privatization of most of the major mines had been completed, although the Government faced investment reversals in 2002 with the Baluba-Luanshya and the Konkola Mines and had to reopen them for new privatization bids. Efforts were ongoing to privatize coal, limestone, gemstones, and other small-scale mining and to attract foreign investors to develop other known industrial and metallic mineral resources.

Environmental Issues

Parliament's Environmental Protection and Pollution Control Act (No. 12) of 1990 is the basis for the formation of the Ministry of Environment and Natural Resources and also the Environmental Council of Zambia. The Act, which formally came into full force in February 1992, gives the Ministry overall responsibility for protecting the environment. In March 1997, the Mines and Minerals (Environmental) Regulations were passed to implement environmental protection provisions of the Mines and Minerals Act of 1995. The 1997 environmental legislation established an environmental protection fund and regulations for environmental impact assessments, mine dumps, air and water quality, and emissions.

Commodity Review

Metals

Cobalt and Copper.—Following the January 2002 announcement of Anglo American plc that it would write off

\$350 million in Zambian assets and withdraw from Zambia, state-owned Zambia Consolidated Copper Mines Ltd. (ZCCM) placed Konkola Copper Mines plc (KCM) back on the privatization bid market; Anglo American owned KCM (Anglo American plc 2002a§, b§). In May 2003, the Government chose Sterlite Industries Ltd., which was an Indian aluminum, copper, and zinc producer, as the winning bidder to acquire a 51% interest in KCM from a shortlist of four companies; the others were Glencore International AG of Switzerland, Metorex Ltd. of South Africa, and a consortium of Mitsui & Co. Ltd. and Mitsubishi Corp. from Japan. By yearend, however, final agreement on the terms of the Sterlite takeover of KCM, which included tax concessions, was still pending. In December 2003, Vedanta Resources plc, which was the new holding company for Sterlite, was listed on the London Stock Exchange. Vedanta raised \$823 million dollars in new equity capital and by January had acquired a 65.8% controlling interest in Sterlite Industries (Datamonitor, 2004§).

Pending its sale, KCM continued to be operated by Zambia Copper Investments Limited (ZCI) [a subsidiary of Anglo American (58%) and ZCCM-Investment Holdings (ZCCM-IH) (42%)]. During 2003, KCM exercised its option to acquire the Nkana copper smelter from ZCCM Smelterco Ltd. in exchange for \$7 million in KCM shares to the Government. In 2003, KCM produced 188,000 metric tons (t) of refined copper and 1,200 t of refined cobalt compared with 220,000 t of copper and 2,000 t of cobalt in 2002. The drop in production was attributed by ZCI to “the planned downscaling of operations at the Nchanga open pit, the partial shutdown of the Nkana smelter for modernization work, the local fuel crisis and an acute shortage of acid supplies” (Zambia Copper Investments Limited, 2004, p. 2). The smelter modernization project was completed in September, and operation of the new counter-current decantation (CCD) circuit at the Nchanga tailings leach plant began in November. The new CCD circuit was expected to increase copper recovery by 7%. KCM planned to invest \$15 million during 2004 to build a sulfur-burning plant at Nkana and to reexamine the resource estimates needed to extend the life of the Nchanga open pit (Zambia Copper Investments Limited, 2004, p. 2).

Mopani Copper Mines plc, which was the second-ranked copper-cobalt producer, was privately owned by Glencore International (73.1%) from which limited operational or financial information was available. Mopani produced 134,000 t of copper and 2,050 t of cobalt from its Mufulira and Nkana Divisions during 2003. The company had several projects underway to update and expand production capabilities; these included development of a new area at the Nkana Mine to produce approximately 13 million metric tons (Mt) of its 90-Mt mineral resource, a new in situ leach operation at Mufulira, and a new heap-leach operation at Nkana. They also included the rebuilding of the smelter at Mufulira by 2006 to add new ISASMELT technology and to increase capacity to 650,000 t of copper concentrates with the potential to expand the smelter capacity to 850,000 metric tons per year (t/yr) from 156,000 t/yr of concentrates in the future (Glencore International AG, 2004§; Minerals Engineering International, 2004§; Reuters, 2004§).

Unlike KCM and Mopani, which were rehabilitating existing operations, First Quantum Minerals Ltd. of Canada was focusing on greenfield project developments to establish its position as a major mining company in the Copperbelt. First Quantum was using its Bwana Mkubwa solvent extraction-electrowinning (SX-EW) plant near Ndola to process ore from its Lonshi Mine, which is located 36 kilometers (km) across the border in the Democratic Republic of the Congo [Congo (Kinshasa)]. In 2003, the company announced its decision to develop the Kansanshi copper deposit near Solwezi. First Quantum was successfully drilling a new copper-cobalt discovery at Lufua, which is located just north of Lonshi, that could provide additional feed to the Bwana Mkubwa plant. In May, it had an option agreement exercised by BHP Billiton Ltd. to acquire a 51% interest in First Quantum’s Lumwata and Mwinilunga prospecting licenses on the western extension of the Lufilian Arc into western Zambia on the border with Angola; the Lufilian Arc is the regional geologic structural feature that hosts most of the sediment-hosted stratiform copper deposits in the Copperbelt of Congo (Kinshasa) and Zambia.

During 2003, First Quantum processed 722,065 t of ore from Lonshi, which contained an average of 4.8% copper, at its Bwana Mkubwa SX-EW plant; the ore yielded 29,513 t of refined cathode copper compared with 11,878 t in 2002. The Bwana Mkubwa operation also produced 132,951 t of sulfuric acid; the surplus (75,228 t) was sold to other Copperbelt operators (First Quantum Minerals Ltd., 2004b§).

During 2003, First Quantum secured most of the capital commitment needed to begin development of the \$224 million Kansanshi copper project. Construction began in September, and by February 2004, 95% of the engineering and design aspects of the project was completed. Commissioning of Phase I of the project was expected by late 2004. The Kansanshi project was based on a measured, indicated, and inferred mineral resource that was based on a 0.5% copper cutoff grade of 301.8 Mt at average grades of 1.17% copper and 0.17 gram per metric ton (g/t) gold, which contained 3.54 Mt of copper and 51.1 t of gold. The Kansanshi proven and probable ore reserve outlined for Phase I was broken into 46.9 Mt of leach ore that contained 1.75% copper and 0.29% gold and 95.6 Mt of float ore suitable for milling and flotation that contained 1.03% copper and 0.19 g/t of gold. The Phase I mine, mill, flotation circuit, and SX-EW plant development will treat shallow oxide and mixed ores during a 16-year period. Production was planned to be up to 70,000 t/yr of copper concentrates, 60,000 t/yr of copper cathode, and 780 kilograms per year (kg/yr) of byproduct gold. Concentrates will be sent to Mopani’s Mufulira Smelter for toll processing. A Phase II development, which will cover years 17 to 28, will focus on processing sulfide ores and the possible construction of a roaster to enable SX-EW production to continue at 60,000 t/yr of copper cathode (First Quantum Minerals Ltd., 2004a§, b§).

Chibuluma Mines Plc, which was majority owned by Metorex, operated the Chibuluma West underground mine near Kalulushi. For the financial year that ended on June 30, 2004, Chibuluma West mined approximately 240,000 t of ore at a grade of 2.0% copper. Ore that was processed into concentrates

at the Chibuluma South mill yielded sales of 4,978 t of copper compared with 8,262 t of copper during the previous financial year. Concentrates were sold under contract to Mopani Mines for local smelting and refining. Resource depletion at the Chibuluma West Mine was expected by mid-2004. In December 2003, development work on a decline and ventilation shaft began to access the deeper sulfides below the Chibuluma South open pit mine, which had been closed in 2001. Underground mining was expected to begin in October 2004 at rate of 5,000 metric tons per month (t/mo) and will build up to 20,000 t/mo of ore in early 2005. By 2006, Chibuluma South will produce 480,000 t/yr of ore at a grade of 3.3% copper that will yield about 14,000 t/yr of copper cathode. At the end of the financial year on June 30, 2004, Metorex reported remaining proved reserves of 135,000 t at a grade of 2.1% copper at Chibuluma West, a reserve of approximately 8 Mt at a grade of 3.6% copper at Chibuluma South, and an inferred resource of 1.5 Mt at a grade of 2.9% copper at the nearby Chifpu prospect (Metorex Ltd., 2004§).

During 2003, J&W Investment Group of Switzerland acquired two Copperbelt companies by purchasing the assets of the former Roan Antelope Mining Corp. of Zambia (RAMCOZ) from the Government and the cobalt-processing company Chambishi Metals plc from Anglovaal Mining Ltd. (Avmin) of South Africa. In September, the Government signed a formal agreement with J&W to take over ownership of the Baluba and the Luanshya Mines and the undeveloped Muliashi North deposit, which had been closed since 2002 following the liquidation of RAMCOZ and the financial default of its previous owners (Binani Industries Ltd.). The transaction cost was \$12 million. A new company, Luanshya Copper Mines Ltd., was expected to reopen the relatively modern trackless underground Baluba Mine in late 2004 or 2005 and to produce at a rate of 37,000 t/yr of copper; the company was likely to leave the Luanshya Mine, which was flooded in 2001, and its older infrastructure closed. Surface oxide caps of the known resource could be amenable to open pit mining (Tassel, 2003§; Times of Zambia, 2003§; Citizen Business, 2004§). Prior to its privatization, ZCCM in its 1997 annual report reported that the remaining oxide resources at Baluba totaled 26 Mt at a grade of 2.3% copper.

In June 2003, J&W and its subsidiary ENYA Holdings BV acquired Avmin's 90% interest in Chambishi Metals for an initial cash payment of \$6.5 million and future payments of up to \$25 million during the next 5 years depending on cobalt prices and production levels at Chambishi. J&W will also assume responsibility for Chambishi's infrastructure development liabilities of \$25 million. Avmin had struggled with technical problems during the startup of Chambishi Metals and had written off \$176 million in Chambishi assets in January 2002. Following redesign and refurbishment of the new cobalt smelter furnace in September 2002, Chambishi had reached full production capacity by December 2002. For its financial year that ended on June 30, 2003, Avmin reported production of 4,900 t of cobalt metal from toll smelting and refining compared with 3,700 t the previous year (Anglovaal Mining Ltd., 2003§; Business Day, 2003§).

NFC Africa Mining Plc. (a subsidiary of China Nonferrous Metal Industry Foreign Engineering and Construction Company) began a trial mining phase at its newly refurbished \$200 million Chambishi underground mine and mill in early 2003. The Chambishi mill can treat 6,500 metric tons per day of ore and will produce 120,000 t/yr of copper concentrates that average 40% copper. Annual capacity of around 45,000 t of copper will be toll smelted and refined in the Copperbelt (Tassel, 2003§). The company planned on a startup production rate of 15,000 t of copper for 2003 and 24,000 t for 2004 (Reuters, 2003§). Prior to its privatization, ZCCM in its 1997 annual report estimated that the remaining resources at Chambishi included 46 Mt at a grade of 2.2% copper at Chambishi West, 45 Mt at a grade of 2.6% copper at Chambishi Main, and 45 Mt at a grade of 2.4% copper at Chambishi Southeast.

During 2002, Equinox Resources Ltd. of Australia increased its equity interest in the Lumwana Copper Project to 51% from 15% by undertaking a \$14 million bankable feasibility study on the project. Its joint-venture partner Phelps Dodge Corp. of the United States held the remaining interest, although Equinox was negotiating to acquire a full 100% ownership. Lumwana is located 220 km northwest of the main Zambian Copperbelt in northwestern Zambia. As a result of the favorable feasibility study, at yearend 2003, Equinox obtained approval from the Zambian Mines Development Department for a Large Scale Mining Lease over the Lumwana project and was seeking project financing to begin development of the project by late 2004 and to start production during the second half of 2006. The Lumwana bankable feasibility study was based on a measured, indicated, and inferred resource of 161.7 Mt at grades of 0.89% copper, 144 parts per million (ppm) cobalt, and 0.03 g/t gold at the Malundwe deposit and 739.6 Mt at grades of 0.66% copper, 89 ppm cobalt, and 0.01 g/t gold at the Chimiwungo deposit. As outlined for the first 11 years of the project's 20-year mine life, proved, probable, and inferred reserves were reported to be 95.6 Mt at grades of 0.91% copper, 124 ppm cobalt, and 0.03 g/t gold at the Malundwe deposit and 252.6 Mt at grades of 0.64% copper, 154 ppm cobalt, and 0.01 g/t gold at the Chimiwungo deposit. The study called for a capital investment of \$296 million to construct the mine and concentrator to treat 18 million metric tons per year (Mt/yr) of Malundwe ore during Phase 1 (years 1 to 5); concentrates will be toll smelted. During Phase 2 (years 6 to 20), \$288 million will be invested in a roast-leach-electrowinning (RLE) plant to treat Chimiwungo ore; copper cathode and byproduct cobalt powder and sulfuric acid will be produced onsite. Production during the first 5 years would average 140,000 t/yr of copper and 2,300 kg/yr of gold. Production during Phase 2 would average 230,000 t/yr sulfuric acid, 104,000 t/yr of copper, and 1,000 t/yr cobalt (Equinox Resources Limited, 2003§).

Industrial Minerals

Lime and Limestone.—The country's sole producer of limestone and lime, Ndola Lime Company Limited, which was 87.6% owned by ZCCM-IH, was being offered for privatization; bid tenders were due to the Zambia Privatisation Agency

(ZPA) by March 26, 2004. The company has operated its own limestone quarries since 1960 and reported a limestone resource in 2002 of approximately 19.5 Mt, of which 2.8 Mt was classified as probable reserves. An additional inferred resource of 35 Mt is located between the 50- and 90-meter bench levels. Resources were reported to be adequate to mine at a rate of 580,000 t/yr for 33 years. Ndola Lime's principal products were agricultural lime, crushed millstone, hydrated (slaked) lime, and quick lime. Up to 80% of its quicklime production was consumed by the local copper industry (Zambia Privatisation Agency, 2002§).

Mineral Fuels

Coal.—After two failed private ownerships since 2000, Maamba Collieries Ltd. reverted to Government control and was again offered for privatization with new bids due by September 26, 2003, to the ZPA. The ZPA subsequently rejected all bids, and the sale of the company was to be readvertised. The Maamba Colliery, which is located 350 km south of Lusaka, was an important supplier of coal to the copper and cement industries and to export markets in Congo (Kinshasa), Malawi, and Tanzania. Remaining coal reserves were reported to be 60.2 Mt of probable reserves and 18 Mt of possible reserves. The company operated two open pit mines at Maamba in the Karoo Formation sediments of the Kanzize and the Izuma Basins. The two mines have the capacity to produce between 600,000 and 800,000 t/yr of salable coal, although in recent years, their operating capacities have ranged only from 10% to 30% (Zambia Privatisation Agency, 2003§).

Exploration

A number of other companies had active exploration projects in Zambia during 2003; one of them, Albidon Ltd. of Australia, was drilling the gabbro-hosted Munali copper-nickel-platinum sulfide prospect, which is located approximately 97 km south of Lusaka. Albidon reported an inferred resource of 7.04 Mt at a grade of 0.83% nickel equivalent at Munali (Albidon Ltd., 2004§). African Eagle Resources PLC of the United Kingdom was drilling copper soil anomalies at its Eagle Eye iron oxide copper gold prospect in its Sasari License in eastern Zambia, which is located near the border with Mozambique. Eagle Eye also held four other prospecting licenses around the country; these included the Lunda sediment-hosted copper prospect in joint venture with Avmin. Zambezi Resources Ltd., which was an Australian-managed company registered in Bermuda, held a block of eight prospecting licenses for copper and gold just east of Lusaka and the Chipata license at the Zambian-Mozambican-Malawian border. A joint venture between Motapa Diamonds Inc. (60%) (an affiliate of BHP-Billiton World Exploration Inc.) and Caledonia Mining Corp. of Canada (40%) was exploring two kimberlite-indicator mineral anomalies in the Mulonga Plain area in northwestern Zambia near the Angolan border; followup airborne gravity surveys will be conducted during 2004 and 2005.

Infrastructure

As a landlocked country, Zambia was dependent on truck and rail transport to sustain most of its economy. The truck road and railway networks within the country and externally were reasonably adequate for access to ocean and lake ports for international trade. Major highways generally paralleled the rail lines. About 20% of the main roads was paved, and about 20% was gravel or stabilized earth.

The principal rail routes were northeast to and from the Port of Dar es Salaam, which was nearly 2,000 km from Ndola in the Copperbelt, mostly on the Tanzania Zambia Railways Authority (Tazara) line and south through Zimbabwe to and from South African ports, which are more than 2,500 km from Ndola, on the Zambia Railways Ltd. line in Zambia. The roughly 2,000-km rail link southeast through Zimbabwe to the Port of Beira was now more accessible following post-civil war refurbishment of rail and port facilities in Mozambique. The more than 2,200-km rail link north into Congo (Kinshasa) and west to the Port of Benguela (Lobito), Angola, has remained unavailable during and since the end of the 20-year civil war in Angola, which ended in 2002.

The crude oil pipeline that ran about 1,700 km southeast from Dar es Salaam to a refinery in Ndola was owned and operated by Tazama Pipelines Ltd., which was a joint venture of the Tanzanian and the Zambian Governments. The pipeline was capable of bringing in about 22,000 barrels per day of crude petroleum to the Indeni petroleum refinery at Ndola for processing.

Except for coal resources previously discussed, Zambia had no domestic resources of oil and gas and was dependent on hydroelectric power for most of the country's power needs. State-owned Zambia Electricity Supply Company managed a hydroelectric-power-generating capacity of 1,670 megawatts.

Outlook

Despite some setbacks in Zambia's program to privatize the copper mining sector, the overall result has been positive in attracting significant new investment to revitalize a declining industry. By early 2004, world cobalt and copper commodity price increases showed indications of continuing for the immediate future. Combined with a more than doubling of production capacity, the mining sector will be an important stimulus to the economy during the next 5 years or more. A U.S. Geological Survey analysis of the Zambian copper supply suggests an increase of production levels to 585,000 t/yr of copper in Zambia by 2005 from the 2003 level of 370,000 t/yr of copper as the Kansanshi project comes onstream. If the Lumwana copper project meets its financing and development goals as scheduled, then national production is expected to increase to around 800,000 t/yr of copper by 2008. Production could be further expanded by developing deeper resources at the Konkola and the Mufulira Mines, but investment decisions on these have not yet been made.

The country faced several internal and external hurdles to development, which included cyclical world commodity prices; high transportation costs; limited infrastructure, particularly west of the Copperbelt; and the threat that high HIV/AIDS rates in the region posed on maintaining a skilled labor force. On the positive side, the apparent end of the civil wars in neighboring Angola and Congo (Kinshasa) is expected to help reduce the political risk of financing new projects. Restructuring of the gemstone sector and efforts to manage the export flow of gemstones better also have the potential to generate a larger value-added industry in Zambia.

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Major Sources of Information

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TABLE 1
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003
METALS					
Cobalt: ²					
Mine output, Co content	5,640	4,600	8,000 ^e	10,000 ^e	11,300
Metal, Co content	4,236	3,342	4,657	6,144	6,550
Copper: ^{2,3}					
Mine output, Cu content:					
By concentration or cementation	213,000	184,100	233,000	251,100	249,000
Leaching, electrowon	67,000	65,000	79,000	78,900	100,000
Total	280,000	249,100	312,000	330,000	349,000
Metal:					
Smelter, primary:					
Electrowon, low grade	25,000	25,000	25,100	NA	NA
Other	217,600	180,000	215,000	NA	NA
Total	242,600	205,000	240,100	253,500	268,000
Refinery, primary:					
Electrowon	67,000	65,000	79,000	83,700	99,800
Other	201,400	162,400	217,000	253,100	250,000
Total	268,400	227,400	296,000	336,800	349,800
Gold ² kilograms	700	600 ^e	-- ^r	--	--
Selenium, refined, gross weight ² do.	11,620	9,370 ^e	-- ^r	--	--
Silver ² do.	5,840 ^e	4,710 ^e	-- ^r	--	--
INDUSTRIAL MINERALS					
Cement:	300,000	380,000	215,470 ^r	230,379	480,000
Clays: ^e					
Brick	3,000	3,000	3,000	3,000	3,000
Building, not further specified	30,000	30,000	30,000	30,000	30,000
China and ball	200	200	200	200	200
Gemstones: ^e					
Amethyst kilograms	800,000	800,000	1,145,029 ^{r,4}	1,064,606 ⁴	1,000,000
Beryl do.	4,000	4,000	1,567 ^{r,4}	8,551 ⁴	8,000
Emerald do.	7,000	7,000	764 ^{r,4}	1,860 ⁴	2,000
Garnet do.	3,000	3,000	NA ^{r,4}	NA ⁴	NA
Tourmaline do.	2,000	2,000	25,619 ^{r,4}	25,755 ⁴	25,000
Gypsum ^e	11,000	11,000	--	--	
Lime, calcined thousand tons	125 ^r	142 ^r	117 ^{r,4}	151 ⁴	145
Limestone, for cement and lime do.	188 ^r	177 ^r	61 ^{r,4}	330 ⁴	350
Limestone, crushed aggregate do.	460 ^r	437 ^r	450 ^{r,4}	450 ^{r,4}	600
Sand and gravel, construction ^e do.	200	200	200	200	200
Sulfur:					
Gross weight:					
Pyrite concentrate	65,000	50,000	199,400 ^r	225,870	226,000
Sulfuric acid ⁵	119,000	110,000	63,000	10,000 ^e	10,000
Sulfur content:					
Pyrite concentrate (42% S)	27,300	21,000	83,752 ^{r,4}	94,900 ⁵	95,000
Sulfuric acid (32.6% S)	38,800	35,800	20,500	32,600 ^e	33,000
Total, S content	66,100	56,800	102,252	127,500 ^e	128,000
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous	127,854	168,000	104,600 ^{r,4}	71,700 ^r	71,800
Petroleum, refinery products ^{e,2} thousand 42-gallon barrels	1,700	--	--	--	5,000

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

¹Table includes data available through October 2004.

²Data for 1999 are for year beginning April 1 of year stated. Calendar year data shown for 2000 through 2003.

³Terms used are as defined by the International Copper Study Group.

⁴Reported figure.

⁵From the Chambishi and the Nkana acid recovery plants.

Sources: Zambia Government data and company reports. Data estimated by the U.S. Geological Survey.

TABLE 2
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2003¹

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity ²
Cement	Chilanga Cement plc (Lafarge Group, 51%)	Lusaka plant	207,000.
Do.	do.	Ndola plant	310,000.
Coal	Maamba Collieries Ltd. (Government, 100%)	350 kilometers south of Lusaka in Kanzie and Izuma Basins	800,000 bituminous coal operating at 150,000 to 400,000.
Copper and cobalt	Konkola Copper Mines plc [Vedanta Resources plc., (India, United Kingdom), 51%; Zambia Copper Investments Limited (Anglo American plc subsidiary), 28.4%; Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 20.6%] (Effective August 2004)	Nchanga open pit	4,500,000 ore, 46,000 copper in concentrate.
Do.	do.	Nchanga underground mine (depletes during 2004)	2,800,000 ore, 47,000 copper in concentrate.
Do.	do.	Nchanga concentrator	88,000 copper in concentrate, 10,000 cobalt in concentrate.
Do.	do.	Nchanga tailings leach plant	100,000 leach cathodes.
Do.	do.	Konkola underground mine	2,200,000 ore.
Do.	do.	Konkola concentrator	50,000 copper in concentrate.
Do.	Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 100%	Konkola deep mining project (on hold in 2003)	(180,000 copper planned).
Do.	KCM (Smelterco) Ltd. [Vedanta Resources plc. (India, United Kingdom), 51%; Zambia Copper Investments Limited (Anglo American plc subsidiary), 28.4%; Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 20.6%] (Effective August 2004)	Nkana copper smelter	240,000 blister/anode.
Do.	do.	Nkana copper refinery	236,000 cathodes.
Do.	Mopani Copper Mines plc [Glencore International AG, 73.1%; First Quantum Minerals Ltd., 16.9%; Zambia Consolidated Copper Mines (ZCCM), 10%]	Mufulira Mine	2,500,000 ore.
Do.	do.	Mufulira in-situ leach (2004 startup)	NA.
Do.	do.	Mufulira concentrator	63,000 copper in concentrate.
Do.	do.	Mufulira smelter	160,000 copper anodes.
Do.	do.	Mufulira (new ISASMELT smelter by 2006)	650,000 t/yr Cu concentrates, 200,000 Cu anodes.
Do.	do.	Mufulira refinery	275,000 copper cathodes.
Do.	do.	Nkana Mine (4 underground mines)	5,500,000 ore.
Do.	do.	Nkana concentrator	95,000 copper in concentrate, 5,500 cobalt in concentrate.
Do.	do.	Nkana heap leach (2004 startup)	NA.
Do.	do.	Nkana cobalt plant	2,500 cobalt, refined, 14,500 copper scrap.
Do.	Chambishi Metals plc [J&W Investments Group, 90%, and Zambia Consolidated Copper Mines (ZCCM), 10%]	Chambishi cobalt plant	4,900 cobalt.
Do.	do.	Nkana slag dump	7,000 copper.
Do.	do.	UCHI tails retreatment plant	7,000,000 t/yr tailings feed.
Do.	First Quantum Minerals Ltd. (Canada), 100%.	Bwana Mkubwa Mine; SX-EW ³ plant treats Nkana tails and ore from Lonshi Mine, Democratic Republic of the Congo	35,000 copper cathode.
Do.	First Quantum Minerals Ltd., 80%, and Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 20%	Kansanshi Mine (To open late 2004)	70,000 copper in concentrates, 60,000 copper cathodes.

See footnotes at end of table.

TABLE 2--Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2003¹

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners		Location of main facilities	Annual capacity ²
Copper and cobalt (continued)	Chibuluma Mines plc [Metorex Ltd., 85%, and Zambia Consolidated Copper Mines (ZCCM), 15%]		Chibuluma West Mine, near Kalalushi, 12 miles west of Kitwe (To close in 2004)	450,000 ore, 7,600 copper, 100 cobalt.
Do.	Chibuluma Mines plc (Metorex Ltd., 65%, and Industrial Development Corp. of South Africa, 35%)		Chibuluma South Mine, 12 miles south of Chibuluma West (closed September 2002, redevelop 2003-04, reopen by 2005 at 17,000 copper)	7,500 copper, 100 cobalt.
Do.	Luanshya Copper Mines Ltd. [J&W Investments Group, 90%, and Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH) 10%] (formerly Roan Antelope Mining Corp.)		Luanshya underground mine (closed)	1,700,000 ore.
Do.	do.		Luanshya concentrator	23,000 copper in concentrate.
Do.	Luanshya Copper Mines Ltd. (Expect to reopen 2004 at 37,000 t/yr copper)		Baluba underground mine	1,400,000 ore.
Do.	do.		Baluba concentrator	24,000 copper in concentrate, 1,900 cobalt in concentrate.
Do.	do.		Mulashi North project (to be reevaluated in 2004)	34,000 copper; 1,400 cobalt.
	Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 100%		Luanshya smelter (closed in 1998)	60,000.
Do.	Lumwana Joint Venture [Equinox Resources Ltd. (Australia), 51%, and Phelps Dodge Corp (United States), 49%]		Lumwana deposit (commissioning planned for 2006)	(140,000 copper potential).
Do.	Orion Mining Zambia		Kabwe slag processing plant to treat feed imported from the Democratic Republic of the Congo	60,000 slag yielding, 1,800 to 5,000 cobalt.
Gemstones:	kilograms			
Amethyst	do.	Vantage Enterprises Corp. (Canada) and various artisanal operations	Krystal Mine in Kaloma; Mumbwa, near Zimbabwean border	NA.
Aquamarine	do.	Various artisanal operations	Katete and Petauke areas	NA.
Beryl	do.	do.	Eastern Province pegmatites	NA.
Citrine	do.	do.	Iteshi Teshi and Mumbwa	NA.
Emerald	do.	30 to 40 artisanal operations	Northwest of Kitwe	600.
Garnet	do.	Various artisanal operations	Eastern Province pegmatites, Mazabuka, Siavunga, Chikankata, Gwemba Valley	NA.
Tourmaline	do.	do.	Kalunga Wbeba Mine, Eastern Province	NA.
Do.	do.	do.	Hofmeyer Mine near Nyimba	NA.
Gold	do.	Luire Gold Mines Limited of Zambia (awarded new mining license in 2004)	Dunrobin (Luire-Matala) Mine, 120 kilometers west of Lusaka (closed since 2000)	600.
Do.	do.	Minerva (PMP) Ltd. [Binani Group (India), 100%] (processes copper refinery slimes)	Ndola Precious Metals Plant	150 refined gold.
Lime		Ndola Lime Company Limited [Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 87.6%]	Ndola plants and kiln capacity	1,000,000 limestone feed, 300,000 quicklime (unslaked), 25,000 hydrated lime (slaked).
Petroleum	42-gallon barrels	Indeni Petroleum Refinery Limited, (Total Outre Mer, 50%, and Government, 45%)	Indeni refinery at Ndola	8,950,000 refined products.
Selenium	kilograms	Minerva (PMP) Ltd. [Binani Group (India), 100%]	Ndola Precious Metals Plant	22,000 refined selenium.
Silver	do.	do.	do.	10,000 refined silver.

See footnotes at end of table.

TABLE 2--Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2003¹

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity ²
Sulfur: ²	Konkola Copper Mines plc [Vedanta Resources plc. (India, United Kingdom), 51%; Zambia Copper Investments Ltd. (Anglo American plc subsidiary), 28.4%; Zambia Consolidated Copper Mines-Investment Holdings (ZCCM-IH), 20.6%] (Effective August 2004)	Nampundwe pyrite mine	79,000 pyrite, 33,000 contained sulfur.
Do.	Chambishi Metals plc [Avmin, 90%, and Zambia Consolidated Copper Mines (ZCCM), 10%]	Chambishi acid plant	65,000 sulfuric acid, 21,190 contained sulfur.
Do.	Mopani Copper Mines plc [Glencore International AG, 73.1%; First Quantum Minerals Ltd., 16.9%; Zambia Consolidated Copper Mines (ZCCM), 10%]	Nkana acid plant	120,000 sulfuric acid, 39,120 contained sulfur.
Do.	First Quantum Minerals Ltd. (Canada)	Bwana Mkubwa acid plant	110,000 sulfuric acid, 35,860 contained sulfur.

NA Not available.

¹Includes data available through October 2004.

²Some capacities shown based on former Zambia Consolidated Copper Mines Ltd. operations.

³Solvent extraction-electrowinning.