

ZAMBIA

By George J. Coakley

Zambia is a landlocked country in southern African with an area of 752,614 square kilometers (km²), 9.8 million people, and for 2000 (the latest year for which purchasing power parity data are available), a per capita gross domestic product (GDP) purchasing power parity estimated to be \$880.¹ In 2001, overall, mining and quarrying accounted for about 6% of real GDP, 68% of merchandise exports, and about 40,000 jobs of a total formal sector employment of 470,000. Total merchandise exports in 2001 were \$871 million, of which metals accounted for \$590 million. Fuel and energy imports accounted for about 10% of total merchandise imports of \$1,253 million (International Monetary Fund, 2002§²).

The Zambian economy was beginning to get back on its feet in 2001, following completion of most of its privatization program in 2000 and reinjection of investment capital, especially in the mining sector, and experienced a 5.2% growth in real GDP compared with 3% in 2000; between 1990 and 1999, Zambia's average GDP growth rate of 1% per year was the lowest in the Southern Africa Development Community. During 2001, inflation declined to 18.7% from 30%. The International Monetary Fund (IMF) wrote off \$3.6 billion of Zambia's \$6.5 billion external debt under its Enhanced Highly Indebted Poor Country Initiative, which reduced its external debt service to \$165 million per year from \$600 million per year. In cooperation with the IMF and the World Bank, the Government also prepared a comprehensive poverty reduction strategy paper (PRSP), which included targeted goals for the mining sector with an emphasis on the development of new large mines and on more technical and economic support for the small-scale mining and related value-added industries. These will include promotion of new jobs in the agricultural and industrial minerals areas, such as limestone for agriculture and clays for brick making and pottery. In the emerald and gemstone sector, a gemstone exchange scheme will be reintroduced to bring together small-scale miners with producers and buyers of rough and processed gemstones and jewelry, to add accountability and transparency, and to reduce the loss of tax revenue from illegal trafficking in gemstones. The PRSP also calls for the creation of a Mining Community Development Fund, which will be funded by the large producing mines, to support community development projects in areas where the mines operate (International Monetary Fund, 2002§).

The mining sector was dominated by copper and cobalt production. Zambia ranked as the world's 4th largest producer of cobalt, 12th largest copper producer, and one of the top

producers of gem-quality emeralds in 2001. Besides copper and cobalt, Zambia produced gold, selenium, and silver as byproducts of copper refining, a variety of industrial mineral commodities, and coal (table 1). Gemstones, mostly emeralds, also recorded significant earnings, but probably an even larger amount bypassed official channels.

The country suffered a major setback in January 2002 when Anglo American plc [the owner of Konkola Copper Mines plc (KCM)] announced it would write off \$350 million in Zambian assets (Anglo American plc, 2002§). High operating costs and low copper and cobalt prices also affected several other producers and led to some suspension of operations or partial asset writeoffs in late 2001 and early 2002. The Government, with the assistance of the World Bank and others, was investigating options for preserving revenue flows and employment from this key sector of the economy.

Government Legislation and Policies

The Investment Act of 1993 established the Zambia Investment Center as a one-stop support facility for investors that 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 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 Companies Act (1994) has brought Zambia's company law in line with modern United Kingdom company law. The Mines and Minerals Act of 1995, which was passed by Parliament as 1995 Act No. 31 on September 13, 1995, was aimed at attracting risk capital, technology, and entrepreneurial efforts to the mining sector. The Act officially put in place a mineral policy that called for a privatization program to encourage private development and diversification of the mining sector. The Act commits 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

¹Where necessary, values have been converted from Zambian kwacha (K) to U.S. dollars at the rate of K3,573=US\$1.00 for 2001 and K3,225=US\$1.00 for 2000.

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

separately as to mineral rights (prospecting and mining authorizations). Export of radioactive minerals, such as monazite, is illegal without special Ministerial approval. It also gives the Government leeway in negotiating individualized contracts with investors. Among other provisions were secure title to mining rights with provision to assign, the right 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, and efforts were ongoing to privatize the gemstone and other small mines sector and to attract foreign investors to develop other known metallic and industrial mineral resources.

Environment

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 the Environmental Council of Zambia. The Act, which formally came into full force in February 1992, gave 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 emission.

During 2001, a World Bank proposal to fund a \$40 million Copper Belt environmental project to be implemented by the Government and Zambia Consolidated Copper Mines-Investments Holdings Plc. (ZCCM-IH) continued along its assessment and approval process. The project was scheduled for World Bank board approval in June 2002. It would be used to help ZCCM-IH address the environmental liabilities and obligations assumed by the Government after the privatization of Zambia Consolidated Copper Mines (ZCCM) assets. ZCCM-IH held a minority (10% to 20%) interest in the respective newly privatized mining companies. The project was designed to develop an environmental management plan (EMP) and an environmental mitigation fund to strengthen the Government’s capacity to monitor adequately the implementation of the EMP (World Bank, 2002§).

Production and Trade

In the copper sector, 2001 was the first full year of production under the new private ownership, with the Bank of Zambia (BOZ) reporting the production of 296,446 metric tons (t) of copper and 4,657 t of cobalt and exports of 296,387 t of copper and 4,380 t of cobalt (Bank of Zambia, 2002§). The BOZ data for copper, however, differ somewhat from the data in table 1, which are derived from the International Copper Study Group. Copper and cobalt exports were valued at about \$590 million. In general, the copper and cobalt production shows the results of new investment during 2000 and 2001—production of copper up by 17% to 30% depending on the stage, and that of

refined cobalt, up by 39% compared with those of 2000. With the closure of the Dunrobin gold mine at the end of 2000, gold production was limited to byproduct production from copper refining and dropped by an estimated 78% in 2001. Production data for many industrial minerals are not reported and have been estimated at a constant level for the past 5 years. Zambia was a major world supplier of amethyst and emerald and also produced gemstone-quality aquamarine, garnet, and tourmaline. Most gemstone mining was done by small-scale artisanal miners, and production and export levels were poorly documented. Emerald production has been largely undocumented, but based on output from the major producer, around 7,000 kilograms per year (kg/yr) of emeralds has been produced with a value estimated to exceed \$200 million.

Chilanga Cement plc, which was the country’s only cement producer, maintained cement production at around 350,000 metric tons per year (t/yr). The Maamba coal mine had returned production to the 150,000-to-180,000-t/yr range following the 1997 flooding of the mine and was back on the list for privatization.

More than one-half of copper and cobalt exports went to Asia and Europe. Bulk copper was exported via rail from Zambia to the Tanzanian port of Dar es Salaam via the Mozambican port of Beira and through the South African ports of East London and Durban. The principal import was petroleum, which included crude and refined products. The Arabian Gulf states were the principal sources of oil imports, and South Africa was also a major source at least partly because of transshipments from overseas sources. Fertilizer components, particularly phosphorus and potassium, were the second largest mineral import.

Commodity Review

Metals

Copper and Cobalt.—Following the completion of the privatization of ZCCM in 2000, 2001 was a year of optimism for Zambia because much needed new capital flowed into mine and plant rehabilitation and production reversed its long downward trend. Compared with other producing mines, like those in Chile and the United States, however, Zambian mines had relatively high operating costs. In addition, the Zambian industry was struggling with low world cobalt commodity prices and with copper commodity prices that were at a 70-year low in constant dollar terms. Cobalt is produced as a coproduct of copper mining and processing. In January 2002, redevelopment plans for the Zambian copper industry had a major setback when Anglo American plc, which owned Zambia Copper Investments Limited (ZCI), announced it would write off \$350 million in losses at KCM and cease operations within 12 months if the sale or transfer of KCM’s assets on a going-concern basis could not be arranged. KCM was owned by ZCI (65%), the Government (through ZCCM) (20%), the World Bank’s International Finance Corporation (7.5%), and Commonwealth Development Corporation Group Plc (7.5%) and employed 10,000 people. ZCI reported losses of \$108 million from its takeover of the mines from March 2000 to December 2001 and said it was unable to obtain external financing “on normal commercial terms” for the more than \$1

billion needed to develop the Konkola Deep Mine Project (KDMP). The existing mines at KCM have a relatively short remaining life, and the longer term prospects for KCM were dependent on development of the KDMP. Anglo American also informed ZCI that it would honor its existing funding commitments to provide ZCI with up to \$310 million for on-lending to KCM for debt payment and other ongoing obligations. As of December 31, 2001, Anglo American had already lent ZCI \$214 million of this amount (Anglo American plc, 2002§). The Government and the other KCM partners will spend the remainder of 2002 examining options for selling or transferring the assets of KCM to another party or to closure in a socially and environmentally responsible manner. A detailed list of KCM's remaining geologic assets is in table 3.

Operationally during 2001, KCM spent \$178 million on the refurbishment of mine assets, which included rehabilitation of the tailings leach plant. Production increased by 18% to 196,805 t of refined copper and 2,422 t of refined cobalt in 2001, but the increase was lower than the planned target owing to problems at the toll smelter at Nkana and to a major accident at the Nchanga open pit. On April 8, a slope failure caused the movement of 5 million metric tons (Mt) of material that killed 10 workers and took the Nchanga pit out of production for 1 month. The future economics of open pit mining at Nchanga were being reevaluated. KCM began a major dewatering program after the slope failure, which also required the removal of an extra 28 Mt of material. The Smelterco smelter at Nkana was shut down for a 2-month overhaul, but intermittent problems with the oxygen plant continued to constrain output and led to a build up of 20,000 t of copper concentrates that will be treated in 2002. For 2001, the Nchanga open pit mined 4.4 Mt of copper ore at a grade of 2.21% and 1.1 Mt of cobalt ore at a grade of 0.6% cobalt. The Nchanga underground block cave mine produced 2.9 Mt of ore at a grade of 3.25% copper. Mine production at KCM's third copper mine at Konkola underground was 1.8 Mt at a grade of 3.29% copper. Deteriorating ground conditions and several seismic events kept new underground development work at Konkola below target levels. The Konkola and the Nchanga concentrators treated 9.2 Mt of ore at an average grade of 2.66% copper, which yielded 138,310 t of copper in concentrates. An additional 794,000 t of cobalt ore was treated, which yielded 3,272 t of cobalt in concentrates. Finished copper production at the tailings leach plant was 76,851 t. KCM sent its concentrates to Smelterco for toll smelting at the Nkana smelter and to Mopani Copper Mines plc's (Mopani) Mufalira smelter. The smelters were being rehabilitated to address several operating problems, stoppages, and concentrate inventory buildup in 2001 (Chadwick, 2002; Zambia Copper Investments Limited, 2002§).

As of December 31, 2000, KCM had estimated proved and probable copper reserves of 372.9 Mt at an average grade of 1.83% and cobalt reserves of 3.3 Mt at an average grade of 0.37% cobalt. Total contained copper in these reserves amounted to 6,822,000 t, of which 51% was located in the KDMP, and 17%, in the Nchanga CRO (refractory ore) waste dump (Zambia Copper Investments Limited, 2001§).

Mopani was owned by the privately owned Swiss metals trading company Glencore International AG (46%), First Quantum Minerals Ltd. (44%) of Canada, and ZCCM-IH

(10%). In an equity-for-debt swap with Glencore in April 2002, First Quantum reduced its interest in Mopani to 16.9%; Glencore's equity increased to 73.1% (First Quantum Minerals Ltd., 2002, p. 4). First Quantum also owned (100%) and operated the Bwana Mkubwa Mine near Ndola and held the rights to develop the Kansanshi copper deposit near Solwezi.

Mopani operated the Mufalira copper mine, mill, smelter, and refinery and the Nkana mill and cobalt plant. For the year ending November 30, 2001, Mopani produced 108,000 t of refined copper and 1,700 t of refined cobalt. With London Metal Exchange (LME) copper cathode prices for 2001 averaging \$0.72 per pound, First Quantum reported Mopani's total costs at \$0.94 per pound of copper and operating cash costs at \$0.78 per pound of copper, net of credits. Owing to a variety of technical and market factors, Mopani underperformed for the year, and its efforts to revitalize the operations were behind schedule. The need for basic maintenance and the resupply of equipment that resulted from ZCCM's lack of capital investment in maintenance in recent years contributed to the problem. Mopani's Mufalira Division treated 1.93 Mt of ore at a grade of 2.29% copper that yielded 37,343 t of copper. The Nkana Division treated 3.13 Mt of ore at a grade of 1.73% copper and 0.14% cobalt that yielded 45,818 t of copper and 1,780 t of cobalt. Exploration drilling during 2001 demonstrated the potential to expand Nkana resources in the Mindola and Synclinorium ore bodies. Mopani reported resources as of November 30, 2001, as follows: the Mufalira Division had 22.53 Mt of reserves at an average grade of 3.01% copper and an additional indicated resource of 42.4 Mt at an average grade of 3.0% copper, and the Nkana Division had 69.24 Mt of reserves at an average grade of 2.24% copper and 0.14% cobalt and an additional indicated resource of 265.8 Mt at an average grade of 2.14% copper and 0.12% cobalt (First Quantum Minerals Ltd., 2002, p. 18-19).

During 2001, First Quantum's Bwana Mkubwa operation treated more than 1.89 Mt of tailings in its solvent extraction-electrowinning (SX-EW) circuit; this yielded 12,774 t of copper compared with 10,025 t in 2000. The SX-EW plant also generated 62,783 t of excess sulfuric acid for sale to other Copper Belt operations. The company reported remaining reserves of tailings at Bwana Mkubwa of 2.11 Mt at a grade of 0.77%; this represented about 1 year's plant feed. The life of the plant was being extended to treat ore from the newly discovered Lonshi deposit, which is located across the border in Congo (Kinshasa) about 36 kilometers (km) southeast of Bwana Mkubwa. During 2001, the newly constructed second acid plant at Bwana Mkubwa increased sulfuric acid production capacity to 145,000 t/yr from 110,000 t/yr. Early in 2002, Phase I expansion of the Bwana Mkubwa SX-EW plant, which included installation of crushing, milling, and preleach filtration facilities designed to treat the high-grade (5.75% copper) Lonshi ore, was completed. Phase II construction, which was scheduled for completion in late 2002, will expand overall production capacity to 30,000 t/yr of copper from its 10,000-t/yr level in 2000 (First Quantum Minerals Ltd., 2002, p. 18-19).

Having reduced its equity position in Mopani, First Quantum's corporate strategy appeared to be shifting to an emphasis on new greenfield developments, which included the former ZCCM mine at Kansanshi that closed in 1998. First

Quantum acquired an 80% interest in Kansanshi in the May 2000 purchase of the exploration portfolio of Cyprus Amax Zambia (Cymax) from Phelps Dodge Exploration Corp. The reassessment of the deposit since 1998 by Cymax has identified resources of 267 Mt at an average grade of 1.28% copper and 0.16 gram per metric ton (g/t) gold at Kansanshi. A bankable feasibility study of Kansanshi was expected to be completed by late 2002. The study was geared to bringing an open pit mine into production in 2004 at an initial capacity of 75,000 t/yr of copper at an estimated capital cost of \$120 million (First Quantum Minerals Ltd. 2002, p. 5, 14-15).

Chibuluma Mines Plc (controlled by Metorex Ltd. of South Africa since late 1997) owned and operated the Chibuluma West Mine near Kalulushi and the Chibuluma South Mine 12 km south of Chibuluma West. Crew Development Corp. of Canada held a 21% majority shareholder interest in Metorex. The Chibuluma West Mine, which has been in operation for 40 years, operated at a rate of 300,000 t/yr of ore, which was railed to the Nkana concentrator and the Smelterco smelter complex where approximately 7,900 t/yr of copper cathode and 990 t/yr of cobalt metal were produced. Efforts were being made to expand production for 2002. As of June 30, 2001, Chibuluma West had about 3 years of reserves remaining, which included proven and probable mineral reserves of 504,000 t at an average grade of 3.8% copper and 0.1% cobalt plus indicated and inferred mineral resources at Chibuluma West and 1.73 Mt at an average grade of 3.0% copper and 0.1% cobalt at the Chifuou Prospect (Crew Development Corp., 2001§).

Metorex's \$12 million Chibuluma South Project was short-lived in 2001. Metorex commissioned the open pit mine and metallurgical plant in July but then placed operations on a care and maintenance suspension on September 28 because of continuing low metal prices and high operating costs in Zambia. The high cost of operating the cement copper circuit was singled out as one of the main factors in the decision. The company took a \$10 million writeoff on Chibuluma South for 2001. Proved mineral reserves at Chibuluma South were 7.3 Mt at a grade of 3.7% copper at a cutoff grade of 1% copper. The open pit mine was designed to produce 40,000 t/yr of ore and 16,500 t/yr of copper along with byproduct cobalt during a 15-year mine life. A deeper sulfide ore body was also available for future underground development at Chibuluma South, which could double its copper production capacity (Chadwick, 2002, p. 66; Crew Development Corp., 2001§).

During 2001, NFC Africa Mining Plc. continued development work and purchase of new mining equipment for its \$200 million Chambishi Mine Project. NFC Africa Mining, which was acquired from ZCCM in June 1998 for \$20 million, was owned by the Chinese parastatal China Nonferrous Materials Industry Engineering and Construction Group (85%) and ZCCM-IH (15%). Mineral resources were estimated by ZCCM to be 136 Mt at a grade of 2.4% copper. Rehabilitation work on the underground mine and surface facilities started in July 2000 and was initially scheduled for completion and start up of mining by the end of 2002 with full operational capacity to be reached by 2003. NFC Africa Mining will mine 2.15 million metric tons per year (Mt/yr) of ore at Chambishi by using a combination of cut and fill and sublevel stoping. The mill will produce 120,000 t/yr of copper concentrates that average 40%

copper. Chambishi ore reserves were reported to be 33 Mt with additional resources of more than 100 Mt. Production of 45,000 t/yr of copper was expected. The project investment will help China meet its growing need for copper imports (Chadwick, 2002, p. 67; Atlas Copco, 2000§; China Government, [undated]§).

Chambishi Metals plc. [owned by Angolvaal Mining Ltd. (Avmin) (90%) of South Africa] purchased the Chambishi cobalt plant and the Nkana slag dumps from ZCCM in August 1998 for \$50 million and made a commitment to invest \$140 million within 3 years. The leach plant, the zinc solvent extraction, and the cobalt tankhouse expansions were all completed by 2001 and were ready to accept material from the smelter. The \$100 million Nkana slag-processing facility, which was referred to as the cobalt slag and copper as a byproduct facility (COSAC) was expected to begin production by early 2001. The COSAC plant was designed to blend, smelt, leach, and electrowin the Nkana slag dump material, which will be trucked in about 35 km to the plant. Avmin reported proven and probable reserves of Nkana slags at 19.86 Mt at an average grade of 0.73% cobalt and 1.09% copper plus an indicated resource of 1 Mt at an average grade of 0.86% cobalt and 1.11% copper (Anglovaal Mining Ltd., 2001a§, b§). Production was expected to reach 4,000 t/yr of cobalt and 7,000 t/yr of copper by mid-2001; technical problems, however, were encountered during startup. The new plant was commissioned during the third quarter of the financial year. During startup, however, water leaked under the magnesite lining, which resulted in hydration of the magnesite refractory bricks. Rebricking of the furnace was continuing into 2002, and reheating of the furnace was expected by July 2002. Full production in the expanded facility was now expected during the third quarter of the 2002 calendar year. Actual production during calendar year 2001 was chiefly limited to toll processing of materials from other Copper Belt operators at the old Chambishi cobalt roast-leach-electrowinning plant and acid plant and amounted to 4,200 t of cobalt and 16,400 t of copper; of these totals, 800 t of cobalt and 640 t of copper were for Avmin's own account (Anglovaal Mining Ltd., 2002b§). Pyrite needed to maintain sulfur levels in the roaster was obtained from KCM's Napundwe Mine, and lime was supplied by the Ndola Lime Co. Ltd. Power to the operation was supplied by Copperbelt Electric Company but was subject to periodic outages. Finished broken cobalt cathode was trucked to the port of Durban for export to Asia, Europe, and the United States.

In January 2002, Avmin announced that it was taking a \$176 million partial write-down of the Chambishi Metals Plc asset as a result of the technical startup problems, large operating cost losses, and the decline in cobalt prices to \$7.00 per pound from \$10 per pound. A residual value of \$70 million remained in Chambishi Metals, and Avmin stated its commitment to the remaining work on the project and to reaching full production by yearend 2002 (Anglovaal Mining Ltd., 2002a§).

In October 2001, Equinox Resources Ltd. of Australia began a \$14 million bankable feasibility study designed to support the financing and development of the Lumwana Copper Project about 230 km west of the Copper Belt in northwestern Zambia. It was expected to be completed by mid-2003. The lack of regional infrastructure, which included electric power and

transportation routes, was a constraint on the project; with assistance from the U.S. Trade and Development Agency, the Zambian Government, however, was studying infrastructure development options. Based on a 1999 agreement with Phelps Dodge, Equinox was earning a 50% interest in the Lumwana Project from Phelps Dodge by spending \$5 million during 4 years and up to 75% equity interest by covering up to \$35 million of project costs during 12 years. The Lumwana Project contains two large copper-cobalt-gold-uranium deposits at Chimiwunga and Malundwe. Lumwana resources were reported to be more than 1 billion metric tons, which contain 0.67% copper using a 0.2% copper cutoff and 481 Mt of ore at a grade of 1.0% copper using a 0.6% copper cutoff grade. The mine feasibility study was based on a mining rate of 14.5 Mt/yr of ore during a 20-year mine life. Conventional milling and flotation was being considered to produce a copper-cobalt concentrate at a grade of approximately 34% copper with potential gold credits; an alternative roast-leach-SX-EW process, however, will also be considered. The open pit operation would produce 102,000 t/yr of copper from years 2 to 20 and 38,000 t/yr from years 21 to 24 and 1,900 t/yr cobalt from years 6 to 24. Between years 2 and 6, more than 3,365 kilograms of gold and 3,600 t of uranium oxide could be recovered. A 2000 prefeasibility study estimated capital costs to be \$340 million (Equinox Resources Ltd., 2001§).

Zambezi Joint Venture (a separate venture between Anglo American and Equinox) was exploring for iron oxide copper-gold and Copper Belt copper-cobalt targets in the Kitwe and the Luanshya South areas, in the Kasanka and the Serenje tenements in eastern Zambia, and on the Mwombehzi Dome tenement adjacent to Lumwana in northwestern Zambia. Anglo American, which was the operator, has reduced the concession area to 21,000 km² from 60,000 km² since 1997 and was focusing detailed exploration in 2001 and 2002 on copper mineralization identified at the Ndola West Prospect and on copper-cobalt-gold-uranium mineralization found at the Nyunga Prospect on the Mwombehzi Dome (Equinox Resources Ltd., 2001§).

In January 2002, Orion Mining Plc closed its cobalt processing plant, which was located near the old Kabwe zinc mine. Orion (owned by South African, Swiss, and German investors) had bought the plant from Colossal Resources Corp. of Canada in 2000. As a result of low cobalt prices, it could not justify needed plant refurbishment. It processed between 2,500 t/yr and 3,000 t/yr of cobalt solely from material imported from Congo (Kinshasa) (Reuters, 2002§).

Zinc.—In late 2001, Sable Zinc was founded by former ZCCM employees with support from Commonwealth Development Corp. and the European Investment Bank-Barclays to retreat tailings from the historic Kabwe zinc mine. The \$3.5 million project included construction of a leach plant to treat a blend of washing plant slimes and sand and tailing leach residue with a grade of 10% zinc at a rate of 80,000 t/yr. Plans were to recover 32,000 t of zinc during an initial period of 8 years. The business plan for the project was based on a minimum zinc price of more than \$900 per metric ton. The average LME zinc price for 2001 was approximately \$926 per ton (African Mining, 2001§).

Industrial Minerals

Cement—Chilanga Cement operated cement plants at Lusaka and Ndola on the Copper Belt with capacities rated at 207,000 t/yr and 310,000 t/yr, respectively. Chilanga also had the capacity to produce 441,000 t/yr of clinker. The company sold more than 10% of its annual production to Copper Belt mines and maintained export markets to Malawi and other neighboring countries. In mid-2001, the largest cement producer in the world, Lafarge of France, bought Pan African Cement Group, which had controlling stakes in the following three significant African cement businesses: Chilanga Cement of Zambia, Portland Cement Company of Malawi, and Mbeya Cement Company of Tanzania. LaFarge owned 51.1% of Chilanga Cement (Lewis Mwanangombe, 2001§).

Gemstones.—Zambia produced a range of semiprecious colored gemstones, which included amethyst, aquamarine, emerald, garnet, morganite, and tourmaline; of these, emerald was, by far, the most important (Africa InSites, undated§). Zambia, along with Brazil and Colombia, was the major source of high-quality natural emeralds in the world, and although exports were not well documented, the value of Zambian production and exports was estimated to be more than \$200 million per year. A 1998 assessment estimated production to be around 7,000 kg/yr of emeralds with approximately 3% appraised as top grade and valued at more than \$500 per carat. An additional 37% was appraised as gemstone quality and valued at \$20 to \$500 per carat. Low-grade emerald is sold for use in making synthetic emeralds. Fines are sold in India for use in the decorative arts. Zambian emerald rough is sent to Israel or Sri Lanka for cutting, although the Government is promoting the establishment of value-added cutting industry in the country (Lamprecht, 1998§).

Nearly all emerald production comes from within the Ndola Rural Protected Area. The Government-controlled area is roughly 30 km by 50 km in area and is located about 40 km west of the Copper Belt town of Kitwe. More than 500 mining licenses have been issued in the area, nearly all to artisanal miners. Mining is intermittent with most activity carried out during the dry season. Production is constrained by the lack of capital and equipment available to the artisanal miners. The cash-poor artisanal miners usually sell their rough stones as they are found to middlemen from India and West Africa (Mali, Nigeria, and Senegal). A few medium-scale mining operations existed; the largest of these was Kagem Minerals Ltd. [owned by the Government (55%) and by an Indian-Israeli joint-venture company (45%)]. Using 3-cubic-meter bucket excavators and 35-t haul trucks, Kagem mined about 35,000 metric tons per month (t/mo) of ore, which yielded about 50 kilograms per month of rough emerald. Emerald mineralization occurs within two stages of intrusive pegmatite dikes and within Precambrian ultramafic rocks metamorphosed to a tremolite-chlorite-magnetite schist. A biotite-phlogopite alteration zone at the contact between the schist and the pegmatite is further enriched in emeralds. Structural traps, which include shearing and folding, play a further role in concentrating the emerald mineralization. Bulk mining was used at Kagem; ore below the weathered zone was blasted, crushed, washed, and sorted at the

expense of some loss of emerald crystals. Beryl and emerald rough stones down to -4-millimeter fines were marketed. Sorting and grading was done onsite in a high security facility. Kagem production was sold at auction every 3 months.

The Zambia Privatization Agency (ZPA) had invited offers to purchase the 87% shareholding held by the Government (50%) and Lonrho Africa Limited (50%) in Kariba Minerals Ltd. (KML), a producer of amethyst and tourmaline. The closing date for bids was October 6, 2000. KML was acquired by Gemhouse Inc. of Canada in 2001 (Gemhouse Inc., 2002§; Zambia Privatization Agency, 2000§).

Caledonia Mining Corp. had a joint venture with BHP World Exploration Inc. and Motapa Diamonds Inc. (its affiliate company) to explore the Mulonga Plain, Kashiji Plain, and Kakenge River licences in western Zambia for diamond. During 2001, BHP earned its 60% interest in the joint venture by completing its initial \$3 million in exploration. BHP can increase its interest to 75% with completion of a feasibility study. A 10- to 20-hole drilling program was scheduled for 2002 (Caledonia Mining Corp., 2002§)

Mineral Fuels

Coal.—In 1997, Benicon Limited of South Africa purchased an 80% interest in the country's only coal mine, Maamba Collieries Ltd., under the Government privatization program. In the succeeding years, however, Benicon was faced with limited markets, floods, and other operational problems. During 2000, the mine produced at a rate of only 14,000 t/mo, which was equivalent to only 20% to 25% capacity utilization. With the failure of Benicon to meet a final deadline in August 2000 to make the last \$1.5 million purchase payment on the mine, however, the Government rescinded its agreement with Benicon and repossessed the mine. Remaining proven coal reserves were estimated to be more than 60 Mt (Mwanangombe, 2000§). Maamba Collieries was offered for sale again by the ZPA in 2001, and a bid was made by Kuyasa Mining of South Africa. Having experienced several reversals of investments under the privatization program, which included with Benicon, Binani Group, and Anglo American on KCM, the ZPA was proceeding cautiously with the approval of the Maamba sale to Kuyasa, which was still pending in early 2002 (Times of Zambia, 2002§).

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 Copper Belt, 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 the 20-year civil war in Angola. A 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. (a joint venture of the Zambian and the Tanzanian Governments).

Essentially all Zambia's 8.16-billion-kilowatt-hour energy production in 2000 was from hydroelectric sources.

Outlook

Despite the relatively successful completion of the privatization of the copper-cobalt sector in 2000, high operating costs at the older facilities and historically low world copper and cobalt commodity prices began to threaten the viability of the metal mining sector of the Zambian economy by early 2002. As much as 500,000 to 600,000 t/yr of existing or planned new copper capacity, and the accompanying investment could be canceled or postponed by 2002. A revised U.S. Geological Survey forecast of Zambian copper production for 2008 suggests a production level of about 425,000 t/yr of copper in Zambia by 2008 plus an additional 100,000 t/yr of copper if the Kansanshi project proceeds. A turn-around in this scenario requires rapid recovery in the global economy and renewed demand for copper and cobalt and a successful turnover of KCM assets from Anglo American to a new owner/operator. Future growth in copper capacity is most likely to come from development of new greenfield projects, such as those at Kansanshi and Lumwana. Development of deeper resources at Konkola and Mufalira will require sustained higher commodity prices to justify the high development and cooling costs of mining at depth and under the high geothermal gradients that exist in the Copper Belt.

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

References Cited

- Chadwick, John, 2002, The Zambian Copperbelt: Mining Magazine, v. 186, no. 2, February, p. 64-80.
First Quantum Minerals Ltd., 2002, 2001 annual report: Vancouver, British Columbia, Canada, First Quantum Minerals Ltd., April 22, 50 p.

Internet References Cited

- Africa InSites, [undated], Zambia gemstones—A buyers guide, accessed May 2, 2001, at URL <http://www.africa-insites.com/zambia/info/General/gemstones.htm>.

- African Mining, 2001 (July-August), Retreatment project at historic Kabwe, African Mining [Johannesburg], v. 6, no. 4, accessed September 1, 2002, at URL <http://www.mining.co.za/DataResult.asp?IdNo136>.
- Anglo American plc, 2002 (January 24), Zambia Copper Investments Limited ("ZCI") concludes strategic review of its investment in the Konkola Copper Mine ("KCM") operations in Zambia, Press Release, accessed January 25, 2002, at URL <http://www.angloamerican.co.uk/press/2002/24012002.asp>.
- Anglovaal Mining Ltd., 2001a, Mineral resources and reserves, Annual Report 2001, accessed August 28, 2002, at URL <http://www.avmin.co.za/annualreport/avmin/2001/mineralresourceandreserves.asp>.
- Anglovaal Mining Ltd., 2001b, Review of operations—Base metals, Annual Report 2001, accessed August 28, 2002, at URL <http://www.avmin.co.za/annualreport/avmin/2001/basemetals.asp>.
- Anglovaal Mining Ltd., 2002a (January 29), Partial right-down [sic] of Avmin's Chambishi Metals assets, Press Release, accessed August 28, 2002, at URL <http://www.avmin.co.za/mediashop/pressrelease.asp?story=65>.
- Anglovaal Mining Ltd., 2002b, Results for the half-year ended 31 December 2001, accessed August 28, 2002, at URL <http://www.avmin.co.za/investor/reports.asp>.
- Atlas Copco, 2000 (December 11), Major rig order for new copper mine venture in Zambia, Mining and Construction Online, accessed May 2, 2001, at URL <http://www.miningandconstruction.com/news/news23.htm>.
- Bank of Zambia, 2002, Mineral production and exports, accessed August 9, 2002, at URL http://www.boz.zm/Economics/Fortnightly/2002-07-19/mineral_production_and_exports.htm.
- Caledonia Mining Corp., 2002 (March 31), Financial information, Annual Report for 2001, accessed August 12, 2002, at URL <http://www.caledoniamining.com/welcome2.html>.
- China Government, [undated], Bank digs deep for mining loan, accessed April 30, 2001, at URL <http://www.mlr.gov.cn/english/Bank%20digs%20deep%20for%20mining%20loan.html>.
- Crew Development Corp., 2001, Operations—Chibuluma Mines Plc., accessed August 28, 2002, at URL <http://www.crewgroup.com/operations.html>.
- Equinox Resources Ltd., 2001 (September), Annual report for year ended June 30, 2001, accessed August May 22, 2002, at URL <http://www.eqr.com.au/investor.asp>.
- Gemhouse Inc, 2002, Kariba Minerals Ltd., accessed September 2, 2002, at URL <http://www.gemhouseonline.com/ ygemhouse/about.jsp>.
- International Monetary Fund, 2002 (March), Zambia—Poverty reduction strategy paper, accessed August 13, 2002, at URL <http://www.imf.org/external/np/prsp/2002/zmb/01/index.htm>.
- Lamprecht, Corrie, 1998 (June 12), Emerald Mine Investment Centre, accessed February 28, 2002, at URL <http://members.tripod.com/~emeraldmine/returns.htm>.
- Mwanangombe, Lewis, 2000 (November 30), Zambia ends coal mine deal due to irregularities, Panafrikan News Agency, accessed May 22, 2001, at URL <http://allafrica.com/stories/200011300009.html>.
- Mwanangombe, Lewis, 2001 (April 5), Africa's big cement company wins take-over bid, Panafrikan News Agency, accessed August 12, 2002, at URL <http://allafrica.com/stories/printable/200104050202.html>.
- Reuters, January 28, 2002, Kabwe cobalt plant to shut in new blow to Zambia, accessed May 5, 2002, at URL <http://allafrica.com/stories/200201280455.html>.
- Times of Zambia, 2002 (March 1), Maamba sale awaits, accessed August 12, 2002, at URL <http://allafrica.com/stories/200203010158.html>.
- World Bank, 2002 (February 13), Zambia—Copperbelt environment project, Report P070962, accessed August 15, 2002, at URL http://www-wds.worldbank.org/servlet/WDS_IBank_Servlet?pcont=details&eid=000094946_02022104015671.
- Zambia Copper Investments Limited, 2001 (March 1), Annual/interim reports, Annual Report 2000, accessed May 3, 2002, at URL http://www.zci.lu/annual_report2000.pdf.
- Zambia Copper Investments Limited, 2002 (March 25), Annual/interim reports, Annual Report 2001, accessed May 3, 2002, at URL http://www.zci.lu/annual_report_2001.pdf.
- Zambia Privatization Agency, 2000, Kariba Minerals Ltd., accessed March 27, 2001, at URL <http://zic.org.zm/kariba.htm>.

Major Sources of Information

- Zambia Investment Centre**
 5th Floor, Ndeke House
 Haile Selassie Avenue
 P.O. Box 34580
 Lusaka, Zambia
 Telephone: 260-1-252240
 Fax: 260-1-252150
 Internet: <http://www.zic.org.zm>
- Zambian Privatization Agency**
 Privatization House, Nasser Road
 P.O. Box 30819
 Lusaka, Zambia
 Telephone: 260-1-223858, 227735, 227791, 223859 or 238303
 Fax: 260-1-227250
 E-mail: zpa@zamnet.zm
 Internet: <http://www.zpa.org.zm>
- Ministry of Mines and Minerals Development**
 Permanent Secretary
 P.O. Box 31969
 Lusaka, Zambia
 Telephone: 260-1-254107
 Fax: 260-1-251224
- Director, Mines Development Department**
 P.O. Box 31969
 Lusaka, Zambia
 Telephone: 260-1-251719
 Fax: 260-1-252916
- Director, Geological Survey Department**
 P.O. Box 50135
 Lusaka, Zambia
 Telephone: 260-1-251570
 Fax: 260-1-251973
- Zambian Consolidated Copper Mines—Investments Holdings Plc.**
 Mukuba Pension House
 5309 Dedan Kimathi Road
 P.O. Box 30048
 Lusaka 10101, Zambia

TABLE 1
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1997	1998	1999	2000	2001
METALS					
Cobalt: 2/					
Mine output, Co content	6,037	11,900	5,640	4,600	8,000 e/
Metal, Co content	4,403 r/	4,837 r/	4,236	3,342 2/	4,657 2/
Copper: 2/ 3/					
Mine output, Cu content:					
By concentration or cementation	288,900	258,000	213,000	184,100 r/	233,000
Leaching, electrowon	64,000	57,000	67,000 r/	65,000 r/	79,000
Total	352,900	315,000	280,000 r/	249,100 r/	312,000 2/
Metal:					
Smelter, primary:					
Electrowon, low grade	61,140	51,736	25,000	25,000	25,100
Other	220,327	206,871	217,600 r/	180,000 r/	215,000
Total	281,467	258,607	242,600 r/	205,000 r/	240,100
Refinery, primary:					
Electrowon	63,736	57,000 r/	67,000 r/	65,000 r/	79,000
Other	268,553	245,820	201,400 r/	162,400 r/	217,000
Total	332,289	302,820 r/	268,400 r/	227,400 r/	296,000
Gold 2/ kilograms	290 e/	765	700	600 e/	130 e/
Selenium, refined, gross weight 2/ do.	15,161	14,670	11,620 r/	9,370 e/	12,520 e/
Silver 2/ do.	6,684	8,363	5,840 r/ e/	4,710 e/	6,290 e/
INDUSTRIAL MINERALS					
Cement	384,000	351,000	300,000	380,000	350,000
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	699,343	800,000	800,000	800,000	800,000
Beryl do.	1,527	2,000	4,000 r/	4,000 r/	4,000
Emerald do.	7,000	7,000	7,000	7,000	7,000
Garnet do.	2,467	3,000	3,000	3,000	3,000
Tourmaline do.	--	--	2,000 r/	2,000 r/	2,000
Gypsum e/	11,000	11,000	11,000	11,000	11,000
Lime, calcined e/ thousand tons	200	200	200	200	200
Limestone, for cement and lime e/ do.	800	800	800	800	800
Sand and gravel, construction e/ do.	200	200	200	200	200
Stone, construction: e/					
Limestone, crushed aggregate do.	700	700	700	700	700
Other do.	700	700	700	700	700
Sulfur:					
Gross weight:					
Pyrite concentrate	69,059	72,366	65,000	50,000	59,500
Sulfuric acid 5/	178,482	134,000	119,000	110,000 2/	63,000
Sulfur content:					
Pyrite concentrate (42%)	29,005 4/	30,394 4/	27,300	21,000	25,000
Sulfuric acid (32.6%)	58,185	43,684	38,800	35,800	20,500
Total, S content	87,190	74,078	66,100	56,800	45,500
Talc	44 r/	-- r/	-- r/	-- r/	--
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous e/	164,443 r/	185,717 r/	127,854 r/	168,000 2/	150,000
Petroleum, refinery products e/ 2/ thousand 42-gallon barrels	5,000	5,000	1,700	--	--

e/ Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. r/ Revised. -- Zero.

1/ Table includes data available through August 1, 2002.

2/ Data for 1996-9 are for year beginning April 1 of year stated. Calendar year data shown for 2000-01.

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

4/ Reported figure.

5/ From Nkana and Chambishi acid recovery plants.

TABLE 2
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2001 1/

(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, 51%)	Lusaka Plant	207,000.
Do.	do.	Ndola Plant	310,000.
Coal	Maamba Collieries Ltd. [Kuyasa Mining (South Africa), 80%; Zambian Government, 20%]	350 kilometers south of Lusaka in Kanzie and Izuma Basins	800,000 bituminous coal, operating at 150,000 to 400,000.
Copper-cobalt	Konkola Copper Mines plc (KCM) [Zambia Copper Investments Ltd. (Anglo American plc) 65%; Zambia Consolidated Copper Mines (ZCCM), 20%; International Finance Corp., 7.5%; Commonwealth Development Corp. Group Plc, 7.5%]	Nchanga Open Pit	4,500,000 ore.
Do.	do.	Nchanga Underground Mine	2,800,000 ore.
Do.	do.	Nchanga Concentrator	88,000 copper in concentrate.
Do.	do.	do.	10,000 cobalt in concentrate.
Do.	do.	Nchanga Tailings Leach Plant	70,000 leach cathodes.
Do.	do.	Konkola Underground Mine	2,200,000 ore.
Do.	do.	Konkola Concentrator	50,000 copper in concentrate.
Do.	do.	Konkola Deep Mining Project	180,000 copper (planned).
Do.	Smelterco [Zambia Consolidated Copper Mines-Investment Holdings, Plc. (ZCCM-IH); KCM has option to buy]	Nkana Copper Smelter	450,000 blister/anode.
Do.	do.	Nkana Copper Refinery	236,000 blister/anode.
Do.	Mopani Copper Mines plc (Glencore International AG, 73.1%; First Quantum Minerals Ltd., 16.9%; ZCCM-IH, 10%)	Mufalira Mine	2,800,000 ore.
Do.	do.	Mufalira Concentrator	63,000 copper in concentrate.
Do.	do.	Mufalira Smelter	130,000 copper.
Do.	do.	Mufalira Refinery	150,000 copper.
Do.	do.	Nkana Mine	5,500,000 ore.
Do.	do.	Nkana Concentrator	45,000 copper in concentrate.
Do.	do.	do.	1,900 cobalt in concentrate.
Do.	do.	Nkana Cobalt Plant	2,500 cobalt, refined.
Do.	do.	do.	15,000 copper.
Do.	Anglovaal Mining Ltd. (Avmin) of South Africa, 80%; ZCCM-IH, 20%	Konkola North Project (exploration feasibility studies)	NA.
Do.	Chambishi Metals plc (Avmin, 90%; ZCCM-IH, 10%)	Chambishi Cobalt Plant	4,000 cobalt.
Do.	do.	Nkana Slag Dump (plant upgrade by 2001)	7,000 copper.
Do.	do.	UCHI tails retreatment plant	7,000,000 tailings feed.
Do.	First Quantum Minerals Ltd. (Canada), 100%	Bwana Mkubwa Mine; SX-EW plant treats Nkana tails and ore from Lonshi Mine, Congo (Kinshasa)	13,000 copper cathode, expanding to 30,000 copper by the end of 2002.
Do.	First Quantum Minerals Ltd., 80%; ZCCM-IH, 20%	Kansanshi Mine and environs (mine closed in 1998; feasibility study underway)	75,000 copper (2004 potential).
Do.	Chibuluma Mines Plc (Metorex Ltd., 85%; ZCCM, 15%)	Chibuluma West Mine (to close by 2003 or 2004)	450,000 ore.
Do.	do.	do.	8,400 contained copper.
Do.	do.	Chibuluma South Mine (commissioned July 2001; operations suspended September 2001)	16,500 copper.
Do.	ZCCM-IH, 100% (Roan Antelope Mining Corp. defaulted in 2000; ownership reverted to Government)	Luanshya Underground Mine	1,700,000 ore.
Do.	do.	Luanshya Concentrator	23,000 copper in concentrate.
Do.	do.	Baluba Underground Mine	1,400,000 ore.
Do.	do.	Baluba Concentrator	24,000 copper in concentrate
Do.	do.	do.	1,900 cobalt in concentrate.
Do.	do.	Luanshya Smelter (closed)	20,000.
Do.	do.	Mulashi North Project (planned)	34,000 copper.
Do.	do.	do.	1,400 cobalt.

See footnotes at end of table.

TABLE 2--Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2001 1/

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity 2/
Copper-cobalt--Continued		NFC Africa Mining Plc. (China Non-Ferrous Metals Industries, 85%; ZCCM-IH, 15%)	Chambishi Mine (closed in 1987)	45,000 copper (planned when mine reopens in late 2002).
Do.		Lumwana Joint Venture [Phelps Dodge Corp. (United States), 100%; Equinox Resources Ltd. (Australia) can earn 50%-75% interest]	Lumwana deposit (exploration and prefeasibility work)	100,000 copper (potential).
Do.		Qasim Mining Enterprises Ltd. (Colossal Resources Corp. of Vancouver, British Columbia, Canada, 60%)	Kabwe Cobalt Tails Retreatment Plant (closed in 1999)	600 cobalt.
Do.		Orion Mining Plc	Kabwe Slag Processing Plant [to treat feed imported from Congo (Kinshasa)]	60,000 slag yielding 1,800 to 5,000 cobalt.
Gemstones: e/				
Amethyst	kilograms	Vantage Enterprises Corp. (Canada); and various artisanal operations	Krystal Mine in Kaloma; Mumbwa, near border with Zimbabwe	NA.
Do.	do.	Kariba Minerals Ltd. (Gemhouse Inc. of Canada)	Amethyst and tourmaline mine near Kariba	NA.
Aquamarine	do.	Various artisanal operations	Katete, Petauke areas	NA.
Beryl	do.	do.	Eastern Province pegmatites	NA.
Citrine	do.	do.	Iteshi Teshi; Mumbwa.	NA.
Emeralds	do.	30 to 40 artisanal operations	Ndola Rural Protected Area, northwest of Kitwe	1,000 to 6,000. e/
Do.	do.	Kagem Minerals Ltd. (Government, 55%; Israeli-Indian Joint Venture, 45%)	Mine in Ndola Rural Protected Area, 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.	Reunion Mining plc (Anglo American plc, 100%)	Dunrobin Mine, 120 kilometers west of Lusaka (closed in late 2000)	600.
Do.	do.	Minerva (PMP) Ltd. [Binani Group (India), 100%]	Ndola Precious Metals Plant (processes copper refinery slimes)	150 refined gold.
Lime	metric tons per day	Ndola Lime Co. Ltd. [Socamer (Belgium)]	Ndola plants	1,000 limestone feed.
Do.		do.	Ndola kiln capacity	300,000 quicklime product.
Petroleum	42-gallon barrels	Zambia National Oil Co.	Indeni refinery at Ndola (damaged by fire in 1999)	8,950,000 refined products.
Selenium	kilograms	Minerva (PMP) Ltd. [Binani Group (India), 100%]	Ndola Precious Metals Plant (closed)	22,000 refined selenium.
Silver	do.	do.	do.	10,000 refined silver.
Sulfur: 2/		Konkoo Copper Mines plc	Nampundwe Pyrite Mine	79,000 pyrite.
Do.		do.	do.	33,000 contained sulfur.
Do.		Chambishi Metals plc (Amin, 90%; ZCCM, 10%)	Chambishi Acid Plant	65,000 sulfuric acid.
Do.		do.	do.	21,190 contained sulfur.
Do.		Mopani Copper Mines plc	Nkana Acid Plant	120,000 sulfuric acid.
Do.		do.	do.	39,120 contained sulfur.
Do.		First Quantum Minerals Ltd. (Canada)	Bwana Mkubwa Acid Plant	110,000 sulfuric acid.
Do.		do.	do.	35,860 contained sulfur.
Zinc		Sable Zinc	Kabwe Mine tailings retreatment plant	4,000 zinc

e/ Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. NA Not available.

1/ Includes data available through August 30, 2002.

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

TABLE 3

ZAMBIA: RESERVES AND RESOURCES OF KONKOLA COPPER MINES PLC AS OF DECEMBER 31, 2000 1/

	Proved and probable reserves		Measured and indicated resources 2/	
	Quantity (million metric tons)	Grade (percentage of copper)	Quantity (million metric tons)	Grade (percentage of copper)
Copper ore:				
Konkola current mine 3/	16.2	3.58	1.6	2.81
Konkola Deep Mine Project	91.1	3.81	47.6	3.21
Nchanga open pit	13.4	2.31	16.3	1.62
Nchanga satellite pits	3.8	2.78	14.1	2.07
Nchanga underground	20.3	2.63	2.6	4.68
Nchanga refractory ore dumps	131.9	0.87	19.1	0.87
Nchanga tailings	95.4	0.69 4/	2.5	0.74 4/
		0.49 5/		0.55 5/
Transit stockpiles (copper)	0.8	1.66	2.7	1.06
Total 6/	372.9	1.83	106.5	2.31
Cobalt ore:				
Nchanga open pit	2.4	0.41	8.5	0.34
Nchanga satellite pits	--	--	0.4	0.23
Transit stockpiles (cobalt)	0.9	0.26	0.1	0.25
		1.16 4/		0.51 4/
Total 6/	3.3	0.37	9.1	0.33
Pyrite ore, Nampundwe pyrite mine	6.9	13.70	0.8	17.20

-- Zero.

1/ All reserves and resources have been classified in compliance with the South African Code for the Reporting of Mineral Resources and Reserves (SAMREC).

2/ Resources stated are in addition to the reserves.

3/ A negative adjustment of 0.491 metric tons needs to be made to the total Konkola reserve to account for overlaps and underlaps at the interface between the current mine and the Konkola Deep Mining Project.

4/ Percentage of total contained copper.

5/ Percentage of acid soluble copper.

6/ Indicates reserves and resources total.

Source: Zambia Copper Investments Limited, Annual Report 2000, p. 6.