THE MINERAL INDUSTRY OF

ZAMBIA

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Zambia is a landlocked country in southern Africa with an area of 752,614 square kilometers, a population of 10 million people, and for 1999 (the latest year for which data were available) a per capita gross domestic product (GDP) of $880,[1] based on 1999 purchasing power parity estimates. Overall, mining and quarrying accounted for about 5% of real GDP, 80% of merchandise exports, and about 38,500 jobs, or about 8% of total employment (Zambia Investment Center, April 19, 1999, Zambia—Country profile, accessed February 12, 2000, at URL http://www.zic.org.zm/profile.htm). In 1999, total merchandise exports were $842 million, of which copper accounted for $372 million, and cobalt, $95 million. Fuel and energy imports accounted for $115 million of total merchandise imports of $871 million. The mining sector was dominated by copper and cobalt production. Zambia ranked as the world's 5th largest producer of cobalt, 12th of copper, and one of the top producers of gem-quality emeralds in 2000. 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, recorded significant earnings, but probably an even larger amount bypassed official channels. During 2000, Zambia completed privatization of Zambian Consolidated Copper Mines (ZCCM) assets and began its first full year of private ownership and operation of the copper industry since 1968.

Government Legislation and Policies

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 Companies Act (1994) has brought Zambia's company law in line with modern British company law. The Mines and Minerals Act of 1995, which was passed by Parliament as 1995 Act No. 31 on September 13, 1995, is aimed at attracting risk capital, technology, and entrepreneurial efforts to the mining sector. The Mines and Minerals Act officially put in place a mineral policy that calls for a privatization program to encourage private development and diversification of the mining sector. The act commits the Government to promote small-scale mining; to development of gemstone mining and liberalization of gemstone marketing facilities; to diversification of mining through development of industrial, ferrous, and energy minerals; to reduction of ecological damage arising from mining; and to 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. 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 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 emission.

In November 2000, the World Bank released a proposal to fund a 5-year $59 million Copper Belt environmental project to be implemented by the Government and Zambian Consolidated Copper Mines Investments Holdings Plc. (ZCCM-IH). The project was scheduled for World Bank board review and vote in May 2001. The project would be used to help ZCCM-IH address the environmental liabilities assumed by the Government after the privatization of ZCCM assets. ZCCM-IH held a minority (10% to 20%) interest in the respective newly

[1]Where necessary, values have been converted from Zambian kwacha (K) to U.S. dollars at the rate of K3,225=US$1.00 for 2000 and K2,388=US$1.00 for 1999.

privatized mining companies. The project was designed to develop an environmental management plan (EMP), which is an environmental management funding mechanism, and to strengthen the Government's capacity to monitor adequately the implementation of the EMP (World Bank, November 7, 2000, Zambia—Copperbelt environment project, accessed May 15, 2001, at URL http://www-wds.worldbank.org/pdf_content/000094946001123054355 37/multi_ page.pdf).

Production

In 2000, copper mine production continued its decline to 241,200 metric tons (t); this was a decrease of 11% compared with that of 1996 and less than 30% of the 1969 peak production of 825,000 t. Estimated cobalt mine production declined by 18%, and refined cobalt, by 19% compared with those of 1999; these were also low by historic standards. Production of byproduct gold, selenium, and silver from copper refinery slimes were all down compared with those of 1999. The new mine owners focused on mine and plant rehabilitation efforts in 2000, and based on a review of company plans, copper production is likely to be increased to 325,000 t in 2001 and to around 460,000 t by 2003. Cobalt production should also increase by a factor of 3 or 4 by 2003. Overall, gold production will drop significantly in 2001 because of the closure of the Dunrobin gold mine in November 2000.

Zambia was a major world supplier of emerald and amethyst 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. Chilanga Cement Plc, which was the country's only cement producer, maintained cement production of more than 300,000 metric tons per year (t/yr), while the Maamba coal mine was returned to production in 1999 and 2000 following the 1997 flooding of the mine. Domestic production of refined petroleum products remained impossible because Zambia's only oil refinery Indeni Petroleum was gutted by fire in December 2000; this was a day before the refinery was to begin operations after undergoing a $13 million rehabilitation following a May 1999 fire, which also severely damaged the refinery (United Nations Integrated Regional Information Networks, December 18, 2000, Zambia—Oil refinery gutted by fire again, accessed May 2, 2001, at URL http://www.reliefweb.int/IRIN/sa/countrystories/zambia/20001218a.phtml).

Trade

For many years, the major mineral exports, by value, have been copper and cobalt. Some observers, however, believe that gemstones have been very significant in export value, possibly second to copper, despite the absence of official records. In 1998, the Government indicated that the value of legally and illegally exported gemstones may be as much as $250 million per year. More than half of copper and cobalt exports went to Europe and Asia. 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.—In 2000, the privatization of ZCCM and the full transition of one of the world's larger copper industries from state-owned to privately owned and operated were completed. Cobalt is produced as a byproduct of copper mining and processing. Details of the structure of the newly privatized mining industry are shown in table 2. In April, a consortium comprising First Quantum Minerals Ltd. of Canada and Glencore International AG, which was a privately owned Swiss metals trading company, finalized its agreement to purchase ZCCM's Mufulira Division (which included mines, the concentrator, the smelter, and the refinery) and selected Nkana Division assets (which included the mining operation, the concentrator, and the cobalt plant). The newly formed operating company Mopani Copper Mines Plc. (Mopani) will be owned by Glencore (46%), First Quantum (44%), and ZCCM (10%). Under the terms of the acquisition, "ZCCM received a cash consideration of $20 million upon closing and will receive deferred payments of $23 million in five equal annual installments starting in January 2003. ZCCM will also be provided with a copper price participation plan to be calculated at 2% of the copper price over and above $0.85 per pound, payable for five years from 2003 and capped at $4.4 million. Mopani will commit to invest $159 million in the Mufulira ($84 million) and Nkana ($75 million) operations over the first three years" (First Quantum Minerals Ltd., April 3, 2000, First Quantum-Glencore consortium complete transaction with ZCCM—Nkana and Mufalira assets transferred to Mopani Copper Mines Plc., accessed April 5, 2000, via URL http://www.first-quantum.com).

First Quantum also owned and operated the Bwana Mkubwa Mine near Ndola. During 2000, Bwana Mkubwa treated more than 1.8 million metric tons (Mt) of tailings in its solvent extraction-electrowinning (SX-EW) circuit; this yielded 10,025 t of copper compared with 9,621 t in 1999. The SX-EW plant also generated 61,889 t of excess sulfuric acid for sale to other Copper Belt operations. The company reported remaining reserves at Bwana Mkubwa of 4 Mt at a grade of 0.73% copper, which was sufficient for an additional 3-year mine life (First Quantum Minerals Ltd., 2001, p. 11).

For the 8 months of operation following its takeover from ZCCM in April, Mopani mined 1.2 Mt of ore at a grade of 2.2% copper at the underground Mufalira Mine; this yielded 27,754 t of copper. As part of its rehabilitation program, Mopani brought in new drilling and mining equipment that enabled it to maintain development of Mufulira Mine reserves well ahead of ore production. At yearend, Mufulira had estimated reserves of 27 Mt at a grade of 3.04% copper included in mineral resources of 69 Mt at a grade of 3.1% copper. For the 8 months of

operation in 2000, Mopani mined 1.6 Mt of ore at a grade of 1.76% copper and 0.12% cobalt at the underground Nkana Mine; this yielded 18,050 t of copper and 749 t of cobalt. A combination of new equipment and improved mining practices resulted in a 20% increase in ore grades mined above the 15-year historic average of 1.5% copper. Cobalt concentrates, which averaged 7% copper and 1.6% cobalt, were sent to the Chambishi and the Nkana cobalt refineries for treatment. Reported yearend reserves at Nkana were 75 Mt at a grade of 2.26% copper and 0.14% cobalt. Mineral resources, which included reserves, were estimated to be 259 Mt at a grade of 2.19% copper and 0.10% cobalt. Mopani forecast production rates at Nkana to be 52,000 t of copper and 1,700 t of cobalt for 2001 and 63,000 t of copper and 2,300 t of cobalt for 2002 (First Quantum Minerals Ltd. 2001, p. 15-17).

In May, First Quantum purchased the exploration portfolio of Cyprus Amax Zambia (Cymax) from Phelps Dodge Exploration Corp. The Cymax assets included the Luamata, the Luswishi, the Mwinilunga, and the Solwezi prospecting licenses. Phelps Dodge received $25,000 plus a 2% to 3% net proceeds interest and the one-time back-in right to acquire a 20% participating interest following First Quantum expenditures of $5 million at Mwinilunga, $3 million at Solwezi, and $2 million at Luamata. Phelps Dodge retained the Cymax interest in the Kansanshi copper project, where identified resources totaled 150 Mt at a grade of 1.5% copper (First Quantum Minerals Ltd., May 26, 2000, First Quantum acquires exploration portfolio from Phelps Dodge, accessed July 8, 2000, via URL http://www.first-quantum.com). In November, First Quantum signed an agreement with Billiton plc. on exploration of the Lumwata and the Mwinilunga prospecting licenses, whereby Billiton can earn-in up to a 51% interest in these projects by completing $2.4 million in exploration and up to a 70% interest by arranging financing for development of any economic deposit found during exploration.

In October 1999, Zambia Copper Investments Ltd. (ZCI) (owned 50.9% by Anglo American plc) signed a heads of agreement with ZCCM to acquire the Konkola and the Nchanga Divisions. The agreement was finalized in March 2000, with the announcement that the new Anglo American company Konkola Copper Mines plc (KCM) will acquire the Konkola Division [which included the Konkola Deep Mining Project (KDMP)], the Nchanga Division (which included the Chingola refractory ore stockpiles), the Nampundwe pyrite mine, and associated infrastructure (which included the Konkola, the Nampundwe, and the Nchanga concentrators and the Nchanga tailings leach plant). KCM will be owned by ZCI (65%), ZCCM (20%), International Finance Corp. (7.5%), and Commonwealth Development Corp. Financial Services (7.5%). KCM agreed to pay ZCCM $90 million in acquisition payments plus a copper and cobalt price participation bonus scheme to be capped at $16 million per year and $125 million during the life of the scheme. In addition, KCM committed to capital expenditures of $260 million to rehabilitate the operations and, subject to financing and favorable copper markets, to develop the KDMP at an estimated cost of $523 million. In a parallel transaction, ZCI sold its 27.3% interest in ZCCM to the Government for $30 million. KCM also had an option to buy the Nkana copper smelter after March 2003 (Anglo American plc, 1999, 2000). In June, the Government of the United Kingdom provided an $81 million grant to ZCCM-IH to rehabilitate the Nkana copper smelter and refinery. The Nkana plants will be managed by KCM under an agreement with ZCCM-IH (Times of Zambia, 2000).

During the 9 months of operation following its takeover of these ZCCM assets in 2000, KCM processed 5.97 Mt of copper ore and 463,000 t of cobalt ore, which yielded 93,711 t of copper and 3,129 t of cobalt contained in concentrates. Refined production amounted to 125,385 t of copper and 1,114 t of cobalt. Efforts by KCM during 2000 focused on investing $70 million in refurbishing operational assets; reconfirming the feasibility study on the KDMP, which was expected to be completed by the first quarter of 2001; and seeking to raise long-term financing for the project. Subject to a favorable feasibility study and obtaining of finance, KCM expected to begin construction of the KDMP, which will take 5 years to complete, in 2002. KCM planned on producing 240,000 t of refined copper in 2001 (Zambia Copper Investments Ltd., 2001). The KDMP could add more than 200,000 t/yr of new copper production by 2008. Konkola deep ore reserves were estimated to be 100 Mt at a grade of 4.33% copper plus mineral resources of 55 Mt at a grade of 3.13% copper (David McKay, March 13, 2000, Anglo's ZCCM purchase is first block in base metals empire, Base metals—The mining web, accessed February 2, 2001, via URL http://www.miningweb.co.za).

Roan Antelope Mining Corp. of Zambia (RAMCOZ) (controlled by Binani Group of India) operated the Baluba and the Luanshya Mines and was examining the feasibility of developing the Muliashi deposit. Binani also owned and operated the Ndola Precious Metals Plant. The company has been faced with operational and financial problems since it took over the mines in 1998. RAMCOZ produced 24,900 t of copper and 476 t of cobalt through January 1999. Unable to pay employees, contractors, Copperbelt Energy Co. for its electrical power, or the obligations owed to the Zambia National Commercial Bank, the Luanshya underground mine was shut down in October 2000, and RAMCOZ was placed into receivership in November 2000 (Chali Nondo, The Monitor for Human Rights and Development [Zambia], November 17-23, 2000, RAMCOZ workers cry foul, accessed May 1, 2001 at URL http://afronet.org.za/monitor133/headline2.htm; World Mining Equipment, November 23, 2000, Zambia's troubled Roan Antelope Mining Corp. (Ramcoz) was put under receivership on 22 November, accessed May 2, 2001, at URL http://www.wme.com/wme/headlines/head1123.htm). With the help of temporary financing arranged in part by the Government receiver, the mine was reopened in January 2001. Problems were compounded when the Luanshya Mine was flooded by heavy rains in early March 2001. Separately, in August 2000, RAMCOZ announced plans to raise $57 million to develop the Muliashi North project at a rate of 34,000 t/yr of copper and 1,400 t/yr of cobalt, which will increase to 60,000 t/yr copper after 5 years (Business Day Online, August 18, 2000, Roan Antelope to develop copper and cobalt operation, accessed January 21, 2001, at URL http://www.businessday.co.za/bday/content/direct/1,3523,680606-6078-0,00.html).

Chibuluma Mines plc (controlled by Metorex Ltd. since late 1997) owned and operated the Chibuluma West Mine near

Kalulushi and the new Chibuluma South Mine, 12 kilometers (km) south of Chibuluma West. During 2000, the Chibuluma West Mine operated at a rate of 276,000 t/yr of ore at an average grade of 3.68% copper and 0.1% cobalt. Overall recovery rates were 87% for copper and 36% for cobalt. Production was 8,844 t/yr of cathode copper, which was smelted and refined at the Smelterco facilities, and 100 t of flake cobalt, which was refined at Mopani's cobalt refinery. As of June 30, proved and probable reserves at Chibuluma West were estimated to be 254,000 t at a grade of 3.8% copper and 0.1% cobalt and at a cutoff grade of 1.2% copper, inclusive of a dilution factor of 25% and an extraction factor of 85%. Mineral resources, exclusive of reserves, at Chibuluma West were estimated to be 981,000 t at a grade of 4.7% copper and 0.1% cobalt. Exploration during 2000 extended the life of the Chibuluma West Mine by 3 to 5 years. Current (2000) copper production of 700 metric tons per month (t/mo) from Chibuluma West will increase to 1,500 t/mo with the startup of Chibuluma South.

The $25 million Chibuluma South project was expected to begin production in April 2001. The first stage of the project will include an open pit to mine near surface ore and a new processing plant capable of treating oxide and sulfide ores at a rate of 40,000 t/mo for 4 years. In the second phase, a vertical shaft and incline ramp system will be constructed to access the underground reserves. Underground production will match the open pit's 40,000 t/mo, thus giving the mine a total life of more than 16 years. Proved mineral reserves at Chibuluma South were 7.3 Mt at a grade of 3.7% copper and at a cutoff grade of 1% copper, inclusive of dilution and extraction factors of 10% and 85%, respectively. Metorex reported an inferred resource of 1.5 Mt at a grade of 2.9% copper at the Chifupu prospect near Chibuluma South (Metorex Ltd., Our companies—Chibuluma Mines PLC, accessed May 12, 2001, at URL http://www.metorexgroup.com/Chibuluma.htm).

NFC Africa Mining plc (controlled by the Chinese parastatal China Nonferrous Materials Industry Engineering and Construction Group) announced that it was planning to invest $200 million in the Chambishi Mine project. It acquired the closed mine from ZCCM in June 1998 for $20 million. Rehabilitation work started in July 2000 and was expected to be completed and mining resumed by the end of 2002, with full operational capacity reached by 2003. Chambishi will mine 2.15 million metric tons per year (Mt/yr) of ore 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 (Atlas Copco, December 11, 2000, Major rig order for new copper mine venture in Zambia, accessed May 2, 2001, at URL http://www.miningandconstruction.com/news/news23.htm; China Economic Review, March 1, 2000, Investment in Zambian mine, accessed July 9, 2000, at URL http://www.chinaeconomicreview.com/htm/20000401cer12i.htm; Ministry of Land and Resources P.R.C., [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).

Chambishi Metals plc [owned by Angolvaal Mining Ltd. (Avmin) 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 $100 million Nkana slag-processing facility was expected to begin production by early 2001. Production was expected to reach 4,000 t/yr of cobalt and 7,000 t/yr of copper by mid-2001. Resources contained in the slags were reported to be 20 Mt at a grade of 0.76% cobalt and 1.16% copper and were expected to last for more than 20 years. Avmin also was examining the potential for developing the Konkola North copper project where resources were reported to be 147 Mt at a grade of 2.15% copper. Following a $15 million refurbishment, Avmin's Chambishi cobalt plant was toll-refining concentrates for the other Copper Belt companies (Anglovaal Mining Ltd., [undated], Base metals—Chambishi Metals plc, accessed May 2, 2001, at URL http://www.avmin.co.za/operations/chambishi.asp).

During 2000, Equinox Resources Ltd. of Australia received the findings of a prefeasibility study completed on the Lumwana project by Bateman Engineering Inc. of South Africa. 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 that 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. Using a 0.2% copper cutoff and a $0.85 copper price, the combined proven and probable reserves plus the inferred resource amounted to 85 Mt at a grade of 0.98% copper at the Malundwe deposit and 245 Mt at a grade of 0.64% copper at the Chimiwunga deposit. These deposits had been discovered by Roan Selection Trust Ltd. in the early 1960s. Based on a 1990 assessment, the Malundwe area also had a geological resource of 7.2 Mt at a grade of 0.14% uranium oxide. 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 will be used at Lumwana to produce a copper-cobalt concentrate at a grade of approximately 34% copper with potential gold credits. 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, as well as 1,900 t/yr cobalt from years 6 to 24. Between years 2 and 6, more than 3,365 kg of gold and 3,600 t of uranium oxide could be recovered. Bateman estimated capital costs to be $340 million. During 2001, Equinox will conduct a full bankable feasibility study and also look at the potential synergies in developing the Lumwana as a combined project with Phelps Dodge's Kansanshi deposit to produce more than 200,000 t/yr of copper for more than 25 years. In a separate joint venture with Anglo American, Equinox also was exploring for iron-oxide/copper/gold and Copper-Belt-style targets in the Kitwe and Luanshya South areas, in the Kasanka and Serenjie tenements in eastern Zambia, and on the Mwombehzi Dome tenement adjacent to Lumwana in northwestern Zambia (Equinox Resources Ltd., September 29, 2000, Annual report

2000, accessed May 22, 2001, at URL http://www.eqr.com.au/pdfs/report.pdf; Equinox Resources Ltd., January 31, 2000, Equinox Resources Ltd. quarterly report to shareholders for the three months ended December 31, 2000, accessed May 22, 2001, at URL http://www.eqr.com.au/pdfs/4qtr00.pdf).

In August, Caledonia Mining Corp. of Canada signed a farm-in agreement with BHP World Minerals Inc. of Australia whereby BHP can earn a 30% interest in Caledonia Mining's Kalimba Group copper-cobalt properties by spending $2.5 million during the first 5 years and up to 50% by spending an additional $4 million. Kalimba Group included the Nama and Ngosa areas, where Caledonia Mining had previously identified a resource of about 950 Mt at a cobalt equivalent grade of 0.029% (Caledonia Mining Corp., August 29, 2000, Caledonia and BHP sign agreement on Caledonia's Kalimba Group properties in Northern Zambia, accessed May 2, 2001, at URL http://www.caledoniamining.com/aug29_00.pdf). Caledonia held other exploration licenses, which included the Kadola copper-cobalt-gold prospects examined between 1997 and 2000 by Cymax (its joint-venture partner before it withdrew from Zambia).

Industrial Minerals

Ammonia.—In February, Nitrogen Chemicals of Zambia (NCZ) announced that it would resume production of ammonia from domestic coal resources in response to the high cost of ammonia imported by rail from Sasol operations in South Africa. NCZ was rehabilitating its ammonia production plant after a 7-year shutdown and was seeking the finances to buy 5,000 t of coal from Maamba Collieries to start producing ammonia gas for nitrogen fertilizer generation (Times of Zambia, February 18, 2000, NCZ to produce ammonia gas, accessed April 30, 2000, at URL http://allafrica.com/stories/20002180039.html).

Cement.—Chilanga Cement plc. operated cement plants at Lusaka and Ndola on the Copper Belt with capacities rated at 200,000 t/yr and 290,000 t/yr, respectively. Chilanga Cement 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. During 2000, however, Chilanga Cement reported that its production costs remained high, which made competitiveness with cement imported from within the region difficult. High production costs were attributed to the high cost of coal bought from Maamba Collieries, which was reportedly five times more expensive than that from neighboring countries, and the high cost of transportation from the Maamba coal mine. Chilanga Cement also had to pay a 25% duty on imported raw materials used at its cement plants (Mackson Wasamunu, October 23, 2000, High costs disadvantage Chilanga Cement, accessed May 2, 2001, at URL http://allafrica.com/stories/200010230110.html).

Gemstones.—The gemstone-processing industry in Zambia has continued to grow as more and more companies decide to invest in this area. In December 1999, the Zambia Investment Centre Board issued a certificate to Dia Star Gemstone Ltd. of India, which planned to invest $111,000 into cutting and polishing of amethyst, aquamarine, emeralds, red garnet, and pink tourmaline for export to markets in India, Japan, and other countries in the Far East. The company, whose operations will be based at Lusaka, will employ 21 Zambians (Zambia Investment Centre, December 1999, Gemstone processing on rise in Zambia, accessed June 1, 2000, at URL http://www.zic.org.zm/december99.htm).

The Zambia Privatization Agency invited offers to purchase the 87% shareholding held by the Government (50%) and Lonrho Africa Ltd. (50%) in Kariba Minerals Ltd. (KML). The closing date for bids was October 6, 2000. KML operated the oldest and largest amethyst mine in Zambia and one of the largest deposits of high- and low-grade amethyst in the world. KML's license was within the Kaloma Mapatizya amethyst mine field, which is located in southwestern Zambia near the Zimbabwean border. Mining was done by bulldozers to remove overburden and by pick and shovel to mine amethyst selectively. Kaloma Mapatizya was estimated to have 2.5 Mt of ore that contained approximately 72,000 t of run-of-mine amethyst, or more than 2.6 million kilograms of high- and low-grade salable amethyst plus "unlimited" amounts of low-grade amethyst (Zambia Privatization Agency, [undated], Kariba Minerals Ltd., accessed March 27, 2001, at URL http://zic.org.zm/kariba.htm).

Zambia possessed a wide variety of semiprecious gemstones, most of which were exploited by artisanal and small scale miners (Africa InSites, [undated], Zambia gemstones—A buyers guide, accessed May 2, 2001, at URL http://www.africa-insites.com/zambia/info/General/gemstones.htm).

Caledonia Mining had a joint venture with BHP and Motapa Diamonds Inc. (its affiliate company) to explore the Mulonga Plain, the Kashiji Plain, and the Kakenge River licences in western Zambia for diamonds. During 2000, BHP conducted geophysical and stream-sampling programs, with a drilling program begun in the last quarter of 2000, to test an area of kimberlite indicator minerals within the Mulanga Plain license (Caledonia Mining Corp., March 31, 2001, Caledonia Mining Corp. annual report for 2000, accessed May 2, 2001, at URL http://www.caledoniamining.com/html/2000_annual_report.html).

Mineral Fuels

Coal.—Since the agreement to purchase an 80% interest in the country's only coal mine Maamba Collieries from the Government in 1997, Benicon Ltd. of South Africa (the new owner) had been faced with limited markets, floods, and other operational problems. During 1999, Maamba accumulated a 15,000-t stockpile of unsold production. During 2000, the mine produced at a rate of only 14,000 t/mo, which was equivalent to only 20% to 25% of capacity. With the failure of Benicon to meet a final deadline in August 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. Maamba Collieries will be offered for sale again by the Zambia Privatization Agency (Lewis Mwanangombe,

Panafrican News Agency, November 30, 2000, Zambia ends coal mine deal due to irregularities, accessed May 22, 2001, at URL http://allafrica.com/stories/200011300009.html).

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 were paved, and about 20% were gravel or stabilized earth. The principal rail routes were northeastward 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 southward through Zimbabwe to and from South African ports—which are more than 2,500 km from Ndola—on Zambia Railways Ltd.'s line in Zambia. The roughly 2,000-km rail link southeast through Zimbabwe to the port of Beira in Mozambique 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 the Democratic Republic of the Congo [Congo (Kinshasa)] and west to the port of Benguela (Lobito) in Angola has remained unavailable during the 20-year civil war in Angola. A crude oil pipeline ran about 1,700 km southeast from Dar es Salaam to a refinery in Ndola and 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-kilowatthour energy production in 2000 was from hydroelectric sources.

Outlook

The successful completion of the privatization of the copper sector held promise for the revitalization of the minerals sector of the Zambian economy. Assuming investment and copper market conditions remain favorable, more than $2 billion is expected to be invested in the rebuilding of the copper industry between 1998 and 2008. Production is expected to increase from 233,000 t/yr of refined copper and 4.2 t/yr of refined cobalt in 1999 to approximately 620,000 t/yr copper and 20 t/yr of refined cobalt by 2008. This could return Zambia to the position of the largest cobalt producer and one of the top five or six copper producers in the world.

The country, however, faces several internal and external hurdles to development, including high transportation costs, the threat that a high HIV/AIDS infection rate in the region poses on maintaining a skilled labor force, cyclical world commodity prices, and the impact of civil wars in neighboring Angola and Congo (Kinshasa), which would add to the political risk of financing new projects. Stabilization of all or some of these factors will be needed for the country to benefit fully from the expected infusion of 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. A renewed exploration interest in diamond and zinc resources is also evident.

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TABLE 1
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 e/
METALS						
Cobalt: 2/						
Mine output, Co content		6,959	6,037	11,900	5,640	4,600
Metal, Co content		4,611	4,386	5,011	4,236	3,450 3/
Copper: 2/ 4/						
Mine output, Cu content:						
By concentration or cementation		276,000	288,900	258,000	213,000 r/	186,200 3/
Leaching (electrowon)		58,000	64,000	57,000	57,000	55,000 3/
Total		334,000	352,900	315,000	270,000 r/	241,200 3/
Metal:						
Smelter, primary:						
Electrowon (low grade)		73,900	61,140	51,736	25,000	25,000 3/
Other		250,300	220,327	206,871	184,000	169,500 3/
Total		324,200	281,467	258,607	209,000	194,500 3/
Refinery, primary:						
Electrowon		58,000	63,736	80,709	57,000	55,000 3/
Other		276,000	268,553	248,820	176,300	170,200 3/
Total		334,000	338,400 r/	240,500	233,300	225,200 3/
Gold 2/	kilograms	119	290 e/	765	700	600 e/
Selenium, refined, gross weight 2/	do.	20,016	15,161	14,670	10,170	9,820
Silver 2/	do.	9,410	6,684	8,363	5,110	4,940
INDUSTRIAL MINERALS						
Cement:		348,000	384,000	351,000	300,000	380,000
Clays:						
Brick e/		3,000	3,000	3,000	3,000	3,000
Building, not further specified e/		30,000	30,000	30,000	30,000	30,000
China and ball e/		200	200	200	200	200
Gemstones: e/						
Amethyst	kilograms	1,198,354	699,343	800,000	800,000	800,000
Aquamarine	do.	866	--	--	--	--
Beryl	do.	4,544	1,527	2,000	2,000	2,000
Emerald	do.	6,000	7,000	7,000	7,000	7,000
Garnet	do.	13,701	2,467	3,000	3,000	3,000
Tourmaline	do.	4,150	--	--	--	--
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
Magnetite, gross weight e/		-- r/	-- r/	-- r/	-- r/	--
Nitrogen, N content of ammonia e/		-- r/	-- r/	-- r/	-- r/	--
Sand and gravel, construction e/	thousand tons	200	200	200	200	200
Stone, construction:						
Limestone, crushed aggregate e/	do.	700	700	700	700	700
Other e/	do.	700	700	700	700	700
Sulfur:						
Pyrite concentrate:						
Gross weight		78,971	69,059	72,366	65,000	50,000
S content (42%) e/		33,200	29,005	30,394	27,300	21,000
Sulfuric acid: 5/						
Gross weight		206,572	178,482	134,000	119,000	110,000 3/
S content (32.6%)		67,340	58,185	43,684	38,800	35,800
Total, S content		100,540	87,190	74,078	66,100	56,800
Talc e/		80	80	80	80	80
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous e/	thousand tons	100	10	186 r/	128 r/	168 3/
Petroleum, refinery products e/ 2/	thousand 42-gallon barrels	5,000	5,000	5,000	1,700 r/	--

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

1/ Table includes data available through May 15, 2001.

2/ Data are for year beginning April 1 of year stated for 1996-1999.

3/ Reported figure.

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

5/ From Nkana and Chambishi acid recovery plants.

TABLE 2
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 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 (Commonwealth Development Corp., 50.1%; general public, 30.2%; Anglo American plc, 16.7%; Civil Service Pensions Board, 6.5%)	Lusaka plant	200,000.
Do.	do.	Ndola plant	290,000.
Coal	Maamba Collieries Ltd. [Benicon Ltd. (South Africa), 80%; Zambian Governmnet, 20%]	350 kilometers south of Lusaka in Kanzie and Izuma Basins	800,000 bituminous coal (operating at 300K to 400K).
Copper-cobalt	Konkola Copper Mines plc [Zambia Copper Investments Ltd. (Anglo American plc), 65%; Zambia Consolidated Copper Mines (ZCCM), 20%; International Finance Corp., 7.5%; Commonwealth Development Corp., 7.5%]	Nchanga and Chingola open pits	4,500,000 ore.
Do.	do.	Nchanga underground mine	2,800,000 ore.
Do.	do.	Nchanga concentrator	88,000 copper in concentrate; 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. 3/
Do.	do. 4/	Nkana copper smelter	450,000 blister/anode.
Do.	do. 4/	Nkana copper refinery	236,000 blister/anode.
Do.	Mopani Copper Mines plc (Glencore International AG, 46%; First Quantum Minerals Ltd., 44%; ZCCM, 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; 1,900 cobalt in concentrate.
Do.	do.	Nkana cobalt plant	2,500 cobalt, refined; 15,000 copper.
Do.	Anglovaal Mining Ltd. (Avmin), 80%; ZCCM, 20%)	Konkola North project 5/	2,200,000 ore.
Do.	Chambishi Metals plc (Avmin, 90%; ZCCM, 10%)	Chambishi cobalt plant	4,000 cobalt.
Do.	do.	Nkana slag dump 6/	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 7/	9,500 copper cathode.
Do.	Chibuluma Mines plc (Metorex Ltd., 85%; ZCCM, 15%)	Chibuluma West Mine 8/	450,000 ore; 8,400 contained copper; 100 contained cobalt.
Do.	do.	Chibuluma South Mine project 9/	18,000 copper. 3/
Do.	Roan Antelope Mining Corp. [Binani Group (India) 85%; ZCCM, 15%]	Luanshya underground mine	1,700,000 ore.
Do.	Roan Antelope Mining Corp.	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; 1,900 cobalt in concentrate.
Do.	do.	Luanshya smelter 10/	20,000.
Do.	do.	Mulashi North project	34,000 copper; 1,400 cobalt. 3/
Do.	NFC Africa Mining plc (China Non-Ferrous Metals Industries, 85%; ZCCM, 15%)	Chambishi Mine 11/	45,000 copper. 12/
Do.	Cyprus Amax Kansanshi plc (United States), 80%; ZCCM, 15%)	Kansanshi Mine and environs 13/	NA.
Do.	Lumwana Joint Venture (Phelps Dodge Corp., 100%) 14/	Lumwana deposit 15/	75,000 copper. 16/
Do.	Qasim Mining Enterprises Ltd. (Colossal Resources Corp. of Vancouver, Canada, 60%)	Kabwe cobalt tails retreatment plant 17/	600 cobalt.
Do.	Orion Mining Zambia	Kabwe slag processing plant 18/	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 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, Mumbwa	NA.
Emeralds do.	30 to 40 artisanal operations	Northwest of Kitwe	600.

See footnotes at end of table.

TABLE 2--Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity 2/
Gemstones--Continued: e/				
Garnet	kilograms	Various artisanal operations	Eastern Province pegmatites, Mazabuka, Siavunga, Chikankata, Gwemba Valley	NA.
Tourmaline	do.	do.	Kalunga Wbeba Mine, Eastern Province; Hofmeyer Mine near Nyimba	NA.
Gold	do.	Reunion Mining plc (Anglo American plc, 100%)	Dunrobin Mine, 120 kilometers west of Lusaka	600.
Do.	do.	Minerva (PMP) Ltd. (Binani Group of India, 100%) 19/	Ndola precious metals plant	150 refined gold.
Lime	tons per day	Ndola Lime Co. Ltd. (ZCCM, 100%)	Ndola plants	1,000 limestone feed
Do.		do.	Ndola kiln	300,000 quicklime product.
Petroleum	42-gallon barrels	Zambia National Oil Co.	Indeni refinery at Ndola 20/	8,950,000 refined products.
Selenium	kilograms	Minerva (PMP) Ltd. (Binani Group of India, 100%)	Ndola precious metals plant	22,000 refined selenium.
Silver	do.	do.	do.	10,000 refined silver.
Sulfur 2/		Konkola Copper Mines plc [Zambia Copper Investments Ltd. (Anglo American plc), 65%; ZCCM, 20%; International Finance Corp., 7.5%; Commonwealth Development Corp., 7.5%]	Nampundwe pyrite mine	79,000 pyrite, 33,000 contained sulfur.
Do.		Chambishi Metals plc (Avmin, 90%; ZCCM, 10%)	Chambishi acid plant	65,000 sulfuric acid, 21,900 contained sulfur.
Do.		Mopani Copper Mines plc (Glencore International AG, 46%; First Quantum Minerals Ltd., 44%; 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.

e/ Estimated. NA Not available.
1/ Includes data available through April 30, 2001.
2/ Some capacities shown, based on former Zambia Consolidated Copper Mines operations.
3/ Planned capacity.
4/ KCM has option to buy.
5/ Exploration and feasibility studies.
6/ Plant upgrade by 2001.
7/ Tailings retreament operation
8/ To close by 2003 or 2004
9/ To open by 2003 or 2004
10/ Closed.
11/ Closed in 1987.
12/ Planned capacity when plant reopens in late 2002.
13/ Mine closed in 1998; exploration continuing.
14/ Equinox Resources Ltd. of Australia can earn 50% to 75% interest.
15/ Exploration and prefeasibility work being conducted.
16/ Potential capacity.
17/ Closed in 1999.
18/ Plant to treat feed imported from Congo (Kinshasa).
19/ Processes copper refinery slimes.
20/ Damaged by fire in 1999.