

# THE MINERAL INDUSTRY OF

# ZAMBIA

By George J. Coakley

Zambia is a landlocked, southern African country with an area of 753,000 square kilometers (km<sup>2</sup>), nine million people and a per capita gross domestic product (GDP) of \$450.<sup>1</sup> The economy is beginning to show some growth and inflation has been reduced from 184% in 1993 to 35% in 1995. Overall, mining contributed to 5.5% of real GDP in 1995. Copper and cobalt production by the state-owned, Zambian Consolidated Copper Company (ZCCM) continued to be the major component of the minerals sector of the Zambian economy and its chief source of foreign exchange earnings in 1995. Zambia ranked as the world's 2nd largest producer of cobalt, after Canada; 11th in copper, down from 5th place in 1992; and as one of the top producers of gem-quality emeralds in 1995. Copper accounted for 71% of export earnings and its byproduct cobalt for 6% of total exports of \$1.19 billion in 1995. Gemstones, mostly emeralds, also recorded significant earnings, but probably an even larger amount bypassed official channels. Besides copper and cobalt, Zambia produced a wide variety of metallic, industrial, and 1 mineral fuel commodities. (See table 1.) Resources of those minerals in production generally were extensive, including separate, unexploited deposits in various areas, and occurrences of other potentially valuable minerals were widespread geographically in the Texas-sized country.

Zambia's economy was dependent on one commodity, copper; however the Government's past practice of diverting mineral earnings for various social or other economic purposes, while neglecting the need for reinvestment in the industry, has led to a progressive decline in copper production and revenue. As part of the economic reform program and transition to a market economy, the new Government began in 1994 to privatize most of the more than 100 Government-controlled companies. Although this effort was progressing with several units in the minerals sector included among those put up for sale, the schedule and precise form of privatization of ZCCM, the country's major single enterprise, was not resolved by year end 1995. ZCCM had been formed in 1982 with the merger of Nchanga Consolidated Copper Mines Ltd. and Roan Consolidated Copper Mines Ltd., making it at the time the world's second largest copper company after Codelco-Chile. The stalemate on the sale of ZCCM was due to differing opinions on its potential impact within the Government and on whether it should be split up or sold as one entity. Several studies by

international firms failed to provide a basis for consensus.

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. In December 1994, the Government announced its policy to no longer participate in exploration or become a shareholder in a mining company, and to limit its functions to regulatory or promotional activities. Subsequently, the new December 1995 Mining Policy officially put in place a privatization program to encourage private development and diversification of the mining sector; to promote small-scale mining; to promote development of gemstone mining and liberalization of gemstone marketing facilities; to promote exploitation of industrial and energy minerals and development of ferrous minerals; to promote reduction of ecological damage arising from mining; and to promote local value added processing of Zambia's mineral raw materials.<sup>2</sup>

The Government continued to promote actively the private sector and seek foreign investment, particularly in minerals. The Mines and Minerals Act of 1995, 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 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 reported were secure title to mining rights with provision to assign; 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.

Parliament's Environmental Protection and Pollution Control Act (No. 12) of 1990 (EPPCA) formed the basis for a Ministry of Environment and Natural Resources and also an Environmental Council of Zambia. The act formally came into full force in February 1992 and gave the Ministry overall responsibility for protecting the environment.

ZCCM had followed a self-regulatory approach to environmental protection for some time. It established

standards based on limits elsewhere in the world. After the EPPCA came into full force, ZCCM put into place an appropriate management structure with the help of consultants under a World Bank Technical Assistance package. In April 1994, ZCCM commenced a more intensive 2-year program of personnel education, discharge measuring, formal reporting, mass balance studies, monitoring stations installation, and conceptual rehabilitation planning. During 1996, the Government was expected to be working on new Mines and Minerals Environmental Regulations to implement environmental protection provisions of the Mines and Minerals Act of 1995.

In 1995, ZCCM copper mine production of 324,000 metric tons (t) continued its decline, dropping to 53% of 1985 levels and 39% of the 1969 peak production of 825,000 t. It should be noted that for purposes of reporting statistical and other technical data on ZCCM for 1995 in this chapter information from the ZCCM 1996 Annual Report, which covers the fiscal year April 1, 1995, to March 31, 1996, has been used. The copper and cobalt resource base still needed substantial new capital investment to expand production, particularly from deeper ore bodies. Cobalt estimated mine production increased by 35% and refined cobalt by 11% over 1994, both still low by historical standards. Lower grade feed, geotechnical and mining equipment problems, low concentrator recovery, and smelter operational difficulties at various units were blamed. Production of manganese and tin ceased in Zambia in 1993 and of lead and zinc following closure of the Kabwe Mine in June 1994. Zambia is a major world supplier of emerald and amethyst and additionally produces gemstone quality aquamarine, tourmaline and garnet. Most gemstone mining is done by small-scale, artisanal miners and production and export levels are poorly documented. Cement production apparently also declined, as did reported gemstones and coal. The latter reduction was said to be the result of equipment problems as well as lower demand, particularly from Nitrogen Chemicals of Zambia Ltd. Petroleum refinery products output probably were lower, based on reports of operating difficulties, but numerical information was not available for estimating any decline.

The major mineral exports by value were copper and cobalt. However, some observers believed gemstones were very significant in export value for some time, possibly second to copper, despite the absence of official records. The value of both legally and illegally exported gemstones may be as much as \$250 million annually, compared to 375,000 t of copper exports in 1994 valued at \$805 million, and 2,600 t of refined cobalt exports valued at \$70 million. Based on \$1.54 billion in ZCCM sales of copper and cobalt sales in the fiscal year ending March 31, 1996, 27.9% of shipments went to Japan, 19.3% to the European Community, 10.8% to India, 6.8% to Thailand, and 2.9% to the United States. The difference between export and sales values is accounted for by domestic sales and by metals

bought by ZCCM to meet customer contracts.

The major import by far was petroleum, including crude and refined products. Fertilizer components were the second largest mineral import, particularly phosphorus and potassium. The Arabian Gulf States were a principal source of imports because of oil purchases. South Africa was also a principal source of imports, at least partly because of transshipments from overseas sources. Mining equipment was normally the largest import from the United States.

The Government still dominated the industry, although the tempo of efforts at privatization appeared to be increasing. The state-owned Zambia Industrial and Mining Corp. Ltd. (ZIMCO), scheduled for phase out in 1994, but apparently still functioning early in 1995, held a majority interest in all principal commercial and industrial ventures other than those privatized. ZCCM, the largest entity in the minerals sector, was owned 60.3% by ZIMCO, 27.3% by Zambia Copper Investments Ltd. (owned 50% by Minorco S.A., in turn, owned more than 60% by the Anglo American Corp.-DeBeers Centenary AG Group), and 12.4% by the public, including institutions. A Small Mines Development Unit of ZCCM supported at least one mine for gemstones in the Eastern Province and one gold, and one copper mine in the Western Province. Other units also produced lime and marble, and ZCCM also owned shares in several ventures not related to minerals.

Divestiture of ZCCM's noncore businesses began in 1992. A restructuring plan developed by ZCCM late in 1993 apparently led, in 1994, to the first ZCCM mineral unit being offered for sale—the Kabwe Division, which produced zinc, lead, and pyrite (for sulfuric acid) prior to closure in June 1994, although the pyrite operation (a separate mine, Nampundwe) presumably would be retained by ZCCM.

Privatization plans for the entire ZCCM remained unresolved. Because of the complexity of the privatization and especially the lack of a national consensus, action was likely to be delayed until after the 1996 elections. In October 1995, the investment banking company, N.M. Rothschild & Sons of the United Kingdom, was appointed to advise the Government on the privatization of ZCCM. The objectives of the privatization were to impose private sector discipline on the mining sector, to mobilize new investment capital, to increase tax returns from mining, to diversify ownership of mines within the Copperbelt, and to increase both investment and management level employment opportunities for Zambians. Recommendations on approaches to privatization from Rothschild were expected by April 1996. Joint ventures with outside firms on specific divisional projects were also being considered.

Separately, Anglo American Corp. of South Africa Ltd. (AAC) began negotiations with the Government to acquire rights to develop the Konkola Deep Mining Project, which contains a known resource reported by ZCCM in the Kirila Bombwe part of the ore body at 297 million metric tons (Mt) grading 3.8% copper and 0.07% cobalt. The Konkola

Deep development is considered a key to maintaining or expanding future copper production in Zambia.

ZCCM offered the Chambishi and Kansanshi Mines for sale about mid-1994 but no further decisions were made on these properties in 1995. ZCCM reported resources as of March 31, 1996 at Chambishi of 136 Mt grading 2.4% copper and at Kansanshi of 26 Mt grading 2.9% copper.

The Government's privatization program and new investment and mining acts were expected to result in the formation of a number of new private companies. Among companies that demonstrated some interest in Zambia's mineral sector, especially privatization of ZCCM or its components, were five of the world's eight largest private mining organizations: RTZ Corp. Plc. (RTZ) of the United Kingdom; the Anglo American Corp. of South Africa (AAC); Broken Hill Pty. Co. Ltd. (BHP) of Australia; Phelps Dodge Corp. of the United States; and Gencor Ltd. of South Africa. A number of other large and small international—South African, British, Canadian, Dutch, and Australian—and small Zambian companies also were active.

ZIMCO also had a Mineral Exploration Department that worked outside ZCCM's properties and also provided services to other subsidiaries.

Other ZIMCO subsidiaries in the minerals sector included wholly owned Reserved Minerals Corp., which, in turn, owned 100% of Mindeco Small Mines Ltd. (producer of several industrial minerals) and 55% of Kagem Mining Ltd. (reportedly the country's largest gemstone producer, 45% of which was owned by the Hagura organization, a private partnership); Chilanga Cement Co., 60% or more owned through Indeco Ltd., another wholly owned subsidiary of ZIMCO, with an unspecified share owned by Commonwealth Development Corp. of the United Kingdom (the Zambia Government's 60% was formally tendered for sale in late 1994); wholly owned Nitrogen Chemicals of Zambia Ltd., producer of ammonia and compounder of fertilizers and explosives; wholly owned Maamba Collieries Ltd., the country's sole coal producer; and Indeni Petroleum Refinery Co. Ltd., 50% owned through Indeco Ltd. with at least some portion believed owned by Agip SpA. of Italy, the operating manager. Additionally, among more than 100 companies, ZIMCO also had majority or full ownership of some minerals-related businesses, such as crushed stone, glass, and ceramics firms; Metal Marketing Corp. of Zambia, a minerals and metals trading firm; as well as Tazama Pipelines Ltd. (the crude oil pipeline from Dar es Salaam), Zambia Railways Ltd., domestic and international airlines, and electric utilities. Private entities operated a number of small mines for which little information was available. More than 20 such mines were producing gemstones. Others produced limited quantities of gold, apparently mostly alluvial, as well as tin and a variety of industrial minerals.

Significant exploration was being conducted throughout the country. More than 70 separate licenses were in effect covering large areas, especially the northwest, southeast, and

much of the areas surrounding ZCCM's mine sites. In addition to copper-cobalt and lead-zinc ores, the companies targeted gold and nickel minerals, diamonds and other gemstones, fluorspar, and phosphate. Several international mining groups were involved, such as BHP and Western Mining Corp. Ltd. from Australia; SouthernEra Resources Ltd. from Canada; AAC, Gencor, Johannesburg Consolidated Investment Co. Ltd. (JCI) of South Africa, and Trans Hex Group Ltd. from South Africa; RTZ; Phelps Dodge; and a number of smaller ventures.

Recovery of cobalt, copper, lead, and zinc from tailings and slag dumps on ZCCM and other properties were of interest to several companies.

ZCCM increased cobalt mine production by 64% and refined cobalt production by 44% over 1994, primarily the result of higher grades of ore mined plus a favorable low acid soluble cobalt mineralogy. At the Nchanga open pit, ore grades averaged 0.58% cobalt in 1995 versus 0.36% cobalt in 1994.

Colossal Resources Corp. of Vancouver, Canada, which acquired a 60% interest in the slag processing venture of the Zambian firm, Qassim Mining Enterprises Ltd. in 1994 continued with plans to reprocess 8.6 Mt of cobalt slag grading 0.70% to 0.81% cobalt and 1.15% copper from ZCCM's Nkana Slag Dump. During the year, work progressed on feasibility studies and process trials for a metallurgical plant at Kabwe. The plant will have a capacity to produce 500 tons per year (t/yr) of cobalt in the first full year, increasing to 3,000 t/yr by the fourth year. The plant will use an energy intensive electric arc furnace smelting technology to produce copper and a high-cobalt ferroalloy. Production startup was scheduled for the first quarter 1996.

Caledonia Mining Corp. of Toronto, Canada, acquired two additional exploration licenses, Ngosa and Luamafula, adjacent to its Nama license. The Nama area covers 93 km<sup>2</sup> and is located about 10 kilometers (km) west of ZCCM's Konkola copper property in the Copperbelt. Exploration during 1995 identified 14 cobalt geochemical anomalies. Initial drilling showed encouraging cobalt values. A 10,000-meter drilling program was planned to further test these anomalies during the first half of 1996.

ZCCM operates one of the largest copper mining complexes in the world through five divisions, Nchanga, Mufalira, Nkana, Luanshya, and Konkola. The Nchanga Division operates one underground and one cobalt-rich open pit copper mine, the Nchanga mill, and a tailings leach plant. As reported in the ZCCM 1996 Annual Report, Nchanga mined 7.18 Mt of copper ore grading 2.26% copper and 627,000 t of cobalt feed grading 1.38% copper and 0.57% cobalt in 1995. Concentrate production of 198,724 t was down 29% from 1994 with a copper recovery rate of 39.12%. Remaining reserves at Nchanga at year end were 63.96 Mt grading 3.77% copper and 8 Mt of cobalt ore grading 0.62% cobalt.

The Mufalira Division operates one major underground

mine, a mill, smelter, and refinery. In 1995 Mufalira mined 2.58 Mt of copper ore grading 2.08%. Concentrate production of 109,021 t was up 7% over 1994 with a copper recovery rate of 96.08%. Smelter production was up 2% to 117,453 t while refined copper cathode production increased nearly 3% to 140,504 t. Remaining reserves at Mufalira at fiscal year end were 35.26 Mt grading 3.10% copper.

The Nkana Division mines ore from four underground zones, Mindola, Central Shaft, South Ore Body, and Chibiluma and operates a mill, smelter, refinery, two cobalt recovery plants at Nkana and Chambishi; and two sulphuric acid plants at Nkana and Chambishi. In 1995, the Nkana Division mined 3.39 Mt of copper sulfide ore grading 1.59% copper and 0.10% cobalt. Production of 114,336 t of copper concentrates with a copper recovery rate of 93.06% and 132,993 t of cobalt concentrates with a cobalt recovery rate of 59.44% was down 6% and 11% respectively, from 1994. At the Nkana smelter, which encountered high maintenance problems during the year, output of 117,004 t was down by 7% from 1994. Remaining reserves at Nkana at year end were 82.28 Mt grading 2.27% copper and 0.14% cobalt.

The Luanshya Division operates the Luanshya and cobalt-rich Baluba underground mines, two mills and the Ndola Precious Metals refinery. Their copper refinery at Ndola remained closed in 1995. In 1995, the Luanshya Division mined 1.75 Mt of ore grading 1.87% copper at the Luanshya mine and 1.25 Mt of Baluba ore grading 1.87% copper and 0.15% cobalt. Production of 56,013 t of copper concentrates with a copper recovery rate of 91.31% and 49,713 t of cobalt concentrates with a cobalt recovery rate of 54.44% were up 28% and 11% respectively, over 1994. Remaining reserves at the Luanshya Mine at year end were 23.19 Mt grading 2.32% copper and at the Baluba Mine, 32.34 Mt grading 2.97% copper and 0.18% cobalt.

The Konkola Division operates a mill and the Konkola underground mine. Konkola, one of the wettest mines in the world, pumps out 275,000 cubic meters a day of water and is becoming a major input to the local water supply. In 1995, Konkola mined 2.09 Mt of copper ore grading 2.72% copper. Copper concentrate production of 114,882 t, with a copper recovery rate of 86.26%, increased 12% over 1994. Remaining reserves at Konkola at year end were 35.36 Mt grading 3.89% copper and 0.07% cobalt.

Caledonia Mining Corporation of Canada held two large copper-cobalt exploration licenses at Kadola and Mpongwe just south of the Copperbelt. Exploration was ongoing during the year. JCI continued to hold title to the Dunrobin gold mine, which was last mined in the 1930's. Exploration by JCI during 1993-94 identified a gossan zone containing a resource of about 1 Mt at a grade of 2 grams per ton. There were indications that the gold potential of the property was below the JCI corporate threshold for development and that bids to acquire the property had been solicited.

Current gold and silver production in Zambia comes from

the treatment of copper refinery tankhouse slimes at ZCCM's Ndola Precious Metal Plant.

Chilanga Cement Ltd., with plants at Lusaka and Ndola on the Copperbelt having capacities rated at 200,000 t/yr and 300,000 t/yr, respectively, was first announced for sale by the Government in 1993. Formal action still was pending at year end 1995.

The Ministry of Mines and Mineral Development continued a program to further develop production of gemstones other than diamonds found in many parts of the country. Training and other assistance were being provided to small local mine operators. The Ministry believed the sector should also be attractive to foreign investment in mining, processing, and marketing. Emeralds, mostly produced about 200 km north of Lusaka (Ndola rural area), were estimated to normally comprise about 80% of total gemstone production in value. In volume, however, amethyst output, mostly from a location about 300 km south-southwest of Lusaka (Kalomo area), usually was the largest reported. Additionally, there was production of aquamarine and tourmaline, mostly from a location about 600 km northeast of Lusaka (Lundazi area), as well as garnet, agate, and other gemstones at a number of locations. Of the 30 to 40 registered gemstone operations reported, two were larger-size, mechanized mines that were joint ventures with the Government. From 200 to several thousand small, unregistered mining operations were estimated to be operational.

Maamba Collieries Ltd.'s strip mine in southern Zambia, an important source of non-coking and metallurgical coal for the Copperbelt, continued to produce with difficulties operating at about one-third of capacity in 1995. Equipment outages and lack of orders appeared to be perennial problems. In 1995, state-owned Maamba gave a \$9 million contract to JCI, financed by the Industrial Development Corporation of South Africa, to help rehabilitate the mine over a 5-year period.<sup>3</sup>

In December 1994, the European Investment Bank offered Zambia a \$22 million loan to cofinance a 3-year, minimum \$51-million petroleum sector restructuring project. Earlier in the year, the World Bank's International Development Association (IDA) approved a \$30 million credit toward the then-estimated \$48 million project. Tazama, the Tanzania-Zambia pipeline company, and a new Zambia Oil Co. reportedly were to fund any balance, which was expected to be in domestic currency. A major portion of the project, \$45 million, was for rehabilitating the Tazama pipeline from the port of Dar es Salaam, Tanzania, to the Indeni refinery at Ndola. The balance was split about equally for rehabilitating the refinery facilities and for improving the management structure. In 1995, water shortages caused by a drought in the Ndola region threatened to close the refinery.

Copper ore reserves of ZCCM were ample for at least 15 years of continued full-scale operation at 450,000 t/yr of finished copper, according to ZCCM officials. ZCCM's

Annual Report for the year ended March 31, 1996, gave total ore reserves for the seven operating mines as 274 Mt averaging 2.97% copper. Additional mineral resources of ZCCM were reported at 1.25 billion metric tons at 2.4% copper. A number of other known copper deposits outside of ZCCM's license area were known as well. The other major deposit was Lumwana with resources of more than 1 billion metric tons at 0.7% copper.

Cobalt reserves associated with copper ore at three of ZCCM's mines totaled 123 Mt averaging 0.15% cobalt and 2.33% copper. This did not include reserves at Nchanga totaling 8 Mt at 0.62% cobalt.

Gold ore resources were being studied by several groups but were yet to be fully defined. Many occurrences were located throughout the country, some around and to the east of Lusaka.

Lead-zinc reserves at former operations were limited, but additional resources were known at several locations. Remaining resources projected at the closed Kabwe Mine were reported at 59 Mt at 3.5% zinc and 1.5% lead, mostly of low-grade disseminated ores.

Nickel resources at the Munali sulfide deposit were put at 10.4 Mt at 1.1% nickel with minor copper, gold, silver, and platinum-group-metal content. The Kalumbila deposit had resources estimated at 8 Mt at 0.55% nickel. Neither deposit was fully defined and extensions were to be explored. Additional resources are projected at other sites.

A large variety of other metallic minerals deposits also were known, but needed further exploration. Most work apparently was on iron, molybdenum, and tin-tantalum.

Of the many industrial mineral resources that were being exploited or studied by commercial groups, gemstones were of the most value, but others included clays for brick and tile, and for refractories; fluorspar; gypsum; limestone for cement and lime manufacture; magnetite for special purposes; marble; phyllite, probably for cement manufacture; silica, mostly for glassmaking; and talc. Phosphate resources were known, but only of low grade, one of which was a carbonatite in the northeast, the subject of continuing studies by Government agencies.

Coal reserves of 78.2 Mt remained at Maamba, 60.2 Mt in the proven category and 18 Mt in the probable category.

Petroleum resources remained conjectural with no known activity after some surveys in 1990 along the Zambesi River east from Victoria Falls to Mozambique.

A reasonably adequate truck road and railway network existed within the country and externally 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. In 1993, the World Bank's affiliated IDA considered the road system to be essential to economic growth but neglected for years, and gave an \$8.5 million credit to restructure the Government system and begin planning for rehabilitation. In early 1995, this resulted in \$800 million in

pledges for rehabilitation from the World Bank and other donors.

The principal rail routes were northeast to and from the port of Dar es Salaam, Tanzania—nearly 2,000 km from Ndola in the Copperbelt—mostly on the Tanzania Zambia Railways Authority (Tazara) line; and south through Zimbabwe to and from South African ports—more than 2,500 km from Ndola—using the Zambia Railways Ltd. line in Zambia. The roughly 2,000-km rail link southeast to the port of Beira, Mozambique, through Zimbabwe, became generally available after a long hiatus due to civil war in the port country; but ocean ship availability apparently was limited. The more than 2,200-km rail link north into Zaire and west to the port of Benguela (Lobito), Angola, remained unavailable during the 17-year civil war in Angola, however the end of the conflict appeared in-sight and the route may become available again in the next few years. The rail system, in general, still had some rolling stock shortages, and track maintenance on internal routes was of concern, but equipment rentals and donor aid programs helped to improve the situation.

A crude oil pipeline ran from Dar es Salaam about 1,700 km southeast to a refinery in Ndola. It was owned and operated by Tazama Pipelines Ltd., a joint venture of the Zambian and Tanzanian Governments.

Electric power capacity was adequate, furnished about 70% from hydroelectric, 20% from oil, and 10% from coal plants. Expansion of hydro sources was planned despite the effect of periodic droughts. Coal was available from domestic deposits. The energy source for mobile equipment continued to be imported petroleum, mostly refined products, although a significant amount imported was crude that was refined in the state-owned facility at Ndola. The household energy source was wood, which continued to be the country's largest single source of energy.

Zambia's ability to turn around its economic difficulties appeared to be tied to the future success of its proposed privatization plan. The economy should benefit from the likely infusion of new foreign investment and technology. In addition, much promise of success can be found in the availability of good agricultural, mineral, and water resources; the open political environment; and a market-oriented Government. With continued political stability and passage of the improved mining and mining investment legislation, the international mining community could be expected to act more vigorously on the opportunities. A number of minerals appeared ready for development. Copper-cobalt output in the short term was likely to decline owing to restructuring and operating problems, but improved efficiency and reinvestment of earnings could bring a turnaround. The gemstone sector also has the potential to generate a larger value added industry in Zambia.

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<sup>1</sup>Where necessary, values have been converted from Zambian Kwacha (K)

to U.S. dollars at the rate of K1032.54=US\$1.00 for 1995.

<sup>2</sup>Ministry of Mines and Minerals Development. Zambia's Mining Policy, Lusaka, Dec. 1995, 13pp.

<sup>3</sup>Mining Magazine (London). JCI assists Maamba in Zambia. Sept. 1995, p. 135.

### **Major Sources of Information**

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### **Major Publication**

Investment Opportunities in the Mineral Sector of Zambia,  
Ministry of Mines and Mineral Development, Lusaka,  
Zambia.

TABLE 1  
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1991	1992	1993	1994	1995
<b>METALS</b>					
Beryllium: Beryl kilograms	836	504	178	857	1,000 e/
Cobalt: 3/					
Mine output, Co content	6,994 r/	6,910 r/	4,840 r/	3,600 r/	5,908
Metal, Co content	4,740 r/	4,610 r/	4,211 r/	2,482 r/	3,577
Copper: 3/ 4/					
Mine output, Cu content:					
By concentration or cementation	320,000 r/	349,100 r/	344,200	289,800	268,900
Leaching (electrowon)	70,600	80,400	84,100	83,400	54,800
Total	390,600	429,500	428,300	373,200	323,700
Metal:					
Smelter, primary:					
Electrowon (low grade)	64,500 r/	63,900 r/	62,400 r/	25,342 r/	22,455
Other	300,300	356,400	305,100	241,036	234,457
Total	364,900 r/	420,300 r/	367,600 r/	266,378 r/	256,572
Refinery, primary:					
Electrowon	45,400	43,700	48,800	67,255	45,713
Other	357,100	428,500 r/	363,200	284,784	275,572
Total	402,500 r/	472,200	412,000	352,039	321,285
Gold 3/ kilograms	136	271	235	123 r/	91
Lead: 3/					
Mine output, Pb content	9,080	4,446	7,027	--	--
Metal, refined	2,640	3,030	2,000	--	--
Manganese concentrate (48% Mn), gross weight	662	292	--	--	--
Selenium, refined, gross weight 3/ kilograms	21,900	31,800	26,700	21,115 r/	18,550
Silver 3/ do.	13,700	21,000	18,000 r/	10,002 r/	8,676
Tin concentrate:					
Gross weight (65% to 72% Sn)	9	3	--	--	--
Sn content	6	2	--	--	--
Zinc: 3/					
Mine output, Zn content of ore milled	19,800	14,706	16,704	--	--
Metal, refined	6,340	7,290	3,450	--	--
<b>INDUSTRIAL MINERALS</b>					
Cement, hydraulic e/	367,000 5/	347,000	310,000	280,000 5/	250,000
Clays: e/					
Brick	2,820 5/	3,000	3,000	3,000	3,000
Building, not further specified	2,000	2,000	2,000	27,000 5/	30,000
China and ball	120 5/	200	200	200	200
Feldspar	70 e/	113	100 e/	--	--
Gemstones:					
Amethyst kilograms	168,000	479,000	398,000	366,000	350,000 e/
Aquamarine do.	65	254	74	21	200 e/
Emerald do.	265	453	138	160	180 e/
Gypsum e/	14,700	13,900	14,000	11,200	11,000
Lime, calcined thousand tons	184 e/	193	206	195	200 e/
Limestone (cement and lime) e/ do.	810	800	770	710	800
Magnetite, gross weight	400	417	1,250	1,070	1,000 e/
Nitrogen: N content of ammonia e/	4,700 5/	7,000	5,000	3,000	3,000
Sand and gravel, construction e/ thousand tons	500	500	500	117 5/	200
Stone, construction:					
Limestone, crushed aggregate do.	739	680 e/	632	668	700 e/
Other e/ do.	700	700	700	700	700
Sulfur: 3/					
Pyrite concentrate:					
Gross weight (e/ 42% S)	73,500	78,200	80,800	55,572	69,228
S content e/	30,600	32,400	33,400	22,062	28,314
In sulfuric acid from: e/					
Pyrite roaster gas, S content	28,000	29,000	30,000	19,900 r/	25,500
Metallurgical gas, S content	71,000	70,000	56,000	40,700 r/ 5/	71,150 5/
Total, S content	99,000	99,000	86,000	60,600 r/ 5/	96,650 5/
Talc	89	366	62	76	80 e/

See footnotes at end of table.

TABLE 1--Continued  
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1991	1992	1993	1994	1995
<b>MINERAL FUELS AND RELATED MATERIALS</b>					
Coal, bituminous	345	422	301	163	141 e/
thousand tons					
Petroleum, refinery products: e/ 3/	5,300	5,300	5,300	5,300	5,000 e/
thousand 42-gallon barrels					

e/ Estimated. r /Revised.

1/ Table includes data available through June 15, 1997.

2/ In addition to commodities listed, the following were probably produced but information is inadequate to reliably estimate output: fluor spar, tourmaline, additional crude construction materials at artisanal operations (clays for brick and tile; sand, gravel, and stone for aggregate and fill; dimension stone; et al.), and clay and/or shale normally used for cement manufacture. Some "industrial sand" and minor amounts of "phyllite" and "silicate" production also was reported but not further defined.

3/ Data are for year beginning Apr. 1 of year stated.

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

5/ Reported figure.