



2007 Minerals Yearbook

BOTSWANA

THE MINERAL INDUSTRY OF BOTSWANA

By Harold R. Newman

Production of gem-quality diamond continued to be the foundation of Botswana's economy. In 2007, Botswana was the world's leading producer of diamond (by value) and the world's second ranked producer of diamond (in terms of volume) after the Russian Federation. The country's nickel production accounted for about 2% of world production. Copper, gold, and soda ash production also had significant, though smaller, roles in the national economy. Botswana accounted for 18% of world diamond production (by volume) and 22% of world diamond reserves. Botswana's mineral resources were a driver behind Botswana's rapid economic growth (Mosinyi, 2008).

Mineral exploration and mining are regulated by the Botswana Geological Survey and the Botswana Department of Mines. Mineral exploration in Botswana is difficult. The geology of most of Botswana is poorly understood owing to extensive cover by recent sediments, and available information was based mainly on drilling. The Government was continuing to carry out geophysical data collection by air (International Outlook, 2007).

Minerals in the National Economy

In 2007, mining accounted for about 35% of Botswana's real gross domestic product, and diamond production contributed about 77% of the value of the mining sector. About 16,500 people were employed in the mining industry. Mineral revenues collected in 2007 were about 10% lower compared with those of 2006. The decrease in revenue was attributable to the 5% lower diamond prices during 2007. All the country's rough-diamond output was by Debswana Mining Co. (Pty) Ltd. (a 50-50 joint partnership of Swiss-based De Beers Centenary AG and the Government) and Tswapong Mining Co. (Pty.) Ltd. Despite efforts by the Government to diversify the economy, diamond mining, as a source of revenue, remained the backbone of Botswana's economy (Department of Mines, 2007, p. 3).

Production

Tati Nickel Mining Co. (Pty.) Ltd. (a subsidiary of MMC Norilsk Nickel of Russia) produced copper and nickel. Total matte production was 53,947 metric tons (t) that contained 22,844 t of nickel, 19,996 t of copper, and 242 t of cobalt. IAMGOLD Corp. produced gold.

In 2007, diamond production totaled about 33.6 million carats and production of semiprecious stones totaled 48,000 kilograms (kg). Debswana Mining was the major diamond producer. The semiprecious stones were mainly varieties of agate and carnelian, and production was not reported separately. Botswana Ash (Pty.) Ltd. produced salt and soda ash. In 2007, 73 companies extracted a total of 4,484 million cubic meters of clay, crushed stone, gravel, and sand compared with 5,945 million cubic meters in 2006. Production of these industrial materials depended on consumption by the construction

industry. Coal production totaled 828,164 t (Department of Mines, 2007, p. 5).

Structure of the Mineral Industry

The Government maintained an equity position in most of the major mining companies; however, the mineral industry operated mainly on a privately owned free-market basis. In addition to these major operations, a number of medium- and small-scale mines produced agates, aggregates, clay, and dimension stone. Production information was not readily available for these operations. Major commodities and the companies that produced those commodities are listed in table 2.

Commodity Review

Metals

Copper and Nickel.—In eastern Botswana about 200 kilometers (km) south of Francistown, the smelter operated by Bامangwato Concessions Ltd. (BCL) of Botswana processed copper-nickel concentrate from its Selebi-Phikwe Mines. BCL also toll-smelted concentrate from Tati Nickel's Phoenix open pit mine.

Several copper and nickel exploration projects were active. African Copper plc had two copper projects underway in 2007. At the Mowana Mine (formerly the Dukwe Mine), construction of the processing plant remained on schedule for completion by yearend 2007. Optimization studies for the mine were essentially complete, with mining by open pit planned to start by midyear 2008. The development cost of the project was estimated to be \$100 million. The mine, which would support open pit mining and, later, underground mining, was expected to have a mine life of 25 years (Mosinyi, 2007a).

African Copper's other interest was the 3,500-square-kilometer (km²) Matsitama exploration concession, which is adjacent to the Mowana Mine. RSG Global Consulting (Pty) Ltd. (RSG) of Australia prepared a resource estimate for the Thakadu project in the Matsitama concession. RSG reported an estimated mineral resource of 4.7 million metric tons (Mt) grading 1.72% copper and an estimated inferred mineral resource of 1 Mt grading 1.29% copper. The Thakadu deposit is a broadly strata-bound disseminated copper-silver deposit hosted in a deformed quartzite unit that is immediately adjacent to biotite schists. Mineralization generally occurs as bornite and chalcopyrite that has oxidized to azurite, malachite, and tenorite. Mineralization is largely contained within the quartzite unit that ranges in thickness from 2 meters (m) to more than 30 m (Mbendi Information Services (Pty) Ltd., 2007).

Tati Nickel operated the Phoenix open pit nickel mine and the Selkirk underground nickel mine in the Francistown area. The Phoenix Mine has estimated proven and probable reserves of 291 Mt at an average grade of 0.32% nickel and 0.56% nickel,

respectively. The Selkirk Mine was considered to be one of the largest undeveloped nickel sulfide deposits in the world. In 2007, Norilsk Nickel acquired an 85% interest in Tati Nickel as a result of Norilsk Nickel's purchase of LionOre International Mining Ltd. of Canada for \$6.5 billion. The Government retained the remaining 15% (Voice Online, The, 2007).

Tati Nickel started a project at the Phoenix Mine to use the dense media separation (DMS) process. DMS is an ore upgrading technology and was commonly used as a method of selectively separating 'heavy' particles from the host rock. In nickel sulfide mining, the target minerals have a density differential and Tati Nickel would be able to use this differential to selectively concentrate the sulfide minerals in a DMS plant. The use of the DMS process would help stabilize the grade through the main concentrator and allow for mining a zero cutoff, providing a constant feed to the plant. The 12-million-metric-ton-per-year (Mt/yr) plant would increase Tati Nickel's nickel production from 14,500 metric tons per year (t/yr) to 22,000 t/yr of nickel in concentrate after 2009, reduce total operating costs, and increase the life of the mine by 7 years, to 2019 (MMC Norilsk Nickel, 2007).

Discovery Metals Ltd.'s Dikoloti nickel project comprises four prospecting licenses, which covered an area of 612 km² that surrounds the three nickel deposits of BCL in the Selebi-Phikwe region. The entire project was located within 45 km of BCL's concentrating and smelter facility, which was the largest capacity nickel processing facility in Africa. In 2007, Dikoloti had an estimated inferred resource of 4.1 Mt at a grade of 0.7% nickel, 0.5% copper, and 1.5-grams-per-metric-ton platinum-group elements at a cutoff grade of 0.5% nickel. Discovery Metals found that the Dikoloti nickel mineralization was amenable to heap-leach bio-oxidation processing using the GEOLEACH™ process. Greater than 74% nickel extraction could be achieved, and 99% of the extracted nickel could be recovered from the bio-oxidation solution as nickel sulfide by use of sodium sulfide precipitation. The GEOLEACH™ process was expected to have significantly lower capital and operating costs than conventional flotation processing (Discovery Metals Ltd., 2007).

Gold.—IAMGOLD Corp. of Canada reported problems with its Mupane Mine, which was an open pit operation located about 30 km southwest of Francistown. IAMGOLD officials had expressed their disappointment with the underperformance of the mine in 2007. The exploration results were disappointing and a decision was made to restrict future exploration. IAMGOLD's second quarter results for 2007 included a loss of \$81.3 million compared with net earnings of \$29.8 million for the second quarter of 2006. IAMGOLD took a \$93.7 million writedown on the operation for 2007 (Kosich, 2007).

Industrial Minerals

Cement.—The mineral industry in northern Botswana was expected to get another boost when the Matsiloje Portland Cement Plant restarts operations in 2008. Matsiloje Portland had been closed for several years and was getting a complete refurbishment in two phases. Completion of the first phase would enable Matsiloje to produce 60 metric tons per day (t/d);

completion of the second phase in 2009 would increase capacity to 400 t/d (Ganetsang, 2007).

The Department of Mines granted Matsiloje a license for a new mine to supply limestone for the plant. When the project comes onstream, clinker was to be imported from Zimbabwe to manufacture quicklime, some of which would be sold to Tati Nickel for use in its Activox® refinery (Mosinyi, 2007b).

Diamond.—Botswana is a participant in the Kimberley Process Certification Scheme, which is an association of the Governments of diamond-producing and importing countries, commercial diamond firms, pan-industry associations, and nongovernmental organizations that have implemented a certification system for the international trade of rough diamond. The Kimberley Process is designed to prevent so-called "blood" or "conflict" diamond from being shipped through legitimate trading channels.

Debswana Diamond Co. (Pty) Ltd. accounted for most of the diamond production in Botswana from four mines—the Damtshaa (meaning "water for a tortoise"), the Jwaneng (meaning "a place of small stones"), the Letlhakane (meaning "little reeds"), and the Orapa (meaning "resting place for lions"). The open pits are medium-scale to large-scale operations. The Jwaneng Mine was considered to be the richest diamond mine in the world when measured by the value of recovered diamond (AllAboutGemstones.com, 2007).

An underground diamond operation was in the planning stage at Debswana's Jwaneng Mine. This would be the first time underground diamond mining would be undertaken in Botswana. In 2007, the Jwaneng Mine open pit operation was mining at a depth of 350 m and would ultimately go to 650 m in depth. Thereafter, underground mining would be initiated. Project planning would begin in 2008 and, in 2009, an exploratory shaft located 1.5 km northwest of the open pit was to be sunk to a depth of 1,000 m. New processing plants were planned for both the Jwaneng and the Orapa Mines (Creamer, 2007).

Boteti Exploration (Pty) Ltd., [a joint venture among De Beers Prospecting Botswana (Pty) Ltd. (70.2% share), African Diamonds plc (28.4% share), and Wati Ventures (Pty) Ltd. (1.4% share)] signed a Heads of Agreement, which set out the terms and conditions for the granting of a mining license by the Government for the AK6 deposit. The Government did not take an equity interest in the project. Developing the mine would entail a two-phase process that would require an investment of about \$380 million during the period 2009 to 2014. The mine was expected to produce an estimated 600,000 carats per year of diamond in the first 3 years; during the second phase, this amount would be increased to 880,000 carats per year for the remaining 7-year life of the mine. This equates to total production of about 8 million carats by the end of the 10-year life of the mine. The AK6 was 1 of 30 known kimberlites that form part of the Boteti joint venture (DIB Online, 2008).

Numerous other companies were exploring for diamond in Botswana. Active exploration operations included Firestone Diamonds plc, which held diamond exploration rights to 17,000 km² in the Jwaneng and Orapa area and was the leading holder of diamond exploration rights in the area. Firestone announced that it had discovered four new kimberlites at the

Tsabong project. This discovery brought to 11 the number of kimberlite deposits discovered from 14 holes drilled since November 2006. The discovery increased the number of kimberlites in the license area to 78. Firestone considered this area to be one of the largest kimberlite fields in the world (Mukumbira, 2007b).

Gem Diamond Ltd. announced the acquisition of Gope Exploration (Pty) Ltd. to explore a known kimberlite deposit in the Gope region of central Botswana. The Gope kimberlite deposit (a significant ore body) has estimated indicated resources of 79 Mt and extends down to 400 m below the surface at an estimated grade of 19 carats per 100 metric tons of ore (Mukumbira, 2007c).

DiamonEx Ltd. of Australia announced that it expected to complete construction of the Lerala diamond mining project by yearend 2007; plant commissioning was planned for 2008. DiamonEx planned to target Lerala's estimated diamond resource of 3.7 million carats at an estimated grade of 27.4 carats per metric ton of ore and was expected to produce an average of 330,000 carats per year during the next 10 years. The Lerala kimberlites were in DiamonEx's Martin's Drift project area, which was originally discovered by De Beers in 1992. DiamonEx's prospecting permits in the region covered 12,400 km². DiamonEx stated that it had identified several high-priority exploration targets in the Martin's Drift area (Mukumbira, 2007a).

Mineral Fuels

Coal.—Coal reserves in the eastern part of Botswana were estimated to be 17 billion metric tons (Gt). Coal Investment Corp (CIC) of Canada was leading the initiative to develop the integrated Mmamabula coal mine and a 3,600-megawatt-capacity power-generating plant. CIC had reported an estimated 1.3 Gt of indicated and measured resources of coal at the Mmamabula project. The quality of the coal was suitable for power generation. A large percentage of the coal has a calorific value of 24 million to 27 million joules per kilogram. The coal reserves were estimated to be sufficient to support the proposed power station for 40 years with the mine supplying about 12 Mt/yr of coal. The Botswana Mmamabula coal deposit was considered to be a large untapped source of coal in the South African Development Community (African Mining Magazine, 2007).

Outlook

International interest in exploration for diamond and base and precious metals is expected to continue. The country's favorable geologic environment, mineral investment climate, low tax rates, and political stability are expected to continue to make Botswana an attractive country for foreign mineral investment. Revenues from diamond operations are expected to continue to be the mainstay of the country's economy for the foreseeable future. The several international companies with active exploration programs for mineral resources are expected to continue to operate in Botswana. Copper, gold, nickel, and soda ash production and processing are expected to continue to be notable factors in the country's economy.

Given the country's extensive coal resources and projected regional power demand, Botswana is expected to develop and support a small-scale coalbed methane industry and additional coal-fueled electricity-generating plants that could supply power to the South African power pool through its land lines to South Africa.

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TABLE 1
BOTSWANA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	2003	2004	2005	2006	2007	
Clay ^c	50,000	50,000	50,000	50,000	50,000	
Coal, bituminous	822,780	913,087	984,876	962,427	828,164 ³	
Cobalt, smelter output, Co content of matte ^{4,5}	294	223	326	303	242 ³	
Copper:						
Mine output, Cu content of ore milled ^c	31,380	29,460	31,300	24,255 ^{r,3}	21,500	
Smelter output, matte, gross weight ⁴	51,983	54,448	68,637	64,368 ^r	53,947 ³	
Smelter output, Cu content of matte ^{4,5}	24,292	21,195	26,704	24,255	19,996 ³	
Diamond ⁶	thousand carats	30,412	31,125	31,890	34,293	33,639 ³
Gemstones, semiprecious ⁷	kilograms	102,000	99,000	165,000	65,000	48,000 ^e
Gold ⁸	do.	9	161	2,709	3,020	2,722 ³
Nickel:						
Mine output, Ni content of ore milled	38,230	35,163	39,305	38,000 ^e	27,600 ^e	
Smelter output, matte, gross weight ⁴	51,983	54,448	68,637	64,368	53,947 ³	
Smelter output, Ni content of matte ⁵	27,400	22,292	28,212	26,762	22,844 ³	
Salt ⁹	229,432	208,319	243,945	151,595	165,710 ³	
Sand and gravel ¹⁰	thousand cubic meters	1,485	2,330	1,906	4,812	2,866 ³
Soda ash, natural	309,350	263,358	279,085	255,677	279,625 ³	
Stone, crushed	thousand cubic meters	1,060	1,219	1,100	1,134	1,200 ^e

^cEstimated; estimated data are rounded to no more than three significant digits. ^rRevised. do. Ditto.

¹Table includes data available through September 2008.

²In addition to commodities listed, palladium, platinum, and silver were produced, and exported in the nickel-copper-cobalt matte; copper and nickel cathodes also were produced at a pilot plant, but information was inadequate to make reliable estimates of output.

³Reported figure.

⁴Smelter product was granulated nickel-copper-cobalt matte.

⁵Included some product from direct smelting of ore; that is, ore not reported as milled.

⁶Assumed to contain about 70% gem and near gem.

⁷Principally agate. Reported as sales.

⁸Reported as bullion; historically included silver estimated to be about 2%. Includes artisanal production.

⁹Byproduct of natural soda ash production.

¹⁰Includes clay (for brick and tile).

TABLE 2
BOTSWANA: STRUCTURE OF THE MINERAL INDUSTRY IN 2007

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Clay ¹		Lobatse Clay Works (Pty.) Ltd. (Botswana Development Corp. and Interkiln Corp. joint venture)	Lobatse, 70 kilometers south-southwest of Gaborone	50,000. ^e
Do.		Makoro Brick and Tile (Pty.) Ltd.	Makoro, 10 kilometers south of Palapye	20,000. ^e
Coal		Morupule Colliery (Pty) Ltd. (Coal Investment Corp. and related firms, 93.3%)	Morupule, 270 kilometers northwest of Gaborone	1,000,000.
Diamond	thousand carats	Debswana Diamond Co. (Pty.) Ltd. (Government, 50%, and De Beers Centenary AG, 50%)	Jwaneng Mine, 115 kilometers west of Gaborone	12,000.
Do.	do.	do.	Orapa Mine, 375 kilometers north of Gaborone	13,000.
Do.	do.	do.	Letlhakane Mine, 350 kilometers north of Gaborone	1,000.
Do.	do.	do.	Damtshaa Mine (opened late 2002)	670.
Do.	do.	Tswapong Mining Co. (Pty.) Ltd. (De Beers Prospecting Botswana Ltd., 85%, and Government, 15%)	Tswapong Mine, 275 kilometers northeast of Gaborone	3.
Gemstones, semiprecious	kilograms	Agate Botswana (Pty.) Ltd.	Processing plant at Pilane, 45 kilometers north of Gaborone	60,000.
Gold	do.	IAMGOLD Corp.	Mupane Mine, near Francistown	3,100.
Nickel-copper-cobalt		Bamangwato Concessions Ltd. (BCL), (Government, 15%, and Botswana RST Ltd., 85%, of which LionOre Mining International Ltd., 12.65%)	Selebi-Phikwe Mines, 350 kilometers northeast of Gaborone	3,000,000 ore matte content (of which 30,000 nickel, 25,000 copper, 400 cobalt).
Do.		Tati Nickel Mining Co. (Pty.) Ltd. (MMC Norilsk Nickel, 85%, and the Government, 15%)	Phoenix and Selkirk Mines, 23 kilometers east of Francistown	3,600,000 ore matte content (of which 15,000 nickel, 9,000 copper, 100 cobalt, 960 kilograms palladium, 145 kilograms platinum).
Do.		Masa Precious Stones (Pty.) Ltd.	Bobonong, east of Selebi-Phikwe	4,000.
Salt		Botswana Ash (Pty.) Ltd. (Government, 50%, and Anglo American plc, 50%)	Sua Pan, 450 kilometers north of Gaborone	650,000.
Soda ash		do.	do.	300,000.

^eEstimated; estimated data are rounded to no more than three significant digits. Do., do. Ditto.

¹For brick and tiles.

