

# THE MINERAL INDUSTRIES OF MOROCCO AND WESTERN SAHARA

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## MOROCCO

Morocco is located in northern Africa and is bordered by Algeria to the east, the Atlantic Ocean to the west, the Mediterranean Sea to the north, and Western Sahara to the south. In 2004, the country's 30.6 million inhabitants shared a land area of about 446,300 square kilometers (km<sup>2</sup>) (U.S. Central Intelligence Agency, 2005§; World Bank Group, The, 2005§<sup>1</sup>). Morocco was the world's third ranked producer of phosphate rock after the United States and China. In addition to phosphate rock, the country produced a wide variety of minerals, which included barite, clays, coal, cobalt, copper, fluorspar, gold, iron ore, lead, nickel, petroleum, salt, silver, talc, and zinc. In 2004, Morocco's gross domestic product (GDP) based on purchasing power parity was estimated to be about \$129 billion; the per capita GDP based on purchasing power parity was \$4,332. According to the Moroccan Federation of the Mineral Industry, mining and mining related activities contributed about 6% to the GDP and represented about 75% of all tonnage exported by sea, 70% of all tonnage transported by rail, and 20% of foreign trade (Federation of the Mineral Industry, 2004, p. 11; International Monetary Fund, 2005§; Jasinski, 2005§).

## Government Policies and Programs

In 2004, Morocco undertook a program of institutional reforms in the transportation sector. The Transport Sector Reform Program received a \$298 million<sup>2</sup> loan in December from the African Development Bank to help fund the program, which was aimed at liberalizing the sector and attracting private investors to develop air, maritime, railway, and road transportation (afrol News, 2004§).

## Trade

According to Morocco's Department of Statistics preliminary estimate, total Moroccan exports were valued at about \$9.5 billion in 2004 compared with about \$8.8 billion in 2003. Phosphate rock exports, which were valued at \$442 million, accounted for about 4.6% of total exports compared with a revised \$362 million in 2003. Phosphoric acid exports, which were valued at \$721 million, accounted for about 7.6% of total exports compared with a revised \$507 million in 2003 (Direction de la Statistique, 2005§). According to the U.S. Census Bureau, Moroccan exports to the United States were valued at \$515 million in 2004 compared with \$385 million in 2003. These included more than \$118 million of petroleum products, more than \$79 million of nonmetallic minerals, about \$10 million of semifinished iron

and steel mill products, and \$167,000 of organic chemicals and fertilizers. Imports from the United States were valued at about \$526 million in 2004 compared with more than \$468 million in 2003. These included about \$21 million of coal and more than \$5 million of petroleum products (U.S. Census Bureau, 2005a§, b§).

Morocco and the United States signed a free trade agreement in June 2004. The agreement will allow for the elimination of tariffs on 95% of all bilateral consumer and industrial exports, and all remaining tariffs are to be eliminated within 9 years. Morocco was to provide immediate duty-free access to 92% of Moroccan nonagricultural and nontextile imports from the United States. Most U.S. exports of capital-intensive machinery, chemicals, civil aircraft, and construction and medical equipment will qualify for immediate duty-free access once the agreement is in force. Before the signing of the agreement, Morocco already benefited from the Generalized System of Preferences, which grants duty-free access to the U.S. market in a broad range of product categories, including that for Moroccan phosphate exports. The United States-Morocco Free Trade Agreement was scheduled to be implemented in 2005 (Office of the United States Trade Representative, 2004§; U.S. Commercial Service, 2005§).

## Structure of the Mineral Industry

The Office National des Hydrocarbures et des Mines (ONHYM) was the Government entity responsible for the exploration for and the promotion of national mineral resources. State-owned Office Chérifien des Phosphates (OCP) managed phosphate mining and beneficiation and owned most of the phosphoric acid and phosphate fertilizer production facilities. Groupe ONA of Morocco was the leading indirect private sector investor through its equity interest in Managem S.A. and Société Nationale d'Investissement S.A. (SNI). Managem had six mines in Morocco: the Akka gold mine, the Bou-Azzer cobalt mine, the Draa Sfar and the Guemassa copper-lead-zinc mines, El Ham mam fluorspar mine, and the Imiter silver mine (Mining Review Africa, 2005).

## Commodity Review

### Metals

**Cobalt.**—Compagnie de Tifnout Tiranimine (CTT), which was a subsidiary of Managem, mined cobalt ore at Bou-Azzer. Cobalt concentrates and tailings from Bou-Azzer were refined at the Guemassa plant. The Guemassa plant also produced about 6,000 metric tons per year (t/yr) of arsenic trioxide (Mining Review Africa, 2005, p. 10-11).

**Copper.**—Odyssey Resources Ltd. of Canada signed an agreement with the Government to acquire 34 exploration licenses that total 392 km<sup>2</sup> in Morocco's copper-silver district.

<sup>1</sup>References that include a section mark (§) are found in the Internet References Cited sections.

<sup>2</sup>Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars (US\$) at the average exchange rate of DH9.0465=US\$1.00 for 2004 and DH9.5744=US\$1.00 for 2003.

The properties are located in southwestern Morocco within the Anti Atlas Mountains. The agreement to acquire 17 of the 34 exploration licenses entailed expenditures totaling \$1.45 million over a period of 4 years and cash payments of about \$16.5 million over an additional 4-year period. Odyssey will own 100% of all claims subject only to a 3% net smelter return royalty (Odyssey Resources Ltd., 2004§).

**Gold.**—Gold exploration activities in 2004 included the Tafrent gold project, which was at a feasibility stage, and the Imawn gold project, which was at a drilling and resource identification stage (Mining Review Africa, 2004§).

**Lead and Zinc.**—Compagnie Minière de Guemassa (CMG), which was a subsidiary of Managem, operated the underground polymetallic Hajar Mine at Guemassa. Ore was crushed prior to conveying it to the surface, stored in silos, and then milled before being sent to an automated differential flotation circuit for the production of copper, lead, and zinc concentrates. The concentrates were then thickened and filtered to produce marketable concentrates and transported 200 kilometers (km) to the Port of Safi for export. The company's second polymetallic mine, the Draa Sfar Mine, began operating in 2004 and produced an average of 2,200 metric tons per day (t/d) of ore. Ore from the Draa Sfar Mine was crushed onsite and then transported to the Guemassa Mine for milling. The estimated life of the Draa Sfar Mine was 10 years. Managem's industrial processing complex at Guemassa produced about 160,000 metric tons (t) of zinc concentrates, 30,000 t of lead, and 10,000 t of copper concentrates annually (Mining Review Africa, 2005, p. 10).

**Silver.**—Silver in Morocco occurs both as the primary mineral in ore deposits at Igoudrane and Imiter and as a byproduct of cobalt, copper, lead, and zinc mining operations. Most of the country's silver production came from the Imiter Mine, which was owned and operated by Société Metallurgique d'Imiter (SMI) (a subsidiary of Managem). Imiter Mine, which is located about 150 km east of Ouarzazate on the northern side of Saghro Mountain, mines about 300,000 t/yr of ore and has a production capacity of about 250 t/yr of 99.7% pure silver in the form of anodes and bullion. At Igoudrane, resources have been estimated to be 500,000 t containing 730 grams per metric ton (g/t) silver (Mining Review Africa, 2004§).

### *Industrial Minerals*

**Bentonite.**—In March 2004, S&B Industrial Minerals S.A. of Greece, through its subsidiary North African Industrial Minerals Exploration, signed an agreement with the Moroccan Bureau de Recherches et de Participation Minières for the acquisition of four mining exploration and exploitation licenses for bentonite deposits in Morocco. The company planned to conduct geophysics studies and a drilling program to identify potential reserves (Industrial Minerals, 2004b; S&B Industrial Minerals S.A., 2004).

**Cement.**—The Moroccan cement industry comprised four companies: Asment de Temara; Holcim (Maroc) S.A.; Lafarge S.A. (Lafarge) through Lafarge Ciments (Maroc), which was a 50% owned subsidiary of the Lafarge Group of France; and Société les Ciments du Maroc S.A. Lafarge Ciments, which

operated the Bouskoura, the Meknes, the Tangiers, and the Tetouan cement plants, planned to build a new production line at Bouskoura, which will increase production capacity by 900,000 t/yr to 3.1 million metric tons per year (Mt/yr). Production was scheduled to start at the beginning of 2006 (Lafarge S.A., 2004c). In Morocco, coal-fired powerplants were estimated to generate about 570,000 t/yr of fly ash, including 400,000 t/yr recovered as dry matter. Lafarge Ciments had a contract with the Jorf Lasfar Energy Company to purchase the fly ash and reuse it as a cement additive at the Bouskoura cement plant. Cement produced at Bouskoura had a fly ash content of about 6.5% (Lafarge S.A., 2004§).

In May 2004, Lafarge Ciments opened a new cement plant in Tetouan with a production capacity of 1 Mt/yr. The new plant, Tetouan-2, replaced an existing unit that had been transformed into a lime-processing facility. Tetouan-2 was designed to accommodate a second production line if needed. About 40% of the plant's electricity needs will be generated by windmills. The construction of a wind farm was contracted to Compagnie du Vent of France, which expected to begin supplying electricity to the plant in 2005 (Lafarge S.A., 2004a, b; North Africa Journal, The, 2004§).

Société Holcim (Maroc) S.A., which operated two cement plants and two clinker-grinding mills in Morocco, planned to build a new cement plant in Settat, which is located about 70 km south of Casablanca. The plant, which will have an annual capacity of 1.7 Mt/yr, was scheduled to come online in 2008 and would cost about \$259 million (International Cement Review, 2004; Middle East Economic Digest, 2004a).

**Diamond.**—In May 2004, Metalex Ventures Ltd. of Canada signed an exploration agreement with ONHYM to conduct preliminary diamond exploration in southern Morocco. The concession included in the exploration agreement is for an area of 24,800 km<sup>2</sup> of Archean cratonic and Proterozoic rocks, which the company considered to be highly prospective for diamond-bearing kimberlite and for base and precious metals, including platinum-group metals and iron ore. In 2004, 942 loam and drainage samples were collected and sent to Canada's CF Mineral Research Ltd.'s laboratory in British Columbia for base- and precious-metal analysis (Metalex Ventures Ltd., 2004).

**Fluorspar.**—Société Anonyme d'Enterprises Minières (Samine), which was a subsidiary of Managem, operated El Hammam fluorspar mine (Mining Review Africa, 2005, p. 10). The mine produced 112,100 t of acid-grade fluorspar in 2004 (table 1).

**Phosphate Rock.**—OCP mined phosphate ore from Benguerir, Khouribga, and Youssoufia. The company's Khouribga operations were spread out over a radius of 30 km and included three mines: Sidi Chennane Mine, Mera El Arech Mine, and Sidi Daoui Mine, which had production capacities of 8 Mt/yr, 6 Mt/yr, 4 Mt/yr, respectively. Sidi Daoui Mine was being gradually depleted of ore. Operations at Khouribga switched from underground methods to open pit methods in 1993. Phosphate deposits were found in layered units ranging from less than 1 meter (m) to 4 m in thickness, and were covered by between 12 and 15 m of overburden. Once the overburden was removed, the material was drilled, blasted, and carried out by drag lines. Trucks carried the material to a

crushing and screening facility where the ore was first screened to 90 millimeters (mm), and then to 15 mm, and was then sent via a 25- to 30-km-long conveyor to a beneficiation plant. The phosphate product with a size of between 40 and 125 microns was sent to a washing plant where it was separated from the slime. The wet product was pumped to basins about 2 km away for storage before being conveyed to the drying plant. The washing plant had a capacity of 6 Mt/yr, a dry beneficiation capacity of 2.4 Mt/yr, a calcination capacity of 200,000 t/yr, and a drying capacity of 18 Mt/yr. About 50% of OCP's output was processed domestically, and the remaining 50% was exported, with Asia being the leading importer. India was one of the major importers of phosphoric acid. Phosphate was exported through an OCP-operated port terminal at Casablanca that had an export capacity of 14 Mt/yr and through the Port of Layoune (Industrial Minerals, 2004a).

The Government was considering cooperative ventures with foreign companies to develop the phosphates industry further. In July, the Government signed a 50-50 joint-venture agreement with the Fauji Fertiliser Bin Qasim Ltd. of Pakistan to develop a 375,000-t/yr phosphoric acid plant in Jorf Lasfar at a cost of about \$200 million. The plant, which will use about 1.3 Mt/yr of phosphate rock from OCP's Khouribga Mine, was scheduled to be completed by 2007 and will feed Fauji's 450,000-t/yr diammonium phosphate plant in Pakistan. Other foreign companies interested in establishing joint ventures with OCP were Chambal Fertilisers and Chemicals Limited of India, Chemische Fabrik Budenheim KG of Germany, Société Regionale d'Investissement de Wallonie of Belgium, and Zuari Industries Limited of India (Middle East Economic Digest, 2004b).

In December 2004, OCP and Bunge Fertilizantes S.A. of Brazil signed a memorandum of understanding to undertake an engineering study for the construction of a joint-venture integrated phosphates fertilizer and phosphoric acid plant at Jorf Lasfar. Investment in the project was estimated to be \$265 million. OCP and Bunge Fertilizantes had agreed in May on a long-term strategic alliance under which OCP would supply about 70% of Bunge's phosphate import requirements for the Latin America market. OCP exports to Brazil have doubled in the past 2 years (Arabic News.com, 2004§; Fertilizer Week Online, 2004§).

### **Mineral Fuels**

According to the U.S. Energy Information Administration, Morocco had proven oil reserves of about 2 billion barrels and gas reserves of about 43 billion cubic feet. The country produced small volumes of natural gas and petroleum from the Essaouira Basin and small amounts of gas from the Gharb Basin. Morocco was a transit center for Algerian gas exports to Spain and Portugal; exports were transported across the Strait of Gibraltar via the Maghreb-Europe Gas (MEG) pipeline. Morocco had two refineries with a combined capacity of about 155,000 barrels per day. The refineries were located at Mohammedia and Sidi Kacem. In 2004, the Samir refinery returned to near-full-capacity output levels when repairs needed to fix damage caused by a severe flood and massive

fire in November 2002 were completed. Among the foreign companies engaged in exploration in 2004 were Maersk Oil og Gas AS of Denmark, which signed an 8-year agreement for eight blocks north of Tarfaya; Norsk Hydro of Norway, which signed a 12-month exploration contract for the Safi offshore northwestern zone; Offshore Oil Corporation of China, which received a license to drill near Agadir; and Stratic Energy Corporation of Canada, which had a 3-year exploration program for two onshore blocks in northwestern Morocco (U.S. Energy Information Administration, 2005§).

### **Infrastructure**

The Moroccan Government's National Electricity Office awarded three contracts worth \$6.6 million to Instalaciones Inabensa S.A. of Spain for rural electrification projects in the southern regions of Agadir and Chtouka Aït Baha. Morocco had launched the rural electrification program in 1996 to bring power to more than 34,000 towns and villages by 2007 (African Energy, 2004).

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## WESTERN SAHARA

According to the U.S. Department of State (2005§), the issue of sovereignty over Western Sahara remained unresolved in 2004. The territory, a desert area that borders the Atlantic

Ocean between Mauritania and Morocco, is contested by Morocco and the Popular Front for the Liberation of the Saguia el Hamra and Rio de Oro (Polisario), an independence movement based in Tindouf, Algeria. Western Sahara's economy was dependent on pastoral nomadism, fishing, and phosphate mining. The country's open pit phosphate rock mine at Boucraa and associated beneficiation facilities in Laayoune were operated by the OCP subsidiary Phosphates de Boucraa S.A. (Phosboucraa). All trade and economic activities were controlled by the Moroccan Government. Western Sahara's population was estimated to be about 267,000 in 2004 (U.S. Central Intelligence Agency, 2005§).

Morocco had granted exploration contracts to several foreign companies to explore for oil offshore Western Sahara; among them were Kerr-McGee Corp. of the United States; Robertson Research International of Wales; Svitzer Ltd. (a subsidiary of the Dutch company Fugro); TGS Nopec of Norway; Total S.A. of France; and Wessex Exploration Ltd. of the United Kingdom in addition to Premier Oil plc and Sterling Energy plc, which had received conditional exploration rights from the Polisario. By the end of 2004, all these companies had ended their operations in Western Sahara with the exception of Kerr-McGee (afrol News, 2004a, b§; U.S. Energy Information Administration, 2005§).

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TABLE 1  
MOROCCO AND WESTERN SAHARA: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Metric tons unless otherwise specified)

Commodity <sup>2</sup>	2000	2001	2002	2003	2004 <sup>c</sup>
<b>METALS</b>					
Antimony, sodium antimonate	548	436	532	500	500
Cobalt:					
Concentrates, gross weight	11,378 <sup>r</sup>	15,725	16,896	16,178	17,000
Co content	967 <sup>r</sup>	1,242 <sup>r</sup>	1,453 <sup>r</sup>	1,391 <sup>r</sup>	1,600
Metal <sup>3</sup>	1,207 <sup>r</sup>	1,341 <sup>r</sup>	1,354 <sup>r</sup>	1,431 <sup>r,4</sup>	1,593 <sup>4</sup>
Copper:					
Concentrates, gross weight	23,150	19,120	17,799	17,539	14,200 <sup>p,4</sup>
Matte, gross weight	2,117	1,580	2,016	2,505	1,600
Cu content, concentrates and matte	7,080	5,400 <sup>r</sup>	5,000	4,900	4,400 <sup>p</sup>
Gold kilograms	505	1,191	2,747 <sup>r</sup>	1,863	1,200 <sup>p</sup>
Iron and steel:					
Iron ore:					
Gross weight	6,462	7,976	8,736	6,300 <sup>r,4</sup>	9,900 <sup>p,4</sup>
Fe content <sup>c</sup>	3,500	4,300	4,700 <sup>r</sup>	3,400 <sup>r</sup>	5,300
Metal: <sup>c</sup>					
Pig iron	15,000	15,000	15,000	15,000 <sup>r</sup>	15,000
Steel, crude	5,000	5,000	5,000	5,000	5,000
Lead:					
Concentrate:					
Gross weight	117,353 <sup>r</sup>	110,906	88,582 <sup>r</sup>	54,779	44,700 <sup>p,4</sup>
Pb content	81,208	76,747	62,400 <sup>r</sup>	38,600 <sup>r</sup>	31,300
Cupreous matte, Pb content <sup>c</sup>	600	500	600	600	600
Metal:					
Smelter, primary only	66,812	58,178	71,840	62,000	62,000
Refined:					
Primary	66,812	58,178	71,840	61,473	35,000 <sup>4</sup>
Secondary <sup>c</sup>	3,000	3,000	3,000	3,000	4,000 <sup>4</sup>
Total <sup>c</sup>	70,000	61,000	75,000	64,000	39,000
Manganese ore, largely chemical-grade	25,830	13,757	18,064	--	9,000 <sup>p,4</sup>
Mercury <sup>c</sup>	10	10	10 <sup>r</sup>	10 <sup>r</sup>	10
Nickel content of nickle sulfate	84	151	109	126	130
Silver:					
Ag content of concentrates and matte kilograms	43,200 <sup>e</sup>	42,400 <sup>e</sup>	57,000 <sup>e</sup>	25,400 <sup>r,e</sup>	26,000
Ag content of mine and smelter bullion do.	246,204	238,043	220,000 <sup>e</sup>	175,155 <sup>r,4</sup>	170,000 <sup>e</sup>
Total do.	289,000 <sup>e</sup>	280,000 <sup>e</sup>	276,789	200,529 <sup>r,4</sup>	195,952 <sup>4</sup>
Zinc concentrate:					
Gross weight	201,692	174,831	178,476	136,433	146,200 <sup>p,4</sup>
Zn content	103,064	89,339	90,487 <sup>r</sup>	69,200 <sup>r</sup>	74,600 <sup>4</sup>
<b>INDUSTRIAL MINERALS</b>					
Arsenic trioxide	4,426	6,026	5,469	6,872	6,900
Barite	343,557	471,102	469,934	358,500 <sup>r,4</sup>	355,800 <sup>p,4</sup>
Cement, hydraulic thousand metric tons	8,100	10,000 <sup>e</sup>	10,200 <sup>e</sup>	10,400	11,000
Clays, crude:					
Bentonite	43,152	71,741	58,754	67,700 <sup>r,4</sup>	85,400 <sup>p,4</sup>
Fuller's earth (smectite)	30,665	40,664	43,243	14,944	15,000
Montmorillonite (ghassoul)	2,476	2,270	2,329	927	900
Feldspar	6,052	8,979	19,401	20,000	20,000
Fertilizers thousand metric tons	2,441	2,719	2,602	2,542	2,405 <sup>4</sup>
Fluorspar, acid-grade	76,991	96,500	94,911	81,255	112,100 <sup>p,4</sup>
Gypsum <sup>c</sup>	475,000	550,000	600,000	600,000	600,000
Mica	1,897	--	--	--	--
Phosphate rock:					
Gross weight <sup>5</sup> thousand metric tons	21,463	21,983	23,038 <sup>r</sup>	22,877	25,369 <sup>4</sup>
P <sub>2</sub> O <sub>5</sub> content do.	7,200	7,400	7,700	7,400	8,500
Phosphoric acid do.	2,732	2,819	2,921	2,930	3,254 <sup>4</sup>

See footnotes at end of table.

TABLE 1--Continued  
MOROCCO AND WESTERN SAHARA: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Metric tons unless otherwise specified)

Commodity <sup>2</sup>	2000	2001	2002	2003	2004 <sup>c</sup>
INDUSTRIAL MINERALS--Continued					
Salt: <sup>6</sup>					
Rock	162,385 <sup>r,4</sup>	233,816 <sup>r,4</sup>	266,903 <sup>r,4</sup>	236,700 <sup>r,4</sup>	253,800 <sup>4</sup>
Marine <sup>e</sup>	40,000	40,000	27,622 <sup>r,4</sup>	36,000	36,000
Total	202,385 <sup>r</sup>	273,816 <sup>r</sup>	294,525 <sup>r</sup>	272,700 <sup>r</sup>	290,000
Strontium minerals, celestite	7,539	1,879	3,780	2,700	2,700 <sup>c</sup>
Sulphuric acid	NA	NA	8,600	8,900	9,500
Talc and pyrophyllite	12,522	27,246	39,612	1,959 <sup>4</sup>	2,000 <sup>c</sup>
MINERAL FUELS AND RELATED MATERIALS					
Coal, anthracite	30,810	1,908	322	214 <sup>4</sup>	200 <sup>c</sup>
Gas, natural:					
Gross million cubic meters	50	49 <sup>c</sup>	63 <sup>r</sup>	61 <sup>r,4</sup>	40 <sup>p,4</sup>
Dry <sup>c</sup> do.	44	43	55 <sup>r</sup>	54 <sup>r</sup>	35
Petroleum:					
Crude <sup>7</sup> thousand 42-gallon barrels	97	95 <sup>c</sup>	49 <sup>r</sup>	90 <sup>4</sup>	246 <sup>p,4</sup>
Refinery products:					
Liquefied petroleum gas do.	2,800	2,710	2,690	1,000	3,000
Gasoline do.	3,800	2,960	3,210	1,500	3,200
Jet fuel do.	2,200	900	1,090	500	1,000
Kerosene do.	800	880	620	300	900
Distillate fuel oil do.	18,000 <sup>c</sup>	21,970	17,330	9,000	24,000
Residual fuel oil do.	16,000 <sup>c</sup>	16,000	14,000	7,000	17,000
Other do.	5,000 <sup>c</sup>	1,500	1,450	700	2,000
Total do.	48,600 <sup>c</sup>	46,920	40,390	20,000	51,000

<sup>6</sup>Estimated, estimated data are rounded to no more than three significant digits; may not add to totals shown. NA Not available. <sup>p</sup>Preliminary. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>Includes data available through November 28, 2005.

<sup>2</sup>In addition to the commodities listed, perlite and a variety of crude construction materials are produced, but information is inadequate to make estimates of output levels.

<sup>3</sup>Cobalt electrowon from cobalt concentrates and tailings from the Bou-Azzer Mine.

<sup>4</sup>Reported figure.

<sup>5</sup>Reported production from Morocco and Western Sahara.

<sup>6</sup>May include production from Western Sahara.

<sup>7</sup>Data for 2000 are based on crude oil and condensate production, which was reported as 13,106 metric tons.