

# THE MINERAL INDUSTRIES OF CAMBODIA AND LAOS

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## CAMBODIA

Cambodia, which is located north of the Gulf of Thailand, south of Laos, southeast of Thailand, and southwest of Vietnam in Southeast Asia, is a small country with a total land area of about 181,000 square kilometers (km<sup>2</sup>). In 2003, it had a population of about 13.1 million. Cambodia was one of poorest and least developed countries in Asia and the Pacific region. Its per capita gross domestic product (GDP) based on purchasing power parity was estimated to be \$1,616 (International Monetary Fund, 2004§<sup>1</sup>). The country's mineral resources were largely unexplored and unexploited mainly because of wars fought during the 1960s and 1980s and a lack of capital, specialists, and technology in the 1990s.

According to the Government of Cambodia, the identified mineral resources were ruby, sapphire, and zircon in the northwestern Province of Batdambang and manganese, phosphate, and salt in the central part of the country. Other mineral potential in Cambodia included bauxite, coal, natural gas, iron ore, kaolin, peat, petroleum, silica sand, slate, and tin (Asian Journal of Mining, 1999; Royal Government of Cambodia, 2003§).

To attract domestic and foreign mining companies to invest in mineral exploration and development, the Law of Minerals Management and Mining of Cambodia was promulgated by the Government on July 13, 2001. The Ministry of Industry, Mines, and Energy (MIME) was the main Government agency that implemented the law and the country's mineral policy. The Department of Geology and Mines and the Department of Energy under the MIME were responsible for developing the country's mineral resources, providing mining assistance to the private sector, and administering mining-related regulations and inspections (Asian Journal of Mining, 2000).

During the 1990s, the Government, through the MIME, issued 11 licenses, of which 5 were for gold exploration in northeastern Cambodia. Gold exploration licenses were awarded to Brewer Natural Resources Development Co. and Jupiter International Resources Cambodia of the United States; Delcom Cambodia Pte Ltd., which was a joint venture of Cambodian and Malaysian companies; Sun Trading Co. Ltd. of the Republic of Korea; and Wang Fa Cambodia Investment Group of China. In 1997, a license was awarded to Royal Phosphate Company of Malaysia to explore for phosphate rock in the Provinces of Batdambang and Kampot (Asian Journal of Mining, 1999).

No significant gold or other minerals findings were reported by any of the exploring companies or by the MIME. Production of minerals in Cambodia was limited to small-scale mining and quarrying of construction aggregates, phosphate rock, quartz sand, sand and gravel, salt, and stone. Exploration and

exploitation of gemstone and gold reportedly were by local artisanal miners or small joint-venture firms. Their activity and production data were not available.

The mining sector, which was the smallest sector of the Cambodian economy, was estimated to contribute only a small fraction (about 0.2%) to the country's GDP. According to the 2001 Labor Force Survey of Cambodia, the total workforce in the mining and quarrying sector was only 4,000 compared with Cambodia's total workforce of 6.2 million (International Monetary Fund, 2003). In 2003, Cambodia's GDP grew by 4.8% compared with 5.5% in 2002. The country's GDP, in current prices, was estimated to be \$4.16 billion compared with \$3.99 billion in 2002 (International Monetary Fund, 2004§).

From 2000 through 2003, mining activities in Cambodia involved the production of crushed stone (construction aggregates), laterite blocks (bricks), phosphate rock, quartz sand, and sand and gravel. Gold and zircon reportedly were mined illegally in the Provinces of Kampong Cham, Mondol Kiri, and Rotanoh Kiri in 1995 (GeoJAG Australia, 2003§). Gemstones were produced at the Pailin Mine in the Province of Batdambang. Crushed stone and sandstone were produced mainly in the Kampong Speu area and in several locations between Phom Penh and Takeo. Phosphate rock was mined and processed in the Tul Meas area in the Province of Kampot or processed at a small plant in the Province of Batdambang. Quartz sand was produced in the coastal areas to the north and southeast of Sihanoukville.

Cambodia reported no proven reserves of natural gas and petroleum. Cambodia and Thailand had overlapping claims in an area of the Gulf of Thailand, which covers about 27,000-km<sup>2</sup>; this area was thought to be rich in hydrocarbons. According to an estimate that was based on 12,000 line-kilometers of high-quality seismic data, the overlapping claims area was thought to contain about 311 billion cubic meters of natural gas reserves. The area also was thought to contain an undetermined amount of natural gas liquids and petroleum. In 2002, the Cambodia National Petroleum Authority awarded block A, which covers a 6,278-km<sup>2</sup> area in the overlapping claims area, to a consortium led by ChevronTexaco Corporation of the United States. During 2003, ChevronTexaco, which was the operator of block A, scheduled the drilling of at least two wells (Alexander's Gas & Oil Connections, 2002§; Cambodian Investment Board, 2003§).

In March, LG-Caltex Oil Corp., which owned and operated the second largest oil refinery in the Republic of Korea, acquired a 15% interest in exploration block A from ChevronTexaco. LG-Caltex reportedly would pay about \$18 million by 2004. A preliminary study estimated that the block could contain about 400 million barrels of crude petroleum and about 85 billion cubic meters of natural gas. After the deal, ChevronTexaco's share in block A decreased to 55% from 70%. Mitsui Oil Exploration Co. Ltd. of Japan owned the remaining 30% of the block (Rigzone.com, 2003§; Webprowire.com, 2003§).

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

During the next 4 to 5 years, the mining sector is expected to remain the smallest sector of the Cambodian economy unless significant reserves of oil and natural gas in block A are discovered and developed by the consortium led by ChevronTexaco. The Cambodian GDP is forecast to grow by 5.9% in 2004 and 2.5% in 2005 (International Monetary Fund, 2004§).

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## Major Source of Information

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## LAOS

Laos, which is located north of Cambodia, southeast of Burma, south of China, northeast of Thailand, and west of Vietnam in Southeast Asia, is a small landlocked country with a land area of about 231,000 km<sup>2</sup>. In 2003, it had a population of about 5.9 million. Laos was one of the poorest and least developed countries in Asia and the Pacific region. In 2003, Laos' per capita GDP based on purchasing power parity was estimated to be \$1,787 (International Monetary Fund, 2004§).

Laos has a wide variety of minerals. The identified mineral resources were barite, clays, coal, copper, dolomite, gold,

graphite, gypsum, limestone, rock salt, sapphire, silver, tin, and zinc. Other mineral potential in Laos included antimony, asbestos, bismuth, cobalt, gemstones, iron ore, lead, lignite, kaolin, manganese, molybdenum, potash, silica sand, and tungsten. Geologic environments for the discovery of coal, copper, gold, iron ore, potash, rock salt, and tin were thought to be good (Asian Journal of Mining, 2000).

The mining sector, which was dominated by the mining of gold, gypsum, limestone, and tin, was the smallest sector of the Laotian economy. The mining sector was estimated to contribute 0.6% to the country's GDP. In 2003, Laos' real GDP growth was estimated to be 5.3% compared with 5.9% in 2002 (International Monetary Fund, 2004§). According to Laos' Department of Geology & Mines, production of mineral commodities included barite, carbonate rocks (construction aggregate and limestone), coal (anthracite and lignite), gold, gypsum, rock salt, sapphire, silver, tin, and zinc. All mining activities in Laos were small scale and mostly owned and operated by state-owned mining enterprises or by joint ventures of state-owned and foreign companies.

To promote and encourage foreign investment in the mining sector, a new mining law was promulgated by the Government on April 12, 1997; fiscal incentives (tax holidays) for minerals exploration were also provided. By October 1998, 21 licenses had been issued to foreign companies—8 were for construction materials (clay, granite, gypsum, limestone, and sandstone) exploration; 5, gold; 3, coal; 2, tin; and 1 each, oil and gas, sapphire, and zinc (Asian Journal of Mining, 1999). In 2003, Oxiana Ltd. (formerly Oxiana Resources, N.L.), Padaeng Industry Public Co. Ltd., and Pan Australian Resources N.L. (PARNL) were the major foreign companies that continued to invest in exploration and development of copper, gold, silver, and zinc resources in Laos.

On February 27, 2003, Laos officially opened its first gold mine; it is located about 40 kilometers (km) north of the town of Sepon in the Province of Savannakhet in south-central Laos. In 2003, the Sepon Mine produced 1.57 million metric tons (Mt) of ore at a grade of 4.42 grams per metric ton (g/t) gold from the Discovery, Discovery West, Nalou, and Vang Ngang pits. The mill (treatment plant) processed 1.17 Mt of ore at a grade of 5 g/t gold and produced 5,140 kilograms (kg) (165,255 troy ounces) of gold and 3,850 kg (123,782 troy ounces) of silver. Gold and silver recovery rates were 87.7% and 39.0%, respectively. The cash operating cost was \$4,340 per kilogram, or \$135 per ounce; and production costs (cash operating cost plus depreciation, depletion, amortization, and rehabilitation), \$6,848 per kilogram, or \$213 per ounce in 2003 (Oxiana Resources N.L., 2003; Oxiana Ltd., 2003§).

As a result of extensive exploration and development drilling by Oxiana near the Sepon Mine, Sepon gold reserves as of December 31, 2003, increased by 70% to 14.22 Mt of ore at grades of 3.43 g/t gold and 5.68 g/t silver that contains 48.8 metric tons (t) (1.57 million troy ounces) of gold and 80.8 t (2.60 million troy ounces) of silver. Of the gold reserves, 6.83 Mt was proven at grades of 3.75 g/t gold and 5.9 g/t silver; 6.87 Mt, probable at grades of 3.11 g/t gold and 5.26 g/t silver; and 530,000 t, stockpile at grades of 3.29 g/t gold and 3.9 g/t silver.

Limited drilling at the Khanong copper deposit in the Sepon mineral district added 120,000 t of contained copper to the Khanong copper reserves. As of December 31, 2003, Sepon copper reserves increased to 15.5 Mt at a grade of 5.2% copper compared with 11.5 Mt at a grade of 5.1% copper in 2002. Of the 15.5 Mt of reserves, 11.99 Mt was proven at a grade of 5.1% copper, and 3.51 Mt was probable at a grade of 5.7% copper. The Sepon gold-copper project was owned and operated by Lane Xang Mineral Ltd. (LXML), which was owned by Oxiana Resources Laos Ltd. (a subsidiary of Oxiana) (80%) and Rio Tinto plc of the United Kingdom (20%) (Oxiana Ltd., 2003, 2003§).

Following completion of an environmental-social impact assessment study in 2001 and a bankable feasibility study in 2002 for the development of the Khanong copper project, Oxiana Ltd. awarded an engineering, procurement, and construction contract to the Khanong Development Group, which was a joint venture of engineering consultants Ausenco Ltd. and Batesman Engineering Pty Ltd., in early 2003. The €32 million solvent extraction-electrowinning (SX-EW) contract was awarded on a lump-sum basis to Outokumpu Technology Oy of Finland in May 2003. Development and construction of the copper mining project, which was adjacent to the Sepon gold mine, were scheduled to be completed in 27 months, and copper production would begin in March 2005. The Khanong copper mine would produce copper ore at the rate of 1.3 million metric tons per year (Mt/yr) that would be processed by way of a Whole of Ore Leach and SX-EW operation to produce 60,000 metric tons per year (t/yr) of copper cathodes. The \$235 million project, which included the capital cost of \$185 million and working capital of \$30 million, would be funded initially with loans of \$185 million, and the balance would be funded from equity contributions through LXML (Oxiana Ltd., 2003§).

In 2003, PARNL made substantial progress in gold and copper exploration at its property in the Phu Bia contract area, which was located about 100 km northeast of Laos' national capital Vientiane. In February, the company began a \$2.3 million prefeasibility study at the Phu Bia gold project to define indicated and measured mineral resources at the Ban Houayxai and Long Chieng Track deposits. As part of the study, the company initiated a drill evaluation of the Phu Kham gold cap and the underlying the Phu Kham copper-gold deposits in the same area. The prefeasibility study was completed in September. Positive drilling results at the Ban Houayxai and the Phu Kham gold cap deposits encouraged PARNL to continue drilling at the latter. Owing to the positive results of the prefeasibility study, a full bankable feasibility study was initiated in October and was scheduled for completion by June 2004 (Pan Australian Resources N.L., 2003a, b, e).

The Phu Kham copper-gold project was estimated to contain 213 Mt of inferred mineral resources at grades of 0.6% copper and 0.3 g/t gold that contains 1.27 Mt of copper and nearly 62,200 kg (2 million troy ounces) of gold at a 0.3% copper cut-off grade. According to PARNL, the Phu Kham copper-gold deposit could be larger than expected after a recent diamond core hole intersected the western limit of the deposit and found continuous mineralization of 0.8% copper and 0.3 g/t gold for 180 meters (m) from a depth of only 30 m. PARNL raised

\$7 million to conduct a feasibility study, which was scheduled to be completed in about 18 months (Pan Australian Resources N.L., 2003c).

The Phu Bia gold project and the Phu Kham copper-gold projects were owned and operated by Phu Bia Mining Ltd. (PBML), which was owned by PARNL (80%) and Newmont South East Asia Pte Ltd. (Newmont SEA) (20%). In May 2003, Newmont SEA transferred 80% of its shares in PBML to PARNL. The share transfer had been approved by the Laotian Government in March 2002 (Pan Australian Resources N.L., 2003d).

Tin was produced from the Nong Sun and the Phon Thiou Mines. Mined tin ore was concentrated at the Phon Thiou plant in the Nam Pathene Valley, Province of Khammouane. All tin concentrate, which graded between 50% and 70% tin, was exported and sold to Malaysia Smelting Corp.

After signing an agreement with the Laotian Government in July 2000, Padaeng Industry Public Co., Ltd. of Thailand began mining operations at the Kaiso zinc deposit in the Vangvieng area in late 2000. All mined zinc ore was exported to Thailand for smelting and refining.

Gypsum was produced from the Dong Hene Mine in the Province of Savannakhet by the State Gypsum Mining Enterprise. Lanexang Gypsum Co. Ltd. (LGC), which had been exploring for gypsum in Laos since 1999, developed a new gypsum mine with estimated reserves of 21 Mt in the Province of Savannakhet (Reywod Manawatao, senior mining engineer, Thai Gypsum Products Pcl, oral commun., July 23, 2002). LGC was a joint venture of Thai Gypsum Products Pcl. of Thailand (70%) and the Laotian Government (30%). The country's gypsum production was estimated to be about 120,000 t in 2003. Most of Laos' gypsum production was exported to Thailand and Vietnam. About 5% of gypsum production was consumed by domestic cement plants.

Laos' first cement plant and the first Chinese-Laotian joint venture, Wanrong Cement Plant One, marketed its cement under the Golden Bull brand. The country's second cement plant, Wanrong Cement in Vang Vieng, which was located about 150 km north of Vientiane, had a capacity of 200,000 t/yr and began operation in March 2002.

The country's third Chinese-funded cement plant, which had a planned capacity of 200,000 t/yr, was under construction in the Province of Saravan. The new cement factory would be 100% owned by the Chinese investors who planned to invest about \$30 million to build the plant. Under the agreement, the Chinese company had a 30-year investment contract before it was required to transfer its assets to the Government of Laos (Vientiane Times, 2002§).

In the next 4 to 5 years, the mining sector is expected to expand considerably. Oxiana is expected to increase its gold production capacity and to begin copper production at its Khanong copper mine by 2005 or 2006. Production capacities of copper and gold could be increased further if development of the Phu Kham copper-gold project by PARNL materializes by 2007 or 2008. The Laotian economy is forecast to grow by 5.8% in 2004 and 6.3% in 2005 (International Monetary Fund, 2004§).

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## Major Source of Information

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TABLE 1  
 CAMBODIA AND LAOS: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Metric tons unless otherwise specified)

Country and commodity	1999	2000	2001	2002	2003 <sup>2</sup>
CAMBODIA <sup>2</sup>					
Cement, clinker <sup>c</sup>	--	--	-- <sup>r</sup>	-- <sup>r</sup>	--
Gravel	13,000 <sup>e</sup>	12,800 <sup>e</sup>	1,880 <sup>r</sup>	9,730 <sup>r</sup>	10,000
Laterite, blocks	--	29,700	42,800 <sup>r</sup>	-- <sup>r</sup>	35,000
Phosphate fertilizer	741	3,617	900 <sup>r</sup>	-- <sup>r</sup>	500
Quartz sand	1,913	17,017	5,050 <sup>r</sup>	-- <sup>r</sup>	1,000
Salt	40,000 <sup>e</sup>	40,000 <sup>e</sup>	11,000 <sup>r</sup>	72,500 <sup>r</sup>	50,000
Sand, construction materials	700,000 <sup>e</sup>	690,000 <sup>e</sup>	563,860 <sup>r</sup>	378,460 <sup>r</sup>	500,000
Stones, crude construction materials	149,800	248,100	280,740 <sup>r</sup>	788,100 <sup>r</sup>	300,000
LAOS <sup>3</sup>					
Barite	6,600	2,000	4,400 <sup>r</sup>	12,696 <sup>r</sup>	12,000
Cement <sup>c</sup>	80,000	92,000	92,000	240,000	250,000
Coal, bituminous	78,825	126,290	122,942 <sup>r</sup>	233,823 <sup>r</sup>	230,000
Gemstones	carats	126,070	189,284	-- <sup>r</sup>	200,000 <sup>e</sup>
Gold	kilograms	--	--	--	5,140
Gypsum	134,745	131,517	121,220 <sup>r</sup>	110,272 <sup>r</sup>	120,000
Limestone	66,549	221,600	287,900 <sup>r</sup>	1,282,900 <sup>r</sup>	1,300,000
Salt, rock	1,759	1,779	2,635 <sup>r</sup>	5,410 <sup>r</sup>	5,000
Silver	kilograms	--	--	--	3,850
Tin, mine output, Sn content	404	408	490 <sup>r</sup>	366 <sup>r</sup>	360
Zinc, mine output, Zn content <sup>e</sup>	--	60	28,745 <sup>r</sup>	1,345 <sup>r</sup>	1,000

<sup>e</sup>Estimated; estimated data are rounded to no more than three significant digits. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through May 28, 2004.

<sup>2</sup>In addition to the commodities listed, clay, gemstone, gold, iron ore, and lime are presumably produced, but available information is inadequate to make reliable estimates of output levels.

<sup>3</sup>In addition to the commodities listed, crude construction materials, such as sand and gravel, and varieties of stone are presumably produced, but available information is inadequate to make reliable estimates of output levels.

Sources: Asian Journal of Mining, Asian Mining Yearbook (11th ed.), 2000, p. 13; Cambodia's Ministry of Industry, Mines and Energy; Laos' Ministry of Industry and Handicraft; U.S. Geological Survey Minerals Questionnaires for Cambodia and Laos, 2000, 2001, and 2002; Oxiana Ltd. Annual Report 2003.