



2005 Minerals Yearbook

THAILAND

THE MINERAL INDUSTRY OF THAILAND

By John C. Wu

Thailand, which is located north of the Andaman Sea and the Gulf of Thailand, east of Burma, west of Cambodia and Laos, and north of Malaysia in Southeast Asia, was classified as a lower-middle-income developing country by the World Bank. The country had a population of about 65.6 million. Its total area is about 514,000 square kilometers (km²). In 2005, Thailand's gross domestic product (GDP) and per capita GDP based on purchasing power parity were estimated to be \$544.8 billion and \$8,319, respectively (International Monetary Fund, 2006[§]; U.S. Central Intelligence Agency, 2006[§]; World Bank, 2006[§]).

Thailand's identified mineral resources are antimony, ball clay, barite, bentonite, copper, diatomite, dolomite, feldspar, fluorite, gold, gypsum, iron ore, kaolin, lead, limestone, manganese, marl, phosphate rock, potash, quartz, rock salt, silica sand, tin, tungsten, and zinc (Department of Mineral Resources, 1998, p. 18). Thailand also has small resources of coal, natural gas, and crude petroleum.

Resources of such industrial minerals as diatomite, dolomite, gypsum, kaolin, limestone, marl, potash, and silica sand were more abundant than other identified minerals. The resources of barite, copper, fluorite, gold, gypsum, iron ore, lead, quartz, potash, tin, tungsten, and zinc, however, have higher unit value. During the past 20 years, most of the identified minerals except potash have been exploited for domestic consumption and export.

In terms of value, limestone, coal (lignite), gypsum, gold, and zinc were the five most important minerals produced in 2005. Thailand was one of the world's top producers of feldspar and gypsum and one of the world's leading exporters of cement, feldspar, and gypsum. Cement, coal (lignite), dolomite, feldspar, natural gas, gold, gypsum, limestone, crude petroleum, rock salt, silica sand, tin, and zinc were important to the Thai economy. Some of these minerals, which included cement, feldspar, gold, limestone, rock salt, refined tin, and zinc, were exported to earn foreign currency. The leading export mineral commodities in 2005 were cement, gypsum, refined petroleum products, and refined tin and zinc.

According to the National Economic and Social Development Board, the output of the mining and quarrying sector, which accounted for 2.3% of the country's real GDP in 2005, grew by 9.5% compared with 4.7% in 2004. The Thai economy as measured by the real GDP in 1988 constant dollars grew by 4.5% compared with 6.2% in 2004. The Thai GDP in 1988 constant dollars was estimated to be \$95.4 billion² compared with \$91.3 billion in 2004. The inflation rate as measured by change in the Consumer Price Index rose to 4.5% in 2005 from 2.7% in 2004. In 2005, Thailand had a merchandise trade deficit of \$8.6 billion compared with a trade surplus of \$1.5 billion in 2004; the deficit was the result of a 26% surge in imports, which

resulted from a 56.7% increase in imports of crude petroleum and refined petroleum products to \$18.8 billion accompanied by an increase in exports of only 15%. The country's total outstanding debt increased slightly to \$52.0 billion in 2005 from \$51.3 billion in 2004 (Bank of Thailand, 2006b[§]).

Government Policies and Programs

Thailand's mineral resources are owned by the state. Mineral exploration and development are governed by the Minerals Royalty Act No. 4 of 1966, the Minerals Act of 1967, and the Tin Control Act of 1977. The Minerals Act of 1967, which had been amended in 1973, 1979, and 1991, was amended again by Minerals Act No. 5 in 2002 for underground mining; the new amendment permits mining at depths of greater than 100 meters (m) below the surface without the need to obtain the specific consent of the holder of the surface right. The Minerals Act governs onshore and offshore exploration, mineral production, mineral trade, ore dressing, transport, and export of minerals other than petroleum. The Minerals Royalty Act prescribes the rates of royalties to be assessed for different kinds of minerals. The Tin Control Act controls tin mining and trade.

Under the Minerals Act of 1967, the Ministry of Industry was appointed as the principal Government agency to govern the mining sector. The Department of Primary Industry and Mines (DPI&M) is empowered to administer the Minerals Act and to issue ministerial regulations and provides technical assistance in mining, mineral processing, and metallurgical activities under the jurisdiction of the Ministry of Industry. The Department of Mineral Resources (DMR) is empowered to draft national mineral and geologic policies and provides technical assistance in geologic prospecting and mineral exploration under the jurisdiction of the Ministry of Natural Resources and Environment (Department of Mineral Resources, 2004[§]).

Environmental Issues

The Klity mining case, which was an ongoing case involving environmental pollution related to lead mining, was still not yet resolved fully in 2005. The village of Klity in Kanchanaburi Province, which is located 109 kilometers (km) west of Bangkok, had long suffered from lead poisoning related to lead sediment and contamination in the Klity Creek near the village. A lead mine, which was operated by Lead Concentrate Thailand Company, discharged waste into the creek. The villagers who drank water collected from this creek suffered from some form of lead poisoning. An independent advocacy group called Environmental Law for the Wants (ENLAW) brought a civil suit against the lead mining company in 2000 to clean up the pollution and offer victim restitution. According to New York-based Blacksmith Institute, ENLAW also brought an administrative suit against the Government's Pollution Control Department (PCD) for its failure to implement its own

¹References that include a section mark (§) are found in the Internet References Cited section.

²Value has been converted from Thai Baht (B) to U.S. dollars (US\$) at a rate of B40.27=US\$1.00 for 2004 and 2005.

plan to restore the quality of lead-contaminated Klity Creek. The PCD reportedly had installed an irrigation apparatus along the contaminated creek to capture the lead sediment, but this had created a sludge problem. In 2005, ENLAW reportedly was considering a case against the Basic Industry Department under the Ministry of Industry to restore the environment in and around the lead concentrator (Blacksmith Institute, The, 2005§).

A research study on the cadmium contamination problem in the vicinity of Mae Tao Creek in Mae Sot district in Tak Province, which was commissioned by Padaeng Industry Public Company Ltd. (PDI) in 2004 and conducted by the National Research Center for Environment and Hazardous Waste Management at Chulaongkorn University, was completed in 2005. The study concluded that contamination in the Mae Tao Basin had emanated from natural sources and from human activities of all kinds that had aggravated the natural process; these included industry, deforestation, forestry firing, and human settlements. As a result, the Government banned farmers from growing edible crops in the cadmium-contaminated area. A task force made up of representatives of local villagers, community leaders, and officials of the public and private sectors was established to 1) prepare a plan to rehabilitate cadmium-contaminated areas, 2) control and prevent pollution, 3) promote economic development that emphasizes quality of life and health, and 4) make the Mae Tao management more efficient. To assist the task force, PDI was to provide such required information as geologic and geographical mapping and resources for sampling and analysis. PDI had donated medical equipment including a bone-quality detector, provided financial support for the nonedible-plant cultivation project, and established the Mae Tao Basin Community Development Fund for the benefit of the community around the mine (Padaeng Industry Public Company Ltd., 2006§).

Production

In 2005, Thailand's mineral production included antimony, barite, coal, diatomite, dolomite, feldspar, fluorspar, natural gas, gemstones, gold, gypsum, iron ore, kaolin, limestone, marble, manganese, crude petroleum, perlite, phosphate rock, quartz, salt, silica sand, silver, talc, tin, tungsten, and zinc. The main processed mineral products were cement, fluorite (metallurgical grade), refined petroleum products, steel, refined tin, and refined zinc. Thailand also produced tantalum metal powder and oxides, which were produced from tantalum-bearing scrap and tin slag purchased from domestic and foreign sources. Production of most minerals, which included metallic minerals, industrial minerals, and mineral fuels, increased in 2005. Production of most processed mineral products, such as cement, refined petroleum products, steel, and refined tin, also increased in 2005 (table 1). The higher level of mining activities in Thailand reflected the continued growth in the Thai economy and increased worldwide demand for materials in 2005.

Trade

In 2005, exports increased by 15% to \$109.2 billion from \$94.9 billion in 2004, and imports increased by 26% to \$117.8 billion

from \$93.5 billion in 2004. Thailand's merchandise trade balance suffered from a deficit of \$8.6 billion versus a surplus of \$1.5 billion in 2004 (Bank of Thailand, 2006a§).

Thailand was a net importer of mineral commodities mainly because of its large import bills for coal, natural gas, crude petroleum, iron and steel products, and nonferrous metals. According to Thailand's Customs Department, exports of mineral products totaled \$2,000.05 million in 2005, of which refined tin was valued at \$191.14 million; gypsum, \$70.07 million; and all other mineral products, \$1,738.84 million. Exports of major processed mineral commodities were base-metal products, which included ferrous and nonferrous metal products, \$4.5 billion; refined petroleum products, \$3.4 billion; pearl, precious stones, and jewelry, \$3.2 billion; ceramic products, \$615.2 million; and cement, \$462.7 million (Bank of Thailand, 2006a§).

In 2005, imports of major mineral fuel commodities were as follows: crude petroleum, \$16.9 billion; refined petroleum products, \$1.9 billion; natural gas, \$1.5 billion; and coal, \$542.4 million. Imports of major nonfuel mineral products were as follows: iron and steel products, \$8.5 billion; metal and metal products, \$5.9 billion; minerals and mineral products, \$2.4 billion; nonmonetary gold (gold ingot), \$2.0 billion; jewelry and silver bar, \$1.9 billion; fertilizers and pesticides, \$1.2 billion; and cement and construction materials, \$212.5 million (Bank of Thailand, 2006a§).

Commodity Review

Metals

Antimony.—Mine and metal production of antimony rose sharply in 2005. According to DPI&M, two metal producers—New Siam Mineral Resources Co. Ltd. and Peak Union Co., which stopped production in 2004—resumed their operations in the first half of 2005. The two companies reportedly imported raw materials from China because of insufficient supply from domestic sources despite a substantial increase in the 2005 mine production. Antimony metal production was sold mostly to domestic battery producers. Exports of antimony metal were mainly to the Asia and Western Europe markets (Metals Place, 2005d§).

Copper.—In June 2005, Pan Australian Resources Ltd. (PAR) of Australia through PNA (Puthep) Pty Ltd. (PNA), which is a wholly owned subsidiary of PAR, received a 20.66% share allocation in the Puthep Company Ltd. (Puthep) in accordance with the participating agreement dated August 21, 2000. The company and its joint-venture partner PDI agreed to the suspension of PNA's expenditure obligations under the agreement until Puthep and/or the DPI&M receives the land permit for the research program on the PUT1 deposit area from the Department of Forestry. PAR has the right to earn a 51% interest in the Puthep copper project, which is located about 20 km southeast of Loei in northern Thailand, through PNA by providing a minimum of \$4 million for a bankable feasibility study. PAR has options to acquire a total of 60% or 70% interest in Puthep, and the Government of Thailand retains a right to acquire a 10% interest in Puthep after it approves plans to develop a mine (Pan Australian Resources Ltd., 2006§).

Thai Copper Industries Plc, which operated a copper smelter and refinery in Rayong Province in eastern Thailand, began operations on September 24, 2004, with an initial capacity of 72,000 metric tons per year (t/yr) of copper cathode. In 2005, the company's copper smelter reportedly produced 62,300 metric tons (t) of blister and anode compared with 19,600 t in 2004, and its copper refinery produced about 30,000 t of copper cathode compared with 20,000 t in 2004. To meet domestic demand for refined copper, Thailand imported 235,900 t of refined copper in 2005 compared with 223,900 t in 2004. Consumption of refined copper totaled 257,000 t in 2005 compared with 240,000 t in 2004 (International Copper Study Group, 2006, p. 14, 16, 19, 29).

According to an official of Thai Copper Industries, the 2005 production of refined copper had been interrupted by technical problems that caused the plant to shut down twice during the first quarter of 2005. With all the major problems solved by the end of 2005, the company was expecting to increase production by 20,000 t in 2006 (Metals Place, 2005a§).

Gold.—Amanta Resources Ltd. of Canada, which obtained two special prospecting licenses (SPL) for the Langu gold property in Satun Province, southern Thailand, in August 2004, commenced its exploration program in March 2005. The Langu gold project covers a 25-km² area that surrounds an outcropping mineralized area with high-grade replacement style sediment-hosted gold in Devonian limestone and shale. Rock samples taken from outcropping decalcified limestone of the Discovery quarry returned assayed values that range from 4.15 grams per metric ton (g/t) to 36.8 g/t gold; samples from abandoned quarried stockpile material had values as high as 153.5 g/t gold. After an extensive 6-month field investigation program, Amanta Resources completed its initial exploration program in September 2005 and believed that the extensive surface findings, especially the large lateral extents of the anomalous ground, the high gold grades in the rock, and the widespread silica alteration, hold substantial promise for significant resource potential. In September 2005, Amanta Resources submitted two additional SPL applications for an area that is contiguous to the present (2005) 25-km² exploration area and covers an additional 32 km² (Amanta Resources Ltd., 2004a; 2005a§-c§).

Tongkah Harbour Plc, through its 96% owned subsidiary Tungkhum Ltd., had been exploring for gold at its Block 4 concession in Loei Province in northeastern Thailand since the late 1990s. Six applications of the first batch had been approved by the Government in January 2003. The mining licenses were valid for a 25-year period. Gold resources had been estimated to be 4.49 million metric tons (Mt) at a grade of 4.14 g/t gold (Tongkah Harbour Plc, 2005a§).

As of December 2005, according to the company's activities update for its Loei gold project, all infrastructure and earth works were mostly completed; mine site development, facilities construction, and processing equipment installation were in progress and expected to be completed on schedule before the end of 2005. The company planned to start commercial gold production in the first quarter of 2006. Under the company's mining plan, about 1.5 Mt of ore would be mined from the Loei gold project to produce about 5.6 t of gold during a 4-year period.

Tongkah Harbour held a 98.86% equity interest in Tungkhum Ltd., which had 100% control of the mineral concession for exploration and mining of gold and related minerals in Loei Province (Metals Place, 2005c§; Tongkah Harbour Plc, 2005b§).

Kingsgate Consolidated N.L. of Australia, through its 90% owned subsidiary Akara Mining Ltd., produced gold from the Chatree Mine, which is located 45 km southeast of the provincial capital of Phichit on the border of Petchabun and Phichit Provinces. Production of gold from the Chatree Mine decreased slightly to 4,400 kilograms (kg) (142,000 troy ounces) in 2005 from 4,500 kg in 2004. Production of silver from the Chatree Mine was about 14,300 kg (459,701 troy ounces). The average ore grade was about 2.7 g/t gold and the recovery rate averaged about 90% in 2005 (Kingsgate Consolidated Ltd., 2005a§).

To upgrade the processing plant, Kingsgate completed installation and the commissioning of Stage 1 of the pebble/scats crusher, increased the throughput to 2.1 million metric tons per year (Mt/yr), and scheduled complete installation of Stage 2 by the end of 2005 to raise the processing capacity to 2.35 Mt/yr. In 2005, Kingsgate started a feasibility study to expand the plant's milling capacity to 5 Mt/yr. The study was scheduled to be completed in 2006 (Kingsgate Consolidated Ltd., 2005b§).

In July 2005, a significant new mineralization zone was discovered 200 m east of the existing A East mineral resource in the Chatree North area. The most significant results included 12 m at a grade of 30.0 g/t gold and 318 g/t silver. In December 2005, an in-pit resources development drilling program at Chatree also identified significant high-grade mineralization and renewal of the C South lode beneath the main open pit. According to Kingsgate Consolidated, results from the latest campaign included 17 m at a grade of 7.36 g/t gold from 72 m below the current pit surface and 9 m at a grade of 7.54 g/t gold from 54 m below the current pit surface. New gold zones were located immediately west of pit H and north of pit C. Ore reserves at Chatree and Chatree North increased by 25% to 57,230 kg (1.84 million troy ounces) and 526,318 kg (16.6 million ounces) (Kingsgate Consolidated Ltd., 2005c§).

Iron Ore and Iron and Steel.—Mine production of iron ore was up by 62% to 219,896 t in 2005. To meet the iron and steel industry's raw material requirements, Thailand relied heavily on imports of ferroalloys, pig iron, and steel scrap.

Thailand's crude steel production was up by 14% to 5.2 Mt in 2005 from 4.53 Mt in 2004 (Southeast Asia Iron and Steel Institute, 2006§). Thailand's crude steel was produced by electric arc furnaces, which used mostly imported iron and steel scrap. According to a forecast by the Federation of Thai Industries, steel demand was to grow by 15% in 2005 from 12.6 Mt in 2004. Demand for steel grew by 16% in 2004 and by 9% in 2003. The estimated strong growth during the next 6 years would be driven by the country's large infrastructure construction projects; the estimated annual average growth rate of Thai steel demand between 2007 and 2010 was forecasted to be 10% and then to grow at a slower average rate of 6% from 2011 to 2020 (Southeast Asia Iron and Steel Institute, 2005c§).

In early 2005, the Thai Cabinet reportedly had signaled its willingness to support the major upstream steel mill projects by agreeing to finance the development of basic infrastructure

requirements for such projects, which had been planned by G-Steel Plc and the Sahaviriya Group Corp. Ltd. G-Steel, which operated three 130-t electric arc furnaces with the capacity of 1.8 Mt/yr, planned to build a blast furnace steel plant with an additional capacity of 2.65 Mt/yr near its existing mill in Rayong on Thailand's eastern seaboard. Sahaviriya Group announced in 2004 that it would launch a five-phase integrated steel project with a 30 Mt/yr capacity during a 15-year period in Bang Saphan district, Prachuap Khiri Khan Province, in southern Thailand. Although the Board of Investment had already approved the two iron smelting projects in 2005, the status of these projects remained vague because both G-Steel and Sahaviriya Group reportedly had not yet decided what type of equipment to install, who would supply the equipment, and who would install the equipment (Southeast Asia Iron and Steel Institute, 2005b§).

In March 2005, Millennium Steel Public Co. Ltd. reportedly completed a project to expand and upgrade the capacity of NTS Steel's billet plant in Sriacha, Chon Buri Province to 500,000 t/yr from 280,000 t/yr. Millennium Steel was a new holding company that had been formed by the merger of Cementhai Steel and NTS Steel Group Public Co. Ltd. in July 2002. Millennium Steel, which had a rated melting capacity of 1.2 Mt/yr, imported about 100,000 t/yr of billet to supplement its operating capacity of 800,000 t/yr. Millennium Steel had the capacity to produce 1.7 Mt/yr of construction long-steel products, which included 900,000 t/yr of rebar, 630,000 t/yr of wire rod, and 170,000 t/yr of small section and other steel bars. In 2005, the company planned to increase its output of long-steel products to 1.15 Mt/yr. The 250,000 t/yr increase in long-steel products would comprise high-quality wire rod in high-carbon, medium-carbon, and low-carbon grades. Millennium Steel distributed most of its products to the domestic market and exported about 3% of its output to such neighboring countries as Indonesia, the Philippines, and Vietnam (Southeast Asia Iron and Steel Institute, 2005a§).

In September, Shougan (Capital Steel) Corp. of China reportedly planned to invest about \$2.5 billion to build an integrated steel plant in Thailand to supply the Thai domestic market and for export to Association of Southeast Asian Nations (ASEAN) countries. According to the Ministry of Industry, the proposed integrated steel plant would have a capacity to produce from 3 Mt/yr to 4 Mt/yr of a wide range of steel products, which would include hot-metal, slab, and rolled products for Thailand's domestic consumption and for export to ASEAN countries (Metals Place, 2005b§).

In December, Tata Steel Ltd., which was India's second ranked steel producer, agreed to buy a 40% equity interest in Millennium Steel Plc for about \$74 million. Tata Steel would acquire Siam Cement Public Company Ltd.'s stake in Millennium and was offering to buy the remaining shares at a total cost of about \$175 million. Tata Steel planned to triple its production to 15 Mt/yr by 2010 by expanding its capacity in India and acquiring steel companies overseas (Bloomberg.com, 2005§).

Tin.—Mine production of tin dropped sharply from 724 t of tin concentrate in 2004 to a new historical low of less than 190 t of tin concentrate in 2005. To meet its tin smelter's

feedstock requirement, Thailand imported more than 20,000 t of tin concentrate in 2005 compared with about 12,800 t in 2004 (World Bureau of Metal Statistics, 2006, p. 127). Tongkah Harbour, which was one of Thailand's major tin producers in 2004, had temporarily stopped tin mining operations at the Bangtao Bay, the Pang-Nga, and the Phuket Bay areas since April 2005 owing to the high royalty rate on tin. According to Tongkah Harbour, the company was negotiating with the DPI&M to review the royalty rate and to adopt a more competitive rate. During 2005, Tongkah Harbour increased its equity-interest holdings in Sea Minerals Ltd., which was one of Tongkah Harbour's subsidiaries engaged in offshore tin mining, to 83.7% for tin mining prospects farther offshore. Sea Minerals reportedly controlled extensive offshore tin resources, which were estimated to be more than 50,000 t of tin. Sea Minerals had completed the technical feasibility study of mining the deposit and was expected to complete the financial feasibility study by the end of 2006 (Mining Journal, 2006; Metals Place, 2006§).

Tearlach Resources Limited of Vancouver, British Columbia, Canada, had negotiated a joint venture with Asian Tiger Resources Limited of Toronto, Ontario, Canada, in early 2004 for a tin tailing recovery project that is located in the tin-rich mountainous region near the Myanmar border in central Thailand about 125 km northwest of Bangkok. The companies commenced a drilling program that involved about 35 holes to evaluate the prior drill program and to collect a representative sample for metallurgical testing. The project was designed to evaluate the economic recovery of tin and other industrial minerals from about 17 Mt of mineralized sands that remained after initial recovery of tin from alluvial deposits mined between 1978 and 1985. The prior drilling suggested that a suite of heavy and light minerals not previously recovered, such as garnet, muscovite mica, rare earths, tantalite, and tin, were present in sufficient quantities to justify a metallurgical review for recovery and extraction cost analysis (Tearlach Resources Ltd., 2005§).

According to the DPI&M, metal production of refined tin increased by 52% to 31,600 t in 2005 from 20,800 t in 2004. According to Thailand Smelting and Refining Co. Ltd. (Thaisarco), the higher tin metal production was a direct result of increased feedstock (tin concentrate) imported from overseas. Thaisarco had operated below its 36,000-t/yr capacity in the past few years because of limited or tight supply of tin concentrate. Thaisarco produced regular refined tin metals, Thaisarco brand tin that contained 99.85% tin and low-lead tin metals with 50 or 100 parts per million lead, tin-lead, and lead-free solders; tin alloys; pewters; and tin powders (Metals Place, 2006§; Thailand Smelting and Refining Co. Ltd., 2006§).

Domestic demand for refined tin totaled about 4,600 t in 2005 compared with 5,900 t in 2004. Thailand refined tin exports went mainly to the Netherlands (61%), Japan (14%), and Belgium (8%) in 2005 (World Bureau of Metal Statistics, 2006, p. 127).

Tungsten.—Amanta Resources Ltd. of Canada had signed a memorandum of understanding (MOU) with Amanta Ltd. of Thailand to acquire exploration and development rights to multiple minerals [fluorite, stibnite (antimony ore), and tungsten] property in Phrae Province in northern Thailand in August 2004. In August 2005, the company announced that

it had successfully completed a systematic surface sampling and mapping program of an area that covered 1.25 km² of the Doi Ngom breccia pipe with total dimensions of about 2.5 km by 0.5 km. The company said that a large tungsten anomaly that covers an area of 500 m by 800 m was identified and that the anomaly's main concentration of high-grade mineralized materials occurs along the north-south trending silicified ridge. Amanta Resources planned to initiate a drilling program in September 2005 (Amanta Resources Ltd., 2004b; 2005d§).

Zinc.—Mine production of zinc increased by 42% to the highest level since 1995. Zinc silicate ore produced from the Mae Sot Mine increased by 4.8% to 175,000 t from 167,024 t in 2004. The average metal content of zinc silicate ore produced in 2005 was 27% zinc compared with 26% zinc in 2004. According to PDI, as of December 31, 2005, the remaining mineral resource at the Mae Sot Mine totaled about 3.86 Mt at a grade of 12.3% zinc, of which 1.45 Mt at a grade of 13.1% zinc was measured resource; 1.64 Mt at a grade of 12.8% zinc, indicated resource; and 0.34 Mt at a grade of 13.0% zinc, inferred resource. Additionally, about 440,000 t of mined low-grade ore at a grade of 7% zinc was stockpiled at the mine site. During 2005, no new exploration had been conducted within the existing pit. The company planned to conduct exploration drilling in 2006 to reassess ore reserves of the existing five mining leases in the Mae Sot area (Padaeng Industry Public Company Ltd., 2006§).

In 2005, PDI's zinc smelter in Tak received 197,276 t of zinc concentrate that contained 51,012 t of zinc metal from the Mae Sot Mine. In addition, PDI imported a total of 92,781 t of zinc concentrate (zinc sulfide) from Australia and South America. The imported zinc sulfide concentrate was delivered to the roaster in Rayong (Padaeng Industry Public Company Ltd., 2006§).

In 2005, PDI's zinc refinery in Tak produced 99,708 t of cathode zinc, which was equivalent to about 88% of its capacity of 113,200 t/yr. The company imported 7,044 t of zinc ingot in 2005 for the production of valued-added zinc alloys. In 2005, the production of zinc metal products decreased by 12% to 101,186 t, of which 60,866 t was special high grade (SPG) zinc of 99.995% purity, and 40,320 t, zinc alloys (Padaeng Industry Public Company Ltd., 2006§).

Industrial Minerals

Cement.—In 2005, cement production increased by 6.3% to about 38 Mt and clinker production increased by 10.8% to about 39 Mt in 2005. This growth was largely the result of a 7% overall growth in the construction sector, which was stimulated mainly by an increase in office building and plant construction projects and ongoing infrastructural projects. Some of the growth momentum was lost in residential housing projects after tax incentives for homebuyers expired in 2004. As a result, domestic demand for cement by the construction industry slowed in 2005 because of the saturated housing market; building and factory investment projects, however, continued to grow in 2005 (Bangkok Post, 2005§).

According to Kasikorn Research Center (K Research), which was a subsidiary of the Kasikorn Bank Group of Thailand,

domestic demand for cement was forecasted to increase by 9.2% to 29.7 Mt in 2005 from 27.2 Mt, compared with the growth of 12.2% in 2004. K Research projected that the Thai cement industry would rely on public investment projects in 2006, especially on the building of megaprojects, including roads, subways, and a water treatment system. Exports of cement were expected to reach more than 15 Mt valued at more than \$460 million in 2005 compared with 11.9 Mt valued at \$312 million in 2004. K Research forecasted that the domestic demand for cement in 2006 would grow by 15% to 34 Mt. If the Government's ambitious megaprojects, such as mass transit electrical train systems, are delayed, however, then the public sector's investment in construction may be reduced. As a result, the domestic demand for cement in 2006 would increase by only about 10% to 32.7 Mt and cement production would increase to between 42.4 and 43.6 Mt (Chinacement.com, 2005§).

Because of the slowdown in domestic cement sales during the second half of 2005, Siam Cement Industry Co. Ltd, which was Thailand's leading cement producer, forecasted that the building materials industry would be relatively unchanged in 2006 despite the continued growth in such sectors as low-cost housing. The company reported sales growth of about 10% in 2005 and expected its cement sales to grow by 3% to 6% in line with industry growth of up to 6% in 2006 (International Cement Review, 2006; Reuters Ltd., 2006§).

Siam City Cement Co. Ltd. in its 2005 annual report indicated that the company's operations were at full capacity after recommissioning of its plant 1 and that its sales were in line with growth of 7% in the domestic market. The company's export sales grew by more than 50% in 2005 (Siam City Cement Co. Ltd., 2005§).

Gemstones.—Thailand was one of the world's leading centers for gemstone cutting and heat treating. In the 1990s, Thailand produced ruby and sapphire mainly from the Bo Phloi area of Kanchanaburi Province, which borders Burma (Myanmar). In recent years, more blue, green, yellow, and star sapphire was produced from the Bang Kacha (Bangkrajai) Mine in Chanthaburi Province in eastern Thailand bordering Cambodia. Many local gemstone dealers speculated that rich sapphire deposits were yet to be discovered in Chanthaburi Province. These deposits, however, are located in the military buffer zone along the border with Cambodia (Colored-stone.com, 2005§).

Potash.—In July 2005, Asia Pacific Resources Ltd. (APR) provided an update on the Udon South potash project. APR indicated that the development of the Udon South project remained APR's first priority and that exploration, engineering, and environmental activities for the project had all been completed. As of July 2005, the project was ready for financing and construction, subject to the grant of a mining license. By June 2005, DPI&M reportedly had completed the survey of the mine site boundaries. DPI&M, however, indicated that the plant site boundary also needed to be surveyed and that the survey results would be posted on the community notice boards. The Environmental Department (ED) had not completed the required review of the supplementary improvements to the Environmental Impact Assessment pending completion of the surveys. The ED had requested a notification from DPI&M of an approved mine plan. In 2005, APR continued its discussions

with potential partners and financiers from China and Thailand. No agreements, however, had yet been reached (Asia Pacific Resources Ltd., 2005§).

The Udon South deposit was estimated to contain a potash resource of 302 Mt at a grade of 23.5% potassium oxide (K₂O). The measured and indicated resources totaled about 30 Mt at a grade of 26.8% K₂O within a high-value core area that averaged 7.2 m in thickness. APR's Udon North deposit, which was estimated to contain 700 Mt of potash resources, remained under exploration (Mining Journal, 2005).

Mineral Fuels

Coal.—Coal (lignite) production increased by 3% to 20.6 Mt in 2005 from 20.0 Mt in 2004. To meet the country's overall coal requirements, Thailand imported about 8.6 Mt of coal valued at about \$383 million in 2005. Of those imports, bituminous steam coal accounted for 93.4% (8 Mt); anthracite, 5.7% (487,760 t); and coking coal, 0.8% (70,960 t) plus peat and briquettes (3,180 t) (Energy Policy and Planning Office, 2006a§).

In 2005, the state-owned Electricity Generating Authority of Thailand (EGAT) produced about 16.9 Mt of coal, of which more than 99% was produced from the Mae Moh Mines in the Province of Lampang (Electricity Generating Authority of Thailand, 2004§). The remaining 3.7 Mt of coal was produced by Banpu Mineral Co. Ltd. from the Lampang Mine (LP-2) in Lampang Province and the Chiang Muan Mine in Phayao Province and by Lanna Lignite Public Co. Ltd. from the Ban Pa Kha coal mines in Lamphun Province (Banpu Public Co. Ltd., 2005§; Lanna Lignite Public Co. Ltd., 2005§).

Consumption of domestically produced lignite totaled 21.1 Mt in 2005, of which 16.6 Mt was consumed by EGAT in power generation at the 2,625-megawatt Mae Moh lignite-fired powerplant and 4.5 Mt was consumed as energy by the manufacturers of cement, fiber, lime, and paper; by tobacco curers; and by other users. Imported coal (mostly anthracite, bituminous, and coking coal), which totaled 8.6 Mt, was consumed mainly by the manufacturers of cement, iron and steel, and nonferrous metals (Energy Policy and Planning Office, 2006a§).

Natural Gas and Petroleum.—Natural gas production increased by 6% to an average of 64.9 million cubic meters per day in 2005 from 61.2 million cubic meters per day in 2004 owing to increased output from the Funan/Jakrawan, the Pailin, and the Yala fields. In 2005, natural gas was produced from 19 gasfields, most of which were offshore. About 54.1% of Thailand's natural gas was produced by Unocal Thailand Ltd. (UT) from offshore gas and condensate fields (Baanpot; Erawan; Funan; Gomin; Jakarawan; Kaphong, which was brought onstream by UT in early 2004; Pailin; Platong; Satun; South Satun; and Trat); the remaining 45.8% was produced by PTT Exploration and Production (PTTEP) [a wholly owned subsidiary of the state-owned Petroleum Authority of Thailand (PTT)], ChevronTexaco Corp., and other companies from offshore gasfields (Benjamas, Bong Kot, Plamuk, Plandaeng, Surat Thani, Tantanwan, and Yala) and onshore gasfields (Nam Phong and Sirikit) (Energy Policy and Planning Office, 2006b§).

In July, Amerada Hess Corp announced that an agreement had been signed with PTT for the sale of natural gas from the Phu Horm field, which is located onshore in the Province of Udon Thani in northeastern Thailand. The Phu Horm field was 35% owned and operated by Amerada Hess with APICO LLC (35%), PTT (20%), and Exxon Mobil Corp. (10%). According to the agreement, Amerada Hess is to supply more than 14.2 billion cubic meters of natural gas from the Phu Horm field for 15 years. The first gas was expected to be delivered to PTT's powerplant at Nam Phong in nearby Khon Kaen Province before the end of 2006 at an initial rate of about 2.27 million cubic meters per day, then gradually to increase to 2.84 million cubic meters per day (Amerada Hess Corp., 2005§).

PTTEP reportedly had jointly studied the feasibility of using the flare gas from Pratu Tao-A Oilfield for electricity generation with Ratchaburi Energy Company Ltd. The company had reached agreement with Ratchaburi Energy on supplying natural gas at the expected average rate of 11,327 cubic meters per day for 8 years beginning in the fourth quarter of 2006 (Rigzone.com, 2006§).

Production of crude petroleum increased by 33% to an average of 113,205 barrels per day (bbl/d) in 2005 from 85,750 bbl/d in 2004 as a result of a 48% increase in output from the Tantanwan Oilfield, a 28% increase in output from the Bung YA&B oilfield, and a 27% increase in output from the Benjamas oilfield. In 2005, two new oilfields—Nangual and Jusmin—came onstream. In 2005, crude petroleum was produced from 12 oilfields. The largest onshore oilfield, the Sirikit oilfield, which was operated by Thai Shell Exploration and Production Co. Ltd., averaged 17,129 bbl/day and accounted for 15% of the total crude petroleum output in 2005. The largest offshore oilfield, the Benjamas oilfield, which was operated by Chevron Offshore Ltd., averaged 50,097 bbl/d and accounted for 44% (Energy Policy and Planning Office, 2006c§).

Production of condensate increased by 3% to an average of 70,342 bbl/d in 2005 from 68,575 bbl/d in 2004; this was mainly the result of increased output from the Gomin and the Pailin gasfields. In 2005, condensate was produced from 10 gasfields, of which about 30% of condensate was produced from the Pailin gasfield; 25%, from the Bongkot gasfield; 16%, from the Erawan gasfield; and the remaining 29%, from seven smaller fields (Energy Policy and Planning Office, 2006d§).

In June 2005, UT announced that it had successfully started up the second oil central processing platform (CPP) at the Platong operating area in the Gulf of Thailand. The Platong Oil CPP 2 was brought onstream safely and on schedule; it was expected to increase production significantly by the third quarter of 2005 to achieve the target of ramping up gross crude petroleum production to 40,000 bbl/d from about 24,000 bbl/d. The Platong Oil CPP2 was the largest CPP ever built in Thailand (Energy Business Review, 2005§).

Outlook

During the next 4 to 5 years, the Thai mineral sector is expected to expand and contribute more to the country's GDP because of the likely development of the Puthep copper deposit in the Province of Loei, the Udon South and the Udon

North potash deposits in the Province of Udon Thani, and the development and expansion of new and existing offshore gasfields and oilfields in the Gulf of Thailand. During the next 2 years, the mineral industry of Thailand is expected to continue to be dominated by the production of coal, gold, gypsum, and limestone.

The International Monetary Fund projects that Thailand's GDP will grow at a rate of 5% in 2006 and 5.4% in 2007 (International Monetary Fund, 2006§). As a result, demand for cement, steel, nonferrous metals, and mineral fuels is expected to continue to grow in 2006 and 2007 at about the same rate as that of 2005.

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TABLE 1
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2001	2002	2003	2004	2005 ^P
METALS					
Antimony:					
Ore:					
Gross weight	40	3	83	110	735
Sb content	18	1	38	52	330 ^c
Metal, smelter	12	--	--	2	460
Copper, metal, refined:					
Primary	--	--	--	18,100 ^r	28,000
Secondary	--	--	--	1,900	2,000
Total	--	--	--	20,000 ^r	30,000
Gold kilograms	320	4,950	4,269	4,500	4,400
Iron and steel:					
Iron ore:					
Gross weight	50	570,110	9,675	135,580	219,896
Fe content ^c	25	285,000	4,800	68,000	110,300
Crude steel thousand metric tons	2,127	2,538	3,572	4,533	5,161
Lead:					
Ore:					
Gross weight	800	6,500	--	--	--
Pb content	500	3,200	--	--	--
Metal, refined:					
Primary	-- ^r	-- ^r	-- ^r	-- ^r	--
Secondary	30,000 ^r	42,900 ^r	45,300 ^r	57,500 ^r	57,600
Total	30,000 ^r	42,900 ^r	45,300 ^r	57,500 ^r	57,600
Manganese ore:					
Battery- and chemical-grade, 75% MnO ₂	45	--	--	--	--
Metallurgical-grade, 46% to 50% MnO ₂	--	--	--	4,550	88,500
Total, gross weight	45	--	--	4,550	88,500
Mn content ^c	23	--	--	2,180	42,400
Silver kilograms	1,159	18,018	12,496	10,700	14,300
Tantalum, metal and oxide powder	150	102	168	317	200 ^c
Tin:					
Concentrate:					
Gross weight	2,383	1,384	980	724	188
Sn content	1,950	1,130	793	586	206 ^c
Metal, primary	22,387	18,600 ^r	15,400	20,800	31,600
Tungsten concentrate:					
Gross weight	92	53	390	337	350 ^c
W content ^c	50	31	208	180	190
Zinc:					
Ore:					
Gross weight	88,664	151,876	148,297	199,477	283,810
Zn content ^c	15,300	33,600	37,100	43,400	42,570
Metal, primary	74,129	72,502	69,600	68,300	60,866
Alloy, Zn content	30,668	32,646	44,086	46,800	40,320
INDUSTRIAL MINERALS					
Barite	23,559	137,469	115,600	211,278	120,000 ^c
Cement, hydraulic thousand metric tons	27,913	31,679	32,530	35,626	37,872
Clays:					
Ball clay	341,272	450,818	579,404	610,193	650,000 ^c
Kaolin, marketable:					
Beneficiated, washed	168,063	127,132	184,562	200,671	201,000 ^c
Nonbeneficiated, unwashed	125,133	168,883	373,811	430,364	400,000 ^c
Filler	13,520	3,150	950	--	--
Diatomite	720	780	1,288	1,372	1,400 ^c
Feldspar	710,543	783,733	824,990	1,001,053	1,000,000 ^c
Fluorspar, crude, metallurgical-grade	3,020	2,270	2,368	2,375	295
Gemstones thousand carats	1,071	1,597	716	911	800 ^c
Gypsum thousand metric tons	6,191	6,326	7,291	7,619	6,920

See footnotes at end of table.

TABLE 1--Continued
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2001	2002	2003	2004	2005 ^P
INDUSTRIAL MINERALS--Continued					
Mica	72	--	--	--	--
Perlite	9,915	7,600	5,700	6,000 ^e	5,500 ^e
Phosphate rock, crude	2,359	3,680	13,870	2,580	2,500 ^e
Salt:					
Rock	852,565	908,968	892,243	1,031,200	1,000,000 ^e
Other ^e	100,000	100,000	100,000	100,000	100,000
Sand, silica, glass	513,880	781,014	1,293,929	587,655	750,000 ^e
Stone:					
Calcite	159,050	172,760	232,025	436,628	440,000 ^e
Dolomite	871,308	933,209	865,708	992,907	950,000 ^e
Granite:					
Dimension stone	6,659	7,597	9,866	10,000 ^e	9,500 ^e
Industrial rock	2,546	3,370	3,107	3,500 ^e	3,000 ^e
Limestone:					
For cement manufacture only	46,984	54,214	46,868	63,196	65,000 ^e
Construction and other uses	40,100	56,226	66,073	70,000	75,000 ^e
Marble, dimension stone and fragment	314,445	461,272	339,166	236,643	250,000 ^e
Marl for cement manufacture only	7,755	83,135	80,405	184,750	185,000 ^e
Quartz	48,908	32,954	65,559	19,216	20,000 ^e
Shale for cement manufacture only	3,364	5,017	2,982	3,622	3,600 ^e
Talc and related materials:					
Pyrophyllite	59,602	103,496	73,556	108,691	105,000 ^e
Talc	6,838	1,702	8,501	12,592	13,000 ^e
MINERAL FUELS AND RELATED MATERIALS					
Coal, lignite	19,607	19,572	18,830 ^r	20,008 ^r	20,643
Natural gas, gross production	19,611 ^r	20,451 ^r	21,677	22,330 ^r	23,690
Petroleum:					
Crude	22,043 ^r	27,200 ^r	31,091 ^r	31,091 ^r	41,320
Natural gas condensate	18,899 ^r	19,609	23,887 ^r	25,030	25,675
Refinery products:					
Liquefied petroleum gas	37,067	37,069	38,872	41,520	45,241
Gasoline	52,376	51,896	54,342	56,339	58,072
Jet fuel	26,651	29,373	26,778	29,127	30,421
Kerosene	3,693	3,457	4,386	7,041	6,395
Distillate fuel oil	40,669	37,610	38,248	42,277	38,740
Residual fuel oil ^e	22,000	22,000	23,000	24,000	25,000
Unspecified ^{e, 2}	3,500	3,500	3,500	3,600	3,600
Total ³	186,000	185,000	189,000	204,000	207,000

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^PPreliminary. ^rRevised. -- Zero.

¹Table includes data available through August 25, 2006.

²Includes refinery fuel and refinery gains or losses.

³Data are rounded to three significant digits; may not add to totals shown.

Sources: Department of Mineral Resources, Mineral Statistics of Thailand; Department of Primary Industries and Mines; Ministry of Commerce, Energy Policy and Planning Office; and U.S. Geological Survey Minerals Questionnaires, 2003-04.

TABLE 2
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2005

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Barite		Asian Mineral Resources Co. Ltd.	Loei, Mae Hong Son, Nakhon Si Thammarat, and Satun Provinces	60
Do.		P & S Barite Mining Co. Ltd.	Loei and Nakhon Si Thammarat Province	60
Cement		Asia Cement Co. Ltd.	Pra Phutthabath, Saraburi Province	4,800
Do.		Jalaprathan Cement Co. Ltd. (Cement Francais S.A., 37%; Veatprapat Holding Co. Ltd., 19%; others, 44%)	Takli, Nakhorn, Sawarn Province; and Cha-Am, Petchburi Province	2,350
Do.		Samukee Cement Ltd.	Pakchong, Nakhon Ratchasima Province	125
Do.		Saraburi Cement Co. Ltd. (CEMEX Asia Holdings Ltd. of Mexico, 99%)	Chalerm Phrakiat, Saraburi Province	700
Do.		Siam Cement Industry Co. Ltd. (Bureau of the Crown Property, 30%; Thai Security Depository Co. Ltd., 6.94%; CPB Equity Co. Ltd., 5.6%; other financial Institutions and general public, 57.46%)	Kaeng Khoi, Phabudhabat, and Khao Wong, Saraburi Province; Chae hom, Lampang Province; Thung Song, Thammarat Province; and Ta Luang, Ayutthaya Province	23,200
Do.		Siam City Cement Co. Ltd. (Holcim Ltd. of of Switzerland, 33.7%; Rattanak family, 27%; other investors, 39.3%)	Kaeng Khoi, Saraburi Province	14,500
Do.		TPI Polene Co. Ltd.	Kaeng Khoi, Saraburi Province	9,900
Coal, lignite		Electricity Generating Authority of Thailand	Mae Moh, Lampang Province;	20,000
Do.		Banpu Public Co. Ltd.	Lampang (LP-2), Lampang Province and Chiang Muan, Phayao Province	3,400
Do.		Lanna Lignite Public Co. Ltd.	Ban Pakha, Lamphun Province	1,000
Copper, refined		Thai Copper Industries Plc (Thai Asset Management, 36%; Thai Film Industry, 27%; Aker Kvarmer, 28%; Industrial Corporation of Thailand Plc, 7%; and others, 2%)	Rayong, Rayong Province	165
Feldspar, concentrate		Asia Mineral Processing Co. Ltd.	Provinces of Nakhon Si Thammarat and Trang	500
Fluorspar, concentrate		Asian Mineral Resources Co. Ltd.	Mae Hong Son Province	14
Gas, natural	million cubic meters per day	Esso Exploration and Production Khorat Inc.	Namphong, Khon Kaen Province	4
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot in the Gulf of Thailand	15
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Kaphong, Pladang, Satun, Pailin, Trat, all in the Gulf of Thailand	33
Gold	kilograms	Akara Mining Ltd. (Kingsgate Consolidated N.L. of Australia, 100%)	Chatree, Pichit Province	5,000
Gypsum		Thai Gypsum Products Pcl. (Thaigips Holdings Ltd., 40.75%; BPB Gypsum B.V., 30%; others, 29.25%)	Nong Bau, Nakhon Sawan Province and Ban Munnak, Phichit Province	2,000
Do.		Vanich Gypsum Co. Ltd.	Khlong Prab, Mai Rieng. Thoong Yai Mai in Provinces of Nakhon Si Thammarat and Surat Thani	2,000
Lead, in concentrate		Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, Nong Phai, and Bo Ngam in Kanchanaburi Province	30
Petroleum, crude, including condensate	thousand 42-gallon barrels per day	Chevron Offshore (Thailand) Ltd.	Benjamas, Tantawan, offshore in the Gulf of Thailand	35
Do.	do.	Tah Shell Exploration and Production Co. Ltd.	Sirikit in Kamphaenghet Province	24
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot, offshore in the Gulf of Thailand	12
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Gomin, Jakrawan, Kaphong, Pailin, Platon, Satun, Surat, Trat Plamuk, offshore in the Gulf of Thailand	38

TABLE 2--Continued
 THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2005

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Steel, rolled		The Bangkok Iron and Steel Works Co. Ltd.	Phrapradaeng, Samutprakarn Province	120
Do.		Bangkok Steel Industry Public Co. Ltd.	do.	300
Do.		Millenium Steel Plc (Siam Cement Public Co. Ltd., 45%; McDonald Investment, 6.5%; and other inverstors, 48.5%)	Map Ta Phut, Rayong Province; Sriracha, Chonburi Province; Ban Mon, Saraburi Province	1,700
Do.		Namheng Steel Co. Ltd.	Lopburi Province	300
Do.		Sahaviriya Group Corp. Ltd.	Bang Saphan, Prachuap Khiri Khan Province	2,400
Do.		Siam United Steel Co. Ltd.	Rayong Province	1,000
Do.		G-Steel Plc (formerly Siam Ystrip Mill Plc)	Map Ta Phut, Rayong Province	600
Tantalum, metal powder and oxides	metric tons	H.C. Starck (Thailand) Co. Ltd. (H.C. Starck GmbH, 94.98%, and others, 5.02%)	do.	250
<u>Tin:</u>				
Concentrate		Numerous small companies	Nakhon Si Thammarat, Phangnga, Phuket, and Ranong Provinces	3
Refined		Thailand Smelting and Refining Co. Ltd. (Amalgamated Metal Corp., 75.25%, and other, 24.75%)	Phuket, Phuket Province	30
<u>Zinc:</u>				
In concentrate		Padaeng Industry Public Co. Ltd. (Umicore SA of Belgium, 44.77%; Ministry of Finance, 13.81%; and others, 41.42%)	Mae Sot, Tak Province	65
Refined		do.	Tak, Tak Province	115