

THE MINERAL INDUSTRY OF MALAYSIA

By John C. Wu

Malaysia has large resources of tin and such tin-associated minerals as ilmenite, monazite, and struverite, which is a columbium (niobium)-tantalum-bearing mineral. It has also substantial resources of natural gas and crude petroleum. In 2000, Malaysia's tin reserves ranked as the world's third largest (Carlin, 2001), and its reserves of natural gas and crude petroleum ranked 12th and 26th in the world, respectively (Oil & Gas Journal, 2000c). Among the identified mineral resources, a greater portion of reserves of barite, bauxite, bentonite, clays, copper, gold, iron ore, limestone, silica, and tin and its associated minerals have already been developed and exploited. In 2000, Malaysia was the world's third largest producer and exporter of liquefied natural gas (LNG), the world's fourth largest producer of refined tin, the world's sixth largest producer of rare earths, and the seventh largest producer of mined tin (Hedrick, 2001; World Bureau of Metal Statistics, 2001, p. 120).

In 2000, Malaysia's economy, as measured by gross domestic product (GDP), continued the 1999 positive growth path. Malaysia's GDP, in 1987 constant dollars, grew by 8.3% in 2000 compared with 6.1% (revised) in 1999. The higher GDP growth in 2000 was attributed mainly to a higher growth in the output of the manufacturing sector, which grew by 21.0% in 2000 compared with 13.5% in 1999. In contrast, the output of Malaysia's mining sector continued its 1999 negative growth path with a 0.5% negative growth in 2000 compared with a 3.1% negative growth in 1999 (Department of Statistics [Malaysia], April 2001, Key statistics, accessed June 7, 2001, at URL <http://www.statistics.gov.my/english/keystats.html>). The mining sector, which continued to play an important role in supplying basic raw materials to the construction and manufacturing sectors for Malaysia's economic development, remained important to the country's economy in 2000. According to the Department of Statistics [Malaysia], the mining sector contributed 6.7% to Malaysia's GDP compared with 7.2% (revised) in 1999. Malaysia's GDP, in 1987 constant dollars, was estimated to be \$55.1 billion, of which \$3.7 billion was contributed by the mining sector in 2000 (Central Bank of Malaysia, 2000, Statistics—VI.2 Gross domestic product by kind of economic activity at 1987 constant prices, accessed April 30, 2001, at URL http://www.bnm.gov.my/pub/msb/200012/vi_02.pdf).

Government Policies and Program

To support the mineral industry, the Government adopted a new national mineral policy in 1994 and established the National Mineral Council in 2000 to oversee the overall integrated development of the mineral industry and to assure such development would meet its policy objectives. The National Mineral Council also was charged with coordinating relations between the Federal and State Governments. The Federal Minerals Act 525 of 1994 defines the powers of the

Federal Government for inspection and regulation of mineral exploration and mining and other related issues. However, as of 2000, only the States of Sabah and Selangor had adopted the State minerals enactment, which provides to the States the powers and rights to issue mineral prospecting and exploration licenses and mining leases and other related matters (Asian Journal of Mining, 2000b, p. 16).

In line with the national mineral policy, the Geological Survey Department and the Mines Department merged into the new Minerals and Geoscience Department [Malaysia] (MGD) in July 1999. The missions of the MGD are to facilitate the speedy development and diversification of Malaysia's mineral industry in a more coordinated manner and to intensify the use of geoscience for socioeconomic improvement. The MGD conducted activities in mineral exploration, mineral economics, mine enforcement, geologic mapping, hydrogeology, engineering geology, environmental geology, information management, laboratory and field consulting, and mineral research and development (Minerals and Geoscience Department [Malaysia], 2000, About us, accessed May 1, 2001, at URL <http://www.jmg.gov.my/welcome/welcome.html>).

Environmental Issues

Under the national mineral policy, a mining lease application must include an environmental protection plan that was approved by the Department of Environment of the Ministry of Science, Technology, and Environment. The environmental aspects of mine development are regulated by the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987, which was an amendment to the Environmental Quality Act of 1974. Under Order 1987, an environmental impact assessment was required for mining lease areas that are more than 250 hectares (ha); for areas in which aluminum, bauxite, copper, gold, and tantalum ore are processed; and areas of sand dredging that are more than 50 ha (Department of Environment, 1993, p. 12, 16).

Production

In 2000, Malaysia's minerals production included barite, bauxite, coal, dolomite, feldspar, gold, ilmenite, iron ore, kaolin, limestone, mica, monazite, natural gas, crude petroleum, sand and gravel, silica, struverite, tin, and zircon concentrate. Malaysia no longer produced copper and silver (as a byproduct of copper mining) because the country's only copper mine the Mamut Mine near Ranau, Sabah, ceased operations in September 1999. Production of mineral fuels included coal, natural gas, and crude petroleum. Production of processed mineral products included cement, LNG, nitrogen fertilizer materials (ammonia and urea), refined petroleum products, crude steel, titanium dioxide pigment, and refined tin (table 1).

Trade

According to the Department of Statistics (Malaysia), total exports increased by 16.1% to \$98 billion, and total imports increased by 25.7% to \$82 billion in 2000. Malaysia's merchandise trade surplus shrank by 16.7% to \$16 billion because of increased imports in 2000 (Ministry of International Trade and Industry, 2000, Malaysia's trade performance [1999-2000], accessed May 2, 2001, at URL <http://www.miti.gov.my/trdind/annu1.htm>). It remained a net exporter of minerals in 2000 because of its large exports of hydrocarbons in the form of LNG, crude petroleum, and refined petroleum products. In 2000, minerals exports totaled \$9.4 billion and accounted for 9.6% of total exports. Minerals imports totaled \$4.2 billion and accounted for 5.1% of total imports. Malaysia had a minerals trade surplus of \$5.2 billion in 2000.

The major mineral exports were crude petroleum valued at \$3.9 billion; LNG, \$3.4 billion; refined petroleum products, \$1.9 billion; and other mineral products, \$207.9 million. Among the major mineral imports, refined petroleum products were valued at \$2.2 billion; crude petroleum, \$1.3 billion; metal ore and scrap, \$183.8 million; crude minerals, \$168.3 million; and other mineral products, \$300.9 million (Ministry of International Trade and Industry, 2000, Export by products [1999-2000], accessed April 4, 2001, at URL <http://www.miti.gov.my/trdind/annu4.htm>; Ministry of International Trade and Industry, 2000, Import by products [1999-2000], accessed April 4, 2001, at URL <http://www.miti.gov.my/trdind/annu5.htm>).

Structure of the Mineral Industry

Malaysia's mining industry consisted of a small sector of coal and nonferrous metals mining, a small mineral-processing sector of ferrous and nonferrous metals, and a large mining and processing sector of industrial minerals and oil and gas. With the exception of oil and gas, mining and mineral-processing businesses were owned and operated by private companies incorporated in Malaysia. Oil and gas exploration and exploitation businesses were owned and operated by the state-owned oil and gas company and by joint ventures of the state-owned oil and gas company and foreign companies. According to the labor force survey, as of June 2000, the total number of persons employed by the mining and quarrying industries was estimated to be 28,200, or about 0.3% of the total employed labor force of about 9.1 million (Department of Statistics [Malaysia], 2001, p. 138).

The structure of mineral industry changed slightly in 2000. Avocet Mining plc of the United Kingdom, which was the country's largest gold producer, increased gold-production capacity at its Penjom gold mine in Pahang State by about 10% to 3,400 kilograms per year. The ownership of two cement companies was sold to two major foreign cement companies. Malaysia LNG Sdn. Bhd. (MLNG) was expanding its capacity by adding 6.8 million metric tons per year (Mt/yr) by 2002 to its existing LNG plant in Bintulu, Sarawak State. Malaysia LNG Tiga Sdn. Bhd. (MLNG-3) was expected to start construction work in early 2001 on its new 7.6-Mt/yr LNG plant in Bintulu, which was scheduled for completion by 2003.

Commodity Review

Metals

Aluminum and Bauxite.—In 2000, Johore Mining and Stevedoring Co. Sdn. Bhd. (JMSC) at Teluk Ramunia and Lembaga Kemajuan Johor Tenggara at Sungai Rengit each operated a bauxite mine in Johor. All bauxite ore was delivered to JMSC's processing plant at Bukit Raja, near Sungai Rengit, for crushing, screening, and washing. The processing plant produced cement-, chemical-, and refractory-grade bauxite. Cement-grade bauxite was sold to the domestic cement manufacturers, and chemical- and refractory-grade bauxite were exported mainly to Japan, Taiwan, Thailand, and the United States (Minerals and Geoscience Department [Malaysia], 2000b, p. 8).

According to the MGD, other bauxite resources were located at Bukit Goh-Jabor Valley with indicated reserves of 66 million metric tons (Mt) in Pahang; at Bukit Gebong, Lundu-Semantan, Tanjung Sebearang, and Bukit Batu in Sarawak; and at Bukit Mengkabau and in the lower Labuk Valley areas in Sabah (Minerals and Geoscience Department [Malaysia], 2000b, p. 10).

In October, Perak State proposed to build an aluminum smelter with a capacity of 250,000 metric tons per year (t/yr) at a site near the port of Lumut. According to the China Metals Newsletter report, China Nonferrous Metal Foreign Construction Co. was asked to design and build the plant at an estimated cost of \$2 billion (Mining Journal, 2000a). According to Perak's State Development Corp. (SDC), the proposed capacity for the aluminum smelter was revised to 500,000 t/yr. Kaiser Aluminum Corp. and Charus Development Corp. of the United States, which were the potential partners in the project, reportedly had discussions with the SDC, but no decision had been made. Under the proposed plan, Malaysia would import alumina from overseas sources, and electrical power for the smelter would be supplied largely by the Janamanjun coal-fired powerplant, which was still under construction (Metal Bulletin, 2001).

Copper and Gold.—In Sabah, Mamut Copper Mining Sdn. Bhd., which ceased its copper mining and milling operations at the Mamut Mine in Sabah in September 1999, continued its joint exploration for copper and gold with its partner Perilya Mines NL of Australia at Tampang in the Merungin and Paginantan areas of Sabah. In May, Perilya Mines began to follow up on the Bongkud anomaly, which is about 10 kilometers (km) east of the Mamut Mine, where gold mineralization had been identified. According to Perilya Mines, geophysical surveys had been completed for identifying potentially higher grade zones within the Bongkud porphyry copper mineralization. Under the 2000 drilling program, the first hole (TRD017), which was drilled as a vertical hole to a depth of 337 meters (m), intersected a strongly veined and mineralized intrusive to a depth of 252 m, where a late-stage unmineralized intrusive was intersected (Asian Journal of Mining, 2000a).

In Pahang, Avocet Mining operated the Penjom gold mine at Ampang Jaleh near Kuala Lipis through Specific Resources Sdn. Bhd. (its subsidiary). Raub Australian Gold Mining Sdn. Bhd. began its mining operation in March 1999 at the 26-ha gold tailing dumps in Bukit Koman near Gali, Rau District. Raub Australian Gold Mining was a joint-venture firm

established by Akay Holding Sdn. Bhd. and Wells Gold Corp. NL of Australia (Minerals and Geoscience Department [Malaysia], 2000b, p. 20).

Avocet Mining's gold production rose to 3,387 kilograms (kg) in 2000 from 2,530 kg in 1999. The increased production was attributed to increased milled ore and improved process recovery rate. The mined ore averaged 7 grams per metric ton of gold, the milled ore totaled about 590,000 metric tons (t), and the process recovery rate averaged about 78%. The conventional processing facilities were modified significantly to solve the problem of carbonaceous ores. The facilities modifications included bolstering the primary/gravity circuit and replacing the carbon-in-leach gold recovery process with a resin-in-leach process (Avocet Mining plc, 2000, Gold mining—Penjom process, accessed May 1, 2001, at URL <http://www.avocet.co.uk/mining/goldmining.htm>).

According to Avocet Mining, a comprehensive review of the ore reserves at its Penjom property had been completed by an independent geologist using a stricter and more definitive interpretation of reserves and their geologic setting. The latest estimated reserves were 2.8 Mt containing about 21.3 t of gold (Avocet Mining plc, 2000, Chairman's statement—Gold—Interim results for the six months ended 30 September 2000, accessed May 1, 2001, at URL <http://www.avocet.co.uk/account/interims/chairman.htm>).

According to a local press report, more than 1,000 illegal prospectors were panning for gold in the Bukit Ibam and the Kampung Jubau areas about 150 km from Kuantan, Pahang. Illegal miners had dug up in a 50-ha former logging site to 6 m underground, and nearby streams had been panned by local villagers. The State's Land and Mines Department, which indicated that the land was not designated for gold prospecting, had been approached by local prospectors to issue permits to pan for gold. More than 30 prospectors had been fined up to \$184 for trespassing on Government land by the State's Forestry Department under the National Forestry Act (Star, August 24, 2000, Gold fever hits Pahang village, accessed May 1, 2001, at URL http://www.jmg.gov.my/news/previous_news/gold_fever.jpg).

Iron and Steel.—Production of iron ore decreased by 23% in 2000. According to the MGD, iron ore was produced from seven small-scale mines operated in Johor, Kedah, Pahang, Perak, and Terengganu States with a total workforce of between 80 and 117 (Department of Statistics [Malaysia], 2001, p. 46). To meet the raw material requirements for its iron and steel industry, Malaysia imported about 1.4 Mt of iron ore in 2000 compared with 2.6 Mt in 1997; Brazil and Chile were the two principal iron ore suppliers. The low level of iron ore imports reflected reduced consumption by the Malaysian producers of direct-reduced iron (DRI).

Production of crude steel increased to about 2.4 Mt in 2000 from 2.2 Mt in 1999 owing to increased demand for steel by the construction industry and by major infrastructure projects. According to the Malaysian Iron and Steel Industry Federation, the latest estimate for Malaysia's apparent steel consumption was 5.8 Mt in 1999 compared with 4.5 Mt in 1998 and 8.2 Mt in 1997. Of the total apparent steel consumption in 1999, 2.2 Mt was long products, such as bars and wire rods, and 3.6 Mt, plate products, such as coil and plate. The estimated apparent steel consumption per capita was 256.3 kg in 1999 compared with 375.9 kg in 1997 (Malaysia Iron and Steel Federation, 2000, Performance & trend—Steel consumption vs GNP/capita,

accessed December 6, 2000, at URL <http://www.misif.org.my/performance.shtml>).

Perwaja Steel Sdn. Bhd., which had been managed by Maju Holdings Sdn. Bhd. since late 1996, continued to suffer from losses, which added about \$210 million to its accumulated losses since 1996. According to a report by Malaysia's Accountant-General, Perwaja Steel's net liabilities had increased to more than \$2.4 billion by the end of 1998, which included \$1.1 billion in direct loans from the Government and \$1.3 billion in state-guaranteed loans from local and foreign banks. Increased costs for imported iron ore and steel scrap, which resulted from depreciation of the Malaysian ringgit (M\$) against the United States dollar, and the low capacity-utilization rate, which resulted from reduced steel demand, had been cited as the two major causes for the mounting losses. To cut production costs, Perwaja Steel was operating at 37% of its plant capacity and was producing only 40,000 metric tons per month of steel for local market (Asian Wall Street Journal, 2000). In late 2000, the Government was considering either to inject more capital or to close down or sell Perwaja Steel (Metal Bulletin, 2000b).

Nusantara Steel Group Sdn. Bhd. (NSG), which planned to construct a new steel mill complex at Kampung Limau-Limauan in Kudat, Sabah, signed an agreement in June with Petroliam Nasional Bhd. (PETRONAS), which is the state-owned oil and gas company to supply up to 5.66 million cubic meters per day of natural gas to the steel complex for 20 years (PETRONAS, June 22, 2000, PETRONAS to supply gas to Nusantara steel mill project, accessed August 28, 2000, via URL <http://www.petronas.com.my>).

The steel mill project involved construction of an integrated steel mill complex, which would comprise a gas-based DRI plant, a hot-rolled coiled mill, and a gas-fired powerplant. China Metallurgical Corp. was expected to be the main contractor for the project's infrastructure. NSG planned to use the HYL process developed by Hylsamex S.A. de C.V. of Mexico for the DRI plant and the electric-arc furnace (EAF) for the strip mill. According to NSG, Ferrostaal AG of Germany was to be the contractor for building the DRI plant, and Danieli & C. SPA of Italy, for installing the EAF-based thin-slab caster and hot-strip mill. The total cost of the project was estimated to be \$1.6 billion. The steel mill complex, which will have a capacity of 1.3 Mt/yr of hot-rolled coil, was scheduled for completion in 2003. By yearend, the State Government of Sabah had agreed to provide \$11 million for acquiring the land for the steel mill complex (Metal Bulletin, 2000a).

In November, China Steel Corp. of Taiwan had reached an agreement in principle with several steelmakers from Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam to build a \$2 billion steel plant in Malaysia. The proposed plan was expected to be finalized in early 2001, and the construction of the steel plant with an initial capacity of 6 Mt/yr of crude steel was to be completed by 2005 (Financial Times, 2000).

Tin.—Malaysia's mined tin production decreased by more than 1,000 t to about 6,300 t in 2000, when the average tin prices in the Kuala Lumpur tin market decreased to \$5.20 per kilogram (M\$19.77 per kilogram) in December from \$5.84 per kilogram (M\$22.19 per kilogram) in January (Malaysian Tin Bulletin, 2001). According to the Malaysian Chamber of Mines, the average cost of producing 1 kg of tin was \$5.00 (M\$19) in 1999 (Metal Bulletin Monthly, 1999). The profit margin of tin mining was reduced because of low market prices

in the last quarter of 2000. As a result, fewer mines were operating in Perak and Selangor. According to the MGD, the number of operating mines decreased to 40 in December from 42 in January, and the number of tin miners decreased to 1,724 in December from 2,237 in January 2000. Tin production by gravel pump accounted for 53.5%; open cast, 20.2%; retreatment (Amang) plant, 12.6%; panning and underground, 8.3%; and dredging, 5.4% (Malaysia Tin Bulletin, 2001).

The major tin mining companies in 2000 were Delima Industries Sdn. Bhd., Mariju Sama Sdn. Bhd., New Lahat Mines Sdn. Bhd., Omsam Telecommunication Sdn. Bhd., Rahman Hydraulic Tin Bhd., S.E.K. (M) Sdn. Bhd., and Tasek Abadi Sdn. Bhd. Delima Industries operated a bucket-ladder dredge in the Langat River Valley near Dengkil 40 km south of Kuala Lumpur; Mariju Sama, five mining units at Puchong in Selangor; New Lahat Mines, mines at Lahat in Perak.; Omsam Telecommunication, mines at Bakap in Perak; Rahman Hydraulic Tin, the country's largest opencut, hard-rock mine at Klian Intan in northern Perak; S.E.K. (M), mines at Kampar in Perak; and Tasek Abadi, mines at Senudong in Perak.

To meet its raw material requirements for its tin smelter, Malaysia imported about 19,276 t of low-grade tin-in-concentrate from overseas in 2000 (Malaysian Tin Bulletin, 2001); the major suppliers of overseas tin ores and concentrates were Peru (34%), Australia (27%), and China (9%). Malaysia Smelting Corp. Bhd. (MSC) operated a 40,000-t/yr tin smelter in Butterworth. The smelter blended imported low-grade tin concentrates that averaged 50% tin with domestic high-grade tin concentrate that averaged 75% tin to meet its smelter's raw material requirements. The smelter's feed grade of tin concentrate was about 61% tin. The smelter continued to import about 2,600 t of low-grade refined tin with purity of up to 99.7% tin mainly from Vietnam to upgrade the tin purity to 99.85% tin. At the smelter site, the company also operated a 300-t/yr electrolytic, high-purity tin refinery. The refinery produced high-purity, premium-grade refined tin that contained between 99.99% and 99.999% tin (Malaysia Smelting Corp. Bhd., 1996, p. 6). In November 2000, MSC reportedly was conducting a study to expand its smelting capacity to meet the world's growing demand for tin, which was estimated to be 3% per year (Mining Journal, 2000b).

Domestic demand for refined tin decreased slightly to 5,639 t in 2000. The Malaysian solder industry remained the major end user and accounted for 56.3% of the total demand, followed by the pewter industry, 14.8%; the tin-plating industry, 10.6%; and other end users, 18.3%. Refined tin consumption by solders and other end users included consumption of domestically refined and high-grade imported refined tin (Malaysian Tin Bulletin, 2001). Exports of refined tin decreased to 20,614 t in 2000 from 24,026 t in 1999. Export earnings from tin metal were valued at \$114.4 million in 2000 compared with \$129.1 million in 1999. In 2000, the major buyers of Malaysian refined tin were the Netherlands (18%), Japan (14%), Italy (10%), the Republic of Korea (10%), the United Kingdom (8%), India (7%), and Taiwan (6%). The United States accounted for about 1.3% of Malaysia's refined tin exports in 2000 (World Bureau of Metal Statistics, 2001, p. 125).

Industrial Minerals

Cement.—According to the Department of Statistics [Malaysia], cement production increased by 13% to about 11.4 Mt in 2000 (Department of Statistics, Malaysia, 2001, p. 58).

According to the Cement and Concrete Association of Malaysia (C&CAM), however, cement production, which included portland cement, white cement, and other types of cement, was estimated to have increased to 14.5 Mt in 2000 from 11.2 Mt in 1999 owing to increased domestic demand by the construction industry in 2000. Domestic demand for cement was estimated to have increased to 11.5 Mt in 2000 from 9.4 Mt in 1999, and cement exports were estimated to have increased to about 3 Mt in 2000 from 1.7 Mt in 1999. Malaysia's cement consumption per capita was about 439 kg in 2000 (International Cement Review, 2000).

According to C&CAM, the cement industry consisted of 15 companies in 2000, 8 of which operated integrated plants (clinker and cement), 7 of which are listed in table 2; 6 operated only clinker grinding plants; 1 operated a small clinker and a clinker grinding plant; and 1 operated only a clinker plant. The six clinker-grinding companies were Cement Industries (Sabah) Sdn. Bhd. (900,000 t/yr) at Sepangar, Sabah; CMS Cement Sdn. Bhd. (1.75 Mt/yr) at Pending, Sarawak; Kedah Cement Holdings Bhd. (180,000 t/yr) at Bt Cave, Selangor; Slag Cement Sdn. Bhd. (1.0 Mt/yr) at Pelabuhan Klang, Selangor; Southern Cement Industries Sdn. Bhd. (770,000 t/yr) at KWS Pelabuhan Johor, Johor; and Tengarra Cement Manufacturing Sdn. Bhd. (1.3 Mt/yr) at KWS Perusahaan Pasir Gudang, Johor (Minerals and Geoscience Department Malaysia, 2000a, p. R-1–R-3). Aalborg RCI White Cement Sdn. Bhd. operated a 42,000-t/yr clinker plant and a 68,000-t/yr clinker grinding plant in Ipoh, Perak. Sarawak Clinker Sdn. Bhd. operated a 600,000-t/yr clinker plant in Kuching, Sarawak (International Cement Review, 2000).

In 2000, Malaysia had a clinker capacity of 16.2 Mt/yr and a cement capacity of 26.6 Mt/yr. The cement industry was operating at less than 50% of its installed capacity between 1998 and 2000. With the low levels of domestic demand, several ailing companies had incurred losses or were barely breaking even. As a result, some cement producers sold plants to such foreign companies as Blue Circle Industries plc (BCI) of the United Kingdom and Holderbank Financiere Glaris Ltd. of Switzerland. One cement producer had been taken over by another domestic cement producer in 2000. BCI, which already owned a 50% interest in the Associated Pan Malaysia Cement Sdn. Bhd. (APMC), acquired the remaining 50% interest of APMC. BCI also acquired a controlling interest in Kedah Cement Holdings Bhd. Holderbank acquired a 70% interest in Tengarra Cement Manufacturing Sdn. Bhd. Cement Industries of Malaysia, which already owned a 35% interest in Negeri Sembilan Cement Industries Sdn. Bhd. (NSCI), reportedly would raise its stake in NSCI to 65% after it acquired a 30% interest from Halla Business Group of the Republic of Korea. Other cement producers, such as Perak-Hanjoong Simen Sdn. Bhd., were seeking foreign buyers (International Cement Review, 2000). In late 2000, Malaysia Cement had taken over the operation of Kedah Cement Sdn. Bhd. to increase cost savings and to improve profitability (Building Bulletin, 2000).

Kaolin.—Kaolin production remained steady in 2000. According to the MGD, kaolin was produced from 21 mines in Johor and Perak. In Perak, which accounted for 83% of the total kaolin production, most kaolin mines operated in the Bidor and the Tapaj areas in southern Perak. Associated Kaolin Industries Bhd. at Chanhkat Rembian, Kaolin (M) Sdn. Bhd. at Bidor, and Tinex Kaolin Corp. Sdn. Bhd. at Tanah Mas and Bidor were the major producers. In Johor, most kaolin mines

operated in the Mersing area. Liew & Son Sdn. Bhd. at Sg. Lenggong and Kahang and Yusof Md. Salleh Sdn. Bhd. at Kata Tinggi were the major producers.

Locally produced kaolin was used in the production of cement, ceramics, chemicals, paint, paper filler, and rubber. Kaolin exports were mainly to Japan, Taiwan, and Thailand. For the production of high-quality ceramic products, such as porcelain figurines, Malaysia imported premium-grade kaolin mainly from Japan, Thailand, and the United States. Malaysia's kaolin reserves were estimated to be 107.6 Mt, of which 59 Mt were in Perak (Minerals and Geoscience Department [Malaysia], 2000b, p. 71-74).

Mineral Fuels

Coal.—Malaysia relied on imports to meet about 90% of its coal requirements in 2000. In Sarawak, coal production by Global Minerals (Sarawak) Sdn. Bhd. from the Nanga Merit and Kapit areas and Luckyhill Coal Mining Sdn. Bhd. from the Silantek and Sri Aman areas was mostly for local consumption by a cement plant and the Sejingkat powerplant. In 2000, Malaysia imported about 2 Mt of coal mainly from Australia, China, and Indonesia. Imported coal was consumed mainly by the cement, iron and steel, and power-generation plants in peninsular Malaysia. About 73% of imported coal was subbituminous; 26%, bituminous; and 1%, anthracite and lignite (Minerals and Geoscience Department [Malaysia], 2000b, p. 89).

Natural Gas and Petroleum.—Malaysia was a net exporter of natural gas and crude petroleum—52.4% of its natural gas production in the form of LNG and about 51.6% of its crude petroleum production in 2000. Its proven reserves of natural gas were estimated to be 2.31 trillion cubic meters and accounted for 1.6% of the world total, and its proven reserves of crude petroleum were estimated to be 3.9 billion barrels (Gbb) and to account for 0.4% of the world total in 2000 (Oil & Gas Journal, 2000b). The Deputy Prime Minister, however, announced in May 2000 that Malaysia's proven reserves of crude petroleum had declined to 3.63 Gbb (Oil & Gas Journal, 2000a).

To intensify oil and gas exploration, PETRONAS signed three production-sharing contracts (PSCs) with three foreign oil companies in 2000, after signing four PSCs with two foreign oil companies in 1999. In March, PETRONAS signed a PSC with Sarawak Shell Bhd. (SSB) for block SK312 offshore Sarawak. According to the agreement, SSB would own a 70% interest in block SK312, and PETRONAS would own 30% through PETRONAS-Carigali Sdn. Bhd. (PCSB) (the wholly owned exploration and production subsidiary of PETRONAS). SSB, which would be the operator of the block, would acquire and process 1,500 line-kilometers of new and would reprocess 500 line-kilometers of existing two-dimensional seismic data (PETRONAS, March 27, 2000, PETRONAS awards block 312 to Sarawak Shell and PETRONAS Carigali, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>).

In June, PETRONAS signed a PSC with Amerada Hess International Ltd. for deepwater block F offshore the northern coast of Sarawak. This contract marked the 10th and the last of the demarcated deepwater blocks to be awarded. According to the agreement, Amerada Hess International Ltd. (a subsidiary of Amerada Hess Corp.) would own an 85% interest in the block,

and PCSB would own 15%. Amerada Hess International, which would be the operator of the block, would acquire and process 4,000 line-kilometers of new two-dimensional seismic data and 1,000 line-kilometers of existing two-dimensional seismic data. Amerada Hess International would also drill one wildcat well to a minimum aggregate depth of 2,500 m below the seabed and carry out a series of geologic and geophysical studies within block F. Amerada Hess International was committed to spend at least \$10.5 million (PETRONAS, June 30, 2000, PETRONAS signs deepwater production sharing contract with Amerada Hess and PETRONAS Carigali, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>).

In December, PETRONAS signed a PSC with Lundin Malaysia Ltd. for block PM 305 offshore peninsular Malaysia. According to the agreement, Lundin Malaysia (a wholly owned subsidiary of Swedish Lundin Oil AB) would own a 60% interest in the block, and PCSB would own 40%. Under the agreement, Lundin Malaysia, which would be the operator of the block, would drill three exploration wells to a depth of at least 2,000 m each and would acquire 300 square kilometers of three-dimensional seismic data between 2001 and 2003. It would also conduct geologic and geophysical studies and undertake a feasibility study on the development of the Ophir field where a recoverable reserves of 20 million barrels had been discovered by other PSC contractors prior to 1993. Lundin Malaysia was committed to spend \$12 million (PETRONAS, December 1, 2000, PETRONAS awards block PM 305 to Lundin Oil and PETRONAS Carigali, accessed June 12, 2001, via URL <http://www.petronas.com.my/news/index.htm>).

In July, PCSB reported an oil discovery from the Alab-1 wildcat well in the Samarang-Asam Paya PSC area offshore Sabah. Alab-1, which was spudded on May 22, was drilled to an aggregate depth of 3,724 m on June 22 and found five oil-bearing sands. A production test from one zone flowed at 4,700 barrels per day (bbl/d). PCSB planned to acquire new seismic data and to conduct more appraisal drills for an early development and production from the new field (PETRONAS, July 19, 2000, PETRONAS Carigali discovers new oil field, offshore Sabah, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>).

In January, PCSB began commercial production from its newly developed Resak Gasfield offshore Terengganu at an average rate of 3.4 million cubic meters per day of natural gas and 3,000 bbl/d of condensate. The output from the field was expected to reach the peak level of 11.3 million cubic meters per day of natural gas and 13,000 bbl/d of condensate by the second quarter of 2001 and was expected to supply about 15% of the anticipated demand for natural gas in peninsular Malaysia (PETRONAS, February 14, 2000, PETRONAS Carigali begins production from Resak Gasfield, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>).

Production of natural gas increased by 8.7% to 44.5 billion cubic meters, or an average of 121.9 million cubic meters per day, because of the incremental output from the Resak Gasfield. Production of crude petroleum decreased by 1.7% to 249 million barrels (Mbb), or an average of 683,000 bbl/d, because of reduced exports in 2000. Exports of crude petroleum decreased by 5.9% to 128 Mbb, and exports of LNG increased by 2.3% to 15.4 Mt, or about 23.1 billion cubic meters, in 2000. Exports of crude petroleum went mainly to Japan, the Republic of Korea, Singapore, and Thailand. Exports of LNG went to

Japan, the Republic of Korea, and Taiwan (Department of Statistics [Malaysia], April 2001, Key statistics, accessed June 7, 2001, at URL <http://www.statistics.gov.my/english/keystats.html>).

In 2000, the natural gas production by Esso Production Malaysia, Inc., and PCSB from the gasfields offshore Terengganu was delivered to the gas-processing plants in Kerteh. The processed natural gas was then delivered by pipeline as fuel to the end users, which included households, manufacturers, and power companies, and as feedstock to petrochemical plants in peninsular Malaysia and Singapore. The natural gas production by Sabah Shell Petroleum Co. Ltd. from the gasfields offshore Sabah was delivered to the processing plant on Labuan Island. The processed natural gas was delivered to the methanol plant as feedstock and to the DRI plant as fuel on Labuan Island. The natural gas production by PCSB and SSB from the gasfields offshore Sarawak was delivered to two LNG plants and the ammonia and urea plants at Bintulu in Sarawak for the production of LNG and nitrogen fertilizers. In May 2000, Shell MDS Malaysia Sdn. Bhd. resumed operation of its middle distillate synthesis (MDS) gas plant at Bintulu, Sarawak. The plant had been badly damaged by an explosion in December 1997. The plant, which began operation in 1992 using the Shell MDS process, operated at full capacity of 12,000 bbl/d in 2000 (Oil & Gas Journal, 2000b).

Production of LNG by MLNG and Malaysia LNG Dua Sdn. Bhd. (MLNG-2) totaled about 15.6 Mt. The LNG production by MLNG was exported to Japan under a 20-year contract with Japanese utilities companies. The LNG production by MLNG-2 was exported to Japan, the Republic of Korea, and Taiwan under long-term contracts.

In January, MLNG-3 awarded a \$1.5 billion turnkey contract for construction of Malaysia's third LNG plant in Bintulu, Sarawak, to a consortium of Kellogg Brown & Root Inc. of the United States, JGC Corp. of Japan, JGC (Malaysia) Sdn. Bhd., and Sime Engineering Sdn. Bhd. According to the agreement, the turnkey contract called for design, procurement, construction, and commissioning of the plant to house two LNG trains with a combined capacity of 7.6 Mt/yr. The contract also called for construction of a 120,000-cubic-meter-capacity LNG storage tank and export facilities. The actual construction was scheduled to start in the first quarter of 2001. The first LNG train with a capacity of 3.8 Mt/yr was scheduled for completion by the end of 2002, and the second train with the same capacity, by the third quarter of 2003. The natural gas feedstock would be delivered through a 110-km pipeline from the Helang, Jintan, and other gasfields offshore Sarawak, which were being developed by PCSB and other foreign contractors. MLNG-3 was 60% owned by PETRONAS, 10% by Shell Gas B.V., 10% by Nippon Oil LNG (Netherlands) B.V., 10% by Occidental LNG (Malaysia) Ltd., and 10% by the Sarawak State Government (PETRONAS, January 21, 2000, MLNG Tiga awards EPCC contract, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>).

References Cited

- Asian Journal of Mining, 2000a, Business news—Malaysia's gold, tin production increase: Asian Journal of Mining, July-August, p. 6.
———2000b, Malaysia, in Asian mining yearbook, 11th ed.: Melbourne, Australia, Asian Journal of Mining, 144 p.
Asian Wall Street Journal, 2000, Malaysia Perwaja rescue plan falters: Asian Wall Street Journal Weekly Edition, v. 22, no. 25, June 19-25, p. 1, 10.

- Building Bulletin, 2000, Malayan prospects hopeful: Building Bulletin, no. 32, December, p. 3.
Carlin, J.F. Jr., 2001, Tin: U.S. Geological Survey Mineral Commodity Summaries 2001, p. 172-173.
Department of Environment, 1993, Environmental impact assessment (EIA)—Procedure and requirement in Malaysia: Department of Environment, May 1993, 28 p.
Department of Statistics [Malaysia], 2001, Monthly statistical bulletin: Department of Statistics [Malaysia], March, 157 p.
Financial Times, 2000, China steel to head \$2 bn Malaysia scheme: Financial Times [London], November 10, p. 24.
Hedrick, J.B., 2001, Rare earths: U.S. Geological Survey Mineral Commodity Summaries 2001, p. 130-131.
International Cement Review, 2000, Malaysia, in Global cement report (4th ed.): Dorking, United Kingdom, International Cement Review, p. 201-203.
Malaysia Smelting Corp. Bhd., 1996, Annual report 1995: Butterworth, Malaysia, Malaysia Smelting Corp. Bhd., 37 p.
Malaysian Tin Bulletin, 2001, KLTM tin prices, production by mining method, and domestic tin consumption: Malaysian Tin Bulletin, v. 12, no. 3, March, appendixes 1, 3, 5 [unpaginated].
Metal Bulletin Monthly, 1999, Tin resilient to Southeast Asia troubles: Metal Bulletin Monthly, no. 344, August, p. 31.
Metal Bulletin, 2000a, Local government backs Malaysian strip mill project: Metal Bulletin, no. 8536, December 21, p. 29.
———2000b, Malaysia mulls options for Perwaja: Metal Bulletin, no. 8537, December 29, p. 13.
———2001, Malaysia modifies plans for new aluminum smelter: Metal Bulletin, no. 8553, February 26, p. 7.
Minerals and Geoscience Department [Malaysia], 2000a, Directory of industrial mineral-related industries, 1999: Minerals and Geoscience Department [Malaysia], 110 p.
———2000b, Malaysian minerals yearbook 1999: Minerals and Geoscience Department [Malaysia], 115 p.
Mining Journal, 2000a, Industry in action—Chinese smelter plan for Malaysia: Mining Journal, v. 335, no. 8604, October 13, p. 299.
———2000b, Industry in action—Malaysia tin expansion potential: Mining Journal, v. 335, no. 8610, November 24, p. 414.
Oil & Gas Journal, 2000a, Exploration and development—Malaysia: Oil & Gas Journal, v. 98, no. 19, May 8, p. 41.
———2000b, Quick takes—A downed GTL plant: Oil & Gas Journal, v. 98, no. 27, July 3, p. 9.
———2000c, Worldwide look at reserves and production: Oil & Gas Journal, v. 98, no. 51, December 18, p. 122-123.
World Bureau of Metal Statistics, 2001, World metal statistics: World Bureau of Metal Statistics, v. 54, no. 5, May 21, 150 p.

Major Source of Information

The Ministry of Primary Industry
Minerals and Geoscience Department [Malaysia]
19th-22d Floor, Tanbung Haji Building
Jalan Tun Razak
P.O. Box 11110
50736 Kuala Lumpur, Malaysia
Telephone: 60-03-2161-1033
Fax: 60-03-2161-1036
E-mail: jmgk@jmg.gov.my
Website: www.jmg.gov.my

Major Publications

- Minerals and Geoscience Department [Malaysia]:
Annual Report
Malaysia Minerals Yearbook.
Department of Statistics [Malaysia]:
Statistical Bulletin, Malaysia, monthly.
Yearbook of Statistics, Malaysia, annual.
Malaysian Chamber of Mines:
Annual Report.
Malaysia Tin Bulletin, monthly.

TABLE 1
MALAYSIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1996	1997	1998	1999	2000 p/
METALS					
Aluminum, bauxite, gross weight thousand tons	219	279	160	223	123
Columbium-tantalum metals, struverite, gross weight	265	391	521	675	970
Copper, mine output, Cu content (Sabah)	20,219	18,821	13,907	4,600 r/	--
Gold, mine output, Au content 3/ kilograms	2,829	4,487 r/	3,394 r/	3,449	4,026
Iron and steel:					
Iron ore and concentrate thousand tons	325	269	376	337	259
Steel, crude do.	3,216	2,962	1,921 r/	2,200 r/	2,430
Lead metal, secondary	36,000	42,000	35,000	33,000 r/	35,300
Rare-earth metals, monazite, gross weight	618	767	517	1,147	818
Silver, mine output, Ag content 3/ kilograms	9,720	9,647	7,285	2,744	4
Tin:					
Mine output, Sn content	5,174 r/	5,065	5,754 r/	7,340	6,307
Metal, smelter	38,051	34,823 r/	27,201 r/	28,913 r/	26,228
Titanium:					
Ilmenite concentrate, gross weight	244,642	167,504	124,689	127,695 r/	124,801
Dioxide, gross weight e/	46,000	46,000	46,000	46,000	46,000
Zirconium, zircon concentrate, gross weight	4,511	4,050	3,057	1,763	3,642
INDUSTRIAL MINERALS					
Barite	17,458	2,608	1,580	13,506 r/	7,274
Cement, hydraulic thousand tons	12,349	12,668	10,397	10,104 r/	11,445
Clays and earth materials do.	31,226	35,601	25,422	33,083	34,000 e/
Clays, kaolin	324,578	221,769	198,930	208,187 r/	225,139
Feldspar	13,983	9,779	31,369	26,940	27,000 e/
Mica	5,501	5,708	3,642	3,675	3,835
Nitrogen, N content of ammonia	328,600	243,200	351,400	432,000	604,800
Sand and gravel thousand tons	32,587	40,295	45,231	33,351 r/	35,000 e/
Silica sand (peninsular Malaysia and Sarawak)	1,168,294	949,948	473,422	508,723 r/	500,000 e/
Stone:					
Dolomite	16,500	8,870	7,500	4,250	5,000 e/
Limestone thousand tons	27,905	25,467	20,124	23,515	24,000 e/
MINERAL FUELS AND RELATED MATERIALS					
Coal	73,747	105,231	349,849	308,502	382,942
Gas, natural: 4/					
Gross million cubic meters	42,320 r/	48,593 r/	48,388 r/	51,376 r/	56,009
Net 5/ do.	33,644 r/	38,631 r/	38,468 r/	40,844 r/	44,527
Liquefied natural gas thousand tons	13,132 r/	15,820 r/	15,450 r/	15,390 r/	15,600 e/
Petroleum: 4/					
Crude and condensate thousand 42-gallon barrels	261,938 r/	260,563 r/	264,641	252,115 r/	248,737
Refinery products:					
Gasoline do.	19,675	20,354	20,331	25,498	22,205
Jet fuel e/ do.	7,665 6/	7,800	7,500	7,500	7,500
Kerosene do.	16,862	17,381	16,924	15,945	19,631
Diesel do.	47,183	50,668	44,563	43,725	57,559
Residual fuel oil do.	18,611	20,997	15,915	11,972	12,413
Other e/ 7/ do.	17,000	15,700	15,000	15,000	15,500
Total 8/ do.	127,000	133,000	120,000	120,000	135,000

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through June 22, 2001.

2/ In addition to the commodities listed, a variety of crude construction materials, which include clays and stone, fertilizers, and salt, is produced but not reported, and available information is inadequate to make reliable estimates of output levels.

3/ Includes byproduct from a copper mine in Sabah, tin mines in peninsular Malaysia, and gold mines in peninsular Malaysia and Sarawak.

4/ Includes production from peninsular Malaysia, Sabah, and Sarawak.

5/ Gross less volume of reinjected and flared.

6/ Reported figure.

7/ Includes liquefied petroleum gas, naphthas, and lubricants.

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

Sources: Ministry of Primary Industry, Minerals and Geoscience Department (Kuala Lumpur), Malaysian Minerals Yearbook 1999; Department of Statistics (Kuala Lumpur), Monthly Statistical Bulletin, March 2001; Tin Industry (Research and Development) Board, Malaysian Tin Bulletin, Appendixes 3-4, v. 12, no. 3, March 2001; and U.S. Geological Survey Minerals Questionnaire, 2000.

TABLE 2
MALAYSIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

(Thousand metric tons unless otherwise specified)

Commodity		Major operation companies and major equity owners	Location of main facilities	Annual capacity
Bauxite		Johore Mining and Stevedoring Co. Sdn. Bhd. (ALCAN Ltd. of Canada, 61%; and local investors and others, 39%)	Teluk Rumania and Sg. Rengit, Johor	400
Cement 1/		Associated Pan Malaysia Cement Sdn. Bhd. (Blue Circle Industries plc of the United Kingdom, 100%)	Rawang, Selangor and Kantan, Perak	6,100 (4,600)
Do.		Cement Industries of Malaysia Bhd. (publicly owned company)	Kangar, Perlis	2,000 (1,600)
Do.		Kedah Cement Sdn. Bhd. (Malaysia Cement Bhd., 65.02%; and minority by general public shareholders)	Langwai, Kedah	5,900 (3,300)
Do.		Negeri Sembilan Cement Industries Sdn. Bhd. (joint venture of Perbadana Kemajuan Negeri-Neheri Sembilan, Cement Industries of Malaysian, and Korean Halla Business Group)	Bahau, Negeri Sembilan	1,400 (1,200)
Do.		Pahang Cement Sdn Bhd. (joint venture of Pahang State Government and Yeoh Toing Lay Sdn. Bhd.)	Bukit Sagu, Pahang	1,300 (1,200)
Do.		Perak-Hanjoong Simen Sdn. Bhd. (Korea Heavy Industries and Construction Co., 60%; Perak State Government, 40%)	Padang Rengas, Perak	1,600 (1,400)
Do.		Tasek Cement Bhd. (publicly owned company)	Ipoh, Perak	2,300 (2,300)
Gas:				
Natural	million cubic meters per day	Esso Production Malaysia, Inc.	Offshore Terengganu	33
Do.	do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	2.8
Do.	do.	Sarawak Shell Bhd.	Offshore Sarawak	77.7
Liquefied		Malaysia LNG Sdn. Bhd. (PETRONAS, 65%; Shell Gas N.V., 15%; Mitsubishi Corp., 15%; and Sarawak State Government, 5%)	Tanjung Kidurong, Bintulu, Sarawak	8,100
Do.		Malaysia LNG Dua Sdn. Bhd. (PETRONAS, 60%; Shell Gas N.V., 15%; Mitsubishi Corp., 15%; and Sarawak State Government, 10%)	do.	7,800
Gold, refined	kilograms	Specific Resources Sdn. Bhd. (joint venture of Pahang State Development Corp. and Avocet Mining plc of the United Kingdom)	Penjon, Pahang	3,400
Nitrogen, ammonia		Asean Bintulu Fertilizer Sdn. Bhd. (PETRONAS, 63.5%; P.T. Pupuk Sriwidjaja Indonesia, 13%; Thai Ministry of Finance, 13%; Philippines National Development Co., 9.5%; and Singapore Temasek Holdings Pte. Ltd., 1%)	Bintulu, Sarawak	395
Do.		PETRONAS Fertilizer Kedah Sdn. Bhd. (wholly owned subsidiary of PETRONAS)	Gurun, Kedah	304
Petroleum, crude	thousand 42-gallon barrels per day	Esso Production Malaysia, Inc.	Offshore Terengganu	390
Do.	do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	100
Do.	do.	Sarawak Shell Bhd.	Offshore Sarawak	184
Do.	do.	PETRONAS Carigali Sdn. Bhd.	Offshore Terengganu	22
Steel, crude		Perwaja Steel Sdn. Bhd. (Maju Holdings Sdn. Bhd., 51%; Lion Group, 30%; and Terengganu State Government, 19%)	Kemaman, Terengganu	1,200
Tin:				
Concentrate		Delima Industries Sdn. Bhd.	Dengkil, Selangor	1.1
Do.		Maiju Sama Sdn. Bhd.	Puchong, Selangor	1.6
Do.		New Lahat Mines Sdn. Bhd.	Lahat, Perak	0.3
Do.		Omsam Telecommunication Sdn. Bhd.	Bakap and Batu Gajah, Perak	0.5
Do.		Rahman Hydraulic Tin Bhd.	Klian Intan, Perak	1.2
Do.		S.E.K. (M) Sdn. Bhd.	Kampar, Perak	0.4
Do.		Tasek Abadi Sdn Bhd.	Senudong and Kampar, Perak	0.5
Refined		Malaysia Smelting Corp. Bhd. (The Straits Trading Co., Ltd., 37.44%; Malaysia Mining Corp., 37.44%; and others, 25.12%)	Butterworth, Penang	40
Titanium, dioxide		Tioxide (Malaysia) Sdn. Bhd. (Tioxide Group plc, 85%; and Terengganu State Government, 15%)	Kemaman, Terengganu	50

1/ All seven companies operated integrated plants. Annual capacity was for cement production and the clinker capacity was in parenthesis.