

THE MINERAL INDUSTRY OF MALAYSIA

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Malaysia's identified mineral resources were antimony, barite, bauxite, bentonite, clays, coal, copper, feldspar, gold, iron ore, lead, limestone, mica, natural gas, crude petroleum, rare earths, sand and gravel, silica, silver, tantalum, thorium, tin, tungsten, zinc, and zirconium. Most of the known reserves of barite, bauxite, bentonite, kaolin, copper, gold, iron ore, limestone, silica, and tin, as well as such associated minerals as ilmenite, monazite, rutile, struverite (a columbium- tantalum bearing mineral concentrate), and zircon have been developed and exploited since the 1970's. In the past 5 years, several identified resources of bauxite, coal, copper, gold, kaolin, silica sand, and silver, which are found mostly in Kelantan, Pahang, Sabah, and Sarawak States, have been explored by domestic and foreign companies to assess their potential for development. No major discovery or development of nonferrous metal deposits, however, was reported in 1999.

Malaysia's tin reserves were the world's second largest (Carlin, 2000), and its natural gas and crude petroleum reserves ranked 12th and 25th in the world, respectively (Oil & Gas Journal, 1999). In 1999, Malaysia was the world's third largest producer and exporter of refined tin and liquefied natural gas (LNG). Malaysia was the world's seventh largest mined tin producer and was one of the important producers and exporters of bauxite, ilmenite, kaolin, monazite, crude petroleum, tin, struverite, and zircon in the Asia/Pacific region (World Bureau of Metal Statistics, 2000, p. 120-121).

In 1999, Malaysia's economy rebounded to the positive growth path from a contraction of its economy in 1998 caused by the severe deflationary impact of the Southeast Asian financial crisis, which began in mid-1997. According to the Department of Statistics (2000, p. 19), the country's gross domestic product (GDP), in 1978 prices, grew 5.6% in 1999 compared with a negative growth of 7.4% in 1998. Malaysia's economic recovery was largely attributed to the strong performance of its manufacturing sector and to an increase in exports.

According to the Index of Industrial Production, manufacturing production increased by 12.9% in 1999 compared with a decrease of 10.3% in 1998. Mining production, however, decreased by 3.2% in 1999 compared with an increase of 1.1% in 1998 (Department of Statistics, 2000, p. 59). The overall decline in the output of the mining sector was caused mainly by the decreased production of copper, natural gas, and crude petroleum in 1999. The mining sector, however, remained important to the Malaysian economy in 1999. According to the Department of Statistics (2000, p. 18), the mining sector contributed 7.3% to Malaysia's GDP compared with 7.9% in 1998. Malaysia's GDP, in 1987 constant dollars, was estimated

to be \$50.7 billion, of which \$3.7 billion was contributed by the mining sector in 1999.

According to Government trade statistics, total exports increased by 12.1% to \$84.5 billion, and imports increased by 9.1% to \$65.5 billion in 1999. The rise in Malaysia's trade surplus (23.8% to \$19 billion) was largely attributed to the increased volume of exports and the depreciation of the Malaysian ringgit (RM), which made Malaysia's commodities more competitive in the world market (Department of Statistics, 2000, p. 87-91). Malaysia was a net mineral exporter in 1999. Minerals exports were \$5.96 billion and accounted for 7.1% of total exports. Minerals imports were \$2.23 billion and accounted for 3.4% of total imports. Malaysia had a mineral trade surplus of \$3.73 billion in 1999. Among the major mineral exports, crude petroleum accounted for 3.2% of total exports; LNG, 2.4%; refined petroleum products, 1.2%; and other mineral products, 0.3%. Among the major mineral imports, refined petroleum products accounted for 1.9% of total imports; crude petroleum, 0.5%; metal ore and scrap, 0.3%; LNG, 0.2%; and other mineral products, 0.5% (Department of Statistics, Export by products 1998-1999, February 2, 2000, accessed August 10, 2000, at URL <http://www.miti.gov.my/trdind/annu4.htm>; Department of Statistics, Import by product 1998-1999, February 2, 2000, accessed August 10, 2000, at URL <http://www.miti.gov.my/trdind/annu5.htm>).

In 1999, Malaysia's minerals production included barite, bauxite, coal, copper, dolomite, feldspar, gold, ilmenite, iron ore, kaolin, limestone, mica, monazite, natural gas, crude petroleum, sand and gravel, silica, silver, struverite, tin, and zircon. 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. Production of barite, bauxite, gold, ilmenite, monazite, nitrogen fertilizer materials, struverite, and tin increased owing to improved market conditions. Production of industrial minerals for building materials decreased because of a weaker domestic demand. Production of copper dropped sharply as a result of the closure of the country's only copper mine, the Mamut Mine near Ranau, Sabah, at the end of July 1999. Production of coal, natural gas, and crude petroleum were at a lower level compared with 1998 because of lower energy prices (table 1).

The structure of Malaysia's mineral industry changed in 1999 (table 2). Production capacity of nitrogen fertilizer materials increased substantially in 1999. In Kedah State, PETRONAS Fertilizer Kedah Sdn. Bhd. brought its Gurun plant, which was capable of producing 370,000 metric tons per year (t/yr) of ammonia (gross weight) and 590,000 t/yr of urea (gross weight),

on-stream. Asean Bintulu Fertilizer Sdn. Bhd. (ABF) expanded its production capacity to 480,000 t/yr of ammonia (gross weight) and 679,000 t/yr of urea (gross weight) at its Bintulu plant in Sarawak. Tin mining capacity increased to more than 7,000 t/yr of tin-in-concentrate in 1999. Majju Sama Sdn. Bhd., Rahman Hydraulic Tin Bhd., and Delima Industries Sdn. Bhd. were the leading tin mining companies, each of which produced more than 1,000 t/yr of tin-in-concentrate in 1999.

According to the Department of Mines, the number of persons engaged in tin mining averaged 1,950 in 1999. The number of persons engaged in mining of barite, bauxite, coal, gold, ilmenite, iron ore, kaolin, limestone, mica, and silica totaled 1,685 at the end of December 1999. According to Malaysia's Labor Force Survey, as of December 1999, the total number of persons employed by the mining and quarrying industries was estimated to be 54,000, or about 0.6% of the total employment of 9,008,000; Malaysia's labor force totaled 9,287,000, 3% of which was unemployed (Department of Statistics, 2000, p. 43-44, 135-136).

In Johor State, bauxite was mined by Johore Mining and Stevedoring Co. Sdn. Bhd. (JMSC) from its open pit mine at Teluk Ramunia and by Lembaga Kemajuan Johor Tenggara from its open pit mine at Sungai Rengit. All bauxite ore was delivered for crushing, screening, and washing to JMSC's processing plant at Bukit Raja, which is north of Sungai Rengit. The 400,000-t/yr 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 was exported mainly to Japan, Taiwan, and Thailand (Geological Survey Department, 1999, p. 9). Exports of bauxite totaled 92,500 metric tons (t) in 1999 compared with 87,100 t in 1998 (Department of Statistics, 2000, p. 39).

Comalco Aluminium Ltd. of Australia signed a preliminary agreement with a Malaysian consortium led by Petrolim Nasional Bhd. (PETRONAS), which was the state-owned oil and gas company, to supply natural gas for the proposed 1.5-million-ton-per-year (Mt/yr) alumina refinery at Similajau near Bintulu, Sarawak. Comalco, however, also signed a similar preliminary agreement with Allgas Energy Ltd. of Australia to supply natural gas from Papua New Guinea for the proposed 1.5-Mt/yr alumina refinery at Gladstone in central Queensland, Australia. Comalco was conducting feasibility studies and would select one of the proposed sites by early 2000. Construction on the proposed alumina refinery was expected to start shortly after the site was selected and to be completed by the second half of 2002 (Metal Bulletin, 1999).

Copper production by Mamut Copper Mining Sdn. Bhd. (MCM) at the Mamut Mine ceased after more than 23 years of operation. Mega First Corp. Bhd., which was the parent company of MCM and owner of the mine, closed the mine a year earlier than the scheduled date because of economic and safety reasons; low copper prices and reduced recoverable reserves caused by several landslides at the mine site during the rainy season were cited as the reasons for the early mine closure (Mining Journal, 1999b).

Production of copper concentrate for the first 7 months of 1999 totaled 17,114 t. Copper contained in the concentrate was

estimated to be 3,860 t plus about 210 kilograms (kg) of gold and 1,970 kg of silver. Exports of copper concentrates, all to Japan, were 27,000 t in 1999. According to the Department of Mines, 853 employees were working at the mine in January 1999. The number decreased to 360 in July and to zero in August 1999 (Department of Statistics, 2000, p. 41, 43).

In a 50-50 joint venture with Perilya Mines NL of Australia, MCM has been prospecting for copper and gold at Tampang in the Merungin area of Sabah since 1996. In spring 1999, Perilya Mines began drilling at Bongkud, which is about 10 kilometers (km) east of the Mamut Mine, where gold mineralization had been identified. According to Perilya Mines, an electrical geophysical survey identified a broad circular zone with a strong response about 2,000 meters (m) in diameter and coincident with the Bongkud porphyry copper mineralization. Drilling, which was completed in 1999, included results of 331.2 m averaging 0.70 gram per metric ton (g/t) gold and 0.31% copper near the surface part of the Bongkud anomaly zone. Drilling at Tampang's Napong prospect included one profile of 285 m averaging 0.56 g/t gold in trench sampling (Gold Mining Journal, 1999).

Gold mine production in 1999 was mainly from the Penjom gold mine, which was operated by Specific Resources Sdn. Bhd., at Ampang Jaleh near Kuala Lipis in Pahang and from another hard rock gold mine, which was operated by PERMINT Minerals Sdn. Bhd., at Sungai Kerak near Rusila in Terengganu State. Specific Resources was a joint-venture company of Avocet Mining PLC of the United Kingdom and Pahang State Development Corp.; PERMINT Minerals was a wholly owned subsidiary of the Terengganu State Development Corp. (Asian Journal of Mining, 1999). Gold produced by Specific Resources from the Penjom gold mine accounted for 73% of the country's gold production in 1999. Gold production by PERMINT Minerals and three or four small-scale gold producers that operated in Kelantan, Pahang, and Terengganu, as well as by MCM in Sabah (byproduct of copper concentrate), accounted for the remaining 27%.

Avocet Mining's gold production totaled 2,530 kg in 1999 compared with 1,520 kg in 1998 (Avocet Mining PLC, 2000, Activities, accessed August 16, 2000, at URL <http://www.avocet.co.uk/activities.htm>). The conventional processing facilities were significantly modified to solve the problem of carbonaceous ores. The modifications included bolstering the primary and gravity circuit and replacing the carbon-in-leach gold recovery process with the resin-in-leach process. As a result, the recovery rate improved to more than 75%. As of October 1998, ore reserves at the Penjom property were estimated to be 6.2 million metric tons (Mt) containing about 24 t of gold (Avocet Mining PLC, 2000, Gold mining, accessed August 16, 2000, at URL <http://www.avocet.co.uk/mining/goldmining.htm>).

To extend gold resources at the Penjom gold mine, Avocet Mining conducted in-fill drilling and exploration drilling in 1999. The diamond drilling program had resulted in identification of the continuity of mineralization in the Kalampong East pit where the mining operations were concentrated. The first six holes drilled indicated that the known high-grade mineralization

extends 200 m to the south of the open pit (Avocet Mining PLC, August 11, 1999, Avocet drilling at Penjom mine in Malaysia extends mineralization, accessed August 16, 2000, at URL <http://www.avocet.co.uk/pr/pr990811.htm>).

According to Malaysia's Geological Survey Department (1999, p. 17), Raub Australian Gold Sdn. Bhd., which was a joint venture of Akay Holding Sdn. Bhd. and Wells Gold Corp. NL of Australia, was expected to start gold mining operations at Bukit Koman in Raub district of Pahang in mid-1999. TRA Mining (M) Sdn. Bhd. was expected to develop a gold mine at Sungai Koyan in Pahang.

Production of iron ore decreased slightly in 1999. According to the Department of Mines, iron ore production was from seven to nine small-scale mines operated in Johor, Pahang, Perak, and Terengganu with a total workforce of about 120. About 56% of iron ore output was consumed domestically by the pipe coating and cement manufacturers, and 44% was exported (Department of Statistics, 2000, p. 39, 43). To meet the raw material requirements for its iron and steel industry, Malaysia imported 1.4 Mt of iron ore compared with 1.1 Mt in 1998 and 2.6 Mt in 1997. The low level of iron ore imports reflected reduced demand for Malaysia's direct-reduced iron (DRI) in the domestic and overseas markets. Production of DRI was about 960,000 t in 1999 compared with 910,000 t in 1998 and 1.5 Mt in 1996.

Production of crude steel remained at the low level of about 2 Mt in 1999 compared with 3.2 Mt in 1996 because of reduced steel demand by the construction industry and cutbacks in the country's infrastructure projects. According to the Malaysian Iron and Steel Industry Federation, the iron and steel industry had been severely affected by the tight liquidity, high interest rates, and higher cost of imported raw materials. Because of a 55% drop in steel demand by the construction industry and a slow down in the manufacturing sector, the overall domestic demand for steel dropped by 60% in 1998. Although domestic demand for steel did not decrease further in the first half of 1999, Malaysia's major steel producers and steel traders were not expecting a strong recovery to the 1996 level until 2004 because of the lack of major infrastructure projects and overbuilt capacity in many sectors of the Malaysian economy. Steel mill capacity utilization rates were about 40% or lower in 1999 (Metal Bulletin Monthly, 1999a). To cope with the weak domestic demand for steel, many steel mills operated only on night shifts to cut power costs and increased intraregional steel exports to Singapore, Taiwan, and Vietnam to reduce inventory buildup.

Malaysia's tin mine production reached the highest level in 6 years, when the average tin prices in the Kuala Lumpur Tin Market increased to \$5.65 (RM 21.46) per kilogram in 1998 and \$5.32 (RM 20.20) in 1999 from \$4.03 (RM 15.31) in 1997. According to the Malaysian Chamber of Mines, the average cost of producing 1 kg of tin was about \$4.74 (RM 18) in 1998 and \$5.00 (RM 19) in 1999 (Metal Bulletin, 1998; Metal Bulletin Monthly, 1999b). The improved profit margin of tin mining had resulted in reopening closed mines and developing and opening new mines in Perak and Selangor during 1998 and 1999. According to the Department of Mines, between October 1998 and October 1999, the number of operating mines increased to 45 from 35, and the number of tin miners increased to 1,924 from

1,408 (Department of Statistics, 2000, p. 42).

In 1999, tin production by gravel pump accounted for 55.5%; open cast, 19.8%; Amang (retreatment) plant, 10.3%; dredging, 8.4%; and panning and underground, 6% (Department of Mines, 1999, p. 7). The top seven tin mining companies in April 1999, in decreasing order, were Mariju Sama Sdn. Bhd., Rahman Hydraulic Tin Bhd., Delima Industries Sdn. Bhd., Tasek Abadi Sdn. Bhd., Omsam Telecommunication Sdn. Bhd., S.E.K. (M) Sdn. Bhd., and New Lahat Mines Sdn. Bhd. The combined output of these producers accounted for about 55% of the total tin concentrate produced in April 1999.

Malaysia Smelting Corp. Bhd. (MSC), which was Malaysia's sole tin smelter, produced refined tin in Butterworth. MSC's 40,000-t/yr tin smelter imported low-grade tin concentrates that averaged 50% tin principally from Australia, Bolivia, China, Peru, and Portugal to blend with domestic high-grade tin concentrate that averaged 75% tin to meet its raw material requirements. The smelter's feed grade of tin concentrate was about 61% tin. The smelter also imported low-grade refined tin with purity of up to 99.7% tin from Vietnam to upgrade its tin purity to 99.85% tin. According to the Department of Statistics (2000, p. 42), imports of tin contained in tin ore and concentrate and low-grade refined tin totaled 20,110 t in 1999 compared with 21,961 t in 1998. 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).

Domestic demand for refined tin increased slightly to 5,723 t in 1999 from 5,453 t in 1998, when Malaysia's manufacturing sector recovered from the slump in 1998. The Malaysian solder industry remained the major end user and accounted for 61% of the total demand, followed by the tin-plating industry, 14%; the pewter industry, 13%; and other end users, 12% (Malaysian Tin Bulletin, 2000). Exports of refined tin increased to 24,024 t from 22,376 t in 1998. Export earnings from tin metal were valued at \$129 million compared with \$128 million in 1998. In 1999, the major buyers of Malaysian tin were the Netherlands, 4,242 t; Japan, 3,394 t; Italy, 2,600 t; the Republic of Korea, 2,562 t; the United Kingdom, 1,768 t; India, 1,674 t; and Taiwan, 1,347 t (World Bureau of Metal Statistics, 2000, p. 125).

Production of struverite, which was recovered as a byproduct of alluvial tin mining, reached the highest level in 6 years. Among the operators of the Amang plant in Perak that recovered ilmenite, monazite, rutile, struverite, xenotime, and zircon from tailings of alluvial tin mining, Beh Minerals Sdn. Bhd. in Lahat and Syarikat Penderong Sdn. Bhd. in Kuala Dipang were the two major struverite producers. Other Amang plants in Perak that recovered ilmenite, monazite, struverite, and zircon were Liow Thai Kong & Son Sdn. Bhd. and Tong Nam Ah (PK) Sdn. Bhd. in Simpang Pulai and Minex Corp. Sdn. Bhd. in Gopeng. Production of other byproducts of alluvial tin mining, which included ilmenite, monazite, and zircon, increased in 1999 owing to improved market conditions.

In the industrial minerals sector, production of barite increased sharply to about 12,000 t from 1,600 t in 1998 owing to increased output by Sykt. Yap Kee Huat at Jeranut in Pahang in the second half of 1999. All barite ore was delivered to two

processing plants in Terengganu for treatment. The processed barite was sold to oil and gas companies for use in drilling muds for oil and gas exploration and development (Geological Survey Department, 1999, p. 48). Production of construction aggregates, limestone, and sand and gravel was at a lower level compared with 1998 owing to the decrease in construction activity caused by high interest rates, the lack of major infrastructure projects, and postponement of nonresidential building projects. At the same time, owing to the reduced cement demand, Malaysia's cement production also decreased.

In fertilizer manufacturing, production of ammonia and urea by ABF at Bintulu, Sarawak was 432,000 t (nitrogen content) and 372,700 t (nitrogen content), respectively, in 1999. About 393,000 t (nitrogen content) of ammonia were delivered to domestic markets for production of urea, and 39,000 t (nitrogen content) of ammonia were exported. About 75,800 t (nitrogen content) of urea were delivered to domestic markets, and about 264,200 t of urea (nitrogen content) were exported (International Fertilizer Industry Association, 2000). In addition to the capacity expansion at the Bintulu plant and the addition to the Gurun plant in 1999, another plant capable of producing 450,000 t/yr (in gross weight) of ammonia was expected to be brought on-stream by PETRONAS Ammonia Sdn. Bhd. in Kerteh, Terengganu, by October 2000 (Asian Chemical News, 2000).

Other fertilizer producers were CCM Fertilizers Sdn. Bhd., which operated a 240,000-t/yr compound fertilizer (NPK) plant and a 87,000-t/yr ammonium nitrate plant in Padang Jawa; FPM Sdn. Bhd., which operated a 150,000-t/yr NPK plant in Johor; United Compound Fertilizers Sdn. Bhd., which operated a 100,000-t/yr NPK plant at Kuantan Port in Pahang; and Federal Fertilizer Co. Bhd., which operated a 70,000-t/yr ammonium sulfate plant in Johor (ASIAFAB, 1998).

To meet the requirements for fertilizer materials during 1997 and 1998, Malaysia imported about 320,000 t/yr of nitrogen, in all forms; about 1 Mt/yr of potash; 600,000 t/yr of phosphate rock, 200,000 t/yr of ammonium sulfate and ammonium nitrate; and about 150,000 to 200,000 t/yr of compound fertilizer. Fertilizer use in Malaysia was based on an NPK ratio of 2.5 parts nitrogen (N), 2.5 parts phosphate (P), and 2.5 parts potash (K); the worldwide consumption ratio for fertilizer usage is 6.0:2.5:1.5. The higher usage of potash in Malaysia is necessitated by the heavy rains that wash the potash from the soil. The major overseas suppliers were Canada and Germany for potash and Jordan for phosphate and potash (International Bulk Journal, 1999).

In the mineral fuels sector, the coal industry comprised two coal producers with a work force of about 2,000. Global Minerals (S) Sdn. Bhd. operated coal mines at Belawei Mujan and at Kapit, Sarawak, and Luckyhill Coal Mining Sdn. Bhd., at Bau and Selantik, Sarawak. In 1999, coal production decreased by 12% to 310,000 t. To meet the coal requirements for its cement and utility industries, Malaysia imported about 2.9 Mt of coal in 1999, of which about 85% was steam coal and 15%, anthracite and bituminous coal. The major overseas coal suppliers were, in decreasing order, Indonesia, Australia, China, and South Africa.

Coal resources have been identified in Perak, Perlis, Sabah, Sarawak, and Selangor States. Coal reserves totaled just over 1

billion metric tons, of which about 230 Mt were proven. About 70% of the reserves were in Sarawak; 28%, Sabah; and 2%, other States (Geological Survey Department, 1999, p. 76, 99). Malaysia has substantial reserves of natural gas and considerable reserves of crude petroleum. Its proven reserves of natural gas were estimated to be 2.31 trillion cubic meters and to account for 1.6% of the world total, and its proven reserves of crude petroleum were estimated to be 3.9 billion barrels and to account for 0.4% of the world total in 1999 (Oil & Gas Journal, 1999).

In oil and gas exploration, PETRONAS signed four production-sharing contracts (PSC) under the new terms of revenue-over-cost (R/C) with two foreign oil companies in 1999. In January, PETRONAS signed three PSC with Murphy Oil Corp. of the United States, for Blocks SK309 and SK311 offshore Sarawak and for Deepwater Block K offshore Sabah. According to the agreement, Murphy Oil would own an 85% interest each in Block SK309 and SK311 and PETRONAS would own 15% through PETRONAS-Carigali Sdn. Bhd. (PCSB). Murphy Oil would own an 80% interest in Deepwater Block K and PCSB would own 20%. Murphy Oil would operate the three blocks and was committed to spend no less than \$29 million (PETRONAS, January 27, 1999, PETRONAS signs three production sharing contracts with Murphy Oil Corp. and PETRONAS Carigali, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>). In September, PETRONAS signed a PSC with Shell Exploration and Production Malaysia B.V. for Block PM303 offshore Terengganu. Shell would own a 70% interest in the block, and PCSB would own 30%. The contract marked the first entry of Shell into exploration activities offshore peninsular Malaysia. According to the agreement, Shell would also evaluate the hydrocarbon potential of Blocks PM320 and PM322 in the Strait of Malacca and was committed to spend no less than \$4.7 million (PETRONAS, September 29, 1999, PETRONAS signs production sharing contract for Block PM303 with Shell and PETRONAS Carigali, accessed August 28, 2000, via URL <http://www.petronas.com.my/news/index.htm>).

Production of natural gas and crude petroleum decreased slightly in 1999 from that of 1998 owing to weak domestic demand and reduced exports. According to the Department of Statistics (2000, p. 37-38), natural gas production decreased to 105.3 million cubic meters per day (Mm^3/d) in 1999 from 109.1 Mm^3/d in 1998. Exports of LNG increased by 2.8% to 15.1 Mt, or about 22.6 billion cubic meters (Gm^3), but exports of natural gas through pipelines decreased by 18.9% to 987,000 t, or about 1.5 Gm^3 in 1999.

In 1999, about 25.8 Mm^3/d of natural gas, which was produced by Esso Production Malaysia Inc. (EPMI), 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. About 2.5 Mm^3/d of natural gas, which was produced by Sabah Shell Petroleum Co. Ltd. (SSP) from the gasfields offshore Sabah, was delivered to the processing plant on Labuan Island. The processed natural gas was then

delivered to the methanol plant as feedstock and to the direct-reduction iron plant as fuel on Labuan Island. About 77 Mm³/d of natural gas, which was produced by PCSB and Sarawak Shell Bhd. (SSB) from the gasfields offshore Sarawak, was delivered to two LNG plants and the ammonia and urea plants at Bintulu, Sarawak for the production of LNG and nitrogen fertilizers.

Production of LNG by Malaysia LNG Sdn. Bhd. (MLNG) and Malaysia LNG Dua Sdn. Bhd. (MLNG-2) totaled 15.4 Mt, compared with 15.5 Mt in 1998 (Department of Statistics, 2000, p. v-key data). MLNG's production of LNG was exported to Japan under a 20-year contract with the Japanese utilities companies. The LNG produced by MLNG-2 was exported to various energy companies in Japan, the Republic of Korea, and Taiwan under long-term contracts. Export earnings from LNG were valued at \$2 billion in 1999.

According to the Department of Statistics (2000, p. 37), crude petroleum production, which included condensate, averaged 694,868 barrels per day (bbl/d); this was slightly lower than the 1998 average of 725,043 bbl/d. The crude petroleum production was from 16 oilfields and gasfields that were operated by EPMI and PCSB offshore Terengganu, 13 oilfields and gasfields that were operated by SSB offshore Sarawak, and 8 oilfields and gasfields that were operated by SSP offshore Sabah. About 58% of crude petroleum was produced by EPMI and a joint venture of EPMI and PCSB, and 42%, by SSP, SSB, and a joint venture of SSB and PCSB (Mining Journal, 1999a).

Most of Malaysia's oilfields contain low-sulfur, high-quality crude petroleum with gravities in the range of 35° to 50° API. Crude petroleum that was produced by EPMI from the Tapis Oilfield, which was the country's largest, contained 0.2% sulfur with 44° API. In March, EPMI's Seligi-F platform in the Seligi Oilfield, which is about 266 km offshore Terengganu, was brought on-stream at a cost of \$155 million. The Seligi-F platform was expected to produce an annual average of 21,000 bbl/d of crude petroleum. By the end of 1999, EPMI completed development of the Raya and the Yong Oilfields and was developing another small oilfield called Larut in its PM5 Block offshore Terengganu (World Oil, 2000).

Malaysia exported about 378,700 bbl/d, or 54% of its crude petroleum output, in 1999. Export earnings from crude petroleum were valued at \$2.7 billion in 1999. Exports of crude petroleum were mainly to Japan, the Republic of Korea, Singapore, and Thailand. Malaysia imported about 69,400 bbl/d of crude petroleum valued at \$357.3 million to meet the requirements of its domestic oil refineries in 1999.

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Major Sources of Information

The Ministry of Primary Industry:

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TABLE 1
MALAYSIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1995	1996	1997	1998	1999 p/
METALS					
Aluminum, bauxite, gross weight thousand tons	184	219	279	160	223
Columbium-tantalum metals, struverite, gross weight	127	265	391	521	675
Copper, mine output, Cu content (Sabah)	20,751	20,219	18,821	13,907 r/	3,860 e/
Gold, mine output, Au content 3/ kilograms	3,161	2,829	4,488	3,352 r/	3,449
Iron and steel:					
Iron ore and concentrate thousand tons	202	325	269	376 r/	337
Steel, crude do.	2,450	3,216	2,962	1,903 r/	2,100 e/
Lead metal, secondary	33,600	36,000	42,000	35,000	35,000
Manganese, gross weight	37,600	--	--	--	--
Rare-earth metals, monazite, gross weight	822	618	767	517 r/	1,147
Silver, mine output, Ag content 3/ kilograms	11,079	9,720	9,647	7,285	2,744
Tin:					
Mine output, Sn content	6,402	5,175	5,065	5,756	7,340
Metal, smelter	39,433	38,051	38,400	27,900	27,300
Titanium:					
Ilmenite concentrate, gross weight	151,680	244,642	167,504	124,689	128,500
Dioxide e/	43,000	46,000	46,000	46,000	46,000
Zirconium, zircon concentrate, gross weight	3,790	4,511	4,050	3,057 r/	1,763
INDUSTRIAL MINERALS					
Barite	16,966	17,458	2,608	1,580 r/	11,651
Cement, hydraulic thousand tons	10,713	12,349	12,668	10,397	10,105
Clays, kaolin	404,336 r/	324,578 r/	221,769 r/	198,930 r/	209,125
Feldspar	27,850	13,983	9,779	31,369 r/	30,000 e/
Mica	5,848	5,501	5,708	3,642	3,675
Nitrogen, N content of ammonia	332,800	328,600	243,200	351,400	432,000
Sand and gravel thousand tons	20,657 r/	32,587 r/	40,295 r/	45,231 r/	45,000 e/
Silica sand (Peninsular Malaysia and Sarawak)	684,612 r/	1,168,294 r/	949,948 r/	473,422 r/	500,000 e/
Stone:					
Dolomite	28,100	16,500	8,870	7,500	4,250
Limestone thousand tons	18,689 r/	27,905	25,467	20,124 r/	20,000 e/
MINERAL FUELS AND RELATED MATERIALS					
Coal	114,100 r/	73,747 r/	105,231 r/	349,849 r/	308,502
Gas, natural: 4/					
Gross million cubic meters	36,485	44,092	50,191	50,071 r/	48,360
Net 5/ do.	29,022	35,053	39,902	39,806 r/	38,446
Liquefied natural gas thousand tons	9,727 r/	12,908 r/	15,068 r/	14,670	15,088
Petroleum: 4/					
Crude and condensate thousand 42-gallon barrels	257,349 r/	261,950 r/	260,584 r/	264,641 r/	253,627
Refinery products:					
Gasoline do.	19,076	19,675	20,354	20,331 r/	25,498
Jet fuel e/ do.	7,700	7,665	7,800	7,500	7,500
Kerosene do.	14,547	16,862	17,381	16,924 r/	15,945
Diesel do.	44,148	47,183	50,668	44,563 r/	43,725
Residual fuel oil do.	15,364	18,611	20,997	15,915 r/	11,972
Other e/ 6/ do.	15,000	17,000	15,700	15,000	15,000
Total e/ 7/ do.	116,000	127,000	133,000	120,000	120,000

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

1/ Table includes data available through September 1, 2000.

2/ In addition to the commodities listed, a variety of crude construction materials, which included 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 and 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/ Includes liquefied petroleum gas, naphthas, and lubricants.

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

Sources: Ministry of Primary Industry, Department of Mines (Kuala Lumpur), Monthly Statistics on Mining Industry in Malaysia, Monthly, 1999; Department of Statistics, Monthly Statistical Bulletin, Monthly 1999; and Geological Survey Department (Kuala Lumpur), Malaysian Minerals Yearbook 1998.

TABLE 2
MALAYSIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

(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 owned 61%, local investors and others, 39%)	Teluk Ramunia, Johor	400
Cement		Associated Pan Malaysia Cement Sdn. Bhd. (Malaysia Cement Bhd. owned 100%)	Rawang, Selangor and Kantan, Perak	6,100
Do.		Cement Industries of Malaysia Bhd. (publicly owned company)	Kangar, Perlis	2,000
Do.		Kedah Cement Holdings Bhd. (Malaysia Cement Bhd. owned 65.02% and general public shareholders owned minority interest)	Langwai, Kedah	5,800
Do.		Perak-Hanjoong Simen Sdn. Bhd. (Korea Heavy Industries and Construction Co. owned 60% and Perak State Government, 40%)	Padang Rengas, Perak	1,440
Do.		Tasek Cement Bhd. (publicly owned company)	Ipoh, Perak	1,500
Do.		Pahang Cement Sdn Bhd. (joint venture of Pahang State Government and Yeoh Toing Lay Sdn. Bhd.)	Bukit Sagu, Pahang	1,300
Copper, concentrate		Mamut Copper Mining Sdn. Bhd. (wholly owned subsidiary of Mega First Corp. Bhd.) 1/	Mamut, Sabah	100
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. (Petroleum Nasional 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 owned 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)	Penjom, Pahang	3,110
Nitrogen, ammonia		Asean Bintulu Fertilizer Sdn. Bhd. (PETRONAS owned 63.5%, P.T. Pupuk Sriwidjaja Indonesia, 13%; the Thai Ministry of Finance, 13%; the 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	million 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.		Maju 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. owned 37.44%; Malaysia Mining Corp., 37.44%; and others, 25.12%)	Butterworth, Penang	40
Titanium, oxide		Tioxide (Malaysia) Sdn. Bhd. (Tioxide Group PLC of the United Kingdom owned 85% and Terengganu State Government, 15%)	Kemaman, Terengganu	50

1/ The Mamut Mine was closed permanently in July 1999.