

THE MINERAL INDUSTRY OF VIETNAM

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According to the Vietnamese Government, the Geological Survey of Vietnam had completed regional geologic mapping of the country's land area at a scale of 1:200,000, and 41% of the land area with mineral potential had been geologically mapped at a scale of 1:50,000 (Tran and Le, 1991). On the basis of the Government's preliminary geologic surveys and detailed exploration of 500 mineral occurrences and deposits, a wide variety of minerals were identified—antimony, bauxite, carbonate rocks, clays, chromite, coal, copper, natural gas, gemstones, gold, graphite, iron ore, lead, manganese, nickel, crude petroleum, phosphate rock (apatite), pyrophyllite, rare earths, silica sand, tin, titanium, tungsten, zinc, and zirconium. Except construction aggregates, coal, and petroleum, these mineral resources remained largely unexploited (Le, 1995). In 2000, Vietnam was the world's fourth largest producer of anthracite and the sixth largest producer of crude petroleum in the Asia and the Pacific region (National Mining Association, 2000, p. I-9; Oil & Gas Journal, 2000). None of Vietnam's mineral resources, however, was of world significance.

The mining and quarrying sector, which played an important role in Vietnam's economic development, was an important sector of the Vietnamese economy. The output of the mining and quarrying sector, which included the output of the oil and gas industry, contributed about 7% to Vietnam's gross domestic product (GDP), which was estimated to be \$31 billion in 2000. Exports of crude petroleum alone accounted for about 18% to the total export earnings, which were estimated to be \$11.5 billion (International Monetary Fund, 2000, p. 3, 6, 28). Vietnam's economy, as measured by real GDP, was estimated to have grown by 5.5% in 2000 compared with 4.25% in 1999 (International Monetary Fund, 2001, p. 6).

Government Policies and Programs

To attract foreign investment in the mining sector, the Government of Vietnam enacted the Law on Foreign Investment in 1987 and the Ordinance on Mineral Resources in 1989. In the past 12 years, 42 production-sharing contracts to explore for oil and natural gas and numerous exploration licenses to explore for coal, copper, gold, nickel, manganese, rare earths, tin, titanium, tungsten, zinc, and zirconium in Vietnam had been granted by the Government to foreign companies from Australia, Belgium, Canada, France, Indonesia, Japan, the Republic of Korea, Malaysia, New Zealand, Norway, Singapore, Sweden, Thailand, the United Kingdom, the United States, and other countries.

To provide a more competitive and favorable environment for foreign investment in its mining sector, Vietnam's National Assembly passed a new mining law in March 1996 and enacted the new law in September 1996 to replace the 1989 Ordinance on Mineral Resources. To implement the new law, the Government issued the Decree No. 68 CP in November 1996 on regulations

and guidelines for the frameworks for managing mineral resources and such activities as geologic survey, prospecting, exploration, development, production, and processing of minerals in the mining sector (Nguyen and Nguyen, 1997).

The Government issued a new foreign investment decree in 1998 that disallowed 100% foreign ownership in oil and mineral exploration projects but eased licensing and export rules for export-oriented companies (Far Eastern Economic Review, 1998). Since the new mining law became effective in 1996, the exclusive right of a successful exploration company to obtain mining licenses, the sole right of an exploration company to conduct exploration within its license's area, and the ability of a foreign mining company to export unprocessed minerals had been the major concerns of foreign investors (SEG Newsletter, 1998).

The Government began implementing a new Enterprise Law in 2000. This new law was to simplify the license application by removing 145 sublicense procedures (Far Eastern Economic Review, 2001). To attract foreign investment in Vietnam, the Government reportedly was expected to lower the tax rates of 5%, 7%, and 10% on foreign remittance to 3%, 5%, and 7%, respectively, effective July 1, 2001. According to the External Finance Department under the Ministry of Finance, the Government would also consider allowing foreign investors to remit their profit abroad on a quarterly basis at a certain proportion if the ministry's new requirements were met (Saigon Times Daily, 2000).

Because of the 1997 Asian financial crisis and the regional economic downturn, overall foreign investment in Vietnam has decreased significantly since 1998. Total approved foreign direct investment (FDI) pledges in 1999 dropped to \$1.48 billion from \$4.06 billion in 1998. For the first 8 months of 2000, the total amount of approved FDI was less than \$700 million (Far Eastern Economic Review, 2001). As of 2000, Vietnam had bilateral investment agreements with 39 countries worldwide, which included Australia, China, India, Indonesia, the Republic of Korea, Laos, Malaysia, the Philippines, Singapore, Taiwan, and Thailand in the Asia and the Pacific region. The United States-Vietnam bilateral trade agreement, which includes provisions on investment, was reached in July, but had not been approved by the U.S. Congress at the end of 2000.

In 2000, minerals exploration activity remained slow owing mainly to the lack of exploration capital and low metals prices in the world market. Several foreign companies that explore for gold and nonferrous metals had suspended their activities in 1999; only two companies were still active in 2000.

Production

In 2000, Vietnam's mineral production included chromite, coal, fluor spar, natural gas, gold, kaolin, ilmenite, lead, phosphate rock, pyrite, crude petroleum, pyrophyllite, salt, silica sand,

stone, sulfur, tin, zinc, and zirconium. Production of processed mineral products included cement, fertilizer materials (ammonia and urea), lime, crude steel, rolled steel, and refined tin (table 1). Most mineral production was processed and consumed domestically, although most chromite, ilmenite, crude petroleum, and zirconium production and some kaolin, coal (anthracite), granite, salt, silica sand, and refined tin production were exported. The major imported mineral products were refined petroleum products, primary aluminum, iron and steel, and fertilizer materials.

Structure of the Mineral Industry

According to Chadwick (1998), about 1,000 mines and quarries were operating in 1998. Mining operations in Vietnam used outdated technologies and unsophisticated equipment. Small-scale mining of coal, chromite, gemstone, gold, and tin commonly was by unorganized and unofficial companies. According to the latest Government statistics, Vietnam has 930 quarries and mines under legal exploitation, of which 433 produced construction aggregates, 88 produced clays, 81 produced cobble stone and sand, and 52 produced coal (anthracite). The remaining 276 quarries and mines produced such ferrous minerals as iron ore and pyrite; such nonferrous minerals as bauxite, chromite, copper, gold, lead, rare earths, tin, and zinc; and such industrial minerals as barite, fluor spar, ilmenite, phosphate, silica, and zircon. Because the mining industry was still in its early stage of development, the annual production totals for all but construction aggregates and coal was small. The mining industry's workforce accounted for about 0.6% of the country's labor force (Embassy of Vietnam in the United States, December 9, 2000, News—Mining industry and national economic development in new century, accessed April 26, 2001, at URL <http://www.vietnamembassy-usa.org/news>).

The mineral industry comprised the following state-owned companies: Vietnam National Cement Corp. (VNCC), Vietnam National Chemical Corp. (VinaChem), Vietnam National Coal Corp. (Vinacoal), Vietnam National Gem and Gold Corp. (VIGEGO), Vietnam National Minerals Corp. (VIMICO), Vietnam Oil and Gas Corp. (PetroVietnam), Vietnam National Salt Corp. (VISALCO), and Vietnam Steel Corp. (VSC). The industry also included several state-owned and foreign mining and mineral-processing company joint ventures, many small-scale local government-owned mining companies, local government and private mining company joint ventures, and local private miners (table 2).

Among the state-owned companies, the Hanoi-based VIMICO controlled 17 companies that were engaged in mining-related activities, such as geologic surveys, exploration, mine development, mineral production, ore processing, metal smelting, and mineral trade. The major VIMICO-affiliated companies, in order of importance, were Thai Nguyen Nonferrous Metal Co. (TNNMC) (producer of chromite, lead, tin, and zinc) in Phu Xa District, Bac Thai Province; Cao Bang Nonferrous Metal Co. (producer of iron ore and tin) in Nguyen Binh District, Cao Bang Province; Nghe Tinh Nonferrous Metal Co. (producer of tin) in Quy Hop District, Nghe An Province; Rare Earth Co. (producer of rare earths) in Dong Da District, Hanoi; Mineral Development Co. (producer of marble) in Hoan Kiem District, Hanoi; Mineral Development Co. No. 3 (producer

of iron ore and pyrite) in Ba Vi District, Ha Tay Province; Mineral Development Co. No. 4 (producer of ilmenite and zircon) in Vinh City, Nghe An Province; Mineral Development Co. No. 5 (producer of construction aggregates, fluor spar, and ilmenite) in Tuy Hoa District, Phu Yen Province; Mineral Development Co. No. 6 (producer of construction aggregates and ilmenite) in District 10, Ho Chi Minh City; and Geological & Mineral Mining Enterprise No. 304 (producer of iron ore and pyrite) in Duyen Hai Quarter, Lao Cai Provincial Town.

Commodity Review

Metals

Bauxite and Alumina.—In the past 5 years, laterite bauxite has been mined in small quantities for domestic consumption in making chemical for water treatment. In 1999, VIMICO and Aluminium Pechiney (AP) of France signed an agreement to conduct prefeasibility studies to develop a 1-million-metric-ton-per-year (Mt/yr) alumina refinery in Lam Dong Province (Metal Bulletin, 1999). AP and the Construction and Investment Development Consulting Co. signed an agreement in September 2000 to conduct a feasibility study to build a bauxite-aluminum complex at Tan Rai in Lam Dong Province. According to VIMICO, which was the project developer, the feasibility study would cost about \$2.8 million, of which AP would receive about \$2 million for consulting. Under the agreement, AP was to study the technology for aluminum production and an affiliate of the Ministry of Industry was to conduct research on bauxite mining and to undertake auxiliary works. The feasibility study was expected to be completed in 2001. The total development cost of the complex was estimated to be \$800 million (Vietnam Economic Times, September 9, 2000, France, VN join in bauxite-alum complex, accessed July 10, 2001, at URL http://www.vneconomy.com.vn/ne/ext_economic/bilateral/00-7002.htm). According to an industry source, the planned output would be about 1.7 Mt/yr of bauxite and 300,000 metric tons per year (t/yr) of alumina, of which more than 50% would be exported, and the remaining alumina would be used to produce about 72,600 t/yr of aluminum ingots (Aluminum Association Inc., October 29, 1999, Industry news—Vietnam pick \$930 M bauxite plant site, accessed July 10, 2001, at URL <http://www.aluminum.org/dailya.cfm?docid=359>).

Chromite.—According to the General Statistical Office, production of chromite was between 51,000 and 55,000 t/yr, of which about 60% was produced by nonstate-owned companies. TNNMC and several small-scale mining companies mined chemical- and refractory-grade chromite from the alluvial deposits in the northeastern foothills of Nui Nua Mountain in Nong Cong District, Thanh Hoa Province. The area has proven reserves of about 20 million metric tons (Mt) of chromium oxide (Nguyen, K.V., 1997). Chromite concentrate produced by TNNMC from Nui Nua contained 46% Cr₂O₃ with less than 27% Fe₂O₃, 5% SiO₂, and 0.4% H₂O. Vietnam exported chromite concentrate mainly to China.

Gold.—Gold was produced by two TNNMC joint ventures—the Russian Geology Federation in Bac Kan Province and Covectory Investment Ltd. of Australia. Additionally, many small-scale miners and illegal individual miners were at the placer

deposits along the Gam, the Lo, the Bac Giang, the Ma, the Da, the Hien, the Ca Long Dai, and the Hinh Rivers (Le, 1998). Illegal miners who used mercury were common in various placer deposits along the rivers and had caused environmental damages to the forest and farmland (Chadwick, 1998). More recently, illegal miners reportedly were mining gold in the Na Ri District, Bac Can Province, and in the Phuoc Son District, Quang Nam Province. The identified gold deposits were at Napai and Paclang in the northern region of the country; Camtam, Langmo, and Lnageo in the central region; and Bonmieu and Trang in the southern region (Nguyen K.V., 1997).

In October 1995, VIGEGO was established by the Government to conduct geologic investigations, exploration, mining, processing, and trading of gemstones, gold, and other minerals associated with gemstones and gold and to provide a defined contact address for foreign companies interested in forming joint ventures with the Government to explore and mine gemstones and gold in Vietnam. In the past 5 years, the foreign companies, which formed joint ventures with VIGEGO to conduct gold exploration, were Bureau de Recherches Geologiques Minieres and Hindustan Zinc Ltd. in Cao Bang Province; Iddison Vietnam Group Ltd. in Lang Son Province; Ivanhoe Mines Ltd. (formerly Indo-China Goldfields Ltd.) in Quang Nam Province; Kim Resources NL in Lam Dong Province; Mindex ASA in the Provinces of Binh Dinh, Dac Lac, and Phu Yen; Newcrest Mining Ltd. in Thanh Hoa Province; Normandy Anglo-Asian Pty. Ltd. in Lai Chau Province; New Vietnam Mining Corp., which was a joint venture of Olympus Pacific Minerals Inc. (57%), Ivanhoe Mines Ltd. (33%), and Zedex (10%), in the Phuoc Son area of Quang Nam Province; and Tiberon Minerals Ltd. in the Nui Phao area of Thai Nguyen Province (Truong and Nguyen, 1997).

Olympus Pacific Minerals, which was active in its Phuoc Son gold project in 2000, increased its ownership to 57% from 43%, Ivanhoe decreased to 33% from 50%, and Zedex of New Zealand bought out Iddison Group and increased its stake to 10% from 7.5% (Metal Bulletin, 2000). Tiberon Minerals, which began its initial 1,500-meter diamond drilling program at its Nui Phao polymetallic project in 2000, owned a 70% interest of the project; TNNMC and Hanoi General Import-Export Company—Thai Nguyen Branch each owned a 15% interest.

Iron and Steel.—The steel industry comprised VSC, several VSC-controlled steel producers, several joint-venture steel producers, and other small local steel producers. The industry operated 40 rolled steel plants with a total capacity of 2.5 Mt/yr. Production of rolled steel was about 1.8 Mt in 2000, of which about 36% was produced by VSC; 47%, by joint-venture companies; and 17%, by other companies. According to VSC, domestic demand for steel was expected to increase by 15.6% to 3.3 Mt in 2001. As a result, Vietnam's steel imports was expected to increase by 20% in 2001 (Mekong News, 2001, Vietnam to import steel this year, accessed March 29, 2001, at URL <http://www.mekongsources.com/newsarticle.asp>).

Iron ore and pyrite produced from the Thai Nguyen deposit in Thai Nguyen Province and the Bac Thai deposit in Bac Can Province were consumed as raw materials for steelmaking by a local steel plant. Production of crude steel using locally produced iron ore was 305,881 metric tons (t) in 2000 compared with 308,305 t in 1999 (South East Asia Iron and Steel Institute, 2000, Regional statistics, accessed June 25, 2001, at URL

http://www.seaisi.org/fr_resource1.htm).

American Steel Corp. (a consortium led by Craft Corp. of the United States) spent \$3 million conducting feasibility studies on building a 1.2-Mt/yr direct-reduced-iron (DRI) plant at Ba Ria, Ba Ria-Vung Tau Province. According to an agreement signed in January 2000, two-thirds of the project would be funded by debt and one-third, by equity. VSC was to take a 30% equity interest, Craft and Raytheon Co. of the United States would take 5% to 19%. According to Craft, Midrex Corp. of the United States and companies from India, Japan, the Republic of Korea, and Taiwan would participate in taking between 60% and 65%. In mid-2000, a recently completed \$1.8 million feasibility study on construction of a \$360 million DRI plant, which was financed by the U.S. Government, had been submitted to VSC (Mining Journal, 2000).

Other Metals.—TNNMC produced lead and zinc mainly from the Cho Dien deposit in Bac Can Province and possibly from the My Due deposit in Quang Binh Province. Production of tin and tungsten was by other VIMICO-affiliated companies from the Pia Qac deposit, 338 kilometers (km) north of Hanoi; the Tam Dao deposit, 130 km north of Hanoi; and the Quy Hop deposit, about 250 km south of Hanoi. Production of tin was mostly for domestic consumption, but some refined tin was exported to Malaysia to upgrade the tin purity to 99.85% from 99.7%. TNNMC's Thai Nguyen tin smelter produced about 2,000 t of refined tin in 2000.

Between 1996 and 1998, several foreign companies in joint venture with the Government were exploring for nonferrous metals in Vietnam. Auridiam Consolidated Co. Ltd. and North Star Resources Co. Ltd. were exploring for copper and gold in the Shin Quyen area of Lao Cai Province. Golden Tiger Resources NL was exploring for lead, manganese, and zinc in the Na Tum area of Bac Can Province. Tiberon Minerals Ltd. was exploring for lead, tungsten, and zinc in the Coi Ky area of Bai Thai Province. Padaeng Industries Co. Ltd. was exploring for copper, lead, tin, and zinc in the Cho Dien and the Na Tum areas of the Bac Can Province. Palmer Resources Ltd. was exploring for copper in the Cam Son, the Lang Cha, and the Bien Dong areas of Bac Giang Province. Spectrum Resources Co. Ltd. was exploring for copper and nickel in the Ban Phu area of Son La Province (Le, 1998).

According to a local press, Japan reached an agreement with Vietnam in October to explore for rare-earth minerals jointly at the Dong Pao deposit in the Phong Tho District, Lai Chau Province. The deposit reportedly contains rare-earth minerals, thorium, and uranium (Vietnam Media Watch, October 6, 2000, Japan joins mines consortium, accessed July 10, 2001, at URL http://www.intellasia.com/products/finance/06oct.00_weekly_file.pdf).

Industrial Minerals

Cement.—Vietnam's cement industry had expanded substantially owing to increased demand for upgrading the country's highway, road, bridge, and other public works, as well as new office buildings and residential housing in Vietnam and in neighboring Cambodia and Laos. Vietnam's clinker capacity had expanded to 11.5 Mt/yr, and cement capacity, to 13.2 Mt/yr in 2000. Cement production grew between 10% and 13% per year from 1998 to 2000. In 2000, cement consumption was

estimated to be 12.5 Mt, and per capita cement consumption was about 145 kilograms (International Cement Review, 2000). According to a local press report, there was an excessive supply of about 1 Mt in the northern part of Vietnam because of a construction slowdown in 2000. As a result, the Government had imposed a ban on imported cement until 2002, and VNCC was seeking overseas markets for export. VNCC planned to export 30,000 t of cement to Laos and 20,000 t to Cambodia in 2001 (Vietnam News, 2000, Cement sector firming up as sales rise and management improves, accessed March 22, 2001, at URL <http://vietnamnewa.vnagency.com.vn/2000-05/26/stories/03.htm>).

Production of cement was by VNCC, which controlled six affiliated cement companies—Cong Ty Xi Mang Bim Son with a 1.3-Mt/yr plant in Bim Son, Thanh Hoa Province; Cong Ty Xi Mang But Son with a 1.4-Mt/yr plant in Kim Bang, Ha Nam Province; Cong Ty Xi Mang Ha Tien I with a 1.5-Mt/yr plant in Ho Chi Minh City; Cong Ty Xi Mang Ha Tien II with a 1.5-Mt/yr plant in Ha Tien, Kien Giang Province; Cong Ty Xi Mang Hai Phong with a 0.45-Mt/yr plant in Hai Phong City; and Cong Ty Xi Mang Hoang Thach with a 2.4-Mt/yr plant in Kim Mon, Hai Duong Province (Vietnam National Cement Corp., 2000, p. 18-28). Production of cement was also by three joint ventures—Chinfon Hai Phong Cement Corp. with a 1.4-Mt/yr plant in Min Duc near Hai Phong City; Morning Star Cement Ltd. with a 1.76-Mt/yr plant in Hon Chong, Kien Giang Province; and Nghi Son Cement Corp. with a 2.3-Mt/yr plant in Nghi Son, Thanh Hoa Province.

The major capacity expansion was a direct result of increased investment in new cement plants by the foreign investors from Japan, Switzerland, and Taiwan in the past 5 years. VNCC had established three joint ventures with foreign companies. In 1997, Chinfong Hai Phong Cement, which was a joint venture of Chinfong Group of Taiwan (70%), VNCC (14.44%) and the Hai Phong City Government (15.56%), completed construction and began operations of its 1.40-Mt/yr plant near Hai Phong City. In 1998, Morning Star Cement Ltd., which was a joint venture of Holderbank Financiere Glaris Ltd. of Switzerland (65%) and VNCC's Ha Tien Cement I Co. (35%), inaugurated and started operations of its 1.76-Mt/yr plant at Hon Chong, Kien Giang Province, which is about 400 km south of Ho Chi Minh City, and a cement packing and distribution terminal at Cat Lai near Ho Chi Minh City (International Bulk Journal, 1999). In 2000, Nghi Son Cement Corp., which was a joint venture of VNCC (35%) and Nihon Cement Co. and Mitsubishi Materials Corp. of Japan (combined 65%), started operations at its 2.27-Mt/yr plant at Nghi Son, Thanh Hoa Province, which is about 200 km south of Hanoi.

Gemstones.—Production of gemstones was from Lam Dong, Nghe An, Thai Nguyen, and Yen Bai Provinces. VIGEGO operated gemstones mines in Thai Nguyen and Yen Bai Provinces. Gemstones produced from these areas were mainly ruby and sapphire. Two new ruby mines were brought on-stream at the Tan Huong and the Truc Lau areas in Yen Bai Province in 1999. VIGEGO continued its gemstone prospecting at the Khe Ngang area in Nghe An Province.

Ilmenite.—Ilmenite was produced mainly by Bimal Minerals Co. Ltd. (BMC) from the Cat Khanh Mine and was processed at the plant at Qui Nhon, Binh Dinh Province. BMC was a joint venture of Binh Dinh Minerals Co. (40%) and Malaysia Mining

Corp. and Syarikat Pendorong Sdn. Bhd. (combined 60%) of Malaysia. According to the Vietnam Titanium Association, among its member companies, BMC, which was the most successful titanium minerals mining company, had an annual sales of \$2.14 million and a net profit of \$0.6 million in 2000 (Mekong News, December 26, 2000, Binh Dinh succeeds in mining, accessed February 7, 2001, at URL <http://www.mekongsources.com/newsarticles.asp?docid=18778>).

Other producers of ilmenite were the Institute of Industrial Chemistry, Meteco, Phu Yen Titanium Minerals Factory, and other local mining companies at Cam Hoa, Ky Anh-Cam Xuyen, Ky Khan, and Ky Ninh, Ha Tinh Province; Quang Ngan and Vinh My, Thua Thien Hue Province; Vinh City, Nghe An Province; and Dong Xuan, Phu Yen Province.

In 2000, Phu Yen Provincial Government was seeking \$500,000 investment capital to expand the capacity of ilmenite mining and processing in its coastal areas of Song Cau and Tuy An where ore reserves were estimated to be 40,000 t (VASC, 2000, VNN Guide—Phu Yen, exploiting and processing minerals diatomite and ilmenite, accessed July 10, 2001, at URL <http://www.vnn.vn/province/phuyen/project12.html>). Vietnam's ore reserves at an unstated grade of titanium minerals were estimated to be 11 Mt (Industrial Minerals, 1996). Vietnam exported ilmenite principally to Japan.

Phosphate Rock.—Production of phosphate rock was by VinaChem from the Lao Cai area in Lao Cai Province. Proven reserves of phosphate rock in the area were estimated to be 505 Mt, of which about 26 Mt was high-grade rock that contained between 36% and 41% P₂O₅ (Le, 1998). Most of the high-grade rock produced in the area was shipped to the Lam Thao fertilizer plant in Phu Tho Province for the manufacture of superphosphate. The low-grade phosphate rock was shipped to other fertilizer plants in various parts of the country. The annual phosphate fertilizer production was estimated to be 795,000 t (Industrial Minerals, 1996).

Salt.—Production of salt was by VISALCO, which engaged in the production and distribution of all types of salt; in the import and export of salt and salt-related materials, machinery, and equipment; and in the research, design, and construction of salt fields. VISALCO controlled five salt companies (salt company No. 1, 2, 3, 4, and 5) in Nam Dinh and Nghe An Provinces and Ho Chi Minh, Than Hoa, and Hai Phong Cities. It operated a foodstuff company in Thai Binh Province, one salt packaging branch in Nam Dinh City, one salt branch each in Hai Tinh Province and Da Nang City, and a transport enterprise in Thanh Tri-Hanoi. It also controlled 25 iodized salt enterprises throughout Vietnam (Vietnam National Salt Corp., Main activities, companies and enterprises under VISALCO, accessed July 10, 2001, at URL <http://www.vietnaminternet.com/visalco>).

Because of increased domestic requirements for salt, VISALCO will need to import about 160,000 t of industrial salt in 2001, of which about 70,000 t will be for the country's salt stockpile. In October, the Government approved the large-scale Quan The salt project, which would be carried out by VISALCO with a capital investment of about \$22 million. The project covers 2,510 hectares (ha) at Thuong Dien and Phuoc Minh communes in the Ninh Phuoc District, Ninh Tuanh Province. The salt fields would cover 2,030 ha. After completion of the project, Vietnam would be self-sufficient in salt and would be

able to export about 30% of its salt production (Vietnam Media Watch, October 6, 2000, Salt project approved, accessed July 10, 2000, at URL http://www.intellasia.com/products/sample/finance/06oct00_weekly_files.pdf).

Mineral Fuels

Coal.—Vinacoal controlled most of the country's coal mining, distribution, and export. Overall coal production of about 11.3 Mt in 2000 was from 29 operating coal mines. According to Vinacoal, of these operating mines, 6 were large-scale open pit mines that produced between 800,000 t/yr and 2.5 Mt/yr each, 5 were large-scale underground mines that produced between 200,000 t/yr and 1 Mt/yr each, and 18 were mostly small-scale open pit mines and underground mines (Vinacoal, oral commun., April 2000).

Production of anthracite, which was concentrated in Quang Ninh Province, was mainly from the Cam Pha (open pit and underground), the Cao Son (open pit), the Coc Sau (open pit), the Deo Nai (open pit), the Dong Trieu (underground), the Ha Tu (open pit), the Hong Gai (open pit and underground), the Mao Khe (underground), the Mong Duong (underground), and the Uong Bi (underground) areas. Production of brown coal was mainly from two open pit mines with a capacity of less than 500,000 t/yr each in the Northern Delta area. The Vietnamese coal mining industry's capacity was estimated to be 12 Mt/yr of raw coal and 10 Mt/yr of clean coal. Raw coal was washed and cleaned at three coal preparation facilities—the Cam Pha plant with a capacity of 2.5 Mt/yr, the Hong Gai plant with a capacity of 2.0 Mt/yr, and the Vang Danh plant with a capacity of 600,000 t/yr (Doan, 1997).

In December 2000, Vinacoal signed a Memorandum of Understanding (MOU) with the Japan International Cooperation Agency (JICA). Under the MOU, JICA was to provide \$6 million financial and technical assistance to improve coal mining safety in Vietnam (Mekong News, 2000, Japan pledged \$6 million to boost Vietnam coal miners' safety, accessed February 7, 2001, at URL <http://www.mekongsources.com/newsarticles.asp>).

The Vietnamese anthracite has a high heating value of about 8,250 kilocalories per kilogram and a low ash and sulfur content. Vietnam's domestic demand for coal was between 7 and 8 Mt/yr. According to Vinacoal, the domestic coal consumers were the utilities (28%), the cement industry (11%), the ceramics, chemicals, fertilizer, paper, and other construction material manufacturing industries (45%), and the households (16%) (Vinacoal, oral commun., April 2000). In 2000, domestic coal consumption increased by 15% because of increased demand by the cement industry. As a result, coal exports decreased by 8% to 3 Mt/yr (Mining Journal, 2001). Japan's iron and steel industry was the major buyer of Vietnamese coal. Coal (anthracite) exports to Japan were about 1 Mt in 2000, which accounted for about 30% of the total.

Natural Gas and Petroleum.—Vietnam produced an average of 315,000 barrels per day (bbl/d) of crude petroleum and an average of 4.25 million cubic meters per day of natural gas in 2000. Production of crude petroleum was from six offshore oilfields—the Bach Ho (White Tiger), the Dai Hung (Big Bear), the Hong Ngoc (Ruby), the Rang Dong (Dawn), the Rong (Dragon), and the Bunga Kekwa; all are in the Cuu Long Basin except the Dai Hung, which is in the South Con Son Basin, and

the Bunga Kekwa Oilfield, which is offshore the southern coast of Vietnam between Vietnam and Malaysia.

The output from the Bach Ho and the Rong Oilfields accounted for about 80% of Vietnam's crude petroleum production; the Rang Dong, 8%; and the Hong Ngoc and the Dai Hung, 6% each. All the crude petroleum production was exported mainly to Japan and the United States. The output from the Bunga Kekwa was shared equally by Vietnam and Malaysia. Production of natural gas was from the Bach Ho Oilfield as associated gas, which accounted for more than 99% of Vietnam natural gas production; and an onshore Tien Hai—C Gasfield, near Hanoi, about 1%.

In 2000, about 93% of crude petroleum production was exported. The major buyers were Japan (30%), the United States (22%), Singapore (20%), and China, the United Kingdom and the Netherlands (8% each). Exports of crude petroleum were valued at \$3.5 billion in 2000 (Mekong News, December, 2000, Vietnam earns \$3.5 billion from crude oil exports, accessed February 7, 2001, at URL <http://www.mekongsources.com/newsarticles.asp>). Natural gas production was delivered as fuel to the Ba Ria and the Phu My electric powerplants in Ba Ria-Vung Tau Province and as raw materials to liquefied petroleum gas (LPG) processing plants in Vietnam.

The Bach Ho and the Rong Oilfields were owned and operated by VietSovPetro, which was a joint venture of PetroVietnam and Zarubezhneft of Russia. The Dai Hung Oilfield was owned and operated by a joint venture of Malaysia's Petronas Carigali Sdn. Bhd. (63.75%), PetroVietnam (15%), France's Total (10.625%), and a Japanese consortium (10.625%) led by Japan National Oil Corp. and Sumitomo Corp. The Rang Dong Oilfield was owned and operated by Japan Vietnam Petroleum Corp. (JVPC). JVPC was a consortium of Japan National Oil (49.3%), Mitsubishi Oil Co. (46.9%), Mitsubishi Corp. (3.5%), and Mitsubishi Petroleum Development Co. (0.3%). The Hong Ngoc Oilfield was owned and operated by a joint venture of Malaysia's Petronas Carigali Sdn. Bhd. (46%), Canada's International Petroleum Development Ltd. (26%), Sweden's Sands Petroleum AB (15.5%), and PetroVietnam (12.5%). The Bunga Kekwa Oilfield was owned and operated by a joint venture of PetroVietnam (50%) and Petronas Carigali (50%).

After more than 4 years of on-and-off negotiations, PetroVietnam signed three MOUs (initial accords with three foreign oil companies) in April 1999 for development of the Lan Do and the Lan Tay gasfields on offshore Block 6/01 in the Nam (South) Con Son Basin in the South China Sea. In September 2000, the Government of Vietnam, through PetroVietnam, signed a guarantee with BP Amoco plc of the United Kingdom, Dnorske Stats Oljeselskap AS of Norway, and the Oil and Natural Gas Co. of India to develop Vietnam's largest offshore gasfield in the Nam Con Son Basin jointly; the gasfield has estimated reserves of 60 billion cubic meters of natural gas. The offshore gasfield, which is about 580 km southeast of Vung Tau, was discovered in 1993 (Associated Press, September 4, 2000, Vietnam guarantee gas field project, accessed September 5, 2000, at URL, http://biz.yahoo.com/apf/000904/vietnam_ga.html). PetroVietnam reportedly had signed final agreement with the three foreign partners to proceed with the \$1.4 billion Nam Con Son gas development project in December 2000 (Mekong News, December 16, 2000, Gas mega deal signed, accessed February 7, 2001, at URL <http://www.mekongsources.com/newsarticles.asp>).

In 1998, the Government of Vietnam, through PetroVietnam, signed an agreement with a Zarubezhneft to establish a 50-50 joint venture—Vietross—to build and operate Vietnam's first oil refinery, which is located in Dung Quat, Quang Ngai Province. The oil refinery, which would be called Refinery No. 1, will have a designed capacity of 6.5 Mt/yr (148,000 bbl/d) of crude petroleum and used deep process configuration with a continuous catalytic reformer unit and a residue fluid catalytic cracker unit to produce gasoline, diesel, and such refined petroleum as fuel oil, kerosene, jet fuel, LPG, and propylene. The estimated total project cost was \$1.4 billion, which excluded financial fees, of which \$800 million in equity was to be provided by the joint-venture partners and the remaining \$600 million in debt was to be financed by borrowing. The refinery was expected to come on-stream by the end of 2004. Foster Wheeler Energy Ltd. of the United Kingdom was selected by Vietross as the contractor for Front End Engineering Design (PetroVietnam, 2001, Vietnamese-Russian joint venture Vietross refinery, accessed May 30, 2001, at URL <http://www.petrovietnam.com/vn/internet/directory>).

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Major Publication

- General Statistical Office, Hanoi, Vietnam
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TABLE 1
VIETNAM: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1996	1997	1998	1999 e/	2000 e/
Cement, hydraulic	thousand tons	6,585	8,019	9,390	10,400 r/	12,500
Chromium ore, gross weight		37,000	51,000	54,000	55,000	53,000
Clays, kaolin e/		1,000	1,100	1,100	1,100	1,200
Coal, anthracite	thousand tons	9,823	11,388	10,708	10,460 r/ 3/	11,300 3/
Fluorspar e/		2,000	2,000	3,000	3,000	3,000
Gas, natural, gross	million cubic meters	830	705	1,000	1,150	1,550 3/
Gold e/	kilograms	1,000	1,000	1,500	1,500	2,000
Ilmenite, gross weight e/		50,000	50,000	80,000	91,000	109,000
Lead, mine output, Pb content e/		1,000	1,000	1,000	1,000	1,000
Lime	thousand tons	992	1,069	1,124	1,200	1,300
Nitrogen, N content of ammonia		54,000	54,000	32,900	33,000	41,900
Petroleum, crude	thousand 42-gallon barrels	63,510	71,457	89,696	109,991 r/ 3/	114,877 3/
Phosphate rock:						
Gross weight	thousand tons	613	581	576	580	600
P ₂ O ₅ content	do.	184	174	173	174	180
Pyrite, gross weight e/	do.	150	150	150	150	200
Pyrophyllite e/		20,000	20,000	20,000	20,000	30,000
Salt	thousand tons	709	743	717	720	730
Silica sand e/	do.	16,000	20,000	50,000	60,000	60,000
Sulfur		22,000	22,000	22,000 r/ e/	22,000 r/	22,000
Stone, building stone	thousand tons	32,400	41,200	45,300	52,000	53,000
Steel, crude	do.	311	314	306	308 r/ 3/	306 3/
Steel, rolled	do.	900	1,050	1,150	1,350	1,770 3/
Tin: e/						
Mine output, Sn content		4,500	4,800	4,500	4,500	3,800
Metal, smelter		2,300	2,400	2,400	2,400	2,000
Tungsten, mine output, W content e/		130	210	--	--	--
Zinc, mine output, Zn content e/		16,000	16,000	18,000 r/	18,000 r/	16,000
Zirconium, gross weight e/		500	800	600	300	150

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

1/ Table includes data available through July 20, 2001.

2/ In addition to the commodities listed, barite, bauxite, benonite, refractory clay, construction aggregates, copper, granite, graphite, iron ore, marble, gemstones, and rare earths were mined, but not reported. Available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

Sources: Vietnam's General Statistical Office, Statistical Yearbook, 1998; British Geological Survey, World Mineral Statistics, 1992-99; World Metal Statistics, May 2000; and South East Asia Iron and Steel Institute, Crude Steel production, Quarterly Statistics, 1998-2000.

TABLE 2
VIETNAM: 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	
Cement 1/	Chinfong Hai Phong Cement Corp. (Chinfong Group of Taiwan owned 70%, Hai Phong Municipal Government; and Vietnam National Cement Corp., 14.44%)	Min Duc near Hai Phong City	1,400	
Do.	Morning Star Cement Ltd. (Holderbank Financiere Glaris Ltd. of Switzerland owned 65% and Vietnam National Cement Corp.-Ha Tien 1, 35%)	Hon Chong, Kien Giang Province	1,760	
Do.	Nghi Son Cement Corp. (Taiheiyu Cement Corp. and Mitsubishi Materials Corp. of Japan owned 65% and Vietnam National Cement Corp., 35%)	Nghi Son, Thanh Hoa Province	2,270	
Do.	Vietnam National Cement Corp. (100% state owned)	Bim Son, But Son, Ha Tien, Hoang Thach, and Hai Phong	6,110	
Chromite	Thai Nguyen Nonferrous Metal Co. (wholly owned subsidiary of state-owned Vietnam National Minerals Corp.)	Nui Nua, Thanh Hoa Province	35	
Coal, anthracite	Vietnam National Coal Corp. (100% state owned)	Cam Pha, Coc Sau, Hong Gai, Mao Khe, Mong Duong, and Uong Bi in Quang Ninh Province	10,000	
Gas, natural	million cubic meters per day	VietSovPetro (a joint venture of Vietnam Oil and Gas Corp. and Zarubezhneft, a Russian oil company)	Offshore Bach Ho Oilfield	3
Fertilizer:				
Apatite	Vietnam National Chemical Corp. (100% state owned)	Lao Cai in Lao Cai Province	600	
Superphosphate	Do.	Lam Thao, Phu Tho Province	800	
Iron ore, pyrite	Mineral Development Co. No. 3 and Geological & Mineral Mining Enterprise Mineral Mining Enterprise 304 (wholly owned subsidiaries of Vietnam National Minerals Corp.)	Ba Vi District, Ha Tay Province; Duyen Hai Quarter, Lao Cai Province	200	
Nitrogen, ammonia	Vietnam National Chemical Corp.	Ha Bac in northern Vietnam	55	
Petroleum, crude	thousand 42-gallon barrels per day	VietSovPetro	Offshore Bach Ho and Rong oilfields	300
Salt	Vietnam National Salt Corp.	Nam Dinh, Nghe An, and Hai Tin Provinces	750	
Steel, crude	Vietnam Steel Corp.	Cai Lan in northern Vietnam	320	
Tin:				
Concentrate	Cao Bang Nonferrous Metal Co. and Nghe Tinh Nonferrous Metal Co. (wholly owned subsidiaries of state-owned Vietnam National Minerals Corp.)	Pia Oac, Cao Bang Province; Quy Hop, Nghe An Province; and Tam Dao, Tuyen Quang Province	7	
Refined	Thai Nguyen Nonferrous Metal Co.	Thai Nguyen, Bac Thai Province	3	
Titanium, ilmenite	Bimal Minerals Co. Ltd. (Binh Dinh Minerals Co., 40%, and Malaysia Mining Corp. and Syarikat Pendorong Schdn. Bhd., 60%)	Cat Khanh, Qui Nhon, Binh Dinh Province	60	
Do.	Mineral Development Co. No. 4 and No. 5 (wholly owned subsidiaries of Vietnam National Minerals Corp.)	Vinh City, Nghe An Province; Tuy Hoa, Dong Xuan, Phu Yen Province; and Quang Ngai and Vinh My in Thua Thien-Hu Province	50	
Zinc, concentrate	Thai Nguyen Nonferrous Metal Co. (wholly owned subsidiaries of Vietnam National Minerals Corp.)	Bac Thai and Cho Dien, Bac Kan Province	38	

1/ Clinker (kilns) capacity.