THE MINERAL INDUSTRY OF

JAPAN

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Japan's reserves of limestone, pyrophyllite, and silica are quite large. Its reserves of ferrous and nonferrous minerals, natural gas, and crude petroleum are, however, very small. Japan has considerable reserves of coal, but the production cost is too high and cannot compete with the major coal-producing countries in the world market. *(See table 3.)* Japan relied on imports to meet virtually all its raw material requirements for energy, ferrous metals, and nonferrous metals for its mineral-processing and mineral-related manufacturing sectors. Japan also relied on imports to meet some of its requirements for refined base and rare metals, industrial mineral products, and refined petroleum products.

In 1997, Japan was the world's largest producer of electrolytic manganese dioxide and selenium metal. It was the world's second largest producer of cadmium metal, cement, iodine, pig iron, crude steel, tellurium metal, and titanium sponge metal. Japan was the world's third largest producer of copper metal, diatomite, indium metal, limestone, nickel metal, pyrophyllite, and zinc metal.

Japan was one of the world's top consumers and importers of primary aluminum, cadmium metal, chromite, coal, cobalt metal, copper ore and metal, diamond, ferrochromium, fluorspar, gallium metal, iron ore, ilmenite and rutile, industrial salt, lead ore and metal, liquefied natural gas (LNG), lithium metal, manganese ore, nickel ore and metal, crude petroleum, potash, phosphate rock, precious metals, rare earths, silicon, steel, zinc ore and metal, and zircon. Japan was one of the world's major producers and exporters of cement, mineral-related chemicals and fertilizer materials, iodine, electrolytic manganese dioxide, high-purity rare metal products, steel products, and titanium sponge metal and mill products.

According to the Government of Japan, the value of output by the mining sector accounted for 0.19% of Japan's gross domestic product (GDP) in 1996 (Economic Planning Agency, 1998. p.125). Despite the small contribution by the mining sector, Japan's mineral-processing sector contributed more than 5% to Japan's GDP and played a very important role in providing the primary materials for the export-oriented manufacturing sector of the Japanese economy. The mineral processing sector also played a significant role in providing ferrous and nonferrous metals, fabricated metal products, and industrial mineral products to the growing economy of China and such export-oriented countries as the Republic of Korea, Malaysia, Singapore, Thailand, and Taiwan in the Asian and Pacific region.

Japan was an important market for U.S. exports of primary aluminum, beryllium metal, boron oxide and acid, cerium oxide and compounds, chromium trioxide and hydroxide, coal, copper, ferrous and nonferrous scrap metals, helium, lead ore and concentrate, lithium oxide and hydroxide, dust and powder of precious stones, primary magnesium, molybdenum, phosphate rock, high-purity silicon and silicon oxide, silver metal, soda ash, tantalum metal and powder products, refined petroleum products, uranium oxide and other compounds, and zinc ore and concentrate.

Japan was an important supplier of fabricated aluminum mill and copper mill products, cement, iodine, iron oxide, high-purity rare metals, high-quality steel products, titanium sponge, titanium scrap, and titanium powder to the United States.

Government Policies and Programs

The underlying mineral policy of Japan was to secure a stable supply of raw material requirements for its national security and growing economy. The Ministry of International Trade and Industry (MITI) reportedly is to review its mining policy and to revise mining laws and tax codes by 1999 to promote overseas mineral-resources development. The Government is expected to continue its policy of encouraging major metal mining companies to explore for mineral resources overseas and to participate in mine development, smelting, and refining nonferrous metals overseas. To cope with the effect of the change in currency exchange rates and the world metals market conditions, the Government was expected to extend its policy of depletion allowances and reduction of corporate taxes to the mining industry in coming years (Nikkan Sangyo Shimbun, 1998).

As part of the Japanese Government Official Development Assistance Program, the Government continued to provide financial assistance, through the Metal Mining Agency of Japan (MMAJ) and the Japan International Cooperation Agency (JICA), to mineral-rich developing and newly developed countries for technical cooperation and joint mineral exploration in 1997. In July, MMAJ signed an agreement with the Government of Argentina for a 2-year technical cooperation for exploration for copper, gold, zinc, and other metals. Under the terms of the agreement, MMAJ will spend about $1.7 million in the next 2 years to conduct geologic and geochemical surveys and satellite image analyses as well as to collect and analyze the existing data for a 77,000-square-kilometer (km^2) area in the southern part of La Rioja and the western part of San Juan and Mendoza in the eastern Andes (Nikkan Sangyo Shimbun, 1997b).

In September, MMAJ and JICA signed a 3-year technical cooperation agreement with the Government of Kazakstan to explore for copper and gold in the Telktynski-Uplift area in central Kazakstan. In June and July, MMAJ and JICA signed three other mineral-exploration agreements to explore for copper and gold in Uzbekistan and Kyrgyzstan. MMAJ planned to spend

about $2.5 million in the next 3 years to conduct satellite image analyses, geologic and geophysical surveys and to analyze the existing data in those three countries. According MMAJ, copper and gold exploration in Kazakstan covers a 6,900-km^2 area in the Telktynski-Uplift area near the city of Dzhezkgan. Gold exploration in Uzbekistan will be in the southern Nuratau area. Copper and gold exploration in Kyrgyzstan will be in the Kichi-Sandyk area (Nikkan Sangyo Shimbun, 1997c).

In November, MMAJ and JICA signed an agreement with the Government of Thailand for a 3-year lead and zinc exploration in an 800-km^2 area in the Mae Sariang area of northwestern Thailand. MMAJ will conduct geologic, geochemical, and geophysical surveys, as well as drilling (Nikkan Sangyo Shimbun, 1997e). In December, MMAJ and JICA also signed an agreement with the Government of Mali for a 3-year gold exploration project in a 7,000-km^2 area in the Kekoro and Baoule-Baniging areas, about 80 kilometers (km) southeast of Bamako. MMAJ will conduct satellite image analyses, geologic, geochemical, and geophysical surveys, followed by drilling (Nikkan Sangyo Shimbun, 1997d).

Environmental Issues

To recognize the environmental issues related to mining and to discuss cooperative measures, MITI, through its affiliated MMAJ, hosted a workshop at the meeting of the Group Expert on Minerals and Energy Exploration and Development (GEMEED) under the Asian Pacific Economic Cooperation (APEC) in Tokyo between October 27, 1997 and October 31, 1997. The major themes of the workshop were the environmental impact from mining activities and problems caused by the abandoned mines, clean production of nonferrous metals industries, reports from member countries on the status of mine-pollution prevention and environmental regulations, and the framework for sustainable development of mining activities. About 100 representatives participated in the workshop; of those, about 70 were from Japan, and 30 were from Australia, Canada, Chile, China, Colombia, India, Indonesia, the Republic of Korea, Malaysia, Mongolia, Pakistan, the Philippines, Taiwan, and the United States.

The general conclusions reached at the four sessions of APEC-GEMEED environmental cooperation workshop were (1) the sustainable development of mining activities is a principal concern in the APEC region, (2) the maturing mining economies should assist the developing economies to achieve the best practice in the development of the mining sector, (3) member economies should exchange ideas and opinions through continued interactions, and (4) a steering committee for environmental cooperation on mining should be set up to facilitate decisions in the area of focus and cooperation. The areas of focus were (1) promotion of information exchanges on environmental problems related to mining, (2) further discussion on the environmental guidelines and action plans of member economies, (3) promotion of technology transfer among member economies, (4) promotion of cooperative research and demonstration projects, and (5) promotion of the best- practice environmental management in mining program (Metal Mining Agency of Japan, 1997b).

Production

Mine production of all nonferrous minerals continued the downward trend begun in 1993 because of depleting domestic ore reserves and lower prices of metals. Mine production of most industrial minerals and construction-related materials, except bentonite, dolomite, and fire clay, was at a lower level than that of 1996 because of a slowdown in construction activities in 1997. Production of coal dropped sharply owing to the closure of the Miike coal mine at Omuta in Fukuoka Prefecture, Kyushu, in March 1997. Output of natural gas and crude petroleum, however, increased slightly.

In the mineral-processing sector, production of nonferrous metals was mixed. Metal production of ferrous and nonferrous metals, except bismuth, indium, manganese oxide, the platinum-group metals, and tin, increased because of increased exports and a steady domestic demand in 1997. Cement production, however, was lower because of decreased domestic demand by the construction industry and a sharp decline in exports to Hong Kong, the Republic of Korea, and Taiwan. Production of most refined petroleum products continued the upward trend begun in 1995 because of the continued growth in domestic demand for gasoline, naphtha, and distillate fuel oil. *(See table 1.)*

Trade

Japan was a major world importer of mineral fuels, nonfuel minerals, and nonferrous metals and was a major world exporter of processed minerals and metal products, mineral-related chemicals, and fertilizer materials. It was, however, a net importer of minerals with a mineral trade deficit of $58.9 billion in 1997 because of its large import bill for mineral fuels.

According to Government trade statistics, imports of minerals totaled $71.7 billion (Ministry of Finance, 1997). Of that total, $62.8 billion was for mineral fuels, including coal, LNG, crude and partially refined petroleum, refined petroleum products, and other mineral fuels; $7.2 billion for nonfuel minerals, including ores and concentrates of ferrous and nonferrous minerals, slag, scrap, and ash of iron and steel, other metals, and metal compounds; and $1.7 billion for industrial minerals, including salt, sulfur, earths and stone, plastering materials, lime, and cement. Imports of processed minerals, mineral-related chemicals, and metals totaled $48.4 billion, of which $21.6 billion was for mineral-related chemicals and fertilizers; $17.4 billion for products of iron and steel, nonferrous metals, and rare metals; $6.4 billion for precious and semiprecious stones and precious metals; and $3.0 billion for products of stone, cement, asbestos, mica, ceramics, and glass. Japan's import bills for minerals, mineral-related chemicals, and processed minerals products totaled $120.1 billion and accounted for 35.5% of Japan's total imports, which were valued at $338.6 billion in 1997.

Japan's export earnings from minerals, mineral-related chemicals, and processed mineral products totaled $61.3 billion and accounted for 14.6% of Japan's total exports, which were valued at $421.1 billion in 1997. Exports of mineral-related chemicals and fertilizer were $25.9 billion. Exports of iron and steel products, nonferrous metals, and rare metals totaled $27.1 billion. Exports of processed mineral products of stone, cement, asbestos, mica, ceramics, and glass amounted to $4.3 billion. Exports of salt, sulfur, earths and stone, plastering materials,

lime, cement, mineral fuels, and nonferrous minerals were $2.5 billion. Exports of precious and semiprecious stones and precious metals were $1.5 billion.

Structure of the Mineral Industry

In terms of the number of establishments, employment, and gross value of production, Japan's mineral industry consisted of a small nonferrous metal mining sector, a small coal mining sector, a large industrial minerals mining sector, and a large ferrous metals, nonferrous metals, and industrial minerals processing sector. Mining and mineral-processing businesses were owned and operated by private companies incorporated in Japan. Because of the high value of the Japanese yen, high production cost, and the sluggish economy during the past 4 years, the minerals industry continued to cut its workforce and output capacity.

In the mining sector, coal was produced from two major mines and several small-scale mines in Honshu (main island), Hokkaido, and Kyushu and had a total capacity of about 4.5 million metric tons per year (Mt/yr) and a workforce of 1,500. The number of operating nonferrous metal mines was 17, unchanged from that of 1996, but employment declined to 1,149 from 1,202 in 1996. The number of operating industrial minerals mines declined to 543 from 544 in 1996, and employment declined to 11,810 from 12,123 in 1996. According to Government statistics, the number of persons employed by the mining industry was 60,000, accounting for 0.09% of the Japanese labor force of 67.9 million (Management and Coordination Agency, 1997).

In the mineral processing sector, the steel industry cut its employment to 226,361 from 237,449 in 1996. The industry's production capacity of pig iron and crude steel remained unchanged at 95.5 Mt/yr and 149.8 Mt/yr, respectively, in 1997. Because of increased overseas demand, Japan's copper refining capacity expanded to 1,288,800 metric tons per year (t/yr) from 1,263,600 t/yr in 1996, but the industry's workforce was reduced to 3,872 from 4,088 in 1996. Japan's lead and zinc production capacity remained unchanged at 193,800 t/yr and 649,200 t/yr, respectively, in 1997. Japan had two secondary lead smelters with a combined capacity of 55,200 t/yr and a secondary zinc refinery with a capacity of 18,000 t/yr, which was renovated from an old zinc refinery at Mikkaichi, Toyama Prefecture. The workforce in the primary and secondary lead and zinc smelting and refining industries was 373 and 1,426, respectively, in 1997. The titanium dioxide production capacity was expanded to 155,000 t/yr from 154,000 t/yr at Yokkaich, to 60,000 t/yr from 48,600 t/yr at Saidaiji, and to 17,000 t/yr from 16,800 t/yr at Akita. *(See table 2.)*

Commodity Review

Metals

Aluminum.—Production of primary aluminum by Nippon Light Metal Co. Ltd. at its Kanbara plant in Shizuoka Prefecture remained insignificant. Japan relied on imports to meet virtually all its annual requirement for primary aluminum. According to Government trade statistics, Japan imported 2,986,016 metric tons (t) of primary aluminum, of which 134,987 t was high-purity (99.9% or more) primary aluminum, 2,030,279 t was regular-grade (less than 99.9%) primary aluminum, and 820,750 t was primary aluminum alloys (Ministry of Finance, 1997). The import bill for primary aluminum in 1997 amounted to $4.9 billion. Despite Japan's wide diversification of its overseas sources of primary aluminum in 50 countries, Australia, Brazil, Canada, China, Indonesia, New Zealand, Russia, South Africa, the United States, and Venezuela accounted for about 90% of the total imports. Of the 18 suppliers of high-purity primary aluminum, the top 4 were the United Arab Emirates, 28%; Indonesia, 27%; New Zealand, 22%; and the United States, 12%. Of the 26 suppliers of regular-grade primary aluminum, the top 10 were Russia, 22%; Australia, 20%; Brazil, 18%; Venezuela, 8%; South Africa, 7%; New Zealand, 6%; Indonesia, 5%; Bahrain, 4%; the United States and China, 3% each. Of the 55 suppliers of primary aluminum alloys, the top 10 were Russia, 17%; Canada, 16%; Taiwan, 12%; Australia, 10%; the United Arab Emirates, 9%; China 8%; New Zealand, 6%; the United States, 4%; Bahrain, 3%; and Ukraine, 2%. Under an agreement with the World Trade Organization, the tariff on primary aluminum was 0.4% in 1997 and will be 0.2% in 1998 and free in 1999 (Japan Tariff Association, 1997).

According to Government minerals and nonferrous metals statistics, despite decreased consumption by the aluminum wire and cable sector, domestic demand for primary aluminum increased to 2,359,392 t from 2,313,427 t in 1996 mainly because of increased consumption by the sectors of aluminum rolling, the aluminum casting, and the secondary smelting (Ministry of International Trade and Industry, 1997d). Consumption of primary aluminum, by sector, was as follows: aluminum rolling, 1,974,397 t; aluminum casting, 110,411 t; secondary smelting, 98,445 t; wire and cable, 74,800 t; aluminum diecasting, 32,480 t; steel deoxidization, 27,426 t; and other, 39,899 t. According to Government trade statistics, Japan's exports of primary aluminum, including aluminum alloys, totaled 10,262 t and were valued at $23.4 million (Ministry of Finance, 1997). The major buyers were the Republic of Korea, 28%; Indonesia, 16%; China, 15%; and Thailand, 11%. The yearend stocks of primary aluminum increased to 438,462 t from 370,977 t in 1996; 315,655 t was held by dealers; 105,035 t, consumers; and 17,772 t, the single primary aluminum producer.

Chromium.—Domestic mine production of refractory-grade chromite by Nippon Chrome Industries Co. Ltd. was at the Wakamatsu Mine in Tottori Prefecture. According to Government minerals and nonferrous metals statistics, production of chromite concentrate at the Wakamatsu Mine had been suspended in 1996 (Ministry of International Trade and Industry, 1997d).

Japan relied on imports to meet all its chromium requirements for the iron and steel industry.

According to Government trade statistics, imports of chromite, including metallurgical and refractory grades, decreased by 15.8%, to 577,858 t, and were valued at $56.7 million (Ministry of Finance, 1997). The major suppliers were South Africa, 67%; India, 17%; Iran, 5%; and Madagascar and the Philippines, 4%

each. Chromite consumption by the ferroalloy industry dropped by 6%, to 377,975 t, and production of ferrochromium also declined by 5%, to 186,400 t, because of increased imports of ferrochromium.

The Japan Metals & Chemicals Co. Ltd. (JMC), the second largest ferrochromium producer in Japan, announced in November that it will stop domestic production of ferroallys in early 1998 because of high production costs and low import prices. In 1997, the company produced about 58,000 t of high-carbon ferrochromium at its 62,800-t/yr Kitakyushu plant in Fukuoka Prefecture; the plant will be shut down at the end of February 1998. JMC planned to switch to imports to supply its customers in Japan. In 1997, JMC established a joint venture with Hernic Ferrochrome Ltd. of South Africa to supply high-carbon ferrochromium to Nippon Steel Corp., JMC's largest customer (Nikkei Shimbun, 1997a). JMC signed an agreement in 1996 with Zimbabwe Alloys Ltd. (Zimalloys) of Zimbabwe to buy up to 16,000 t/yr of low-carbon ferrochromium from Zimalloys' Gweru plant in Zimbabwe. JMC's 21,000-t/yr plant at Oguni in Yamagata Prefecture was shut down in March 1996 (Metal Bulletin, 1997a).

Imports of ferrochromium rose by 13%, to 811,353 t. The major suppliers of ferrochromium were South Africa, 56%; Kazakstan, 20%; India, 9%; and Zimbawe, 8%. Imports of ferrochromium were valued at $467 million. In 1997, consumption of ferrochromium for steelmaking was 906,504 t, of which 856,127 t was high-carbon ferrochromium and 50,377 t was low-carbon ferrochromium, and for other uses, 1,468 t. Exports of ferrochromium were 915 t, of which 56% went to the United States and 29%, to Thailand.

Cobalt.—Japan relied on imports to meet all its cobalt requirements. Domestic metal production of cobalt using imported raw materials (cobalt matte) at by Sumitomo Metal Mining's Niihama nickel-cobalt refining facilities in Ehime Prefecture remained small when compared with Japan's overall demand for cobalt. The rated capacity of Niihama refinery was 500 t/yr, but the actual production was about 260 t/yr during the past 2 years owing to a lack of cobalt-bearing nickel sulfide. Japan continued to rely mostly on imports of cobalt ingot, cobalt powder, flakes, cobalt salt, and other cobalt chemicals to meet its overall demand.

According to Government trade statistics, imports of cobalt mattes and other intermediate products of cobalt totaled 287 t (Ministry of Finance, 1997). Australia was the principal supplier, accounting for 99%. Imports of cobalt ingot, waste and scrap, powder, and flakes totaled 6,658 t. The major suppliers were the Democratic Republic of the Congo, 22%; Canada, 20%; Zambia, 16%; Norway, 13%; Belgium, 10%; Finland, 7%; and Russia, United Kingdom, and Germany, 2% each. Japan also imported 1,402 t of cobalt oxides and 351 t of hydroxides. The major supplier of cobalt oxides was Belgium, accounting for 88%; and the top two suppliers of cobalt hydroxides were Belgium and Finland, accounting for 39% and 37%, respectively.

According to Government minerals and nonferrous metals statistics, domestic demand for cobalt metal increased by 16.6%, to 2,860 t, of which 26.7% was for manufacturing of specialty steel; 15.3%, magnetic materials; 15.1%, pipe, plate, rod, and wire; 13.4%, ultra-hard tool steel (cemented carbides); 11%, catalysts; and 18.5%, other end uses (Ministry of International Trade and Industry, 1997d). According to an industry source, the estimated consumption of cobalt for the manufacturing of batteries had grown to more than 2,500 t, or about 47% of overall demand for cobalt from 200 t in 1990 (Mitsui & Co, Ltd., 1998). The estimated overall consumption of cobalt in 1997 amounted to 6,700 t, of which 42% was for the manufacturing of batteries; 17%, for specialty steels; 12%, for magnetic materials; 10%, for powder metallurgy; 7%, for catalysts and chemicals; 6%, for magnets; 2% for ceramics; and 4%, for other uses (Roskill's Letter from Japan, 1998a).

Copper, Lead, and Zinc.—Mine production of copper, lead, and zinc was by the Kamioka Mining and Smelting Co. Ltd. at the Kamioka Mine in Gifu Prefecture and by the Toyoha Mining Co. Ltd. at the Toyota Mine in Hokkaido Prefecture. Copper concentrate has been produced as a byproduct of lead and zinc mining operations at the Kamioka and the Toyota Mines since 1987. Mine output of copper, lead, and zinc reached a record low in 1997. According to Government minerals and nonferrous metals statistics, the quantity of domestic mine output of copper, lead, and zinc was equivalent to 0.07%, 2.29%, and 11.87%, respectively, of Japan's raw material requirements for production of these three metals in 1997 (Ministry of International Trade and Industry, 1997d).

To secure a steady supply of nonferrous metal ores and concentrates, Japan's major nonferrous metals mining and trading companies signed either short- and long-term contracts or financing agreements with overseas suppliers. In recent years, these companies have been actively seeking a long-term supply of nonferrous minerals from overseas through direct investment as partners in the exploration and development of major mining projects.

As of 1997, Japan's major overseas investments in major productive copper mines through equity participation were the Northparkes project in Australia, the Huckleberry and the Mount Polley projects in Canada, La Escondida and La Candelaria projects in Chile, El Roble project in Colombia, and the Morenci and the Chino projects in the United States. Japan's major overseas investments in productive lead, silver, and zinc mines through equity participation were the McArthur River project in Australia, the Tizapa project in Mexico, and the Huanzala project in Peru.

The major nonferrous metals mining companies involved in overseas investment projects through equity participation in exploration and development of nonferrous metals mines were Dowa Mining Co. Ltd., Furukawa Co. Ltd., Mitsui Mining and Smelting Co. Ltd., Mitsubishi Materials Corp., Nippon Mining and Metals Co. Ltd., Nittetsu Mining Co. Ltd., and Sumitomo Metal Mining Co. Ltd. The major participating trading companies were Itochu Corp., Marubeni Corp. Mitsubishi Corp., Mitsui & Co. Ltd., Nissho Iwai Corp., and Sumitomo Corp.

To increase overseas investment through direct-equity participation in overseas mineral exploration and development projects, Japan's major nonferrous metal mining and trading companies continued to raise their investments in the exploration and development of copper in 1997. In August, a consortium of

Nippon Mining and Metals, 15%; Mitsubishi Materials, 10%;, Marubeni, 8.75%; Mitsubishi Corp., 5%; and Mitsui & Co., 1.25%; had completed acquisition of a 40% equity interest in Los Pelambres copper project, about 200 km north of Santiago, Chile, for $256 million from Antofagasta Holding, 60%; a subsidiary of the Luksic Group of the United Kingdom. It was the most expensive acquisition ever made by the Japanese in a Chilean mine (Nikkan Sangyo Shimbun, 1997a). In September, an agreement was reached between the Japanese and the Chilean partners to secure financing for the $1.3 billion Los Pelambres project and to begin construction by the end of 1997. The development of Los Pelambres Mine and new milling facilities was scheduled for completion by September 1999. The Japanese companies are to purchase 400,000 t/yr of copper concentrate, of which Nippon Mining and Metals will take 250,000 t/yr and Mitsubishi Materials, 150,000 t/yr for 12 years (Nikkan Sangyo Shimbun, 1997f).

Other Japanese overseas nonferrous minerals development projects, which are expected to start and be completed within the next 2 to 3 years, are El Bronce copper project by Nittetsu Mining and Itochu Corp. in Chile, Lay de Plata lead-zinc project by Dowa and Sumitomo Corp. in Mexico, and the Batu Hijau project by Sumitomo Corp., Sumitomo Metal Mining, and Mitsubishi Materials in Indonesia. A Japanese consortium of Nittetsu Mining (32%) and Itochu Corp. (8%) announced in July that they will invest $130 million to develop El Bronce copper mine owned by El Bronce SA (60%) in the Tierra Amarilla area, about 600 km north of Santiago, Chile. The copper mine was expected to produce 90,000 t/yr of copper concentrate beginning in 2000; about half of the production will be purchased by the Japanese companies (Nikkei Shimbun, 1997c).

A Japanese consortium of Dowa Mining (39%) and Sumitomo Corp. (10%) announced in November that they will jointly invest about $45 million to develop the Lay de Plata lead-zinc mine owned by Industrias Penoles S.A. de C.V.(51%) in Guerrero, about 100 km southwest of Mexico City, Mexico. The lead-zinc mine was expected to produce 3,900 metric tons per month of zinc concentrate and 1,200 metric tons per month of lead concentrate in 2000 (Japan Metal Review, 1997a).

A Japanese consortium led by Sumitomo Corp. and Newmont Gold Co. of the United States had secured financing of their Batu Hijau copper-gold project on the island of Sumbawa in Indonesia in 1997. The $1.9 billion project was to be financed partially by a $500 million loan from the Export-Import Bank of Japan and nine other Japanese banks. The Export-Import Bank of the United States and a German finance cooperation were expected to provide an additional $500 million loan for the project. The project was expected to start development of an open-pit mine and a large milling facilities in 1998 and to produce 727,000 t/yr of copper concentrate for a period of 20 years beginning in September 1999. Sumitomo Metal Mining and Mitsubishi Materials were expected to acquire a 5% and a 2.5% interest, respectively, from Sumitomo Corp., which had a 35% interest in the Batu Hijau project (Nikkei Shimbun, 1997d).

Japan was the world's largest importer of copper ore and concentrate and one of the major importers of lead and zinc ores and concentrates. According to Government trade statistics, Japan's imports of copper concentrate totaled 3,837,455 t and were valued at $2.4 billion in 1997 (Ministry of Finance, 1997). The major suppliers of copper concentrate were Chile, 36%; Indonesia, 20%; Australia, 14%; Canada, 12%; Papua New Guinea, 4%; Peru and the Philippines, 3% each. Japan's imports of lead and zinc concentrates were 154,242 t and 1,016,464 t, and were valued at $49 million and $324 million, respectively, in 1997. The major suppliers of lead concentrate were Australia, 45%; Peru, 27%; and the United States, 19%. The major suppliers of zinc concentrate were Australia, 46%; the United States, 12%; Peru 11%; Canada, 9%; China, 7%; and Chile and Mexico, 4% each.

Production of refined copper increased by 2%, despite a slightly weaker domestic demand for refined copper by the manufacturers of wire and cable and a lower level of exports. Production of refined lead increased by 1%, reflecting an increase in demand for refined lead by the manufacturers of storage batteries. Production of slab zinc remained at about the same level as that of 1996 with a stronger domestic demand for slab zinc and a higher level of imports.

To meet the domestic demand for refined copper and to increase exports to Asian markets, the major Japanese copper producers began construction of the capacity expansion of their domestic smelting and refining facilities and proceeded with construction of their overseas copper smelting and refining facilities. Nippon Mining and Metals was expected to spend about $43 million to expand the capacity of its Saganoseki copper smelter by 20%, to 420,000 t/yr, and the combined capacity of its Saganoseki and Hitachi copper refineries by 11.3%, to 390,000 t/yr. The construction work for the capacity expansion at the Saganoseki smelter began in 1997 and was expected to be completed by the end of 1998 (Japan Metal Review, 1997c). Sumitomo Metal Mining was expected to spend about $67 million to expand the capacity of its Toyo copper smelter by 10%, to 300,000 t/yr, and the copper refinery at its Besshi complex from 210,000 to 230,000 t/yr by mid-1998 and then to 250,000 t/yr by 2000 (Japan Metal Review, 1997e).

Overseas, Furukawa and its partners, Itochu, Nittetsu Mining, and Nissho Iwai were expected to spend more than $250 million to expand and renovate the Port Kembla copper smelter-refinery complex, including a sulfuric acid plant in the city of Wollongong, New South Wales, Australia, that they acquired from Southern Copper Ltd. in 1996. Construction began in 1997, and operation of the 120,000-t/yr smelter-refinery complex was expected to start by the end of 1998. The copper smelter-refinery complex is owned by Furukawa, 50%; Nittetsu Mining, 20%; Nissho Iwai, 17.5%; Itochu, 10%; and Denehurst Ltd. of Australia, 2.5% (Japan Metal Review, 1997b).

Mitsubishi Materials (75%), in a joint venture with P.T. Freeport Indonesia (25%), continued construction of the $600 million copper smelting and refining complex at Gresik, East Java, Indonesia. The 200,000-t/yr copper smelter was scheduled for completion by January 1999, will have an initial capacity of 150,000 t/yr, and is expected to reach full capacity by 2001. Mitsubishi Materials also had an 18% equity interest in a joint venture with Metdist Group (42%) of the United Kingdom and the Indian general public (40%) for a 150,000-t/yr copper smelting and refining complex, under construction and scheduled for completion by early 1998, at Pipavav, Gujarat State, India. In

1997, Sumitomo Metal Mining (20%), Sumitomo Corp. (7.5%), and Itochu Corp. (7.5%), in joint venture with Tonling Nonferrous Metals Corp. (52%) and Hong Kong-based Sharpling International Ltd. (10%) of China, were building a 100,000-t/yr copper smelter at Tonling, Anhui Province, China. The copper smelter was scheduled to come on-stream in March 1998.

To meet the strong demand for slab zinc, five major shareholders led by Nippon Mining and Metals decided to spend about $16.5 million to expand the capacity of their Akita zinc refinery in Iijima, Akita Prefecture, by 13%, to 176,000 t/yr. After the closure of the 120,000-t/yr Mikkaichi zinc refinery in Mikkaichi, Toyama Prefecture, in 1995, the plant had been renovated into a secondary zinc refinery by Nikko Mikkaichi Recycle Co. Ltd. The plant began operation with a rated capacity of 14,400 t/yr in 1997. The secondary zinc refinery uses zinc dust generated from electric furnaces at the steelmaking facilities and brass mills. This zinc dust normally contains between 40% and 60% zinc.

According to Government trade statistics, imports of refined copper decreased by 1.8%, to 353,464 t, and were valued at about $840 million (Ministry of Finance, 1997). The major suppliers of refined copper were Chile, 52%; Peru, 14%; Zambia, 10%; the Philippines, 9%; and the United States, 8%. Imports of refined lead decreased by 3%, to 32,634 t, and were valued at about $23 million. Imports of slab zinc increased by 33%, to 179,672 t, and were valued at about $222 million. The major suppliers of refined lead were China, 44%; Peru, 24%; Mexico, 9%; Australia, 5%; and the United Kingdom, 4%. The major suppliers of zinc slab were China, 72%; Peru, 6%; Canada, 5%; and the Republic of Korea and North Korea, 3% each.

According to Government minerals and nonferrous metals statistics, domestic consumption of refined copper decreased slightly to 1,508,152 t from 1,520,766 t in 1996 (Ministry of International Trade and Industry, 1997d). Demand for refined copper, by sector, was 68% for wire and cable, 31% for brass mill, and 1% for copper alloys, casting, and others. Exports of refined copper decreased by 4.2%, to 157,697 t, and were valued at about $366.8 million. The major buyers of refined copper were Taiwan, 59%; China (including Hong Kong) and Thailand, 10% each; and Indonesia and the Republic of Korea, 5% each. As a result of higher production, lower domestic demand, and lower exports, the overall stocks of refined copper rose by 29%, to 146,039 t, at the end of December.

Domestic consumption of refined lead increased slightly to 272,227 t from 271,396 t in 1996; of which 70% was for storage batteries; 14%, for inorganic chemicals; and the remaining 16%, for solders and other uses. Exports of primary lead dropped sharply to only 62 t from 1,148 t in 1996; of which 57 t went to China, and 5 t, to Cambodia. Overall stocks of primary lead decreased by 17%, to 27,647 t, at the end of December. Domestic consumption of zinc slab increased to 635,437 t from 617,142 t in 1996. Demand for slab zinc, by sector, was 50% for sheet galvanizing; 16%, for other plating; 13%, for brass mill products; 9%, for zinc die-cast products; 5%, for inorganic chemicals; and 7%, for other uses. Exports of zinc slab decreased by 17%, to 23,535 t. The major buyers were the Philippines and Taiwan, accounting for 63% and 19%, respectively. Overall stocks of zinc slab increased by 19%, to 104,119 t, at the end of December.

Gold and Silver.—Mine production of gold decreased slightly and that of silver increased by 2.5% because of increased output as a coproduct from the lead-zinc-sliver mine at Toyota, Hokkaido Prefecture. Gold mine production was mainly by Sumitomo Metal Mining from the Hishikari Mine, Kagoshima Prefecture, Kyushu. The company, working on its Honko (main), Sanjin, and Yamada deposits in the Hishikari mining area, produced between 7 and 8 t/yr of gold. According to Sumitomo Metal Mining, the cumulative gold production from the Hishikari Mine reached 83.1 t at the end of May. This amount was the largest gold output from a single Japanese gold mine. As of 1997, the remaining ore reserves at the Hishikari Mine were estimated to be about 180 t of gold (Mining Journal, 1997b).

As a result of the detailed geologic and geophysical surveys and drilling conducted by MMAJ in 1997, two gold veins were discovered at 1 km southwest of the Yamada deposit in the Hishikari area. According to MMAJ, at the 9MAHAK-6 hole, one vein at a depth of 270 meters (m) is 6.1 m wide, grading 9.5 grams per metric ton (g/t) of gold and 11.3 g/t of silver, and another vein at a depth of 300 m is 2.9 m wide, grading 4.7 g/t of gold and 3.3 g/t of silver. The highest grade discovered from the hole is 0.5 m wide, grading 37.3 g/t of gold and 7.7 g/t of silver (Metal Mining Agency of Japan, 1997c).

Overseas, MMAJ assisted Sumitomo Metal Mining in conducting detailed geologic, geochemical, and geophysical surveys and drilling at the Stone Boy property in Alaska during the past 3 years. MMAJ had confirmed promising auriferous veins in the area with 31.8 g/t of gold at a depth of 10.4 m and 322.9 g/t of gold at a depth of 1.0 m. MMAJ continued its drilling program in the area, during June and September in 1997. The Stone Boy gold property was owned by Sumitomo Metal Mining, 75% and by Sumitomo Corp., 25% (Metal Mining Agency of Japan, 1997a and Mining Journal, 1997a).

Refined gold and silver were produced by Kosaka Smelting and Refining Co. Ltd. at Kosaka, Akita Prefecture; Mitsubishi Materials at Naoshima, Kagawa Prefecture; Nippon Mining and Metals at Hitachi, Ibaraki Prefecture; and Sumitomo Metal Mining at Niihama, Ehime Prefecture. Mitsui Mining and Smelting operated a small gold and silver refinery using mainly gold- and silver-bearing scrap, such as semiconductor scrap, near the Kushikino gold mine in Kagoshima Prefecture. In August, Nippon Mining and Metals began test running its new hydrometallurgical plant for the recovery of precious and rare metals from slimes generated at its Saganoseki copper refinery in Oita Prefecture. The new plant is capable of processing 1,750 t/yr of copper refinery slimes to produce 30 t/yr of gold and 300 t/yr of silver (Japan Metal Review, 1997d).

According to Government trade statistics, Japan's imports of gold ingots dropped by another 15%, to 109.4 t, following a 50% drop in the gold imports in 1996 owing to excess supply and low demand for jewelry and private investment (Ministry of Finance, 1997). Imports of silver ingots rose by 19%, to 1,400.3 t. The major suppliers of gold ingots were Australia, 25%; South Africa, 19%; Switzerland, 16%; the Republic of Korea, 11%; the United Kingdom, 9%; and Mongolia, 8%. The major suppliers of silver ingots were Mexico, 40%; the United States, 36%; Australia, 7%; Peru and Singapore, 5% each; and Canada, 3%.

The Japanese gold market continued to weaken as a result of low demand in 1997. Gold demand for private investment and jewelry, the two major consumers, decreased to a record low. The overall demand for gold decreased to 287 t from 330 t in 1996. Domestic demand for gold, by end use, was 28 t for dentistry compared with 18 t in 1996, 75 t for electronics and telecommunications compared with 67 t in 1996, 29 t for plating compared with 24 t in 1996, 65 t for jewelry compared with 85 t in 1996, 52 t for private investment compared with 79 t in 1996, and 38 t for other uses, such as china and porcelain, fountain pens, clocks and watches, arts and crafts, and others, compared with 57 t in 1996 (Sumitomo Corp., 1998).

According to the Government minerals and nonferrous metals statistics, domestic demand for silver increased by 1.5%, to 3,445.5 t, of which 47% was for silver nitrate for photographic use; 26%, for brazing alloy, jewelry, silverware, and other uses 10%, for electric contacts; 8%, for silver nitrate for other uses; 5%, for electroplating; and 4%, for rolled products (Ministry of International Trade and Industry, 1997d).

Iron and Steel.—Japan's iron sand production was small and insignificant. Japan's iron and steel industry relied on imports to meet virtually all its iron ore requirements. According to Government trade statistics, imports of iron ore, including iron sand, pellet, and sinter, increased by 6.2%, to 126.6 million metric tons (Mt) (Ministry of Finance, 1997). The major suppliers of iron ore were Australia, 51%; Brazil, 23%; India, 13%; South Africa, 4%; and Chile, 2%. Imports of pig iron increased by 34.7%, to 1.3 Mt. China and Brazil provided 60% and 12% of total pig iron imports, respectively. Import bill of iron ore increased to $3.3 billion from $3.1 billion in 1996. The average cost, insurance, and freight (c.i.f.) import price per metric ton of iron ore decreased to $25.90 from $26.20 in 1996. Import bill of pig iron increased to $282 million from $222 million in 1996. The average c.i.f. import price per metric ton of pig iron decreased to $219.39 from $232.51 in 1996.

According to the Government iron and steel statistics, consumption of iron ore, including iron sand, pellet, and sinter by blast furnaces, increased by 4.9%, to 129 Mt (Ministry of International Trade and Industry, 1997c). Pig iron production increased by 5.3%, to 78.5 Mt, of which 77.6 Mt was for steelmaking and 0.8 Mt was for foundry use. By yearend, the total capacity and number of furnaces, including blast, electric, and other furnaces for pig iron production, remained unchanged at 95.5 Mt/yr and 47, respectively.

According to the International Iron and Steel Institute, Japan ranked as the world's second largest producer of pig iron and crude steel, accounting for 14.5% and 13.2%, respectively, of the world total in 1997 (Ministry of International Trade and Industry, 1997c). Nippon Steel Corp., which produced 26.93 Mt of crude steel in 1997, was the largest steelmaker in the world; NKK Corp., which produced 11.12 Mt, ranked 10th; Kawasaki Steel Corp., which produced 10.88 Mt, ranked 12th; Sumitomo Metal Industries, which produced 10.37 Mt, ranked 13th; and Kobe Steel Ltd., which produced 6.05 Mt, ranked 30th (Metal Bulletin, 1998).

Crude steel output increased by 5.8%, to 104.5 Mt; of that amount, 67.2% was processed by basic oxygen furnaces, and 32.8%, by electric furnaces. In the steelmaking sector, the number of basic oxygen furnaces remained unchanged at 69; the number of electric arc furnaces was reduced by 12, to 458, by yearend; and the overall crude steel production capacity increased slightly to 149.77 Mt/yr. By yearend, the industry cut its labor force by 11,088, to 226,361 workers.

After achieving 20% energy savings in steelmaking during the past two decades, the Japanese steel industry began focusing on developing innovative processes to reduce CO_2 emissions and to address the issue of global warming and creating new materials and markets for the next century. The important research and development projects involving innovative processes and new materials were (1) direct iron ore smelting-reduction (DIOS) process, (2) next-generation coke-making technology (SCOPE21), (3) multipurpose coal conversion technology, (4) basic technology for recovery and reuse of ecologically harmonious metallic materials, (5) metal manufacturing process using electromagnetic force, (6) high-performance industrial furnaces, and (7) technology for creating supermetals. During the past 5 years, a 500-metric-ton-per-day pilot plant employing the DIOS process was successfully tested; a 2-year basic research for SCOPE21 was completed, and full-scale research was started in 1996; a technology to remove tramp elements and reuse of metallic materials was to be completed in 1997, and assessment of the process was expected to begin in 1998; a metal manufacturing process using electromagnetic force to produce defect-free slab and bloom was being developed, and bench-scale test was expected to start in 1998; and a research project to develop the technology for making supermetals (high-performance steel) was started in 1997 (Steel Today & Tomorrow, 1997).

Japan's domestic demand for ordinary steel products and specialty steel products increased slightly. Exports of these products, however, increased considerably in 1997. According to the Japan Iron and Steel Federation (1998), domestic demand for ordinary steel products and specialty steel was 59.74 Mt and 10.51 Mt, respectively, in 1997. Domestic demand for ordinary steel products, by end-use industry in 1997, was as follows: 21.66 Mt was for steel dealers; 14.28 Mt, for construction and building; 9.72 Mt, for automobiles; 3.42 Mt, for secondary processing; 3.26 Mt, for shipbuilding; 2.41 Mt, for electrical machinery and equipment; 1.99 Mt, for tanks and containers; 1.74 Mt, for general machinery and equipment; 0.62 Mt, for home appliances and office machines; and 0.62 Mt, for railway vehicles and other. Domestic demand for specialty steel products, by end-use industry in 1997, was as follows: 3.63 Mt was for secondary processing; 2.71 Mt, for automobiles; 1.41 Mt, for steel dealers; 1.36 Mt, for general machinery and equipment; 0.77 Mt, for construction and building; 0.23 Mt, for home appliance and machines; 0.13 Mt, for electrical machinery and equipment; and 0.27 Mt, for railway vehicles, shipbuilding, tanks and containers, and other.

According to Government trade statistics, exports of iron and steel increased to 23,533,815 t from 20,614,826 t in 1996—pig iron, 275,207 t; ferroalloys, 124,951 t; steel ingots, 17,157 t; semifinished ordinary steel, 543,206 t; semifinished specialty steel, 14,137 t; ordinary steel products, 18,321,246 t; specialty steel products, 3,632,144 t; and other iron and steel products, 605,767 t (Ministry of Finance, 1997). Export earnings from iron and steel totaled $17.2 billion, of which $10.4 billion was from

ordinary steel products; $4.4 billion, from specialty steel products; and $2.4 billion, from other iron and steel products. Exports of iron and steel products to Asian markets totaled 17.65 Mt, accounting for 75% of total exports. The major Asian buyers of Japan's iron and steel products were the Republic of Korea, 3.57 Mt; China, 2.66 Mt; Taiwan, 2.43 Mt; Thailand, 2.19 Mt; Malaysia, 1.66 Mt; Hong Kong, 1.64 Mt; and Indonesia and Singapore, 1.18 Mt, each. Exports of iron and steel products to the United States increased to 2,703,721 t from 2,049,283 t in 1996, of which 1,878,473 t was ordinary steel products; 549,076 t, specialty steel products; and 276,172 t, other iron and steel products.

Imports of iron and steel products increased to 9,568,554 t from 8,624,721 t in 1996, of which 1,285,214 t was pig iron; 1,814,040 t, ferroalloys; 3,697 t, steel ingots; 270,412 t, semifinished steels; 5,664,837 t, ordinary steel products; 241,106 t, specialty steel products; and 271,211 t, process steels and other. Hot-finished hoop, hot-rolled heavy and medium plates, cold-rolled coils and sheets, and galvanized sheets were the major import ordinary steel items. The major suppliers of ordinary steel products to Japan were the Republic of Korea, 2,892,662 t; Taiwan, 1,027,986 t; China, 573,823 t; and Brazil, 297,035 t. The Republic of Korea and Taiwan were the principal suppliers of specialty steel products, providing 151,894 t and 41,610 t, respectively, or 63% and 17% of Japan's total imports of specialty steel products. Import bill of iron and steel products totaled $4.6 billion in 1997, of which $2.1 billion was for ordinary steel products; $1.3 billion, for ferroalloys; $282 million, for pig iron; $251 million, for specialty steel products; and $627 million, for other iron and steel products.

Manganese.—Production of manganese ore from the Nodatamagawa Mine in Iwate Prefecture had been suspended, according to Government minerals and nonferrous metals statistics (Ministry of International Trade and Industry, 1997d). All of Japan's manganese ore requirements were met by imports. According to Government trade statistics, Japan imported 16,481 t of high-grade manganese dioxide ore, 900,452 t of high-grade manganese ore, and 208,889 t of low-grade manganese ore (Ministry of Finance, 1997). The major suppliers of high-grade manganese dioxide ore were Australia, 79%; China, 7%; and Gabon, 6%. The major suppliers of high-grade manganese ore were South Africa, 46%; Australia, 41%; and Brazil, 6%. The major suppliers of low-grade manganese ore were South Africa, 48% and India, 45%. Japan also imported 237,827 t of ferruginous manganiferous ore principally from Ghana, 59%; India, 29%; and South Africa 11%.

According to Government iron and steel statistics, consumption of manganese ore for production of ferroalloys increased by 13%, to 697,469 t, and for steelmaking, by 2%, to 168,751 t (Ministry of International Trade and Industry, 1997c). Four companies with a total capacity of about 407,000 t/yr produced ferromanganese—Chuo Denki Kogyo Co. Ltd. operated a 85,000-t/yr plant in Kashima, Ibaraki Prefecture; JMC, three plants with a combined capacity of 145,400 t/yr in Takaoka, Toyama Prefecture; Kobe Steel, Ltd., a 61,200-t/yr plant in Kakogawa, Hyogo Prefecture; and Nippon Denko Co. Ltd., a 95,200-t/yr plant in Tokushima, Tokushima Prefecture, and a 20,300-t/yr plant in Miyako, Iwate Prefecture. In March 1997, Nippon Denko shut down its Miyako plant and JMC shut down its Takaoka facilities and ceased production of ferromanganese (Metal Bulletin, 1997b). JMC formed joint ventures with Samancor Ltd. of South Africa in 1996 and with Broken Hill Proprietary Co. of Australia in 1997 to supply ferromanganese and silicomanganese to JMC's customer, Nippon Steel Corp., for 5 years beginning in 1998 (Metal Bulletin, 1997b).

In 1997, imports of ferromanganese totaled 95,240 t. The major suppliers were South Africa, 57% and China, 32%. Consumption of ferromanganese for steelmaking was 399,349 t, of which 331,382 t was high-carbon ferromanganese; 67,967 t, low-carbon ferromanganese; and 1,973 t, for other uses. Exports of ferromanganese totaled 45,555 t. The major buyers were the United States, 33%; the Netherlands, 28%; Taiwan, 13%; the Republic of Korea, 12%; and Australia, 8%.

Molybdenum.—All Japan's molybdenum requirements for its ferroalloys, specialty steels, inorganic chemicals, and refined metal (powder) industries were met by imports. According to Government trade statistics, imports of roasted molybdenum ore and concentrate totaled 31,262 t (Ministry of Finance, 1997). The major suppliers were Chile, 42%; the United States, 25%; Canada, 21%; and China, 5%. According to Government iron and steel statistics, consumption of molybdenum ore and concentrate by the ferroalloys industry decreased by 3% to 5,600 t (Ministry of International Trade and Industry, 1997c). Production of ferromolybdenum and molybdenum briquette was by three companies with a combined capacity of 7,100 t/yr—Awamura Metal Kogyo Co. Ltd. operated a 2,500-t/yr plant in Uji, Kyoto Prefecture; Taenaka Mining Co. Ltd., a 1,600-t/yr plant, in Mobara, Chiba Prefecture; and Taiyo Mining and Industries Co. Ltd., a 3,000-t/yr plant in Akou, Hyogo Prefecture. These three companies produced a total of 4,328 t of ferromolybdenum and about 900 t of molybdenum briquette in 1997. Japan also imported 3,167 t of ferromolybdenum principally from China, 62%, and Chile, 32%. Consumption of ferromolybdenum for steelmaking was 5,537 t and for other uses, 142 t. Exports of ferromolybdenum were 98 t, of which 70% went to Taiwan and 14%, to Thailand.

Molybdenum metal (powder) production using imported raw materials was by Awamura Metal Kogyo Co. Ltd. in Uji, Kyoto Prefecture; Nippon Shinkinzoku (Newer Metals) Co. Ltd. in Toyonaka, Osaka Prefecture; Toho Kinzoku (Metals) Co. Ltd. in Neyagawa, Osaka Prefecture; Tokyo Tungsten Co. Ltd. in Toyama, Toyama Prefecture and in Tokyo; and Toshiba Corp. in Yokohama, Kanagawa Prefecture. Imports of molybdenum metal, including ingot and powder, totaled 401 t. The major suppliers were Germany, 31%; China, 24%; Russia, 11%; and the Republic of Korea and the United States, 9% each. According to Government minerals and nonferrous metals statistics, domestic demand for molybdenum metal was 1,781 t, of which 47% was for specialty steel; 35%, for plate, rod, and wire; 2%, for magnetic materials; and 16%, for other uses (Ministry of International Trade and Industry, 1997d). Exports of molybdenum metal were 21 t. The major buyers were Canada, the Republic of Korea, and the United States, 24% each, and the Netherlands, 14%.

Nickel.—Japan was the world's largest importer and consumer of nickel and the third largest producer of nickel metal, including ferronickel, nickel oxide, and refined nickel, using imported raw materials. Nickel ores and nickel mattes were imported for production of ferronickel, refined nickel, and nickel oxide sinter. Ferronickel, refined nickel, nickel oxide sinter, nickel powder and flake, and nickel waste and scrap were imported to meet the nickel requirements of the battery, magnetic materials, nonferrous alloys, and specialty steel industries, as well as other end users.

According to Government trade statistics, imports of nickel ore increased by 7.3%, to 4.36 Mt, and were valued at $181 million (Ministry of Finance, 1997). The major suppliers were New Caledonia, 50%; Indonesia, 27%; and the Philippines, 23%. Imports of nickel matte, in gross weight, decreased by 9%, to 74,439 t, and were valued at $329 million. The major suppliers were Indonesia, 57%, and Australia, 43%. Imports of ferronickel, in gross weight, decreased by 15%, to 49,749 t, and were valued at $110 million. The major suppliers were New Caledonia, 64%; the Dominican Republic, 17%; Indonesia, 10%; Russia, 5%; and the United States, 2%. Imports of refined nickel increased by 23%, to 57,096 t, and were valued at $409 million. The major suppliers were Russia, 23%; Zimbabwe, 16%; Norway, 14%; South Africa, 12%; Brazil, 9%; Australia and Canada, 8% each; and the United Kingdom, 4%. Imports of nickel oxide sinter and other intermediate products of nickel metallurgy totaled 2,272 t and were valued at $14.3 million. The major suppliers were Australia, 85% and Cuba, 12%. Imports of nickel powders and flakes increased by 37% to 10,105 t, and were valued at $98 million. The major suppliers were Canada, 50%, and the United Kingdom, 48%. Imports of nickel waste and scrap increased by 66%, to 12,840 t, and were valued at $67 million. The major suppliers were Russia, 19%; the United States, 14%; the Republic of Korea, 11%; Singapore, 10 %; and Zimbabwe, 9%.

According to Government iron and steel statistics, consumption of nickel ore by the ferroalloy industry for ferronickel production increased by 12%, to 3,189,329 t (Ministry of International Trade and Industry, 1997c). Production of ferronickel was by Pacific Metals Industry Co. Ltd. in Hachinohe, Aomori Prefecture, with a capacity of 54,000 t/yr of nickel contained in ferronickel; Nippon Yakin Kogyo Co. Ltd. at Oeyama near Miyazu, Kyoto Prefecture, with a capacity of 14,400 t/yr of nickel contained in ferronickel; and Sumitomo Metal Mining, through Hyuga Smelting Co. Ltd., in Hyuga, Miyazaki Prefecture, with a capacity of 18,000 t/yr of nickel contained in ferronickel. Japan's ferronickel production totaled 352,840 t with average nickel content of 20.4% or containing 72,000 t of nickel. Consumption of ferronickel for steelmaking was 355,606 t. Japan exported 69,662 t of ferronickel in 1997, of which 61% went to Taiwan; 36%, to the Republic of Korea; and 3%, to Spain.

Production of refined nickel was solely by Sumitomo Metal Mining at its 30,000-t/yr plant in Niihama, Ehime Prefecture using its Matte Chorine Leaching Electrowinning process. The company was to spend $12 million for the capacity expansion of its Niihama nickel plant by 20%, to 36,000 t/yr, by 1998 (Nikkei Sangyo Shimbun, 1997). Production of nickel oxide sinter was solely by Tokyo Nickel Co. Ltd. at its 43,000-t/yr plant in Matsusaka, Mie Prefecture. The company was to increase the capacity of its Matsusaka plant to 60,000 t/yr by the end of 1998 to cope with the expected increase in raw material supply from the nickel smelter operated by P.T. Inco at Soroako, Indonesia (The Tex Report, 1997).

Consumption of nickel, including ferronickel, nickel oxide sinter, refined nickel, and nickel powder and flakes, increased to 201,000 t from 197,000 t in 1996—80,000 t was refined nickel; 80,000 t, ferronickel (nickel content); 33,000 t, nickel oxide sinter (nickel content); and 8,000 t, nickel powder and flake. The overall increase in demand for nickel in 1997 was largely due to increased consumption by the manufacturers of electronic materials, battery materials, and stainless steel (Sumitomo Corp., 1998).

According to Government minerals and nonferrous metals statistics, domestic demand for refined nickel increased by 13.8%, to 80,320 t, of which for production of specialty steel was 53,751 t; galvanized sheet, 6,116 t; batteries, 4,670 t; magnetic materials, 4,472 t; nonferrous alloys, 4,141 t; catalysts, 638 t; and other uses, 6,532 t (Ministry of International Trade and Industry, 1997d). Exports of refined nickel were 817 t, of which 80% went to Taiwan; 7%, to the Republic of Korea; and 6%, to Indonesia. Exports of nickel oxide sinter and other intermediate products of nickel metallurgy were 1,468 t, of which 63% went to the Republic of Korea; 30%, to Taiwan; and 7%, to the United Kingdom. Exports of nickel powders and flakes were 697 t, of which 26% went to France; 25%, to Hong Kong; 20%, to Taiwan; and 15%, to the United States. Exports of nickel waste and scrap were 8,563 t, of which 84% went to Hong Kong; 11%, to Singapore; and 2%, to the United States.

Titanium.—Japan was the world's second largest producer of titanium sponge metal and one of the world's top producers of titanium dioxide pigment, but all the raw material requirements for production of titanium metal and dioxide pigment were met by imports. Rutile was consumed by the producers of titanium sponge metal. Ilmenite and titanium slags were consumed mainly by the manufacturers of synthetic rutile and titanium dioxide pigment. Small amounts of rutile and ilmenite were consumed as blast furnace additives in the steel industry.

According to Government trade statistics, for the production of titanium sponge, 66,954 t of rutile was imported principally from Australia, 60%; South Africa, 21%; and India, 18% (Ministry of Finance, 1997). For the production of synthetic rutile and titanium dioxide pigment, 341,751 t of ilmenite was imported mainly from Australia, 41%; Malaysia, 23%; Vietnam, 14%; Canada, 9%; and China, 3%. For the production of titanium dioxide pigment, 72,956 t of titanium slag was imported principally from Canada, 51%, and South Africa, 49%.

Production of titanium sponge was by Sumitomo Sitix Corp. in Amagasaki, near Osaka, Hyogo Prefecture, and Toho Titanium Co. Ltd. in Chigasaki, about 20 km south of Yokohama, Kanagawa Prefecture,. Titanium production reached the highest level in 7 years because of increased overseas demand for the Japanese high-quality titanium sponge and titanium mill products. Following a 35.6% increase in 1996, the total shipments of titanium sponge rose by 15.6%, to 24,578 t; domestic shipments held steady at 11,094 t, but overseas shipments increased by 33.2%, to 13,486 t (Japan Titanium Society, 1998).

According to Government trade statistics, exports of titanium sponge increased 27.6%, to 13,571 t, of which 53% went to the United States; 39%, to the United Kingdom; 5%, to France; and 3%, to the Republic of Korea (Ministry of Finance, 1997). Exports of titanium sponge to the United States increased to 7,153 t from 5,322 t in 1996. Exports of titanium waste and scrap and titanium powder totaled 3,013 t, of which 71% went to the United States and 25%, to the United Kingdom. To meet the domestic requirements, Japan imported 10,922 t of lower grade titanium sponge, waste, scrap, and powder principally from Kazakstan, 58%; Russia, 36%, and the United States, 2%.

According to the Japan Titanium Society (1998), total shipments of titanium mill products increased by 39.0%, to 13,286 t; domestic shipment increased by 38.8%, to 7,171 t, and overseas shipments increased by 39.3%, to 6,115 t. Domestic shipments of titanium mill products, by end user, were 36% for the chemical industry, including electrolysis and heat exchange; 20% for consumer goods, including sporting and leisure goods and medical equipment; 19% for merchants; 14% for electrical power and water-desalination plants; 4% for aircraft; 3% for construction; and 4% for other users, including automotive, shipbuilding, and other (Roskill's Letter from Japan, 1998b).

According to Government trade statistics, Japan imported 2,119 t of titanium mill products, principally from the United States, accounting for 95% of titanium mill imports in 1997 (Ministry of Finance, 1997). Exports of titanium mill products increased by 36.5%, to 7,127 t. The major buyers were France and Sweden, 17% each; Taiwan, 13%; the Republic of Korea, 10%; the United States, 8%; and the Netherlands, 6%.

Production of titanium dioxide pigment increased because of strong domestic demand. Output was equivalent to about 70% of the industry's capacity. According to Government chemical industries statistics, total shipments of titanium dioxide pigment increased by 9.2%, to 254,576 t (Ministry of International Trade and Industry, 1997b). According to Government trade statistics, exports of titanium oxides totaled 27,513 t in 1997 (Ministry of Finance, 1997). The major buyers were Taiwan, 30%; China and the Republic of Korea, 19% each; Indonesia, 5%; Hong Kong, Thailand, and the United States, 4% each; and Italy, 3%.

Industrial Minerals

Cement.—Japan was the world's second largest cement producer. Cement production decreased by 2.7% owing to a slow down in the construction activities. According to Government statistics on principal economic indicators, orders for construction work decreased by 7.4%; new dwelling construction started, 15.6%; and amount of public works, 9% in 1997 (Ministry of International Trade and Industry, 1998a). According to Government ceramics and building materials statistics, Japan's cement clinker capacity increased to 94.4 Mt/yr from 93.9 Mt/yr in 1996 (Ministry of International Trade and Industry, 1997a). Production of cement clinker, however, decreased to 88.4 Mt from 91.5 Mt in 1996. Production of cement also decreased to 91.9 Mt from 94.5 Mt in 1996; 74.8 Mt was portland cement and 17.2 Mt was blended cement. About 95.1% of blended cement contained blast furnace slag.

According to the Japan Cement Association (1998), the cement industry comprised 20 companies operating 39 integral plants having a total of 75 operating kilns with 5,258 plant employees in 1997. The industry has 565 distribution terminals with a total capacity of 4.5 Mt. The industry's total sales reached $7.5 billion in 1997. The 20 companies were Aso Cement Co. Ltd., Chichibu Onoda Cement Corp., Daiichi Cement Co. Ltd., Denki Kagaku Kogyo Co. Ltd., Hachinohe Cement Co. Ltd., Hitachi Cement Co. Ltd., Kanda Cement Co. Ltd., Mikawa Onoda Cement Co. Ltd., Mitsubishi Materials Corp., Mitsui Mining Co. Ltd., Myojo Cement Co. Ltd., Nihon Cement Co. Ltd., Nippon Steel Chemical Co. Ltd., Nittetsu Cement Co. Ltd., Ryukyu Cement Co. Ltd., Sumitomo Osaka Cement Co. Ltd., Tokuyama Corp., Tosoh Corp., Tsuruga Cement Co. Ltd., and Ube Industries Ltd.

In September, Japan's top cement producers—Chichibu Onoda Cement, Sumitomo Osaka Cement, and Nihon Cement—announced that they would cut their production beginning in October because of falling prices, weakening domestic demand, and decreasing exports to the Southeast Asian market. Chichibu Onoda Cement would cut its output by 10%; Sumitomo Osaka Cement, 3%; and Nihon Cement, 5% (Nikkei Shimbun, 1997b).

Because of the industry's excess capacity and price competition, Chichibu Onoda Cement, Japan's largest cement producer, and Nihon Cement, the third largest, announced in October that they will merge on October 1, 1998. The merger, subject to approval by Japan's Fair Trade Commission, would have 39.3% of the domestic market share, surpassing the 18% controlled by Sumitomo Osaka Cement (Nikkei Evening News, 1997). Following the industry's consolidation trend, Mitsubishi Materials and Ube Industries announced in November that they planned to set up a joint sales and distribution company on July 1, 1998, to cut costs. The venture company, Ube Mitsubishi Cement Co., would have a market share surpassing that of Sumitomo Osaka Cement, the third largest, but only next to Chichibo Onoda-Nihon Cement (The Nikkei Weekly, 1997a).

On the basis of statistics provided by the Japan Cement Association, total shipments decreased to 90.3 Mt from 94.5 Mt in 1996. Overseas shipments (exports) decreased to 12.1 Mt from 12.8 Mt in 1996 and domestic shipments decreased to 78.2 Mt from 81.7 Mt in 1996. Domestic shipments, by end user, were ready-mixed concrete, 71.3%; cement products, 14.7%; civil engineering works, 5.1%; public and private buildings, 1.9%; construction of roads, railroads, bridges, powerplants, and ports, 1.2%; and other use, 5.8%.

According to Government trade statistics, exports of cement clinker decreased to 3.65 Mt from 4.83 Mt in 1996 (Ministry of Finance, 1997). Exports of portland cement, however, increased to 8.44 Mt from 7.95 Mt in 1996. The major buyers of cement clinker were Singapore, 1.52 Mt; the Philippines, 0.73 Mt; Malaysia, 0.49 Mt; Taiwan, 0.29 Mt; Australia, 0.26 Mt; and Hong Kong, 0.18 Mt. The major importers of portland cement were Singapore, 1.74 Mt; Taiwan, 1.54 Mt; Hong Kong, 1.46 Mt; the Republic of Korea, 1.44 Mt; Malaysia, 1.23 Mt; and Indonesia, 0.49 Mt. Export earnings from cement clinker and portland cement were $141 million and $336 million, respectively, in 1997. The average export free-on-board (f.o.b.) price of portland cement was $39.69 per metric ton. Imports of cement, including portland, white, and aluminous, totaled 544,686 t, of which about 80% was provided by the Republic of

Korea and 16%, by China. The average import c.i.f. price was $57.43 per metric ton.

Diatomite.—Japan was one of the world's leading producers of diatomite. Mining and processing of diatomite began in 1980. According to Government minerals and nonferrous metals statistics, between 1980 and 1989, diatomite production ranged to 198,000 t/yr from 120,000 t/yr (Ministry of International Trade and Industry, 1997d). Production reached its peak at 236,000 t in 1992, then gradually decreased to about 200,000 t/yr in the second half of the 1990's.

According to the Geological Survey of Japan (1994), diatomite occurs as sediments of Neogene and Quaternary ages in the Takanosu area of Akita Prefecture, the Nanao area of Ishikawa Prefecture, the Yasuka area of Okayama Prefecture, the Kuju-Shonai area of Oita Prefecture, and the Hiwaki area of Kagoshima Prefecture. The Japanese diatomite deposits, however, are small. In 1997, 17 active diatomite mines operated in those five areas with total output of about 194,000 t. The major producers were Isorito Mining Co. Ltd. producing about 50,000 t/yr; Sakamoto Mining Co. Ltd., 30,000 t/yr; Hakusan Industries Co. Ltd., 25,000 t/yr; Showa Chemical Co. Ltd., 25,000 t/yr; and Nittetsu Mining Co. Ltd., 13,000 t/yr. Diatomite was consumed as filter for sugar, oil, fat, sake (rice wine), and beer, 33%; construction materials, 21%; refractories, 11%; pesticide carrier, filler of paper, plastics, and rubber, and other uses, 35%.

Gypsum.—Japan stopped production of natural gypsum in 1977. After 1977, all Japan's gypsum production was synthetic gypsum. Of the total output, about 75% was produced as the byproduct from gypsum plants at major nonferrous metals smelters, chemical fertilizer material plants, and power-generation plants. About 25% was produced as the byproduct of titanium processing plants, hydrofluoric acid plants, mineral water refineries, and other sources. Prior to 1980, Japan was almost self-sufficient (99%) in gypsum. The rate of import reliance rose to 47% from 40.8% in 1990 and from 7.6% in 1985. According to Government chemical industries statistics, the output of synthetic gypsum was between 4.6 and 5.2 Mt in the second half of the 1980's and gradually decreased to about 3.9 Mt in 1994 from 4.5 Mt in 1990 (Ministry of International Trade and Industry, 1997b). The output rose to 5.3 Mt in 1995 then gradually increased to about 5.4 Mt in 1996 and 1997.

According to Government mining statistics, the latest available statistics for domestic demand for gypsum was 9.6 Mt in fiscal year 1996, of which 5.3 Mt was for plasterboard; 3.3 Mt, for cement; 0.1 Mt, for plaster; and 0.9 Mt, for other (Ministry of International Trade and Industry, 1998b). Domestic demand for gypsum, by end user for fiscal year 1997, was expected to remain about the same as that of fiscal year1996. According to Government trade statistics, Japan imported 4.8 Mt of gypsum in 1997 principally from Thailand, 68% and Mexico, 24%. Japan exported only 1,727 t of gypsum mainly to the Republic of Korea and Sri Lanka (Ministry of Finance, 1997).

Limestone.—Japan was the world's third largest producer of limestone. Production of limestone decreased slightly in 1997 owing mainly to decreased consumption by the cement industry. According to information provided by the MITI's Mining Division, limestone was mined at 257 limestone quarries, located mainly in the Prefectures of Aomori, Fukuoka, Iwate, Kochi, Oita, Tochigi, and Yamaguchi. Most of the major limestone quarries were owned and operated by cement, construction, or steel companies. The leading limestone producers were, in decreasing order, Nittetsu Mining Co. Ltd., Chichibu Onoda Cement Co. Ltd., Todaka Mining Co. Ltd., Mitsubishi Materials Corp., Ube Industries Ltd., Sumitomo Osaka Cement Co. Ltd., and Nippon Cement Co. Ltd.

According to Government minerals and nonferrous metals statistics, shipments of domestically produced limestone decreased to 202.9 Mt from 205.3 Mt in 1996—manufacturing sector, 140.9 Mt; construction sector, 56.3 Mt; and other, 5.8 Mt (Ministry of International Trade and Industry, 1997d). Of the 140.9 Mt consumed by the manufacturing sector, the cement industry used 97.9 Mt; the iron and steel industry, 22.7 Mt; the lime industry, 10.6 Mt; the filler and fertilizer industries, 5.8 Mt; the soda and glass industries, 1.7 Mt; and other, 2.2 Mt. Of the 56.3 Mt consumed by the construction sector, concrete making accounted for 35.0 Mt; road construction, 15.7 Mt; and, other construction, 5.6 Mt. Japan was self-sufficient in limestone. According to Government trade statistics, Japan imported only 86,933 t of limestone principally from the Philippines, 55% and Malaysia, 36% in 1997 (Ministry of Finance, 1997). Japan, however, exported 4.1 Mt of limestone mainly to Hong Kong, 43%; Australia, 27%; and Taiwan 23% in 1997.

Mineral Fuels

Coal.—Japan's coal production dropped by 34% because of the closure of the Miike coal mine in Omuta, Fukuoka Prefecture, in March 1997. After 124 years of operation, Mitsui Coal Mining Co., the owner and operator of the Miike Mine, finally closed its chapter in Japan's coal mining history and put 1,207 of its employees out of work (The Nikkei Weekly, 1997b). In 1997, the remaining major coal mining companies were Taiheiyo (Pacific) Coal Mining Co. Ltd. at Kushiro, Hokkaido Prefecture and Matsushima Coal Mining Co. Ltd. at Ikeshima, Nagasaki Prefecture. In an effort to keep its customers when the Government policy guideline requiring power companies to purchase high-priced domestic coal expires in 2001, Taiheiyo Coal Mining announced in November that it planned to cut operating expenses by 30% by 2002. After 2001, Taiheiyo Coal Mining planned to produce 2 Mt/yr of coal with a production cost of about $100 per metric ton, or 29% less than present production cost, but 50% more expensive than the present average cost of imported coal (Nikkei Shimbun, 1997e).

According to Government coal and petroleum statistics, of the total coal produced, 61% was from the Hokkaido area and 39% was from the Kyushu and the Honshu areas in 1997 (Ministry of International Trade and Industry, 1997e). Japan's coal production was equivalent to about 3.2% of domestic demand for coal. Japan relied on imports to meet virtually all its requirements for coking coal and about 92% of its requirements for steam coal.

Because of the continued growth in demand, mainly by the electric power industries, coal imports increased by 2.5%, to

129.4 Mt. According to Government coal and petroleum statistics, imports of coking coal remained steady at 65.4 Mt (Ministry of International Trade and Industry, 1997e). The major suppliers of coking coal were Australia, 50.6%; Canada, 24.4%; the United States, 7.7%; China, 4.8%; Indonesia, 4.3%; Russia, 3.7%; and South Africa, 3.4%. Imports of anthracite increased by 9.8%, to 4 Mt. The principal suppliers of anthracite were China, 56.7%; Vietnam, 33.4%; and North Korea, 9.9%. Imports of steam coal increased by 5.2%, to 60.1 Mt. The major suppliers of steam coal were Australia, 60.8%; Indonesia, 12.5%; China, 11.1%; South Africa, 4.7%; the United States, 4.3%; Canada, 3.4%; and Russia, 3.1%.

According to Government coal and petroleum statistics, the overall total demand for coal in 1997 increased by 1.7%, to 134.7 Mt (Ministry of International Trade and Industry, 1997e). Increased demand for coal was attributed largely to the continued growth in demand for steam coal by the electric power industry, which increased by 4.1%, to 44.6 Mt, and for coking coal by the iron and steel industry, which increased by 1.3%, to 63.2 Mt. Demand for coal by other industries was as follows: manufacturers of coke, 5.8 Mt; manufacturers of cement and ceramics, 10.1 Mt; other manufacturers, 11.0 Mt; gas industry, 34,000 t; and other industries, 53,000 t. Of the total coal consumed, 129.5 Mt was import coal, and 5.2 Mt was domestic coal. Demand for coking coal totaled 65.4 Mt, of which 59.6 Mt was consumed by the iron and steel industry; 5.8 Mt, by the coke industry; and 22,666 t, by the gas industry. Demand for steam coal totaled 65.3 Mt, of which 44.6 Mt was consumed by the electric power industry; 8.6 Mt, by the cement and ceramics industries; 4.3 Mt, by the chemical industry; 4.0 Mt, by the pulp and paper industry; 2.0 Mt, by the iron and steel industry; and 1.8 Mt, by other manufacturing industries. Demand for anthracite totaled 4.0 Mt, of which 2.1 Mt was consumed by the iron and steel industry; 1.5 Mt, by the cement and ceramics industry; and 0.4 Mt, by other manufacturing industries.

Natural Gas and Petroleum.—Japan was the world's largest importer of natural gas and crude petroleum. Domestic production of natural gas and crude petroleum was very small when compared with its huge requirements for natural gas and crude petroleum, including refined petroleum products. According to Government coal and petroleum statistics, domestic production of natural gas and crude petroleum remained steady at 2.3 billion cubic meters and 5.3 million barrels (Mbbl), respectively, and domestic consumption of natural gas and crude petroleum was 70.3 billion cubic meters and 1,581 Mbbl, respectively (Ministry of International Trade and Industry, 1997e). According to an industry source, Japan's natural gas and crude petroleum reserves were estimated to be 39.2 billion cubic meters and 60.2 Mbbl, respectively (Oil & Gas Journal, 1997).

In 1997, Japan relied on imports to meet more than 92% of its domestic natural gas requirements and more than 99% of its crude petroleum requirements. According to Government coal and petroleum statistics, Japan imported 67.9 billion cubic meters of natural gas, in the form of LNG, and 1,709 Mbbl of crude petroleum (Ministry of International Trade and Industry, 1997e). LNG imports were from Indonesia, 38.6%; Malaysia, 21.1%; Australia, 15.5%; Brunei, 11.9%; the United Arab Emirates, 10.2%; and the United States, 2.7%. Crude petroleum imports were mainly from the Middle East, accounting for 82.4% compared with 78.6% in 1995; and Asia including China, accounting for 14.6% compared with 18.1% in 1995. The major nine suppliers of crude petroleum were the United Arab Emirates, 26.4%; Saudi Arabia, 22.1%; Iran, 9.8%; Qatar, 7.0%; Indonesia and Kuwait, 5.9% each; Neutral Zone (the area equally shared by Kuwait and Saudi Arabia), 5.3%; Oman, 5.1%; and China, 4.7%.

Production of refined petroleum products increased by 3%, to 1,459.6 Mbbl. Refined petroleum products were produced by 38 refineries with a total capacity of 4.97 million barrels per day. Overall demand for refined petroleum products, which included asphalt, diesel, gasoline, heavy fuel oil, jet fuel, kerosene, lubricant, naphtha, and paraffin, decreased by 0.6%, to 1,594 Mbbl. Imports of refined petroleum products, which included diesel, gasoline, heavy fuel oil, jet fuel, kerosene, and naphtha, decreased by 12.2%, to 223.8 Mbbl, because of increased domestic production for all refined petroleum products except kerosene, which had a weaker demand in 1997. Gasoline consumption increased by 2.7%, to 341.0 Mbbl; naphtha increased by 5.9%, to 295.7 Mbbl; jet fuel increased by 0.6%, to 30.5 Mbbl; kerosene decreased by 5.5%, to 181.2 Mbbl; diesel decreased by 0.7%, to 286.9 Mbbl; heavy fuel oil, including types A, B, and C, decreased by 5.3%, to 407.4 Mbbl; lubricant increased by 1.8%, to 15.3 Mbbl; asphalt dropped by 2.2%, to 35.5 Mbbl; and paraffin increased by 13.2%, to 0.4 Mbbl. Consumption of domestically produced natural gas totaled 2.8 billion cubic meters—the gas industry consumed 44.2%; the electric power industry, 24.3%; the chemical industry, 12.8%; the oil and gas industry, 14.7%; and other manufacturing and service industries, 4.0%. Additionally, Japan consumed 45.3 Mt, or 67.9 billion cubic meters, of imported natural gas, in the form of LNG—the electric power industry consumed 68.8% for power generation, the city gas industry, 29.9% for household use; and the iron and steel industry, 1.3% for steelmaking.

Reserves

Japan's ore reserves for limestone and other industrial minerals, such as iodine, pyrophyllite, and silica stone, are large and of world significance. With the exception of gold and zinc, its ore reserves for other minerals, especially oil and gas, and metallic minerals are very small. *(See table 3.)*

Infrastructure

Japan has one of the world's most modern and complete infrastructures for its mining and mineral processing industries. Despite its small land area, Japan has a highway system of 1.1 million kilometers, of which 68% is paved, and a railroad network of 27,327 km, of which 25,315 km is 1.067-m narrow gauge. Highway and railroad networks link not only all major seaports and coastal cities on the four major islands, but also connect Honshu (the main island) to the islands of Shikoku and Kyushu in the south and Hokkaido in the north by mean of bridges and tunnels.

Japan's domestic and international telecommunication services

are among the best in the world with five satellite earth stations, as well as submarine cables to China, the Philippines, Russia, and the United States. For electric power transmission, Japan has a route length of 87,500 km and a circuit length of 152,000 km. For power distribution, Japan's total length of line distances, including high- and low-voltage, was 1.13 million kilometers, concentrating in the major industrial areas of Fukuoka, Hiroshima, Nagoya, Osaka, Takamatsu, Tokyo, and Toyama. Japan also has an extensive pipeline system—natural gas, 1,800 km; crude petroleum, 84 km; and refined petroleum products, 322 km.

Japan has 25 major ports and more than 2,000 minor ports to receive raw materials from overseas and to export manufactured products. The major port facilities, including the terminals and warehouses, are among the most indispensable parts of the infrastructure for the mineral industry because of their role in receiving imported raw materials, such as coal, iron ore, nonferrous ore, phosphate rock, crude petroleum, and LNG for mineral processing plants and powerplants, as well as exporting value-added mineral and metal products. The important seaports of the major mineral-processing centers were Akita, Amagasaki, Chiba, Hachinohe, Higashi-Hamrima, Himeji, Hiroshima, Kawasaki, Kinuura, Kobe, Kushiro, Mizushima, Moji, Nagoya, Osaka, Sakai, Sakaide, Shimizu, Tokyo, and Yokohama on Honshu; Fukuoka, Kita Kyushu, and Oita on Kyushu; and Muroran and Tomakomai on Hokkaido.

Japan has 175 airports, of which 173 have permanent-surface runways. The major international airports were Fukuoka, Haneda (Tokyo), Kansai, Nagoya, Narita (New Tokyo), and Osaka. Japan's first round-the-clock airport, Kansai International, opened in September 1994 on reclaimed offshore land in Osaka Bay and was operating smoothly in 1997.

Outlook

The nonferrous metal mining and coal sectors are expected to remain steady in 1998. Mining activities of industrial minerals, such as limestone and silica stone and sand, are expected to decrease as the slowdown in construction activities continues into 1998 because of the sluggish economy and the depressed housing market. The declining mine production of copper, lead, and zinc was expected to continue because of the depleting ore reserves at the remaining two major nonferrous metal mines in the Prefectures of Gifu and Hokkaido.

The outlook of the mineral processing sector is mixed. Metal production of lead and zinc is expected to remain steady, production of refined copper is expected to hold steady in 1998 with decreasing domestic demand and increasing exports to Asian markets, especially to China, the Republic of Korea, and Taiwan. Production of crude steel is expected to be slightly lower than that of 1997 because all sectors of the Japanese economy continued to show weakness in the last quarter of 1997.

As a result of decreasing domestic mine production of nonferrous minerals and coal, imports of coal, nonferrous minerals, and metals are expected to remain at a high level. In line with its mineral policy to secure and diversify its long-term supply of raw materials, thus ensuring a steady economic growth, Japan is expected to continue its active search for direct investment in joint exploration and development of minerals in developed and developing countries, especially in Australia, Canada, Chile, China, Mexico, Peru, and the United States. The targeted minerals were antimony, chromium, coal, copper, columbium (niobium), gold, lead, lithium, manganese, molybdenum, natural gas, nickel, crude petroleum, rare earths, silver, strontium, tantalum, titanium, tungsten, vanadium, and zinc.

References Cited

Economic Planning Agency, 1998, Annual report on national accounts—Gross domestic products by kind of economic activity, 1996: Economic Planning Agency, March, 577 p.

Geological Survey of Japan, 1994, Industrial mineral resources in Japan: Bulletin of the Geological Survey of Japan, v. 45, no. 3, p. 111-113.

Japan Cement Association, 1998, Cement in Japan: Japan Cement Association, May, 15 p.

Japan Iron and Steel Federation, 1998, The steel industry of Japan—Domestic market, domestic orders increase for the fourth consecutive year: Japan Iron and Steel Federation, p. 5.

Japan Metal Review, 1997a, Dowa Mining decided entering development of Lay de Plata mine in Mexico: Japan Metal Review, no. 1,212, November 20, p. 2.

————1997b, Furukawa Co. will enter into construction works in Australia: Japan Metal Review, no. 1,184, April 24, p. 2.

————1997c, Nippon Mining and Metals set the second expansion plan at Saganoseki: Japan Metal Review, no. 1,163, January 23, p. 4.

————1997d, Nippon Mining and Metals will start recovery of precious metals by new process: Japan Metal Review, no. 1,194, July 3, p. 4.

————1997e, Sumitomo Metal Mining decided increasing copper capacity to 230,000 t/yr in 1998 and to 250,000 t/yr in 2000: Japan Metal Review, no. 1,183, April 17, p. 2.

Japan Tariff Association, 1997, Customs tariff schedules of Japan: Japan Tariff Association, April 1, p. 788.

Japan Titanium Society, 1998, Titanium: Japan Titanium Society, v. 46, no. 2, April 28, p. 70.

Metal Mining Agency of Japan, 1997a, Annual report 1996—Overseas mineral exploration activities, Metal Mining Agency of Japan, July, p. 5.

————1997b, Chairs' remarks of APEC-GEMEED Environmental Cooperation Workshop for Sustainable Development on Mining Activities, Tokyo, October 27-31, 1997, p. 3-4.

————1997c, Gold veins discovered in the area south of the Hishikari Mine in Kagoshima: Tokyo, Metal Mining Agency of Japan, news release, December 15, p. 1.

Management and Coordination Agency, 1997, Monthly reports on the labor force survey—Labor force: Management and Coordination Agency, December, p.1.

Metal Bulletin, 1997a, Japanese seek salvation overseas: Metal Bulletin Monthly Ferro-Alloys Supplement, November, p. 34.

————1997b, JMC to halt domestic production: Metal Bulletin, no. 8227, November 10, p. 5.

————1998, Top steelmakers of 1997: Metal Bulletin, no. 8260, March 12, p. 20.

Mining Journal, 1997a, Industry in action—Japanese success in Alaska: Mining Journal, v. 328, no. 8416, February 14, p. 129.

————1997b, Industry in action—Sumitomo record: Mining Journal, v. 328, no. 8432, June 6, p. 447.

Ministry of Finance, 1997, Japan imports and exports, commodity by country: Ministry of Finance, December, 1,019 p.

Ministry of International Trade and Industry, 1997a, Yearbook of ceramics and building materials statistics: Ministry of International Trade and Industry, June 30, 125 p.

————1997b, Yearbook of chemical industries statistics: Ministry of International Trade and Industry, June 30, 255 p.

————1997c, Yearbook of iron and steel statistics: Ministry of International Trade and Industry, June 30, 161 p.

————1997d, Yearbook of minerals and nonferrous metals statistics: Ministry of International Trade and Industry, June 30, 225 p.

————1997e, Yearbook of production, supply and demand of petroleum, coal and coke: Ministry of International Trade and Industry, July 27, 221 p.

————1998a, Statistics on Japanese industries: Ministry of International Trade and Industry, March 31, p. 2-3.

————1998b, Mining Bendan (mining handbook): Ministry of International Trade and Industry, March 25, p. 115.

Mitsui & Co., Ltd., 1998, Rechargeable batteries and cobalt in Japan: Tokyo, Mitsui

& Co. Ltd., January, p. 1.
Nikkan Sangyo Shimbun, 1997a, Japan wants shares in Chilean copper mines: Nikkan Sangyo Shimbun, August 14, p. 1.
————1997b, MMAJ and Argentina signed mineral exploration agreement: Nikkan Sangyo Shimbun, July 17, p. 1.
————1997c, MMAJ and Kazakstan signed mineral exploration agreement: Nikkan Sangyo Shimbun, September 17, p. 1.
————1997d, MMAJ and Mali signed mineral exploration agreement: Nikkan Sangyo Shimbun, December 12, p. 14.
————1997e, MMAJ and Thailand signed mineral exploration agreement: Nikkan Sangyo Shimbun, November 18, p. 1
————1997f, Pelambres to receive an approval: Nikkan Sangyo Shimbun, October 6, p. 1.
————1998, 1998—The year of mining policy revision: Nikkan Sangyo Shimbun, January 8, p.16
Nikkei Evening News, 1997, Chichibu Onoda, Nihon Cement to merge in October, 1998: Nikkei Evening News, v. 2, no. 485E, p. 1.
Nikkei Sangyo Shimbun, 1997, Sumitomo to increase nickel production by 20%: Nikkei Sangyo Shimbun, May 14, p. 1.
Nikkei Shimbun, 1997a, Japan Metals & Chemicals to end domestic ferroalloy output: Nikkei Shimbun, November 6, p. 4.
————1997b, Major cement makers to reduce output to buoy prices: Nikkei Shimbun, September 20, p. 3.
————1997c, Nittetsu and Itochu to develop a copper mine in Chile: Nikkei Shimbun, July 15, p. 1.
————1997d, Sumitomo got Batu Hijau financing: Nikkei Shimbun, August 1, p. 1.
————1997e, Taiheiyo coal mining targets 30% cut in output cost: Nikkei Shimbun, November 6, p. 3.
The Nikkei Weekly, 1997a, Cement heavyweights forming new bonds: The Nikkei Weekly, December 29, p. 8.
————1997b, Japan in focus: The Nikkei Weekly, April 7, p. 6.
Oil & Gas Journal, 1997, Worldwide look at reserves and production: Oil & Gas Journal, v. 95, no. 52, p. 38.
Roskill's Letter from Japan, 1998a, Batteries to account for over one-half of Japanese cobalt consumption: Roskill's Letter from Japan, no. 262, February, p. 20.
————1998b, Titanium metal, Japanese shipments of mill products reach a record level in 1997: Roskill's Letter from Japan, no. 263, March, p. 9.
Steel Today & Tomorrow, 1997, Development of steel technology toward the 21st century: Steel Today & Tomorrow, no. 137, January-March, p. 5-8.
Sumitomo Corp., 1998, Nonferrous metal in Japan—1997 review and 1998 outlook: Sumitomo Corp., April, 167 p.
The Tex Report, Ltd., 1997, Tokyo Nickel increases nickel production capacity at Matsusaka plant: The Tex Report, v. 29, no. 6803, March 26, p. 9.

Major Sources of Information

Ministry of International Trade and Industry
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Geological Survey of Japan
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Telephone: 81-298-54-3513, Fax: 81-298-54-3533

Major Publications

Japan Aluminium Federation, Tokyo:
Light Metal Statistics in Japan, annual.

Japan Chemical Daily Co. Ltd., Tokyo:
Japan Chemical Annual, annual.

Japan Iron and Steel Federation, Tokyo:
The Steel Industry of Japan, annual.

Japan Metal Review, Ltd., Tokyo:
Japan Metal Review, weekly.

Japan Society of Newer Metals, Tokyo:
Bulletin of Newer Metal Industry, quarterly.

Japan Mining Industry Association, Tokyo:
Bulletin of Japan Mining Industry Association, monthly.

Metal Mining Agency of Japan, Tokyo:
Mining Activities of Japan, annual.

Ministry of International Trade and Industry, Tokyo:
Yearbook of Minerals and Nonferrous Metals Statistics; Mining Bendan (Handbook), annual. Yearbook of Iron and Steel Statistics.
Yearbook of Production, Supply and Demand of Petroleum, Coal and Coke Statistics. Yearbook of Ceramics and Building Materials Statistics. Yearbook of Chemical Industries Statistics. Statistics on Japanese Industries, annual.

Ministry of Finance, Tokyo
Japan Exports & Imports, Commodity by Country, monthly.

Nihon Keizai Shimbun, Inc., Tokyo:
The Nikkei, weekly. Japan Economic Almanac, annual.

Roskill Information Services Ltd., London:
Roskill's Letter From Japan, monthly.

The Tex Report, Ltd., Tokyo:
Ferro Alloy Manual, annual.

TABLE 1
JAPAN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 p/
METALS						
Aluminum:						
Alumina, gross weight	thousand tons	327	326	363	337 r/	340 e/
Metal:						
Primary:						
Regular grades	do.	18	17	18	17	17
High-purity	do.	20	24	28	29	36
Secondary 2/	do.	1,006	1,175	1,181	1,191 r/	1,277
Antimony:						
Oxide		10,485	10,395	10,393	10,311	10,916
Metal		225	207	93	98	122
Arsenic (equivalent of arsenic acid) e/		40	40	40	40	50
Bismuth		497	505	591	562	550
Cadmium, refined		2,832	2,629	2,652	2,344 r/	2,473
Chromium:						
Chromite, gross weight e/		-- r/	-- r/	-- r/	-- r/	--
Metal		3,297	2,200	1,010	--	--
Cobalt metal		191	161	227	258 r/	264
Columbium (niobium) and tantalum, tantalum metal e/		80	80	80	80	80
Copper:						
Mine output, Cu content		10,277	6,043	2,376	1,145	932
Metal:						
Blister and anode:						
Primary		1,086,937 r/	1,029,742 r/	1,043,275 r/	1,122,571 r/	1,214,172
Secondary		97,888 r/	92,257 r/	125,206 r/	110,856 r/	136,274
Total		1,184,825 r/	1,121,999 r/	1,168,481 r/	1,233,427 r/	1,350,446
Refined:						
Primary		1,099,083	1,025,510	1,081,235	1,140,502 r/	1,157,299
Secondary		89,693	93,658	106,724	110,871 r/	121,400
Total		1,188,776	1,119,168	1,187,959	1,251,373	1,278,699
Gallium metal: e/						
Primary		6	6	6	6	6
Secondary		39	40	40	41	41
Germanium:						
Oxide e/		11	10	10	11	11
Metal		3	2	2	2	1
Gold:						
Mine output, Au content	kilograms	9,352	9,551	9,185	8,627	8,384
Metal:						
Primary	do.	108,769	102,778	113,148	127,506	136,079
Secondary 3/	do.	12,206 r/	20,273 r/	14,736 r/	17,150 r/	22,000 e/
Total	do.	120,975 r/	123,051 r/	127,884 r/	144,656 r/	158,079 e/
Indium metal	do.	56,161	58,564 r/	61,222	33,184	24,407
Iron and steel:						
Iron ore and iron sand concentrate:						
Gross weight	thousand tons	11	3	3	4 r/	4
Fe content	do.	6	2	2	2	2
Roasted pyrite concentrate (50% or more Fe):						
Gross weight	do.	200	160	--	--	--
Fe content	do.	126	101	-- r/	--	--
Metal:						
Pig iron and blast furnace ferroalloys	thousand tons	73,738	73,776	74,905	74,597	78,519
Electric-furnace ferroalloys:						
Ferrochrome		204,719	192,989	210,445	193,695	186,432
Ferromanganese		382,912	345,153	346,977	343,104	376,633
Ferronickel		257,316	242,447	351,337	328,699	352,840
Ferrosilicon		29,084	12,208	3,650	--	--
Silicomanganese		64,758	69,183	64,870	72,727	74,897
Other:						
Ferrocolumbium		1,086	868	37	--	--
Ferromolybdenum		3,656	3,930	4,109	4,420	4,328
Ferrotungsten		80	68	120	64	62
Ferrovanadium		3,670	3,418	3,618	3,902	4,232

See footnotes at end of table.

TABLE 1--Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 p/
METALS--Continued						
Iron and steel--Continued:						
Metal--Continued:						
Electric-furnace ferroalloys--Continued:						
Other--Continued:						
Unspecified		5,174	6,363	4,669	4,820	5,021
Total		952,455	876,627	989,832	951,431	1,004,445
Steel, crude	thousand tons	99,623	98,295	101,640	98,801	104,545
Semimanufactures, hot-rolled:						
Of ordinary steels	do.	79,078	76,631	79,449	78,266 r/	82,201
Of special steels	do.	14,767	15,014	16,171	15,332	16,517
Lead:						
Mine output, Pb content		16,470	9,946	9,659	7,753	5,227
Metal, refined:						
Primary		212,145	181,707 r/	148,117 r/	140,531	142,326
Secondary		97,307	110,512 r/	139,461 r/	146,842	154,433
Total		309,452	292,219 r/	287,578 r/	287,373	296,759
Magnesium metal:						
Primary		7,471	3,412	--	--	--
Secondary		13,215	19,009	11,767	8,175 r/	10,934
Manganese:						
Ore and concentrate: e/						
Gross weight		-- r/	-- r/	-- r/	-- r/	--
Mn content		-- r/	-- r/	-- r/	-- r/	--
Oxide		56,106	54,560	60,366	58,523	57,920
Metal		3,169	2,555	865	--	--
Molybdenum metal		619	651	689	596	699
Nickel metal:						
Refined		23,108	25,311	26,824	26,564	26,889
Ni content of nickel oxide sinter		28,812	34,711	35,966	34,800 r/	27,000 e/
Ni content of ferronickel		51,120	50,186	69,876	66,796 r/	72,000
Ni content of chemical		2,258	2,400	2,297	2,323 r/	2,536
Total		105,298	112,608	134,963	130,483 r/	128,425 e/
Platinum-group metals:						
Palladium metal	kilograms	1,183	1,277	2,174	2,182	1,899
Platinum metal	do.	661	691	730	816	693
Rare-earth oxide 4/		3,830	4,397	4,667 r/	4,892	5,161
Selenium, elemental		541	614	548	588	546
Silicon, high-purity		2,523	3,031	3,328	4,112	5,486
Silver:						
Mine output, Ag content	kilograms	136,886	133,713	100,078	85,115	87,180
Metal:	do.					
Primary	do.	2,159,517	2,020,223	2,056,657	2,032,120	2,094,097
Secondary 3/	do.	143,605	162,025	171,969	156,022 r/	180,000 e/
Total	do.	2,303,122	2,182,248	2,228,626	2,188,142 r/	2,274,097 e/
Tellurium, elemental		47	47	43	37	25
Tin, metal, smelter		804	706	630	524 r/	507
Titanium:						
Metal		14,426	14,847	16,702	21,062 r/	24,462
Oxide		245,992	237,956	249,290	237,942	241,417
Tungsten:						
Mine output, W content		66	--	--	--	--
Metal		3,477	3,825	4,468	4,288 r/	4,759
Vanadium metal e/ 5/		252	300	250	250	250
Zinc:						
Mine output, Zn content		118,599	100,653	95,274	79,709	71,569
Oxide		75,203	73,888	75,973	76,008	79,688
Metal:						
Primary		609,272	571,880	573,912	500,674	500,603
Secondary		135,297	141,154	137,139	141,593 r/	149,475
Total		744,569	713,034	711,051	642,267 r/	650,078
Zirconium oxide e/		6,200	6,000	6,000	6,000	6,000

See footnotes at end of table.

TABLE 1--Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 p/
INDUSTRIAL MINERALS						
Asbestos e/		24,900	21,000	20,000	18,000	18,000
Bromine, elemental e/		15,000	15,000	15,000	15,000	15,000
Cement, hydraulic	thousand tons	88,046	91,624	90,474	94,492	91,938
Clays:						
Bentonite		517,389	484,115	478,056	468,728	495,646
Fire clay		736,503	685,390	566,569	526,143 r/	560,759
Kaolin		110,318	138,412	182,122	141,230	110,915
Diatomite		206,254	183,779	174,510	194,115	194,000 e/
Feldspar and related materials:						
Feldspar		71,568	56,003	65,086	55,122	55,000 e/
Aplite		403,724	381,160	388,000	365,580	310,000 e/
Gypsum	thousand tons	3,953	3,873	5,334	5,432 r/	5,371
Iodine, elemental		6,489	5,592	5,492	6,178 r/	6,036
Lime, quicklime	thousand tons	7,958	7,712	7,871	7,744	8,104
Nitrogen, N content of ammonia	do.	1,471	1,483	1,584	1,567 r/	1,589
Perlite e/		200,000	200,000	200,000	200,000	200,000
Salt, all types	thousand tons	1,378	1,387	1,351 r/	1,390 e/	1,400 e/
Silica sand		3,882,719	3,942,368	3,734,425	3,556,998 r/	3,305,595
Silica stone	thousand tons	18,849	18,479	18,349	19,026	18,074
Sodium compounds, n.e.s.:						
Soda ash		1,055,959	1,049,676	1,049,017	925,671	801,169
Sulfate		229,346	200,111	206,893	193,439 r/	203,530
Stone, crushed and broken:						
Dolomite	thousand tons	4,755	3,831	3,773	3,905	4,013
Limestone	do.	200,455	202,481	201,097	202,894	201,399
Sulfur:						
S content of pyrite	do.	29	4	2 e/	2 e/	2 e/
Byproduct:						
Of metallurgy	do.	1,383	1,269	1,312	1,285 r/	1,301
Of petroleum e/	do.	1,510 6/	1,550	1,500	1,550	1,500
Talc and related materials:						
Talc		57,229	56,120	57,269	56,153	53,000 e/
Pyrophyllite		1,028,399	934,007	947,713	913,973 r/	913,822
Vermiculite e/		15,000	15,000	15,000	15,000	15,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	thousand tons	702	704	757	757	776
Coal:						
Anthracite	do.	--	1	--	4	2
Bituminous 7/	do.	7,217	6,931	6,263	6,476	4,272
Total	do.	7,217	6,932	6,263	6,480	4,274
Coke including breeze:						
Metallurgical	do.	41,767	41,287	42,010	40,728	41,089
Gashouse including breeze	do.	1,024	705	593	528 r/	135
Gas, natural:						
Gross 8/	million cubic meters	2,204	2,274	2,209	2,230	2,279
Marketed	do.	2,308	2,334	2,315	2,325 r/	2,367
Petroleum:						
Crude	thousand 42-gallon barrels	5,730	5,472	5,415	5,265	5,296
Refinery products:						
Gasoline:						
Aviation	do.	72	70	64	63	63
Other	do.	301,782	312,959	319,263	328,164 r/	336,957
Asphalt and bitumen	do.	37,296	37,222	36,459	37,230 r/	36,026
Distillate fuel oil	do.	259,442	276,392	287,498	296,381 r/	302,872
Jet fuel	do.	40,569	45,010	49,520	47,155 r/	58,017
Kerosene	do.	169,573	171,010	171,675	177,577 r/	173,724
Liquefied petroleum gas	do.	52,975	52,806	56,665	56,272 r/	58,798
Lubricants	do.	15,951	17,080	17,203	17,423	17,819
Naphtha	do.	109,178	109,821	112,110	104,379	120,997
Paraffin	do.	804	793	909	823 r/	790
Petroleum coke e/	do.	900	950	950	900	900
Refinery fuel and losses e/ 9/	do.	150,000	160,000	160,000	155,000	160,000

See footnotes at end of table.

TABLE 1--Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 p/
MINERAL FUELS AND RELATED MATERIALS--Continued						
Petroleum--Continued:						
Refinery products--Continued:						
Residual fuel oil	thousand 42-gallon barrels	479,799	508,505	489,605	463,087 r/	467,452
Unfinished oils e/	do.	58,000	60,000	60,000	55,000	60,000
Total e/	do.	1,676,341	1,752,618	1,761,921	1,739,454 r/	1,794,415

e/ Estimated. p/ Preliminary. r/ Revised.
1/ Table includes data available through September 16, 1998.
2/ Includes unalloyed ingot and alloyed ingot.
3/ Includes recovered from scrap and waste.
4/ Includes oxide of cerium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, and yttrium.
5/ Represents metal content of vanadium pentoxide recovered from petroleum residues, ashes, and spent catalysts.
6/ Reported.
7/ All steam coal.
8/ Includes output from gas wells and coal mines.
9/ May include some additional unfinished oils.

Sources: Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1997; Yearbook of Iron and Steel Statistics, 1997; Yearbook of Chemical Industries Statisitics, 1997; Yearbook of Ceramics and Building Materials Statistics, 1997; and Yearbook of Production, Supply and Demand of Petroleum, Coal and Coke, 1997.

TABLE 2
JAPAN: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Aso Cement Co. Ltd.	Tagawa, Fukuoka Prefecture	1,443
Do.		Chichibu Onoda Cement Corp.	Ofunato, Iwate Prefecture; Chichibu and Kumagaya;Saitama Prefecture; Fujiwara, Mie Prefecture; Tsukumi, Oita Prefecture	16,716
Do.		Daiichi Cement Co. Ltd.	Kawasaki, Kanagawa Prefecture	1,169
Do.		Denki Kagaku K.K.	Omi, Niigata Prefecture	2,762
Do.		Hachinohe Cement Co. Ltd.	Hachinohe, Aomori Prefecture	1,533
Do.		Hitachi Cement Co. Ltd.	Hitachi, Ibaraki Prefecture	941
Do.		Kanda Cement Co. Ltd.	Kanda, Fukuoka Prefecture	1,118
Do.		Mitsubishi Materials Corp.	Higashidori, Shimokita-gun, Apmori Prefecture; Higashiyama, Higashiiwai-gun, Iwate Prefecture; Yokoze, Saitama Prefecture; Kurosaki, Kyushu, and Higashitani, Fukuoka Prefecture	13,467
Do.		Mitsui Mining Co. Ltd.	Togawa, Fukuoka Prefecture	2,075
Do.		Myojo Cement Co. Ltd.	Itoigawa, Niigata Prefecture	2,482
Do.		Nihon Cement Co. Ltd.	Kamiiso, Hokkaido Prefecture; Saitama, Saitama Prefecture; Tosa, Kochi Prefecture; Kawara, Fukuoka Prefecture; Saiki, Oita Prefecture	13,188
Do.		Nippon Steel Chemical Co. Ltd.	Tobata, Kitakyushu, Fukuoka Prefecture	855
Do.		Nittetsu Cement Co. Ltd.	Muroran, Hokkaido Prefecture	1,589
Do.		Ryukyu Cement Co. Ltd.	Yabu, Nago, Okinawa Prefecture	722
Do.		Sumitomo Osaka Cement Co. Ltd.	Tamura, Fukushima Prefecture; Aso, Tochigi Prefecture; Motosu, Gifu Prefecture; Sakata, Shiga Prefecture; Ako, Hyogo Prefecture; and Susaki, Kochi Prefecture	14,402
Do.		Tokuyama Cement Co. Ltd.	Nanyo, Yamaguchi Prefecture	5,936
Do.		Tosoh Corp.	Shin Nanyo, Yamaguchi Prefecture	2,869
Do.		Tsuruga Cement Co. Ltd.	Tsuruga, Fukui Prefecture	1,710
Do.		Ube Industries Ltd.	Ube, Isa, Yamaguchi Prefecture; and Kanda, Fukuoka Prefecture	10,736
Coal		Matsushima Coal Mining Co. Ltd.	Ikeshima in Sotome, Nagasaki Prefecture	1,400
Do.		Mitsui Coal Mining Co. Ltd. 1/	Miike in Omuta, Fukuoka Prefecture	2,500
Do.		Taiheiyo (Pacific) Coal Mining Co. Ltd.	Kushiro, Hokkaido Prefecture	2,200
Copper:				
Refined	metric tons	Hibi Kyodo Smelting Co. Ltd. (64% owned by Mitsui Mining and Smelting Co. Ltd., with minority ownership by Nittetsu Mining Co. Ltd. and Furukawa Co. Ltd.)	Tamano, Okayama Prefecture	190,800
Do.	do.	Mitsubishi Materials Crop.	Naoshima, Kagawa Prefecture	187,200
Do.	do.	Nippon Mining and Metals Co. Ltd. (wholly owned subsidiary of Nikko Kyodo Co. Ltd.)	Hitachi, Ibaraki Prefecture Saganoseki, Oita Prefecture	132,000 218,400
Do.	do.	Onahama Smelting and Refining Co. Ltd. (30% owned by Dowa Mining Co. Ltd., 12% by Furukawa Group Co., 49% by Mitsubishi Materials Corp., 4% by Mitsui Mining and Smelting Co. Ltd., and 5% by others)	Onahama, Fukushima Prefecture	247,200
Do.	do.	Sumitomo Metal Mining Co. Ltd.	Besshi, Ehime Prefecture	210,000

See footnotes at end of table.

TABLE 2--Continued
JAPAN: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper--Continued:				
Refined--Continued:	metric tons	Kosaka Smelting and Refining Co. Ltd. (wholly owned subsidiary of Dowa Mining Co. Ltd.)	Kosaka, Akita Prefecture	60,000
Do.	do.	Mitsui Mining and Smelting Co. Ltd.	Takehara, Hiroshima Prefecture	38,400
Gold:	kilograms			
In concentrate		Sumitomo Metal Mining Co. Ltd.	Hishikari, Kagoshima Prefecture	9,000
Refined		Mitsubishi Materials Corp.	Naoshima, Kagawa Prefecture	60,000
Do.		Nippon Mining and Metals Co. Ltd.	Hitachi, Ibaraki Prefecture	15,000
Do.		Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	30,000
Limestone		Chichibu Onoda Co. Ltd.	Ohunato, Iwate Prefecture, and Ganji, Oita Prefecture	170,000
Do.		Mitsubishi Materials Corp.	Higashitani, Fukuoka Prefecture	10,000
Do.		Nippon Cement Co. Ltd.	Garo and Tsukumi, Oita Prefecture	11,000
Do.		Nittetsu Mining Co. Ltd.	Torigatayama, Kochi Prefecture; Onoda-Tsukumi and Nittetsu-Tsukumi, Oita Prefecture; and Shiriya, Aomori Prefecture	29,000
Do.		Sumitomo-Osaka Cement Co. Ltd.	Shuho, Yamaguchi Prefecture, and Karazawa, Tochigi Prefecture	10,000
Do.		Todaka Mining Co. Ltd.	Todaka-Tsukumi, Otia Prefecture	13,500
Do.		Ube Industries Ltd.	Isa, Yamaguchi Prefecture	9,000
Iodine, crude	metric tons	Ise Chemical Industries Co. Ltd. (wholly owned subsidiary of Asahi Glass Co. Ltd.)	Oami-Shirasato, Ichinomya, Misaki, and Hikari, Chiba Prefecture; Kurosaki, Niigata Prefecture; and Sadowara, Miyazaki Prefecture	4,300
Do.	do.	Nippon Natural Gas Industry Co. Ltd.	Minamihinato-Shirako, Koji-Shirake, Yokoshiba, and Narashino, Chiba Prefecture	1,300
Do.	do.	United Resources Industry Co. Ltd.	Chosei and Otaki, Chiba Prefecture	1,800
Lead:				
In concentrate		Kamioka Mining and Smelting Co. Ltd. (wholly owned subsidiary of Mitsui Mining and Smelting Co. Ltd.)	Kamioka, Gifu Prefecture	4
Do.		Toyoha Mining Co. Ltd. (wholly owned subsidiary of Nippon Mining and Metals Co. Ltd.)	Toyoha, Hokkaido Prefecture	8
Refined	metric tons	Kamioka Mining and Smelting Co. Ltd. 2/	Kamioka, Gifu Prefecture	33,600
Do.	do.	Mitsui Mining and Smelting Co. Ltd.	Takehara, Hiroshima Prefecture	43,800
Do.	do.	Toho Zinc Co. Ltd.	Chigirishima, Hiroshima Prefecture	94,800
Do.	do.	Sumitomo Metal Mining Co. Ltd.	Harima, Hyogo Prefecture	30,000
Do.	do.	Kosaka Smelting and Refining Co. Ltd.	Kosaka, Akita Prefecture	25,200
Do.	do.	Hosokura Mining Co. Ltd. (wholly owned subsidiary of Mitsubishi Materials Corp.) 3/	Hosokura, Miyagi Prefecture	21,600
Manganese:				
In electrolytic dioxide		Mitsui Mining and Smelting Co. Ltd.	Takehara, Toyama Prefecture	25
Do.		Tosoh Corp.	Hyuga, Miyazaki Prefecture	24
Nickel:				
In ferronickel	metric tons	Hyuga Smelting Co. Ltd. (wholly owned subsidiary of Sumitomo Metal Mining Co. Ltd.)	Hyuga, Miyazaki Prefecture	18,000
Do.	do.	Nippon Yakin Kogyo Co. Ltd.	Oheyama, Kyoto Prefecture	14,400
Do.	do.	Pacific Metals Co. Ltd.	Hachinohe, Aomori Prefecture	54,000

See footnotes at end of table.

TABLE 2--Continued
JAPAN: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Nickel--Continued:				
In oxide	metric tons	Tokyo Nickel Co. Ltd.	Matsuzaka, Mie Prefecture	43,000
Refined	do.	Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	30,000
Pyrophyllite		Goto Kozan Co. Ltd.	Goto, Nagasaki Prefecture	204
Do.		Ohira Kozan Co. Ltd.	Ohira, Okayama Prefecture	132
Do.		Sankin Kogyo Co. Ltd.	Otsue, Hiroshima Prefecture	72
Do.		Shinagawa Shirenga Co. Ltd.	Mitsuishi, Okayama Prefecture	180
Do.		Shokozan Kogyosho Co. Ltd.	Yano-Shokozan, Hiroshima Prefecture	180
Do.		Showa Kogyo Co. Ltd.	Showa-Shokozan, Hiroshima Prefecture	60
Steel, crude		Kawasaki Steel Corp.	Mizushima, Okayama Prefecture, and Chiba, Chiba Prefecture	16,880
Do.		Kobe Steel Ltd.	Kakogawa and Kobe, Hyogo Prefecture	8,300
Do.		NKK Corp.	Fukuyama, Hiroshima Prefecture, and Keihin, Tokyo Prefecture	22,130
Do.		Nippon Steel Corp.	Oita, Oita Prefecture; Kawata, Fukuoka Prefecture; Kimitsu, Chiba Prefecture; and Nagoya, Aichi Prefecture	48,800
Do.		Sumitomo Metal Industries, Ltd.	Kashima, Ibaraki Prefecture; Kokura, Fukuoka Prefecture; and Wakayama, Wakayama Prefecture	22,140
Titanium:				
In sponge metal		Sumitomo Sitix Corp. (92.4% owned by Sumitomo Metal Industries, Ltd. and 7.6% owned by Kobe Steel Ltd.)	Amagasaki, Hyogo Prefecture	15
Do.		Toho Titanium Co. Ltd. (47% owned by Nippon Mining and Metals Co. Ltd., 20% by Mitsui & Co. Ltd., and 33% by others)	Chigasaki, Kanagawa Prefecture	11
In oxide	metric tons	Fuji Titanium Industry Co. Ltd. (24.8% owned by Ishihara Sangyo Co. Ltd.)	Kobe, Hyogo Prefecture	16,200
Do.	do.	Furukawa Co. Ltd.	Osaka, Osaka Prefecture	23,400
Do.	do.	Ishihara Sangyo Co. Ltd.	Yokkaichi, Mie Prefecture	155,000
Do.	do.	Sakai Chemical Industries Co. Ltd.	Onahama, Fukushima Prefecture	43,200
Do.	do.	Tayca Corp.	Saidaiji, Okayama Prefecture	60,000
Do.	do.	Titan Kogyo Co. Ltd.	Ube, Yamaguchi Prefecture	17,000
Do.	do.	Tohken Products Corp.	Akita, Akita Prefecture	30,000
Zinc:				
In concentrate		Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	50
Do.		Toyoha Mining Co. Ltd.	Toyoha, Hokkaido Prefecture	60
Refined	metric tons	Akita Smelting Co. Ltd. (52% owned by Dowa Mining Co. Ltd., 24% by Nippon Mining and Metals Co. Ltd., 14% by Sumitomo Metal Mining Co. Ltd., and 5% each by Mitsubushi Materials Corp. and Toho Zinc Co. Ltd.)	Iijima, Akita Prefecture	156,000
Do.	do.	Hachinohe Smelting Co. Ltd. (20% owned by Dowa Mining Co. Ltd., 50% by Mitsui Mining and Smelting Co. Ltd., 10% each by Nippon Mining and Metals Co. Ltd. and Mitsubishi Materials Corp., and 5% each by Toho Zinc Co. and Nisso Smelting Co.)	Hachonohe, Aomori Prefecture	108,000
Do.	do.	Hikoshima Smelting Co. Ltd.	Hikoshima, Yamaguchi Prefecture	84,000
Do.	do.	Kamioka Mining ans Smelting Co. Ltd.	Kamioka, Gifu Prefecture	72,000

See footnotes at end of table.

TABLE 2--Continued
JAPAN: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Zinc--Continued:				
Refined--Continued	metric tons	Nikko Mikkaichi Recycle Co. Ltd. 4/	Mikkaichi, Toyama Prefecture	18,000
Do.	do.	Toho Zinc Co. Ltd.	Annaka, Gunma Prefecture	139,200
Do.	do.	Sumitomo Metal Mining Co. Ltd.	Harima, Hyogo Prefecture	90,000

1/ Closed in March 1997.
2/ The plant was renovated to a secondary lead smelter recycling batteries in 1995.
3/ The plant became a secondary lead smelter recycling batteries in 1995.
4/ The plant, closed in October 1995, was renovated to a secondary zinc refinery in 1997.

TABLE 3
JAPAN: RESERVES OF MAJOR MINERAL
COMMODITIES IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Coal 1/		821,000
Copper ore, Cu content		36
Dolomite 2/		1,210,000
Gold ore, Au content	kilograms	180,207
Iodine		1,800 e/
Lead ore, Pb content		623
Kaolin		61,600
Limestone 3/		57,914,734
Pyrophyllite		151,143
Silica sand 4/		275,199
Silica stone, white 5/		1,738,944
Zinc ore, Zn content		3,245

e/ Estimated.
1/ Recoverable reserves, including 17 million metric tons of lignite.
2/ Average ore grade is 17.9% MgO.
3/ Average ore grade is 54.2% CaO.
4/ Average ore grade is 73.1% SiO.
5/ Average ore grade is 87.9% SiO.

Sources: Ministry of International Trade and Industry (Tokyo). Agency of Natural Resources and Energy.