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MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC



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BUREAU OF MINES

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Preface

This edition of the Minerals Yearbook records the performance of the worldwide minerals industry during 1991 and provides background information to assist in interpreting that performance. Content of the individual Yearbook volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and industrial mineral commodities important to the U.S. economy. In addition, a chapter on survey methods used in data collection with a statistical summary of nonfuel minerals and a chapter on trends in mining and quarrying in the metals and industrial mineral industries are included.

Volume II, Area Reports: Domestic, contains chapters on the minerals industry of each of the 50 States and Puerto Rico, Northern Marianas, Island Possessions, and Trust Territory. This volume also has a chapter on survey methods used in data collection, including a statistical summary of domestic nonfuel minerals.

Volume III, Area Reports: International, contains the latest available mineral data on more than 160 foreign countries and discusses the importance of minerals to the economies of these nations. The 1991 review is presented as five area reports and one world overview: Mineral Industries of Africa, Mineral Industries of Asia and the Pacific, Mineral Industries of Latin America and Canada, Mineral Industries of Europe and Central Eurasia, Mineral Industries of the Middle East, and Minerals in the World Economy. This year's reports incorporate location maps, industry structure tables, and an outlook section previously incorporated in our Mineral Perspectives Series quinquennial regional books, which have been discontinued. The U.S. Bureau of Mines continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the Yearbook are welcomed.

Acknowledgments

The U.S. Bureau of Mines, in preparing these Volume III Minerals Yearbook Reports, extensively utilized statistics and data on mineral production, consumption, and trade provided by various foreign government minerals and statistical agencies through various official publications. The cooperation and assistance of these organizations is gratefully acknowledged. Statistical and informational material was also obtained from reports of the U.S. Department of State, from United Nations publications, and from the domestic and foreign technical and trade press. Of particular assistance were the routine and special reports submitted by the 10 Regional Resource Officers assigned to minerals and petroleum reporting and by economic and commercial officers and other officials of the Department of State in American Embassies worldwide. Their contributions are sincerely appreciated.

The text and production, structure of the mineral industry, and reserve tables of this volume were prepared by the respective country authors of the staff of the Division of International Minerals, Information and Analysis Directorate. The mineral export and import trade tables were prepared by the International Data Section of the Division of Statistics and Information Services, Information and Analysis Directorate.

The regimes of some countries reviewed in this volume may not be recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not to be construed as conflicting with or being contradictory of U.S. foreign policy.

George J. Coakley
Chief, Division of International Minerals

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MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC

By Staff, Branch of Asia and the Pacific

INTRODUCTION¹

The Asia and the Pacific region has large mineral resources of antimony, barite, bauxite, bismuth, copper, fluorspar, gold, graphite, iron ore, magnesite, mica, rare earths, salt, talc and pyrophyllite, titanium, zinc, and zirconium. The region overall lacks large resources of oil and natural gas, but it has large resources of anthracite and bituminous coal. In terms of exploitation, many minerals, metals, and fuel are produced in significant quantities in the Asia and the Pacific region as shown in table 1. Collectively, the area accounts for a substantial amount of the world production of antimony, barite, bauxite, fluorspar, gold, graphite, ilmenite and rutile, iodine, iron ore, lead, magnesite, manganese, nickel, salt, tin, tungsten, and zinc.

Total coal production of the region exceeds 1.6 billion metric tons. The production of bituminous coal accounts for more than 80% of the total output. China is the region's largest coal producer, with an output of almost 1.1 billion tons. Other major producers are Australia and India. The combined production by Australia, China, and India is more than 1.5 billion tons or 93% of the area's output. The remainder of the coal output in the region comes from Afghanistan, Cambodia, Indonesia, Japan, the Korean peninsula, Malaysia, Mongolia, New Zealand, Pakistan, the Philippines, and Taiwan. The production of crude oil throughout the Asia and Pacific region is close to 2.4 billion barrels. China and Indonesia together account for 67% of the total output. The remainder of the output is primarily from Australia, Brunei, India, and Malaysia. Indonesia is the largest producer of natural gas in the region with an output

of close to 58 billion cubic meters, followed by Malaysia and Australia with 23 and 22 billion cubic meters, respectively. Other producers in the region of lesser stature by output include Brunei, China, India, and Pakistan.

In terms of consumption, Japan is by far the largest, single consumer of metals in the Asia and Pacific region. It accounts for about 40% of the total crude steel consumption and generally for 50% of the consumption of the major nonferrous metals in the region. The second largest consumer is China, accounting for about 30% of the total crude steel consumption and about 20% of the consumption of nonferrous metals. A bloc of countries, consisting of Australia, India, the Republic of Korea, Taiwan, and Thailand, account for virtually the bulk of the remainder of the consumption of metals in the region.

The estimated value of total trade by countries in the Asia and Pacific region is given in table 3. The region as a whole accounts for about 20% of the value of overall world commerce. The foci of the five major trade areas in the region center around Japan; Hong Kong, the Republic of Korea, and Taiwan; China; the countries of the Association of Southeast Asian Nations (ASEAN); and Australia and New Zealand. The value of Japan's total trade alone was \$510 billion in 1991. The collective trade value for Hong Kong, the Republic of Korea, and Taiwan, the little dragons of Asia, amounts to \$496 billion, followed by \$323 billion for that of ASEAN. China's overall trade was \$109 billion, with much of its export value originating from the free trade zones around Guangzhou in Guangdong Province in southern China. In the Southern Hemisphere, the combined value of total

trade of Australia and New Zealand was close to \$100 billion.

Australia is a large supplier of bauxite, coal, iron ore, lead and zinc, manganese, titaniferous minerals, and zircon. Indonesia is noted for its exports of bauxite, ore and concentrate of copper and nickel, and oil and liquefied natural gas. Malaysia generates export earnings with bauxite, ore and concentrate of copper and titanium, and oil and liquefied natural gas. Papua New Guinea and the Philippines are noted for copper exports.

The outlook for mineral development in Asia and the Pacific includes a good potential for petroleum in coastal Asia, particularly in the South China Sea. There is a potential for an increase in hard-rock mining in Australia, China, India, Papua New Guinea, and particularly in the countries of Indo-China.

The mineral mining and processing industries of the region are sizable and continue to expand. The countries of Asia and the Pacific as a whole will continue to expand in their consumption of minerals, metals, and fuels in the manufacture of value added goods for each country's domestic market as well as for the world market.

¹E. Chin and Pui-Kwan Tse.

SELECTED GENERAL SOURCES OF REGIONAL INFORMATION

Barclays Bank International, London:
ABECOR Group Country Reports.

British Broadcasting Corp., London:
Summary of World Broadcasts,
Far East Weekly Economic Report.

British Sulphur Corp. Ltd., London:
Nitrogen, bimonthly.
Phosphorus and Potassium, bimonthly.
Sulphur, bimonthly.

Fairchild Publications, New York: American
Metals Market, daily.

Far Eastern Economic Review, Hong Kong:
Asia Yearbook.

IBJ Associates, Surrey, England:
International Bulk Journal, monthly.

International Bauxite Association (IBA),
Kingston, Jamaica: IBA Quarterly Review.

International Lead and Zinc Study Group
(ILZSG), London: ILZSG annual report.

International Monetary Fund, Washington,
DC: International Financial Statistics,
monthly and annual.

International Tin Council, London: Tin
International, quarterly.

Institution of Mining and Metallurgy,
London:
Transactions, monthly.
Bulletin.

Maclean Hunter Publishing Co., Chicago,
IL: Engineering and Mining Journal,
monthly.

Metal Bulletin Journals Ltd., London:
Metal Bulletin, semiweekly, and Metal
Bulletin Monthly.

Miller Freeman Publications, San Francisco,
CA: World Mining, monthly.

Mining Journal Ltd., London:
Mining Magazine, monthly.
Mining Annual Review.

PennWell Publishing Co., Tulsa, OK: Oil
and Gas Journal, monthly.

Petroleum Press Bureau Ltd., London:
Petroleum News, monthly.

Southeast Asia Ltd., Hong Kong: Petroleum
News, monthly.

United Nations Economic and Social
Council, New York:
Periodic country reports by the Economic
and Social Commission for Asia and the
Pacific.

United Nations Statistical Office, New York:
U.N. Trade Statistics and Energy Statistics
Yearbook.

U.S. Department of Commerce:
Bureau of the Census, Washington, DC:
trade statistics.
International Trade Administration,
Washington, DC: Foreign Economic
Trends and Their Implications for the
U.S., International Marketing Information
Series.

U.S. Department of State: Periodic
Reporting on Select Minerals Industry by the
American Embassies.

U.S. Joint Publications Research Service,
Arlington, VA: Foreign Broadcast
Information Service Regional Publications,
weekly.

World Bank, Washington, DC: Bank news
releases.

World Bureau of Metal Statistics, London:
World Metal Statistics Yearbook.

TABLE 1
ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1991

(Thousand metric tons unless otherwise specified)

Country	Aluminum			Barite	Cement	Coal		Copper	
	Bauxite	Alumina	Metal			Anthracite	Bituminous	Mine, Cu	Refined, primary
Afghanistan	—	—	—	2	112	—	170	5	—
Australia	40,503	11,713	1,235	11	6,750	—	207,395	311	252
Bangladesh	—	—	—	—	275	—	—	—	—
Bhutan	—	—	—	—	75	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—
Burma	—	—	—	9	435	—	42	5	—
Cambodia	—	—	—	—	—	—	—	—	—
China	2,600	1,600	860	1,800	248,000	190,000	900,000	300	560
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	90	—	—	—	—
Hong Kong	—	—	—	—	—	—	—	—	—
India	4,738	1,700	50	615	51,000	—	224,699	55	47
Indonesia	1,242	—	173	—	16,153	—	13,688	267	—
Japan	—	438	32	—	89,560	7	8,046	12	968
Korea, North	—	—	—	100	16,000	70,000	—	15	19
Korea, Republic of	—	—	2	1	34,999	14,850	—	(^c)	202
Laos	—	—	—	—	7	—	—	—	—
Malaysia	376	—	—	17	7,451	—	64	26	—
Mongolia	—	—	—	—	400	—	550	90	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	136	—	—	—	—
New Caledonia	—	—	—	—	65	—	—	—	—
New Zealand	—	—	312	—	750	—	2,550	—	—
Pakistan	4	—	—	29	7,762	—	3,040	—	—
Papua New Guinea	—	—	—	—	—	—	—	204	—
Philippines	—	—	—	500	4,500	—	1,267	150	120
Singapore	—	—	—	—	1,852	—	—	—	—
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	—	—	400	—	—	—	—
Taiwan	—	—	—	—	19,389	—	403	—	—
Thailand	—	—	—	100	18,054	14	—	—	—
Vietnam	—	—	—	—	3,000	4	—	—	—
Total	49,463	15,451	2,664	3,184	527,215	274,875	1,361,914	1,440	2,168
Share of world total, percent	545	39	15	60	44	92	44	16	21
United States	W	5,230	4,121	448	69,853	2,730	820,062	1,631	1,577

See footnotes at end of table.

TABLE 1—Continued
ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1991

(Thousand metric tons unless otherwise specified)

Country	Fluorspar	Gold mine, Au content ²	Graphite	Iodine	Iron			Lead		Magnesite	Manganese ore, Mn content
					Ore, gross weight	Pig	Steel, crude	Mine, Pb content	Refined, primary		
Afghanistan	—	—	—	—	—	—	—	—	—	—	—
Australia	—	234	—	—	117,134	5,647	6,018	571	220	60	701
Bangladesh	—	—	—	—	—	—	58	—	—	—	—
Bhutan	—	—	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—	—	—
Burma	—	1	—	—	—	—	—	5	2	—	—
Cambodia	—	—	—	—	—	—	—	—	—	—	—
China	1,600	120	200	(¹)	178,070	67,200	70,570	380	330	2,600	3,400
Christmas Island	—	—	—	—	—	—	—	—	—	—	—
Fiji	—	3	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	350	—	—	—	—
India	24	2	70	—	56,915	14,180	15,100	25	33	534	630
Indonesia	—	17	—	(¹)	173	—	3,250	—	—	—	—
Japan	—	8	—	8	31	79,985	109,649	18	220	—	—
Korea, North	41	5	35	—	10,000	6,500	8,000	80	75	1,600	—
Korea, Republic of	(¹)	21	77	—	222	18,510	26,001	13	41	—	—
Laos	—	—	—	—	—	—	—	—	—	—	—
Malaysia	—	3	—	—	375	—	900	—	—	—	—
Mongolia	370	—	—	—	—	—	—	—	—	—	—
Nauru	—	—	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	—	—	—	25	—
New Caledonia	—	—	—	—	—	—	—	—	—	—	—
New Zealand	—	7	—	—	2,060	—	700	—	—	—	—
Pakistan	5	—	—	—	—	1,100	1,000	—	—	5	—
Papua New Guinea	—	61	—	—	—	—	—	—	—	—	—
Philippines	—	25	—	—	—	—	250	—	—	1	14
Singapore	—	—	—	—	—	—	—	—	—	—	—
Solomon Islands	—	(¹)	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	6	—	—	—	—	—	—	—	—
Taiwan	—	—	—	—	—	5,561	10,957	—	—	—	—
Thailand	62	—	—	—	240	—	711	16	—	—	5
Vietnam	—	—	—	—	—	—	115	—	—	—	—
Total	2,102	507	388	8	365,220	198,683	253,629	1,108	921	4,825	4,825
Share of world total, percent	48	24	62	50	41	39	35	33	31	44	57
United States	58	290	—	2	56,596	44,123	79,738	477	346	W	—

See footnotes at end of table.

TABLE 1—Continued
ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1991

(Thousand metric tons unless otherwise specified)

Country	Mercury, mine, Hg content ²	Mica	Nickel		Petroleum crude ⁴	Natural gas	Salt	Tin ²	
			Mine, Ni content	Refined ³				Mine, Sn content	Refined, primary
Afghanistan	—	—	—	—	—	2,500	12	—	—
Australia	—	—	69	46	199	21,687	7,791	5,700	268
Bangladesh	—	—	—	—	1	4,893	300	—	—
Bhutan	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	53	9,200	—	—	—
Burma	—	—	(¹)	—	6	950	260	176	157
Cambodia	—	—	—	—	—	—	40	—	—
China	800	—	36	28	1,015	15,400	25,500	43,000	38,000
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	—	—	—
India	—	—	—	—	233	11,744	9,503	—	—
Indonesia	—	—	72	27	581	57,626	700	30,061	30,415
Japan	—	—	—	49	6	2,134	1,380	—	692
Korea, North	—	—	—	—	—	—	580	—	—
Korea, Republic of	—	5	—	6	—	—	696	—	—
Laos	—	—	—	—	—	—	8	300	—
Malaysia	—	4	—	—	238	22,900	—	20,710	50,400
Mongolia	—	—	—	—	—	—	17	250	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	7	—	—
New Caledonia	—	—	92	8	—	—	—	—	—
New Zealand	—	—	—	—	10	5,664	80	—	—
Pakistan	—	—	—	—	23	14,673	781	—	—
Papua New Guinea	—	—	—	—	—	—	—	—	—
Philippines	—	—	18	—	2	—	500	—	—
Singapore	—	—	—	—	—	—	—	—	—
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	2	—	—	—	—	53	—	—
Taiwan	—	9	—	7	1	776	195	—	—
Thailand	—	—	—	—	9	8,079	225	14,937	11,255
Vietnam	—	—	—	—	—	—	350	850	800
Total	800	20	287	171	2,377	178,226	48,978	115,984	131,987
Share of world total, percent	⁵ 18	10	31	30	11	8	24	⁵ 59	64
United States	W	103	6	—	2,680	615,612	39,620	W	—

See footnotes at end of table.

TABLE 1—Continued
**ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL
 COMMODITIES, 1991**

(Thousand metric tons unless otherwise specified)

Country	Titanium		Tungsten mine, W content ²	Zinc	
	Ilmenite	Rutile		Mine, Zn content	Refined, primary
Afghanistan	—	—	—	—	—
Australia	1,363	201	237	1,048	304
Bangladesh	—	—	—	—	—
Bhutan	—	—	—	—	—
Brunei	—	—	—	—	—
Burma	—	—	277	3	—
Cambodia	—	—	—	—	—
China	150	—	25,000	650	526
Christmas Island	—	—	—	—	—
Fiji	—	—	—	—	—
Hong Kong	—	—	—	—	—
India	311	13	11	85	105
Indonesia	—	—	—	—	—
Japan	—	—	279	133	641
Korea, North	—	—	1,000	200	175
Korea, Republic of	—	—	780	22	254
Laos	—	—	—	—	—
Malaysia	336	—	—	—	—
Mongolia	—	—	300	—	—
Nauru	—	—	—	—	—
Nepal	—	—	—	—	—
New Caledonia	—	—	—	—	—
New Zealand	—	—	—	—	—
Pakistan	—	—	—	—	—
Papua New Guinea	—	—	—	—	—
Philippines	—	—	—	—	—
Singapore	—	—	—	—	—
Solomon Islands	—	—	—	—	—
Sri Lanka	61	6	—	—	—
Taiwan	—	—	—	—	—
Thailand	17	—	230	87	62
Vietnam	—	—	—	—	4
Total	2,238	220	28,114	2,228	2,071
Share of world total, percent	⁵ 65	⁵ 49	⁵ 67	31	47
United States	W	W	W	547	253

W Withheld to avoid disclosing company proprietary data.

¹Less than 1/2 unit.

²Metric tons.

³Includes Ni content of intermediate products but excludes ferroalloy.

⁴Million 42-gallon barrels.

⁵Excludes U.S. production.

TABLE 2
ASIA AND THE PACIFIC: CONSUMPTION OF SELECTED METALS, 1991

Country	Aluminum, primary	Cadmium	Copper, refined	Lead	Magnesium	Nickel	Tin	Zinc
Australia	304,600	25	101,200	56,000	3,500	1,400	1,100	71,400
Bangladesh	15,000	NA	NA	NA	NA	NA	NA	15,000
Burma	NA	NA	NA	1,000	NA	NA	NA	NA
China	800,000	500	590,000	250,000	15,500	29,000	17,000	530,000
Hong Kong	36,700	NA	NA	2,000	NA	3,000	5,800	20,000
India	420,000	446	120,000	78,000	1,800	15,000	1,600	130,000
Indonesia	89,500	—	49,300	30,000	NA	NA	1,300	52,600
Japan	2,431,600	4,990	1,613,200	422,200	27,200	180,100	34,800	845,500
Korea, North	40,000	NA	32,000	40,000	NA	600	NA	NA
Korea, Republic of	383,300	400	343,300	173,000	1,700	29,500	8,400	283,500
Malaysia	66,600	NA	64,000	35,900	NA	NA	3,400	28,100
New Zealand	19,800	NA	2,600	5,500	300	400	100	17,200
Oceania (other)	NA	NA	NA	100	NA	NA	NA	100
Pakistan	11,100	NA	NA	5,900	NA	NA	100	30,000
Philippines	17,600	NA	11,000	21,100	NA	NA	300	30,600
Singapore	13,500	NA	NA	6,000	NA	NA	NA	15,000
Sri Lanka	NA	NA	NA	1,200	NA	NA	NA	NA
Taiwan	262,900	15	399,100	86,500	1,700	19,000	6,250	138,200
Thailand	146,700	2	80,000	36,000	NA	900	4,400	74,000
Vietnam	4,000	NA	2,500	NA	NA	NA	NA	10,000
Total	5,062,900	6,378	3,408,200	1,250,400	51,700	278,900	84,550	2,291,200
Share of world total, percent	29	34	32	37	17	35	38	33
United States	4,200,700	3,238	2,124,500	1,246,800	91,900	126,700	35,300	933,200

NA Not available.

Source: Metal Statistics, 1981-91; Metallgesellschaft AG.

TABLE 3
ASIA AND THE PACIFIC: VALUE OF TRADE OF SELECTED
COUNTRIES IN 1991¹

(Million dollars)

Country	Total trade	Exports	Imports	Surplus or (deficit)
Afghanistan ²	1,049	235	814	(579)
Australia	80,510	42,010	38,500	3,510
Bangladesh	4,778	1,689	3,089	(1,400)
Bhutan	132	53	79	(26)
Burma	744	310	434	(124)
China	109,095	58,919	50,176	8,743
Fiji	988	435	553	(118)
Hong Kong	199,854	99,080	100,774	(1,694)
India ³	38,398	16,144	22,254	(6,482)
Indonesia	54,056	29,430	24,626	4,804
Japan	510,070	306,580	203,490	103,090
Korea, Republic of	146,142	69,581	76,561	(6,980)
Malaysia	67,931	33,882	34,049	(167)
Nepal	601	161	440	(279)
New Zealand	17,048	9,545	7,503	2,042
Pakistan	14,951	6,352	8,599	(2,247)
Papua New Guinea ³	2,660	1,319	1,341	(22)
Philippines	20,891	8,840	12,051	(3,211)
Singapore	117,767	56,819	60,948	(4,129)
Solomon Islands	175	83	92	(9)
Sri Lanka	4,492	2,009	2,483	(474)
Taiwan ⁴	150,890	75,585	75,305	280
Thailand	62,450	28,232	34,218	(5,986)
Vanuatu	89	15	74	(59)
Total	1,605,761	847,308	758,453	88,483
Percent of world total	23	25	21	—
United States	908,860	421,730	487,130	(65,400)
Percent of world total	13	12	14	—
World total	6,997,200	3,442,100	3,555,100	(113,000)

¹The year stated except as noted.

²1990.

³1989.

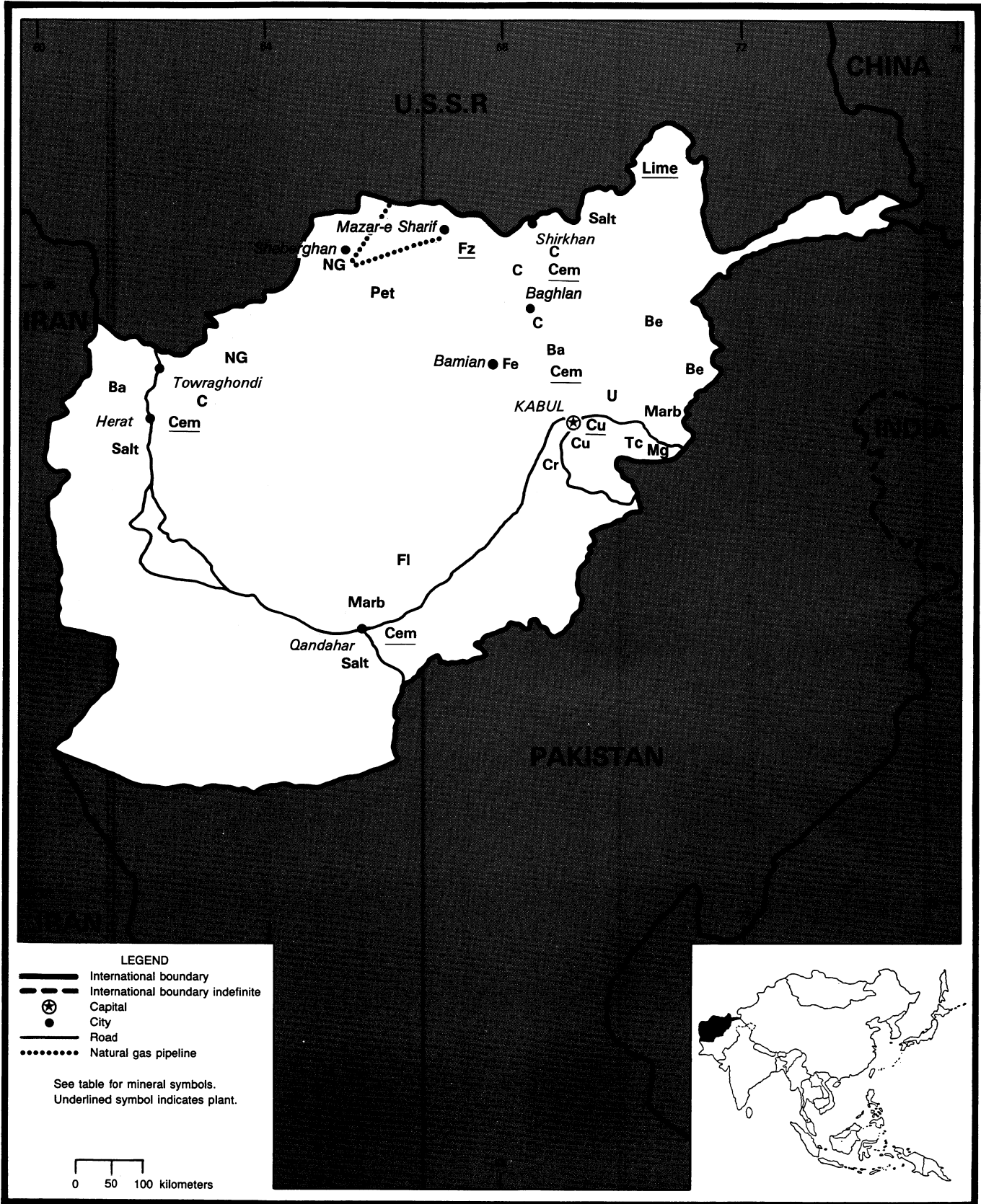
⁴Monthly Statistics of Imports and Exports (Taiwan).

Source: International Financial Statistics (International Monetary Fund) except as noted in footnote 4.

AFGHANISTAN

AREA 647,500 km²

POPULATION 16.5 million



THE MINERAL INDUSTRY OF AFGHANISTAN

By Chin S. Kuo

The country's economy, under tight state control, was virtually ruined by 12 years of civil war. Production and revenue were declining while the money supply and the budget deficit were increasing. The State Bank estimated inflation at about 58% and expected it to rise even further. The Government tried to revive the economy by deregulating food and fuel supplies and offering incentives to the private sector to import. New laws were to provide Government transport so that food and fuel could reach Kabul along the Salang highway and allow the market to set prices rather than the Government. It was proposed that the private sector be allowed to import petroleum products to the country and engage in their distribution.

By October, Afghan traders had signed deals for about 500,000 tons of wheat with France, the Federal Republic of Germany, Hungary, and the former U.S.S.R. Afghanistan also imported coal and petroleum products such as diesel, gasoline, kerosene, and super benzene from the former U.S.S.R.

Exports of dried and fresh fruit and wool fell as agricultural production and manufacturing had been wiped out in many areas. Export of natural gas to the former U.S.S.R. was reported to be 300 Mm³ during the winter of 1990-91. Near yearend, Afghanistan uncapped 31 wells in the Sibirgan fields to resume supplying 1.2 billion m³/a of natural gas to the Soviet Republics. The country sought part of the payment in food and machinery; however, the Soviet Republics ended barter trade. Beginning in 1992, Afghanistan was to pay for imports with hard currency or natural gas.

Sale of natural gas to European markets such as Hungary, Czechoslovakia, and other countries was also being

offered to generate cash for rebuilding its economy. The Soviet Republics supplied wheat, construction materials, cement, refrigerators, coolers, and other items to the country. Afghanistan was reported to have invited Indian equity joint ventures in its mining sector. The equity was proposed to be set off against buyback arrangements with Afghan mines particularly where it involved coal, rough diamonds, and nonferrous metals. (See table 1.)

The country had huge reserves of natural gas estimated at 99 billion m³. A natural gas field was discovered in Chekhcha, Jowzjan Province, adding 10 billion m³ to the reserves. Another field of about 10 billion m³ was found near Kabul, which increased Afghanistan's natural gas reserves to 120 billion m³. The country established an export ceiling of 60% of its total reserves, earmarking the remainder for its agricultural sector.

A 400-kV substation with a cost of \$3 million¹ was opened in the Chaman-e Huzori area of Kabul to ease the power supply problems. A power station with a capacity of 800 kW was built in the city of Kabul at a cost of \$1.4 million. The project was jointly financed from the state budget and a credit from Bulgaria. Two power stations, having a combined capacity of 600 kW, were planned to be constructed in Samandarah village, Charikar city. A transformer with an output of 125 kW•h went into operation in the Koshk District, Herat Province.

A new 72-collector installation for utilizing solar energy was completed in Kabul at a cost of \$364 million. The installation was able to heat 40,000 L of water at an average temperature of 60° C around the clock.

¹Where necessary, values have been converted from Afghan afghanis (Af) to U.S. dollars at the rate of Af586=US\$1.00 for 1991.

TABLE 1
AFGHANISTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991
Barite	2,000	2,000	2,000	2,000	2,000
Cement, hydraulic	100,000	100,000	100,000	112,000	112,000
Coal, bituminous	167,000	138,000	125,000	180,000	170,000
Copper: Mine output, Cu content	5,000	5,000	5,000	5,000	5,000
Gas, natural:					
Gross	3,000	3,000	2,100	2,400	2,500
Marketed	2,600	2,600	1,800	2,100	2,200
Gypsum	3,000	3,000	3,000	3,000	3,000
Natural gas liquids	70	35	30	30	35
Nitrogen: N content of ammonia	40,000	40,000	40,000	40,000	40,000
Salt, rock	10,000	10,000	10,000	10,000	12,000

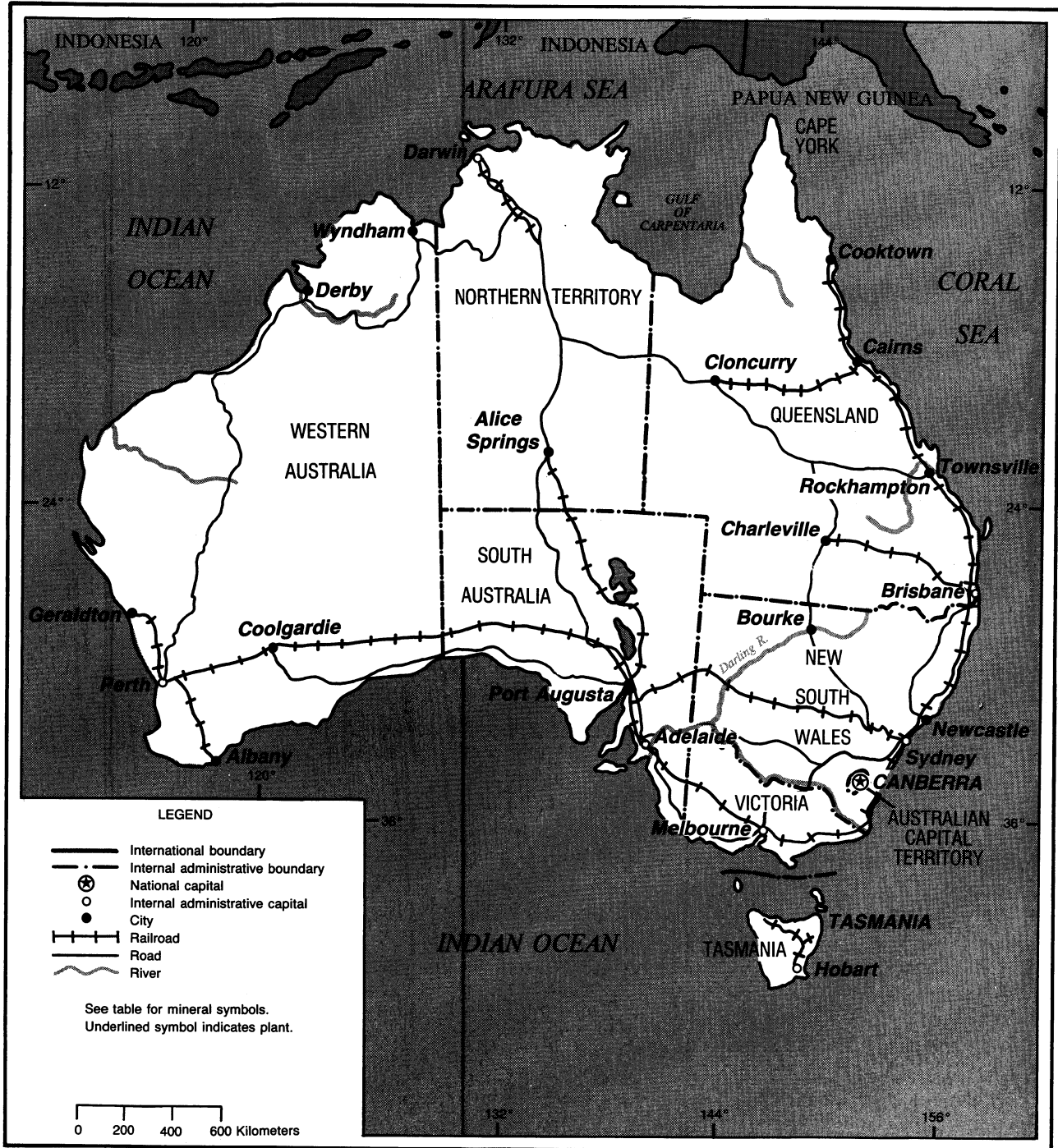
¹Table includes data available through Aug. 26, 1992.

²In addition to the commodities listed, asbestos, lapis lazuli, uranium, and a variety of crude construction materials (clays, stone, and sand and gravel) presumably have been produced. However, output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

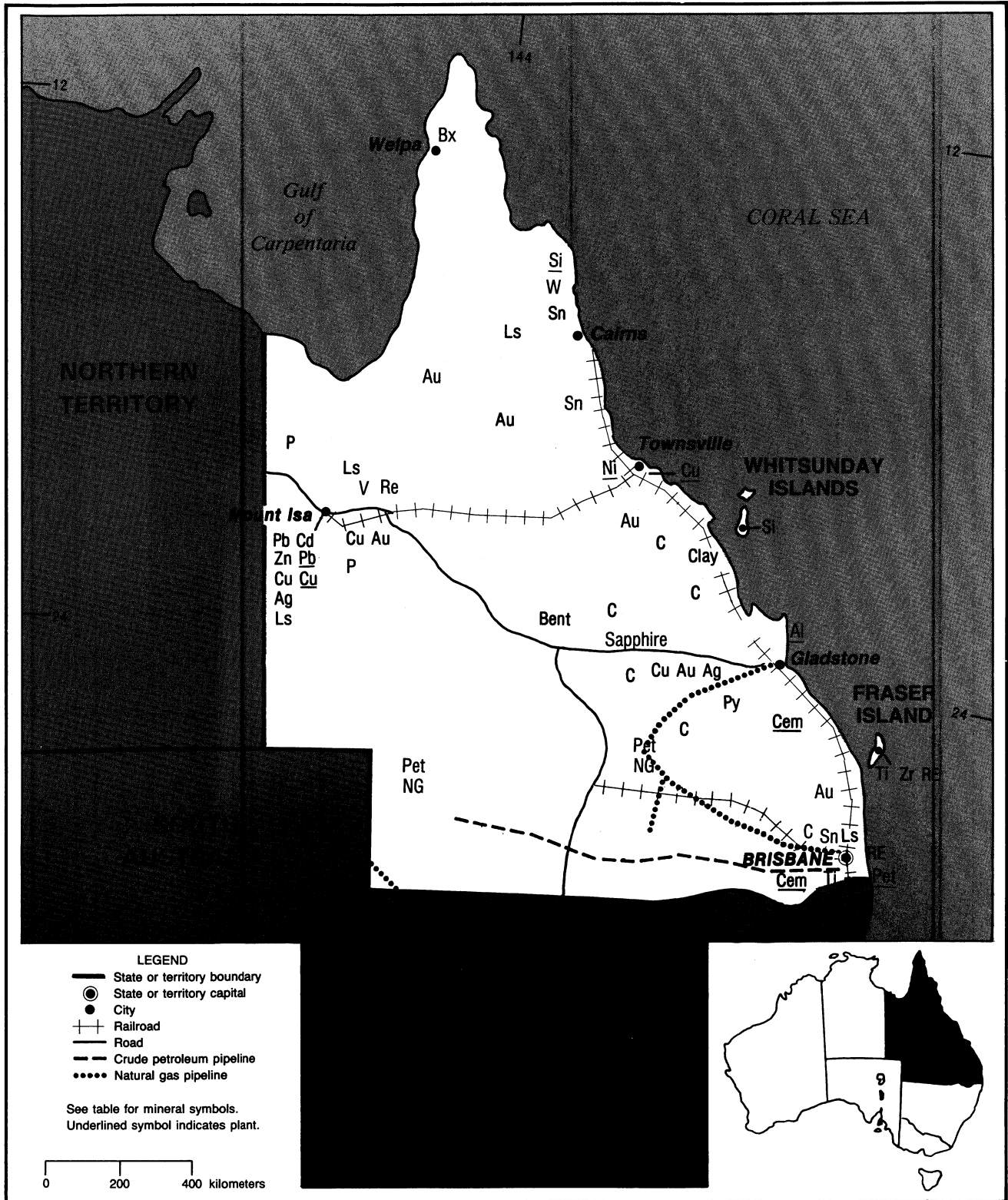
AUSTRALIA

AREA 7,686,850 km²

POPULATION 17.3 million

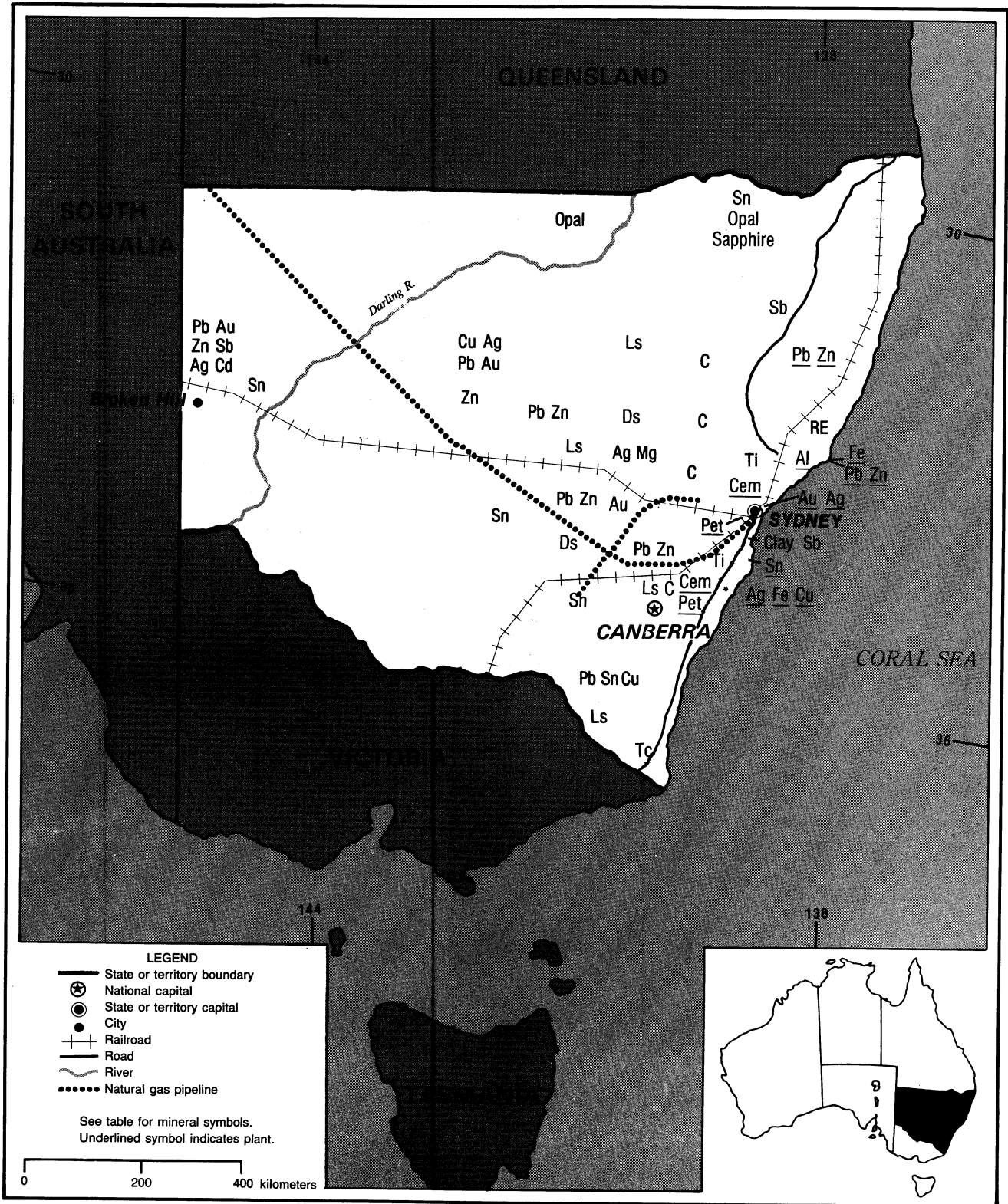


QUEENSLAND



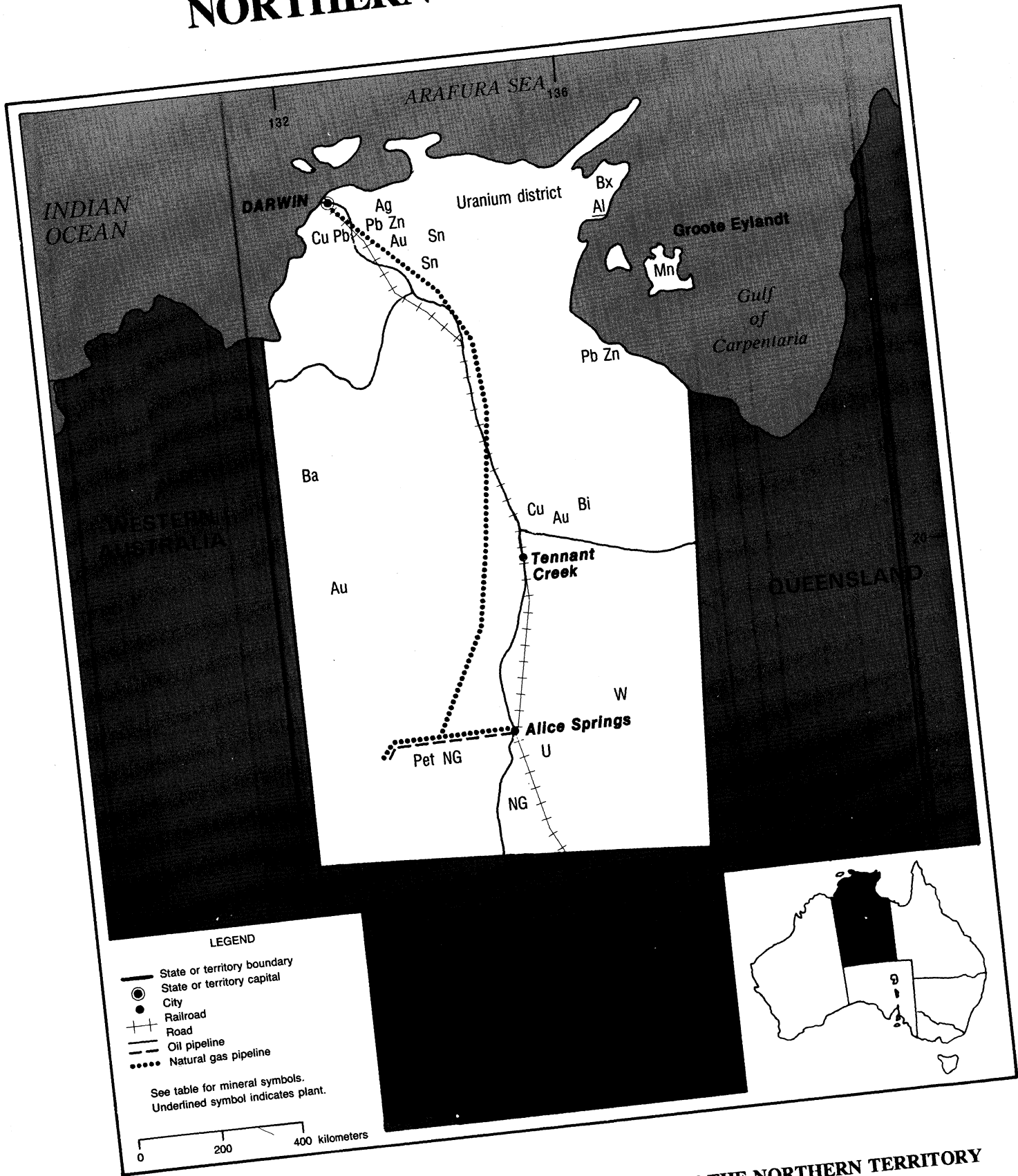
MINERAL SITES AND PIPELINES OF THE STATE OF QUEENSLAND

NEW SOUTH WALES



MINERAL SITES AND PIPELINES OF THE STATE OF NEW SOUTH WALES

NORTHERN TERRITORY



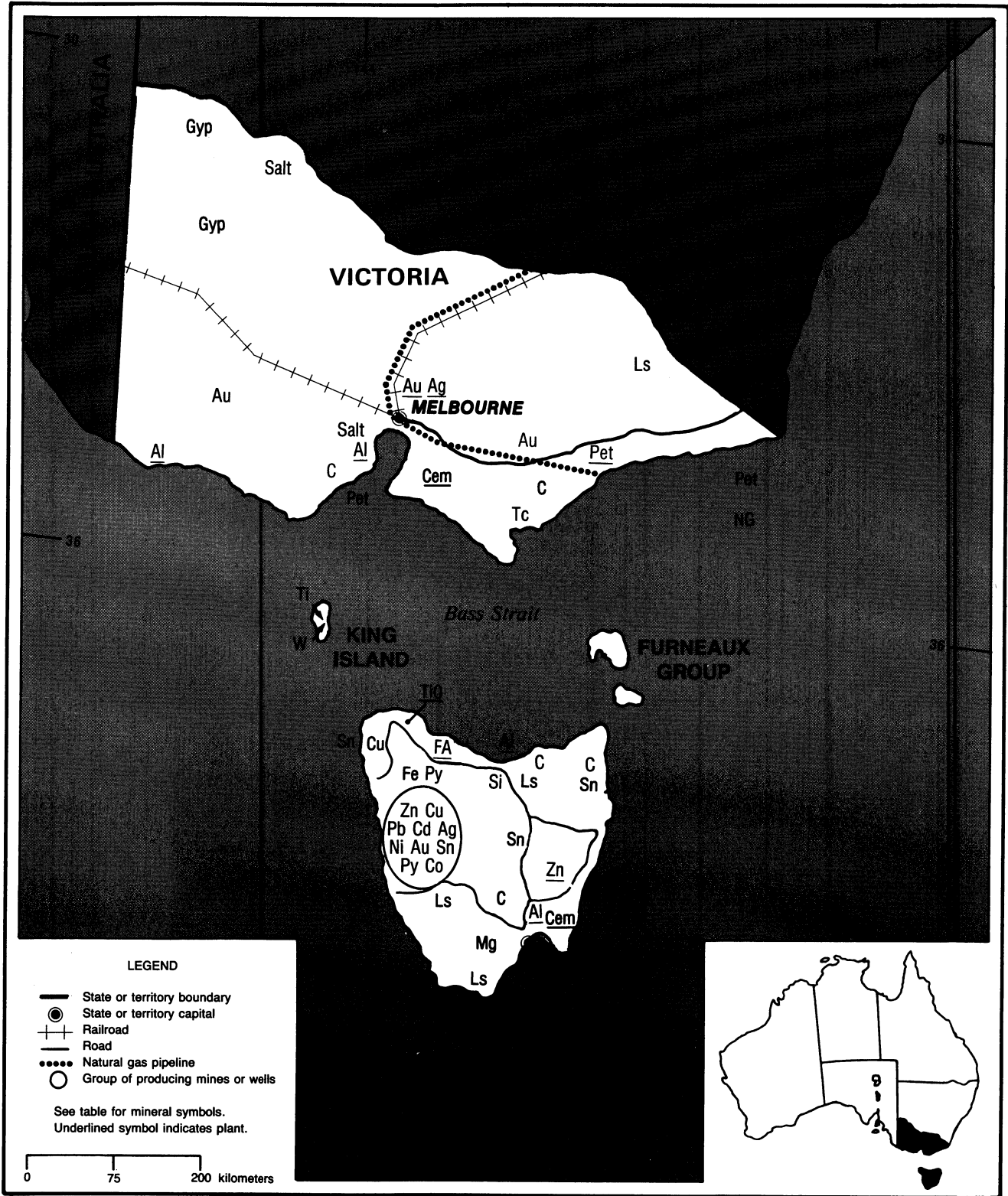
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SOUTH AUSTRALIA



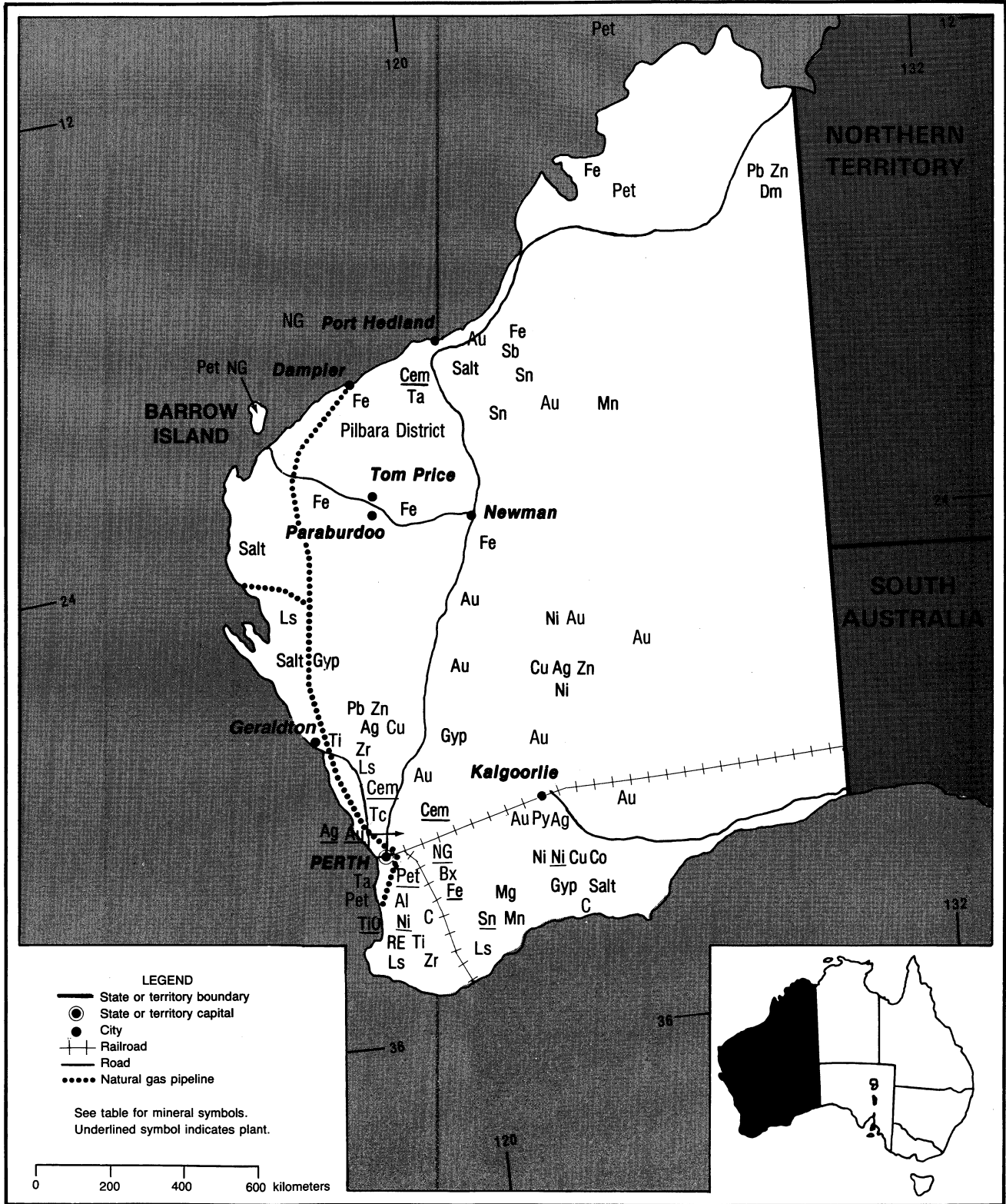
MINERAL SITES AND PIPELINES OF THE STATE OF SOUTH AUSTRALIA

TASMANIA AND VICTORIA



MINERAL SITES AND PIPELINES OF THE STATES OF TASMANIA AND VICTORIA

WESTERN AUSTRALIA



MINERAL SITES AND PIPELINES OF THE STATE OF WESTERN AUSTRALIA

THE MINERAL INDUSTRY OF

AUSTRALIA

By Travis Q. Lyday

Australia is well endowed with a wide range of mineral commodities. While the country has been an important producer of base metals and gold since the past century, the Australian minerals industry has experienced a period of significant and sustained growth over the past 25 years. The growth of the Asian market, in particular the steel and base metals industries in Japan, placed the country among the world's main producers of a number of minerals.

However, the depression entering the Australian mining industry toward yearend 1990 continued throughout 1991. Prices of most minerals decreased, with the exception of coal and iron ore, which remained firm owing to strong demand for steel in north Asia, especially for the base metals and the individual components of mineral sands. The prices of precious metals also remained bearish.

The Australian minerals industry is heavily export-oriented, with about 70% of production destined for overseas markets. Mineral exports are heavily concentrated into just five commodity groups: alumina, aluminum, and bauxite; coal; gold; iron ore; and heavy-mineral sands.

Ownership of mineral rights in Australia is divided between State ownership in State onshore areas and Commonwealth ownership in Territories and in offshore areas. However, the Commonwealth's responsibility for minerals in the Northern Territory (NT), except for uranium, has been transferred to the Government of the NT.

GOVERNMENT POLICIES AND PROGRAMS

The 8-year Federal mining policy restricting uranium production to three

named mining sites was preserved in June at the Australian Labor Party's national convention in Hobart, Tasmania (TAS). The three sites remained the active mines, Olympic Dam in South Australia (SA) and Ranger in the NT, and the inactive (depleted) Nabarlek Mine, also in the NT.

The Australian Parliament introduced in May legislation to prevent oil exploration on the Great Barrier Reef off the Queensland (QLD) coast.

The Government announced in November that Federal controls on the export of natural gas would be removed.¹

The Commonwealth Government announced in December that the coal export duty would be abolished effective at the start of the fiscal year July 1, 1992.²

PRODUCTION

In 1991, Australia was the world's leading producer of alumina, bauxite, diamond, ilmenite, mined lead, monazite, opal, rutile, sapphire, and zircon; second in mined zinc; third in mined gold and iron ore; fourth in aluminum, mined nickel, and uranium; fifth in manganese; and among the top 10 in the production of mined antimony, coal, mined copper, mined tin, salt, and mined silver.

The output of minerals produced in 1991 generally was mixed, with most commodities showing either a slight increase or decrease over those of 1990, with production of the remainder commodities staying about the same as those of the previous year. Of the major mineral commodities produced in Australia in 1991, only the production of iron ore, crude petroleum, salt, and zinc increased more than 5% over 1990 levels. Copper, ilmenite, manganese, rutile, tin, tungsten, and zinc production decreased

more than 5% from 1990 levels. The decreases were, in general, much more profound than were the increases. (See table 1.)

TRADE

Australia relied heavily on the export of the majority of its mineral production to bolster economic growth. It continued to be the premier exporter of alumina, coal, ilmenite, refined lead, monazite, rutile, and zircon. In addition, for the first time since 1985, Australia led the world in iron ore exports, reclaiming the lead from Brazil. Using plentiful resources of coal, liquefied natural gas, and uranium, Australia remained one of the few market economy countries to be a net exporter of mineral fuels, enabling the country to retain a favorable trade balance in energy products.

Coal remained Australia's largest mineral export earner in 1991, followed by refined gold, iron ore, and bauxite, respectively. Total mineral export revenues for fiscal year 1991³ were estimated to be about \$15.8 billion, down almost 21% from those of the previous year.

STRUCTURE OF THE MINERAL INDUSTRY

The Australian minerals industry covers just about the whole spectrum of minerals, from major industrial minerals (ilmenite, rutile, and zircon), base metals (copper, lead, and zinc), ferrous metals (iron ore, manganese, and nickel), nonferrous metals (aluminum and tin), precious metals (gold and silver), fuel minerals (coal and uranium), to gemstones (diamond, opal, and sapphire). It is one of the world's principal

producers and suppliers of ores, concentrates, and refined metals. Australia is estimated to rank fifth in the value of nonfuel mineral production after the former U.S.S.R., the United States, the Republic of South Africa (RSA), and Canada. The value of mineral production, including fuels, was estimated to rank eighth in the world.

The Australian mining industry is based on a system of free enterprise, with private companies involved in exploration, mine development, production, mineral processing, and marketing. A number of foreign companies in mineral ventures in Australia are affiliates or subsidiaries of U.S. companies. Foreign companies currently control a majority of the mining, smelting, and refining sectors and a significant portion of the petroleum and natural gas sectors.

Many of Australia's mineral industries are fully integrated, producing ores, concentrates and other intermediate products (e.g., alumina), and refined metal or other end products (e.g., cut-and-polished gem diamond) within the country. In 1991, there were six alumina refineries and aluminum smelters each; four copper smelters and refineries each; two principal gold refineries; three principal primary lead-zinc smelters and/or refineries; one manganese ferroalloy plant; one nickel smelter and two nickel refineries; three principal crude steel plants; one primary tin smelter and refinery each and two secondary tin refineries; and two silver refineries.

The Australian Constitution contains no specific reference to natural resources, and like the U.S. Constitution, all powers not specifically assigned to the Commonwealth automatically reside with the States. Therefore, the ownership of mineral resources in Australia generally resides with the State or Territory in which they occur. The major exception concerns offshore resources beyond the territorial limit, where Commonwealth jurisdiction prevails. Thus, the individual States and Territories administer the minerals industries within their borders,

including issuing exploration and development permits; overseeing mining operations; ensuring compliance with health, safety, and environmental regulations; and levying royalties and taxes.

However, the Federal Government can restrict mineral exports for the good of the country and, therefore, has de facto control over most mineral production. (See table 2.)

COMMODITY REVIEW

Metals

Antimony.—Fimiston Mining Ltd. acquired in August both the Blue Spec and the adjacent Golden Spec gold-antimony mines, 26 km east of Nullagine in the Pilbara District of Western Australia (WA), from Chase Minerals NL and Minproc Engineers Pty. Ltd. Both mines were on a care-and-maintenance basis since May 1988. Refurbishment of the mines was carried out during the remainder of the year for an expected renewal of mining in the first quarter of 1992.⁴

Bauxite, Alumina, and Aluminum.—Australia remained the unchallenged world leader in bauxite production for the 21st consecutive year, producing more than 40% of production of market economy countries. Although other substantial, but as yet undeveloped, deposits are known, bauxite mining was limited during the year to three principal regions in Australia: the huge Weipa deposit in the north of the Cape York Peninsula, QLD; the Gove operation across the Gulf of Carpentaria in Arnhem Land, NT; and the bauxite mines southeast of Perth in the Darling Ranges, WA.

Australia also continued to dominate the alumina market in 1991, producing from six refineries more than one-third of Western World production. Aluminum in Australia was produced at six smelters in New South Wales (NSW), QLD, TAS, and Victoria (VIC).

Bauxite, together with its value-added products alumina and aluminum, remained for the third year in a row the nation's next most important export, after coal, contributing almost 12% of the value of total exports.⁵

Tomago Aluminium Co. Pty. Ltd., the operator of the consortium owning the Tomago smelter in NSW, announced at the beginning of the year that expansion to increase the capacity of the smelter by almost 60%, to 380,000 mt/a of aluminum, will proceed with the addition of a third 140,000-mt/a potline. The expansion will make Tomago Aluminium the largest smelter in Australia when completed in mid-1993. Government approval was obtained for a 75% expansion of the plant, to 420,000 mt/a, and Tomago Aluminium was considering further expansion at a later date by extending the existing potlines, adding 20,000 mt/a to each.⁶

The \$107 million expansion, from 1.4 Mmt/a to 1.6 Mmt/a, of Nabalco Pty. Ltd.'s mine site Gove alumina refinery in the NT was completed in July, more than 6 months ahead of schedule. Nabalco is a subsidiary of Zurich-based Swiss Aluminium Ltd., or Alusuisse, 70%, and Gove Aluminium Ltd., 30%.

The First National Resource Trust, managed by National Australia Managers, was reportedly about to make an offer at yearend for a portion of the 35% held by the Victorian Government, through Aluminium Smelters of Victoria (AluVic), in the 327,000-mt/a Portland aluminum smelter. AluVic has been trying to sell all or part of its share in the smelter since early in 1990. The Trust already owns a 10% share in the smelter, which is managed by 45% shareholder Alcoa of Australia Ltd. The remaining 10% is owned by the Government of China through the China International Trust and Investment Corp.⁷

Comalco Ltd., 30% owner and a 67%-owned subsidiary of CRA Ltd., was still aspiring at yearend to expand its Boyne Island aluminum smelter near Gladstone with the construction of a third potline. The upgrading of the 230,000-mt/a facility to 450,000 mt/a depended upon

Comalco obtaining access to low-cost power from the QLD Government-owned Gladstone power station. Comalco was attempting to purchase the power station with the intention of selling power in excess to its needs to the State grid. Reportedly, negotiations between Comalco and the QLD Government concerning the purchase price of the power station had resumed after having broken off in 1990. The availability of inexpensive power was a prerequisite for the smelter's expansion. The new potline would increase the smelter's consumption from 30% to about 60% of the Gladstone station's output, necessitating a refurbishing of the station.

Closure of Alcan Australia Ltd.'s Kurri Kurri aluminum smelter was prevented late in the year when Pacific Power (formerly the Electricity Commission of New South Wales) accorded the smelter flexible power rates linked to the price of aluminum. A similar flexible tariff was made in 1990 with Tomago Aluminium for its Tomago smelter north of Newcastle.⁸

The Government announced near yearend that Australia would withdraw from the 17-year-old International Bauxite Association (IBA), primarily because of the escalating cost of membership, but also because of a changed perception of the role of producer organizations in the modern world. Contributions to the IBA, whose members produce about 85% of world bauxite output, are based on the volume of ore produced. Australia, the largest producing member, contributes about 40% of the total budget.⁹ The effective date of withdrawal will be in October 1992.

Copper.—Mine production of copper in Australia continued to be from operations that produced other metals, either as the primary product or as a coproduct.

Mount Isa Mines Ltd. (MIM) began the construction of a 210,000-mt/a copper smelter that will use the ISASMELT technology, developed by MIM and Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) over a 15-year period, at its Hilton

operations at Mount Isa, QLD. The ISASMELT-process smelter will replace the central part of the existing smelter. Prior to building the new structure, production was 180,000 mt/a of copper. The new plant is scheduled to be commissioned in the latter half of 1992. In addition to processing its own concentrates, MIM was planning to increase production from the expanded plant by processing concentrates from other mines, both Australian and foreign.¹⁰

MIM increased the capacity at its copper refinery at Townsville on QLD's coast by 10,000 mt/a, to 200,000 mt/a, through technical advances and improvements in work practices.¹¹

The Olympic Dam joint-venture partners began the stage 2 expansion at their South Australian copper-uranium mine. The expansion, envisioned when the mine was given the go-ahead in 1985, will increase copper production by more than 45%, from 45,000 mt/a to 66,000 mt/a. The joint venture is managed by WMC (Olympic Dam Operations) Pty. Ltd., owned jointly by WMC (Olympic Dam Corp.) Pty. Ltd., a subsidiary of Western Mining Corp. Holdings Ltd. (WMCH), 51%, and BP Minerals Ltd. of the United Kingdom, 49%. BP's share has been on the market since 1989 after BP sold almost all of its mining assets to RTZ Corp., but WMCH has a preemptive right to buy BP's share if offered for sale. No price or decision was made by yearend. The joint venture is mining one of the largest copper-uranium deposits in the world.¹²

An explosion on August 25 at the new Noranda reactor of Southern Copper Ltd.'s Port Kembla smelter in NSW allowed about 50 tons of molten copper matte to escape onto equipment and buildings.¹³ The smelter workshop was set on fire and completely destroyed. The smelter was shut down for 2 months while the damaged reactor was repaired. In addition, commissioning problems plagued the smelter ever since the modernization and expansion work was completed in March. Output for the year was only 26,200 tons of cathode copper,

only a little more than 30% of the design capacity of 80,000 mt/a.¹⁴ The smelter is owned by CRA's subsidiary, formed to manage the company's gold-copper-lead-zinc interests, Enterprise Metals Pty. Ltd., 60%, and the Japanese companies Furukawa Co. Ltd., 30%, and Nissho Iwai Corp., 10%.

AGIP Australia Pty. Ltd., a wholly owned subsidiary of Italy's AGIP SpA, began mining operations at its Radio Hill, WA, property in midyear. AGIP, after several tries, obtained approval from the Foreign Investment Review Board to purchase Dominion Mining Ltd.'s one-third interest by demonstrating that it could not obtain other Australian partners to develop the project.¹⁵

Gold.—In spite of the predicted collapse of the gold mining industry in Australia following the reintroduction of taxation by the Federal Government on gold mining profits beginning January 1, gold output for the year decreased only 4% from that of the previous year's record high. However, this was the first time since 1980 that production declined. In addition, this level (234 tons of gold) of production was attained despite the difficulties for smaller companies in attracting equity funding and a gold price that fell in 1991.¹⁶ The alltime record high for gold production in Australia (244 tons) was set in 1990 when miners accelerated mining and high graded their operations to beat the introduction of the gold tax and maximize their profits. Australia held onto its third place position, after the RSA and the United States, of leading gold producers in the world in 1991.

WA retained its dominance as the country's largest gold-producing State, generating more than 75% of national production. Several of its larger mines; e.g., Boddington, Kambalda's gold operations, Mount Magnet, Telfer, and the Kalgoorlie Super Pit, individually exceeded the total production of NSW, SA, VIC, and TAS.¹⁷ QLD maintained its lead over the NT as Australia's second biggest gold mining State.

The Boddington Mine, in WA, remained Australia's largest producer. The Mount Leyshon Mine replaced the Kidston Mine as the leading producer in QLD. The Granites Mine was the leader in gold production in the NT. The Temora Mine remained NSW's leading producer. Gold produced from the Olympic Dam Mine in SA was the most in the State, although the mine is primarily considered a copper mine. The mainstay of Victorian gold output was the Stawell Mine. Gold output from TAS remained almost entirely a byproduct of base metal mining, predominantly from the Mount Lyell copper mine. Table 3 gives the 15 largest gold mines in Australia in 1991. (See table 3.)

The Australian Nugget became the world's best selling gold bullion coin in 1991, nudging out Canada's Maple Leaf gold coin. The Nugget accounted for a 35% share of the world market in 1991, up from a 15% share in 1990, following the launch in March of coins containing two ounces, 10 ounces, and 1 kilogram of 24 carat (99.99% pure) gold. The coin series is minted by Australian Gold Refineries (AGR), a division of the Western Australian Mint, which is a subsidiary of the Gold Corp. of Australia, an agency of the WA State Government. The Australian Nugget, when originally introduced in April 1987, was minted only in 1/10-ounce, 1/4-ounce, 1/2-ounce, and 1-ounce denominations.¹⁸

AGR's Kalgoorlie refinery was accredited during the first quarter by the London Bullion Market Association (LBMA), which sets the standards for the world's gold trade. AGR had applied for the refinery to be accredited by the LBMA in 1990. Accreditation means that, for the first time since the discovery of the Eastern Goldfields of WA in the 1890's, gold mined in the region will be able to be sent directly to the world's bullion markets. Bars from the Kalgoorlie refinery will be stamped "Australian Gold Refineries—Kalgoorlie." Previously, gold processed at the Kalgoorlie refinery had to be weighed, assayed, and stamped at AGR's Perth refinery, which has had

international accreditation, as the Perth Mint, since the 1920's.¹⁹

Carpentaria Gold Pty. Ltd. suspended mining and placed its Toms Gully Mine, 100 km southeast of Darwin, on care and maintenance in May when opencut ore reserves were exhausted. An exploration program was started to identify proven underground reserves. Open pit mining began at the mine in 1988.²⁰

Production capacity at the Boddington Mine was increased 8% in midyear following the addition of a second extraction process that permitted the recovery of gold and copper-gold concentrates from supergene ores. The \$15 million plant added almost 245,000 mt/a of ore throughput capacity, enabling the production of an additional 900 kg/a of gold and 3,000 mt/a of copper.²¹

Carpentaria Gold Pty. Ltd., a wholly owned subsidiary of MIM Holdings Ltd., announced in midyear that it would develop the Tick Hill Mine, 110 km southeast of the Mount Isa mining complex, QLD.

The mine, initially to be developed as an open pit, was expected to produce about 3,100 kg/a of gold from 170,000 mt/a of ore. Development, including a carbon-in-pulp plant, was expected to be completed during the first quarter of 1992 at a cost of \$9 million.²²

With phase 2 of the expansion of the Kalgoorlie Super Pit, an amalgamation of the Fimiston underground, Mount Charlotte, and Paringa operations at Kalgoorlie, WA, completed in September, the Super Pit became the country's largest gold producer during the final quarter of the year. It was projected to produce almost 14,000 kg during 1992.

Kidston Gold Mines Ltd. announced in December plans to expand the existing treatment plant at the Kidston Mine at a cost of \$11 million. The expansion will involve the installation of a secondary crushing circuit and an additional ball mill, which will increase annual ore throughput capacity from an average of 4.0 Mmt/a to 5.5 Mmt/a and will enable gold production to increase from 5,900 kg/a to 6,850 kg/a. The Kidston Mine

has produced more than 46,000 kg of gold since its commissioning in 1985.²³

Iron Ore.—Australian iron ore production continued to be heavily concentrated in the Hamersley Range of the Pilbara District, WA, which accounted for more than 95% of the country's total. Iron ore was also produced at Koolan Island in Yampi Sound, northern WA, at the Savage River Mine in northwestern TAS, and at the Iron Duke Mine in the South Middleback Ranges near Whyalla, SA.

Australia overtook Brazil to become the world's largest iron ore exporter in 1991. Brazil had been the biggest exporter since 1985. With a 16% increase to 115.9 Mmt, Australia's exports were just over 1 Mmt more than Brazil's 114.7 Mmt. Iron ore was Australia's eighth largest export in 1991, providing a 29.1% share of world exports.²⁴ Table 4 shows the shares of world iron ore exports. (See table 4.)

Portman Mining Ltd., manager and equal partner with Hancock Mining Ltd., developed in July a 3-Mmt/a mine at Ferro Gully on the McCameys Monster deposit, 42 km west of Newman in the Pilbara District. Production, 950,000 tons in 1991, was sold to BHP Iron Ore Pty. Ltd. (BHP Iron) for blending with production from BHP Iron's Mount Whaleback operation.²⁵

Following sacred-site claims by the Karijini Aboriginal community, the WA Government decided in August to conduct an additional anthropological study of Hamersley Iron Pty. Ltd.'s Marandoo iron ore project area. Although the Government was anxious for the 10-Mmt/a mine to proceed and excised in 1990 about 3% of the Hamersley Range National Park specifically to facilitate the project, it was unsure about the legalities of earlier anthropological studies, which did not identify any sacred sites. Marandoo is 35 km northeast of Hamersley's Mount Tom Price Mine.²⁶

An earlier feasibility study of Marandoo as a greenfield project showed that it would not be viable as a stand alone development; only its proximity to

existing infrastructure would establish it as an economical project. If the Marandoo project is developed, the ore will be railed to the Port of Dampier via a 57-km spur line to the main 386-km rail line between Mount Tom Price and Dampier.

Hamersley's preferred plans for development of Marandoo were to bring the mine on-stream in 1994 at an initial rate of about 2 Mmt/a, increasing to a design capacity of about 10 Mmt/a in 1997.²⁷

China was considering in September building a \$190 million sponge iron processing plant in the northwest of WA. The proposed plant would supply 500,000 mt/a of sponge iron for the manufacture of high-quality steel at steelworks in China. A feasibility study undertaken by the Chinese and regional Governments was to be completed early in 1992. The proposed 500,000-mt/a plant would have majority Australian equity.²⁸

Commissioning of BHP Iron's \$60 million Yandi satellite mine 90 km northwest of the company's Mount Whaleback Mine began in November, 2 months ahead of schedule. It was expected that the first shipments for export would be in January, rather than in March as originally planned. Initial production at Yandi will be 5 Mmt/a of iron ore, although BHP Iron already was planning to increase this to as much as 10 Mmt/a. The first major markets for Yandi ore, in addition to customers in Australia, will be China and Japan. Europe, the Republic of Korea, and Taiwan were considered potential future markets.²⁹ The Yandi Mine will replace the 4-Mmt/a capacity at BHP Iron's Koolan Island operation, which was scheduled for closure in 1993.

Lead and Zinc.—Most lead and zinc ore mined in Australia continued to be from operations that produced both, since the two metals commonly occur in associated minerals in the same ore bodies. Only the Scuddles Mine at Golden Grove in WA mined just one of the two, namely zinc. However, Scuddles

also was a producer of copper and byproduct gold and silver.

The final feasibility study on the Lady Loretta lead-zinc deposit, 135 km northwest of Mount Isa in QLD, was completed in January. The study concluded that mining of the deposit would be viable at a rate of 500,000 mt/a at grades of 16.5% zinc and 8.3% lead over a 12-year mine life. However, Pancontinental Mining Ltd. (Pancon), 51% owner, deferred development because of the prevailing low lead-zinc prices. Other partners in the project were AGIP, 25%, and Outokumpu Australia Pty. Ltd., 24%, a subsidiary of Outokumpu Oy of Finland.³⁰

Underground mining began in February at Pancon's 50%-owned Thalanga Mine, 150 km southwest of Townsville, QLD. Mining at the open cut was concluded in October 1990. Stockpiled supergene ore was milled during the interlude between the termination of surface mining and the beginning of mining of primary ore by underground methods. Mining at Thalanga was expected to reach its full production capacity of 550,000 mt/a in mid-1992, enabling production of almost 146,000 mt/a of separate copper, lead, and zinc concentrates.³¹

Work began in May at the Woodcutters Mine and concentrator 80 km south of Darwin in the NT to increase throughput from 380,000 mt/a to a nominal 750,000 mt/a. Actual throughput to the mill will be about 660,000 mt/a, scheduled to begin in July 1992, producing 175,000 tons of lead and zinc concentrates averaging 51.5% lead and 53.5% zinc. The mine was owned by Nicron Resources Ltd., a 78.6%-owned subsidiary of Aztec Mining Co. Ltd.³²

CRA was issued a mineral development license at the end of November for its large Century zinc deposit 250 km northwest of Mount Isa, QLD, at Lawn Hill Station. The license would permit CRA to conduct additional mining, processing, environmental, and infrastructural studies. A shaft was being bored to mine a 1,000-ton sample to test smelting and refining techniques. CRA was contemplating the development of a

5-Mmt/a opencast mine, with a mine life of about 25 years, by late 1995. Production would be 400,000 mt/a of zinc-in-concentrates, about 10% of world supply.³³ CRA obtained an exploration license for the Century tract in 1987, 100 years after the area was first pegged as a mining claim, hence the name Century for the deposit.

After many years and numerous studies, MIM confirmed in midyear through testing at the Mount Isa metallurgical complex that previous problems in treating the fine-grained lead-zinc-silver ores from the McArthur River deposit had been solved and that a salable concentrate could be produced. The McArthur River prospect is at McArthur River in the northeast corner of the NT, about 100 km south of the Gulf of Carpentaria and 230 km west of the QLD State line. Proven and possible reserves were reported to be 227 Mmt at a grade of 41 g/mt silver, 4.1% lead, and 9.2% zinc. MIM was planning to conduct a full feasibility study in 1992.³⁴

An explosion occurred December 30 at MIM's 60,000-mt/a ISASMELT lead smelter at Mount Isa, QLD. The explosion was apparently caused by failure of the refractory brickwork, which allowed molten slag to escape and mix with water beneath the smelter. The smelter was officially opened less than 2 weeks earlier, on December 19, at a cost of \$65 million. During the commissioning phase, the smelter had been producing 400 to 700 tons of lead bullion per week. The explosion did not affect shipments of lead bullion to MIM's refining subsidiary, Britannia Refined Metals Ltd. at Northfleet in the United Kingdom, because the main 180,000-mt/a smelter at Mount Isa continued to operate normally.³⁵

However, the main lead smelter at Mount Isa was shut down from February 7 to March 9 because of the collapse of an attached cooling tower. The closure caused production losses of about 10,000 tons of lead bullion while the tower was repaired, causing the suspension of shipments of bullion to Britannia's refinery.³⁶

Aberfoyle Ltd.'s Que River Mine in northwestern TAS ceased production in December 1990. Stockpiled ore sent to Renison Goldfields Consolidated Ltd.'s (RGC) nearby Rosebery mill under contract was concluded in February 1991.³⁷

Magnesium.—Queensland Metals Corp. NL (QMC), MIM Holdings, Ube Industries Ltd. of Japan, and CSIRO initiated a \$37 million program to research and develop a magnesium metal industry for QLD. The project will be based on the processing of magnesite from the Kunwarara deposit, near Rockhampton, QLD, which is being developed by QMC. The aim of the 5-year program is to develop smelting technology and provide technical data for a subsequent feasibility study, with the construction of a commercial production plant at Gladstone the ultimate objective if results are favorable.³⁸

The first production of deadburned magnesia (MgO) was achieved at the Queensland Magnesia Project, a part of the Kunwarara magnesite deposit, in early November following the earlier production of electrofused MgO. The first deadburned production line will produce at the rate of 50,000 mt/a of MgO and the electrofusion plant will produce at a rate of 15,000 mt/a of electrofused MgO. A second deadburned line will raise annual production to 100,000 mt/a beginning in early 1992. Mining of the magnesite deposit began in March by Pancon, operator and a 40% shareholder. Other shareholders are QMC, 50%, and Radex Australia Pty. Ltd., 10%.³⁹

Devex Ltd. completed a feasibility study for expanding and redeveloping operations at its Thuddungra magnesite deposit in NSW. Devex was considering a staged expansion, starting with increased production from 8,000 mt/a to 30,000 mt/a, including higher grade caustic and fused MgO products. The second stage consisted of the production of high-grade deadburned MgO.⁴⁰

Manganese.—The Woodie Woodie Mine near Nullagine in the Pilbara

region, WA, mined 305,000 tons of high-grade manganese ore during the year. All of the production was exported, and through effective marketing, managed to capture about 20% of the Japanese manganese market and 30% of the manganese imports of both the Republic of Korea and Taiwan during 1991, the first full year of operation. The high-grade fines and lump ores from Woodie Woodie, transported by road train 380 km to Port Hedland for shipment overseas, constitute the first manganese exports from WA since the late 1960's. Portman Mining, the manager in equal partnership with Gayna Park Pty. Ltd., was planning to increase production by 30%, to 400,000 mt/a, in 1992, with the additional output going to new markets in Europe.⁴¹

Mineral Sands.—Australia's mineral sands industry included the mining and processing of high concentrations of the heavy minerals—ilmenite, leucoxene, monazite, rutile, and zircon. Australia remained the world's leading producer and exporter of mineral sands and produced an estimated 60% of world demand for the mineral sands products ilmenite, rutile, monazite, and zircon, even though production in 1991 decreased 14.9%, 18.0%, 54.5%, and 33.2%, respectively, because of a severe world downturn in mineral sands prices. The weak prices resulted from increased production capacity and plentiful stocks worldwide as a consequence of strong growth during the 1980's.

Ilmenite and rutile are valued for their titanium dioxide (TiO₂) content, which is used as white pigment in the paint, paper, plastics, printing, and rubber industries, and as the source for titanium metal used in the aerospace and medical industries. Monazite is a source of rare-earth oxides that are used in electronics and other high-technology products. Zircon is widely used in the refractory, foundry, and ceramics industries.⁴²

RGC Mineral Sands Ltd. (formerly AMC Mineral Sands Ltd.) suspended in January dry mining at the Eneabba North Mine 300 km north of Perth at Eneabba,

both to reduce inventories of mineral sands products at a time of reduced demand and to allow the commissioning of its new, lower cost Eneabba West dredge and concentrator in February. The Eneabba West project involved construction of the world's largest underwater bucket wheel sand mining dredge and floating concentrator plant, Amanda II, capable of operating to a depth of 16 m and dredging mineral sands at a rate of 3,000 mt/h.⁴³

Australia's largest resource processing project since 1987 commenced early in June at Kwinana, 30 km south of Perth, WA. Downstream processing of concentrates by Tiwest Pty. Ltd. involved, for the first time in Australia, a fully integrated mineral sands-to-TiO₂ pigment project.⁴⁴ Tiwest, a 50-50 joint venture of Minproc Chemical Co. Pty. Ltd. and Kerr-McGee Chemical Corp. of the United States, produced heavy-mineral sands concentrate at its Cooljarloo Mine, 170 km north of Perth, and separated it into its component constituents in a dry mill at Chandala, 60 km north of Perth. Approximately one-half of the raw ilmenite produced was used as feedstock for the production of synthetic (upgraded ilmenite) rutile (SR) averaging 94% TiO₂ in an adjacent plant at Chandala. The remainder of the ilmenite and the SR was railed separately to Kwinana, where the ilmenite was exported and the SR was converted to TiO₂ pigment using the chloride process at the new 56,400-mt/a Kwinana plant.⁴⁵

Nickel.—Western Mining Corp. (WMC) was planning a significant expansion of all its WA nickel operations, which included the mines at Kambalda, the Leinster Mine, the Kalgoorlie smelter, and the Kwinana refinery. Kambalda Nickel Operations (KNO), a division of WMC, operated several mines in the Kambalda area and Leinster Nickel Operations (LNO), also a division of WMC, operated mines near Leinster. In practice, however, the LNO was essentially only the Rocky's Reward Mine, as the mostly inactive Leinster Mine, an underground mine mothballed

in 1986, was being mined only on a limited basis by an open cut on a shallow ore body.

WMC's planned \$165 million expansion program announced in September would include doubling ore throughput at LNO to about 2 Mmt/a, producing 35,000 mt/a of nickel in concentrate; increasing its Kwinana refinery south of Perth from a nominal capacity of 30,000 mt/a to 42,000 mt/a; and upgrading its Kalgoorlie smelter to produce at least 65,000 mt/a of nickel in matte.

The plans for KNO mainly concerned attempts to lower production costs, which have risen significantly because of increasingly greater mining depths as well as a slight lowering of the ore grade, by changing work practices and introducing flexible rosters. The new work practices were to allow greater capital equipment use by implementing around-the-clock, 7-day-per-week work shifts. Kambalda was working on a 5-day workweek.

Converting to continuous working was met with strong opposition from the Australian Worker's Union, and KNO lost many days of work through industrial action into 1992. Another requirement in KNO's quest for work practice changes was the necessity to have the WA Government amend the Western Australian Mines Regulation Act to allow continuous working rosters in existing underground mines, which already was permitted by all the other States.⁴⁶

Dominion Mining, after completing its feasibility study, announced that it would develop its Yakabindie sulfide nickel deposit south of Mount Keith, WA. The Yakabindie has proven mineral reserves of 134 Mmt delineated in two deposits, Six Mile and Goliath North, sufficient for open pit mining at a combined rate of 6 Mmt/a of ore at a grade of 0.52% nickel, sufficient for a mine life of 20 years. The mine was expected to be in full production by yearend 1994.

Earlier, the State and Federal Governments overruled opposition to development of the Yakabindie deposit when aboriginal land rights activists utilized the aboriginal Heritage Act to forestall development.⁴⁷

Outokumpu Australia and Outokumpu Western Australia Pty. Ltd., both subsidiaries of Outokumpu Oy, announced in December that they would proceed with the development of their 50-50 joint-venture Forrestania nickel project, 375 km east of Perth. The initial construction of the mine was expected to take about a year, with production scheduled to begin early in 1993. The project will consist of three mines, two underground and an open pit, and a 500,000-mt/a flotation concentrator. The mine was expected to have a mine life in excess of 10 years, producing nickel concentrate containing 7,500 mt/a of nickel. The concentrates initially will be shipped to Finland through the port at Esperance on WA's southern coast.⁴⁸

WMC gained control of Mount Keith, regarded as the world's largest low-grade sulfide nickel deposit, in a successful hostile-bid takeover near yearend. The deposit was wholly owned by Australian Consolidated Minerals Ltd. (ACM). The takeover offer was made by Resplendid Pty. Ltd., a company jointly owned by WMC and Normandy Poseidon Ltd.

Following the takeover, WMC and Outokumpu Metals and Resources Oy, ACM's former partner in the Mount Keith project, signed an agreement to develop the property on a 50-50 basis. WMC had not revealed any development plans by yearend.⁴⁹

Platinum and Palladium.—No Australian mines were primary producers of platinum or palladium in 1991. A small amount, about 1,000 kg/a of platinum and 600 kg/a of palladium, continued to be produced as a byproduct from the treatment of nickel ore by WMC at Kalgoorlie, WA.

Although the mining industry of Australia was hopeful this would change with development of the Coronation Hill gold-platinum-palladium project in the South Alligator River region of the NT, the Government's Resource Assessment Commission, set up in 1991 to issue a final determination, ruled that mining at Coronation Hill would be prohibited because the aboriginal custodians of the

area objected to mining at the site on religious grounds. The Coronation Hill site had been registered as a sacred site to the Jawoyn people in October 1985. The Coronation Hill Project is within the Kakadu Conservation Zone of Kakadu National Park. The Government will now incorporate the conservation zone into the national park.⁵⁰

Partners in the project were Newcrest Mining Ltd. (formerly Newmont Australia Ltd. prior to Newmont's merger with BHP Gold Mines Ltd.), 45%, acting as manager; Plutonic Resources Ltd. (formerly Pioneer Mineral Exploration Ltd.), 45%; and Norgold Ltd., a subsidiary of North Broken Hill-Peko Ltd., 10%.

Steel.—BHP Steel Ltd. was the only integrated steel producer in Australia during the year. BHP Steel's contribution to total world steel output was relatively small, having three integrated steelworks producing at a rate of about 6.2 Mmt/a in 1991.⁵¹ Australia ranked as the 23d largest steel producer in 1991.

HIsmelt Corp. Pty. Ltd., a 50-50 joint venture of CRA and Midrex Corp. of the United States, began construction in midyear of a \$77 million research facility for the development of a trial direct-reduction steelworks at Kwinana, WA, using the High Intensity Smelting (HIsmelt) process. This process is a single-stage method for direct smelting of iron ore in a closed molten bath reactor to produce a pig iron equivalent. It eliminates the need for blast furnaces, coke ovens, and sintering plants that are part of the conventional ironmaking process. The HIsmelt process is able to use iron ore fines and noncoking coals. Construction of the pilot plant with a nominal capacity of 100,000 mt/a was expected to be completed late in 1992. The Government-owned research body CSIRO also will be involved in researching the HIsmelt process at the new plant.⁵²

CRA initiated the HIsmelt process in 1981 through a partnership with Klöckner-Werke AG of Germany. In the early years of development it often was

called the Klöckner Process. CRA acquired 100% of the rights to the process in 1987. In 1989, CRA entered into the partnership with Midrex, a leader in direct-reduced iron technology, to form Hismelt. Hismelt is but one of a number of proposed direct-smelting technologies under development.⁵³

Perth-based Compact Steel Ltd. began in midyear a final feasibility study for a 1.5-Mmt/a steel mill in WA. The study was being based on using the Corex ironmaking process developed by Voest Alpine AG of Austria, a direct-smelting application similar to that of Hismelt's. Compact Steel was proposing to build the steel plant near the existing steaming coal mines at Collie, south of Perth.⁵⁴

Tantalum.—The Wodgina-Pan West Mine was opened early in the year, 100 km south of Port Hedland, in the Pilbara region of WA. The mine became the second large tantalum producer in Australia, after Gwalia Consolidated Ltd.'s Greenbushes Mine, 250 km south of Perth, also in WA, and the third of the Western World's large operating primary tantalite mines. Together, these three mines (the third one is Canada's Bernic Lake Mine owned by Tantalum Corp. of Canada Ltd.) supply about 30% of the world's supply of high-grade tantalum pentoxide (Ta_2O_5) concentrates. The Wodgina-Pan West Mine, an equal joint venture of Pancon and Goldrim Mining Australia Ltd., produces about 90,000 kg/a of Ta_2O_5 concentrates from 85,000 tons of ore.⁵⁵

The Greenbushes Mine became a single operating unit after the merger of Greenbushes Ltd. into Gwalia Consolidated in late 1990. Gwalia Consolidated announced in midyear plans to proceed with mine expansion and development of new hard-rock treatment facilities, appropriately as the project goes from relatively soft and weathered to hard and fresh pegmatite ore at the mine site. The mine expansion will essentially be a new and bigger open pit, lifting production to almost 300,000 kg/a of Ta_2O_5 concentrates by 1996 from the current 180,000 kg/a. Sufficiently

weathered pegmatite ore and high-grade tailings are available to permit continuous operation of the existing soft-rock treatment plants until production from the new facilities begins. The expansion project started in December, and the plant was scheduled to be commissioned in November 1992.⁵⁶

Tin.—The Renison Mine near Zeehan, TAS, the world's largest hard-rock underground tin mine, underwent a major reorganization early in the year as a response to continued depressed prices, the lowest in real terms in more than 30 years, and massive oversupply in international markets. To reduce operating costs, RGC, 100% owner and operator, implemented a survival strategy reducing the work force by 100, to 250 employees, and replacing the 2 12-hour-shift, 7-day week operation with one based on a 3 8-hour-shift, 5-day week. The plan also incorporated, by selective mining, an increase of the average grade mined, from 1.27% to 1.43% tin.⁵⁷ Production of ore was reduced from 745,000 mt/a, containing about 7,000 tons of tin-in-concentrate, to 525,000 mt/a containing about 5,500 tons of tin-in-concentrate. Initial rejection of the plan by employees resulted in a shutdown from March 6 to April 4 when underground mining resumed.

Modifications made to the concentrator during the year improved concentrate grades and reduced costs and the introduction of short-hole open stope mining instead of cut and fill in some of the more complex ore bodies further improved productivity as well as safety.⁵⁸

The ninth meeting of members of the Association of Tin Producing Countries (ATPC), held in Canberra during October, agreed to limit production through a sixth supply rationalization period, from January to December 1992. The ATPC also decided to reduce the total permissible export tonnages by 9.1% in 1992. These actions were taken in an attempt to reduce the oversupply of tin stocks on the world market, which continue to contribute to the weakening of world tin prices.⁵⁹

Tungsten.—The Kara open pit, owned and operated by Tasmania Mines Ltd. at Hampshire, south of Burnie on TAS's northern coast, remained Australia's only operating scheelite mine. The Dolphin scheelite mine, on King Island in Bass Strait off the Tasmanian coast, closed in December 1990 owing to depressed prices caused, in part, by Chinese producers oversupplying the market.⁶⁰ China supplies up to 70% of the international market for tungsten. All plant and equipment and accumulated stocks of concentrate at Kara were sold during 1991.

Vanadium.—Precious Metals Australia Ltd. (PMA) was progressing with its plans to develop its Windimurra vanadium deposit near Mount Magnet in WA to become Australia's first vanadium pentoxide (V_2O_5) producer. PMA anticipates production of 3,700 mt/a of V_2O_5 high-purity fused flake and byproducts, including 22,000 mt/a of sodium sulfate, 2,000 mt/a of sodium zeolites, and an estimated 375,000 mt/a of titanohematite ore beginning in early 1993.⁶¹

In September, PMA finalized the purchase of an 80% interest in the Barrambie vanadium project, near Sandstone, WA, from Trans-Global Resources NL, which retained a 20% interest.⁶²

Industrial Minerals

Asbestos.—Mineral Commodities Ltd. (MCL) continued negotiations with the NSW Government to reprocess the Woodsreef Mine's 25-Mmt chrysotile asbestos-fiber tailings dump left when the mine, near Barraba in Northern NSW, closed in 1983. MCL planned to use a dust-free process pioneered and in use at the company's Canadian operations at Baie Verte, Newfoundland.

Diamond.—The mammoth Argyle Mine in the Kimberley region of WA again retained in 1991, for the sixth consecutive year, its position as the world's biggest single-mine producer of diamond with

another record-high production. Argyle produced 35 million carats from the combined treatment of AK-1 lamproite pipe ore and its derived alluvium in the lower reaches of the Smoke and Limestone Creeks that drain the pipe. AK-1 production accounted for about 32.4 million carats from about 6 Mmt of ore. Alluvial production for the year contributed about 1.6 million carats from about 2 Mmt of ore. Production increased in spite of declining ore grades as mining moved into deeper levels on the AK-1 pipe. About 5% of production was of gem quality, including a small proportion of very rare pink stones; 40% was near-gem quality and 55% was industrial quality.

The Argyle Mine was owned and operated by the Argyle Diamond Mines Joint Venture (ADMJV), a joint venture of CRA, 59.9%, and Ashton Mining Ltd., 40.1%.

The ADMJV renewed in July its 5-year marketing contract with the Central Selling Organization (CSO), through Argyle Diamond Sales Ltd. The contract covers the major part of Argyle production. Although most diamonds will be sold through the CSO, a selection of the better gemstones will be retained for cutting and polishing by Argyle in its Perth facility and a portion of the near-gem-quality and industrial-grade stones will be sold on the open market through Argyle's Antwerp, Belgium, office.⁶³

Australia's only other significant producing diamond mine, Normandy Poseidon's Bow River Mine 25 km northeast of Argyle, also produced another record-high production, recovering almost 1 million carats from more than 3 Mmt of ore. Normandy Poseidon was formed in May from the merger of Normandy Resources NL and sole owner of the Bow River Mine, Poseidon Ltd.

All of Bow River's output is under a sales agreement with the CSO. About 20% of the Bow River production was gem quality, with a consistent percentage of pink diamonds, 70% was industrial grade, and 10% was bort. Bow River diamonds were recovered from buried

diamondiferous gravels that originated from the AK-1 pipe.

Gemstones.—Australia continued to be the world's leading producer of natural sapphire, which was mined in the New England (Inverell-Glen Innes) District of NSW and near the town of Anakie in QLD. It produced about 70% of the world's rough sapphire supply output, with about 90% of the uncut gems being exported to Thailand, the recognized world leader for cutting and marketing. Australia processed only about 1% of its production.

Between 80% and 90% of the world's natural opal was mined in Australia, mostly from three fields in SA at Andamooka, Coober Pedy, and Mintabie. In NSW, Lightning Ridge was the world's sole source of black opal. A small quantity of opal also was produced in central QLD.

The world's largest resource of nephrite jade was at Cowell on the Eyre Peninsula in SA. In addition to the important deposits of opal and sapphire, Australia also produced a variety of other gemstones, including amethyst, aquamarine, chrysoprase, emerald, garnet, rhodonite, topaz, and zircon.

Graphite.—The Esperance (formerly Munghlinup) graphite project 80 km east of Ravensthorpe, WA, was deferred in October by Gwalia Consolidated, manager and 51% owner, pending improved demand for graphite. The project originally planned for the development of an open pit mine initially to produce 8,000 to 12,000 mt/a of graphite. Warrior International Ltd. held the remaining 49%.⁶⁴

Salt.—Dampier Salt (Operations) Pty. Ltd. supplied more than one-half of Australia's salt exports, 70% of which go to Japan, from its solar operations at Dampier Field, on Mistaken Island near Dampier in the Pilbara, and Lake Macleod Field, near Carnarvon, both in WA. Indonesia, the Republic of Korea, and Taiwan received the bulk of remaining exports.

Dampier was nearing at yearend completion of its expansion program to increase production capacity by 500,000 tons at the Dampier Field. Expansion of production capacity by 500,000 tons at the Lake Macleod Field was completed in 1990. Capacity of the Dampier and Lake Macleod Fields combined will be 4.5 Mmt/a when the Dampier program is completed, expected to be early in 1992.

The Leslie Salt Div. of Cargill Australia Ltd., a wholly owned subsidiary of Cargill Inc. of the United States, was increasing production at its Port Hedland, WA, operation to 2.75 Mmt/a, up from 2.25 Mmt. The expansion was expected to be completed in 1994.⁶⁵

Mineral Fuels

Coal.—The coal industry remained Australia's largest foreign-exchange earner, accounting for more than one-quarter of export revenues from the minerals sector and about 15% of the country's export earnings. Australia also retained its position as the world's largest exporter of coal, setting a record of more than 120 Mmt shipped in 1991, an increase of 12.8% over that of 1990. Coking coals accounted for almost 55% of shipments, about the same as that in 1990. Australia was the world's sixth largest producer of coal (all grades) in 1991, ranking behind China, the United States, the former U.S.S.R., Germany, and Poland. NSW and QLD remained virtually Australia's only coal-exporting States. A large share of production in NSW was from underground mines, while most of the mines in QLD were open cut. QLD remained the leading Australian coal exporting State.

Australia's largest single coal mine remained Pacific Coal Pty. Ltd.'s 57.19%-owned Blair Athol open cut in QLD, producing about 9 Mmt/a of steaming coal, primarily for export to Japan. Australia's largest single underground coal mine was Austen and Butta Ltd.'s wholly owned South Bulli Mine in NSW, producing about 3 Mmt/a of coking and steaming coal for export to Asian markets.

Coal for export from QLD is primarily delivered by rail for shipment from five ports on the Pacific Coast, namely, Abbot Point, Brisbane, Dalrymple Bay, Gladstone, and Hay Point. NSW's coal exports are shipped from terminals at Newcastle, Port Kembla, and Sydney. Table 5 gives Australian coal exports by State and port.⁶⁶ (See table 5.)

Pacific Power continued trying to privatize or sell all its State-owned mines. Tenders were requested early in the year but, when the tenders closed later in the year, none was accepted. A tender recall in early 1992 was expected to produce positive results by midyear.

After 113 years of continuous operation, the Coal Cliff Mine 25 km north of Wollongong, NSW, was closed in March by Kembla Coal and Coke Pty. Ltd., a subsidiary of CRA. The mine was closed because of low coal recovery due to obsolete mining methods, as well as near depletion of reserves. The mine will continue to be maintained for possible future development of its western reserves.⁶⁷

In April, the joint venture of MGC Resources Australia Ltd., operator and 75% shareholder, and MIM, 25%, announced the Queensland Coalbed Methane Project (QCMP) for the exploration of natural methane gas fields in QLD coalbeds to determine the potential for methanol production. The QCMP covers an area of 14,000 km² of the Central QLD coalbeds. The project will determine the extent of commercially recoverable reserves of methane. MGC plans to establish a plant to convert the methanol for export as a basic raw material for various chemical products. MGC is a subsidiary of Mitsubishi Gas Chemical of Japan.⁶⁸

The \$110 million opencut Camberwell Mine in the Hunter Valley coal district of NSW began production in April. Capacity is scheduled to be 2.4 Mmt/a by 1994. Production will be a mix of about 60% steaming coal, with 40% of production upgraded to soft or semisoft coking coal. The mine, the first single union coal mine in NSW, is operated by Camberwell Coal Pty. Ltd., owned by Navidale Pty. Ltd.,

50%, Toyota Tsusho Mining (Australia) Pty. Ltd., 40%, and Dia Coal Mining Australia Pty. Ltd., 10%.⁶⁹

The Federal Government and the Australian coal industry signed a Memorandum of Understanding incorporating the repeal of coal export duties after the Commonwealth Government announced on December 2 that the coal export duty would be abolished effective July 1, 1992, the beginning of the next fiscal year.²

Petroleum and Natural Gas.—More than a dozen local and international companies signed production-sharing contracts in December to work in the newly released Timor Gap permit areas in the Timor Sea between Australia and Indonesia. The first seismic work in the area was expected to begin during early 1992, but exploration drilling was not expected until 1993. The area was off limits to petroleum exploration for more than a decade until a zone of cooperation with Indonesia was agreed to in 1988 and ratified by the Australian Parliament in 1990.

The total number of petroleum exploration and development wells drilled during 1991 (215) was 11% lower than the number drilled during 1990 (242). The number of onshore exploration wells drilled in 1991 (114) remained virtually the same as that in 1990 (113). However, the number of offshore exploration wells drilled (36) was 44% lower than the number drilled in 1990 (64). The total number of exploration wells drilled in 1991 (150) decreased 15% from the number drilled in 1990 (177). The total number of development wells drilled (65) was the same as that in 1990, with both onshore and offshore drilling remaining at 17 and 48, respectively. The total meters drilled for exploration and development wells in 1991 (459,573) was about 15% less than that drilled in 1990 (542,402). In seismic survey activity during 1991, the total number of line km recorded (163,642) increased by almost 82% compared with that of 1990 (89,938). The level of offshore activity in 1991 (155,023 line km) was almost 93%

greater than the corresponding level achieved during 1990 (80,415 line km).⁷⁰

The Australian Marine Oil Spill Centre (AMOSC), funded by members of the Australian Institute of Petroleum Ltd. (AIP), became operational at Corio Quay, near Geelong, on Port Phillip Bay, VIC. The AMOSC facility is on call 24 hr/d and is equipped to respond to an oil spill incident anywhere around the Australian coast within 12 to 24 hours. AMOSC's location was chosen because of its proximity to national transport facilities as well as an excellent communications network and because the area is at the hub of the Australian oil industry and its tanker movements. AIP established a wholly owned subsidiary, Australian Marine Oil Spill Centre Pty. Ltd., to be responsible for the stockpile of equipment to deal with a major oil spill and direct the center's operations, including training. The AMOSC also includes a world-class training facility for spill combat techniques that can cater between 200 and 300 industry and Government personnel per year. The participating companies involved in the AMOSC are: Ampol Ltd.; BHP Petroleum Pty. Ltd.; BP Australia Ltd.; Caltex Oil (Australia) Pty. Ltd.; Esso Australia; Hadson Energy Ltd.; Mobil Australia; The Shell Co. of Australia Ltd.; Santos Ltd.; West Australian Petroleum Pty. Ltd.; and Woodside Petroleum Ltd.⁷¹

Uranium.—The Commonwealth Government's 8-year-old uranium policy of restricting uranium production to three sites was reaffirmed at the biennial Australian Labor Party's National Conference in June. The mines involved continued to be the operational Olympic Dam Mine in SA and the Ranger Mine in the Alligator Rivers region of the NT. The third permissible site, Queensland Mines Ltd.'s (QML) Nabarlek Mine, also in the Alligator Rivers region of the NT, was depleted of reserves and closed in 1988. Thus, the "three mines" policy is in practice a "two mines" policy, as the export permit holders, Energy Resources of Australia Ltd. (ERA) and the consortium of WMCH-BP Minerals Ltd.

are the only ones with viable mines. The Commonwealth Government has de facto control over uranium mining by controlling the licenses for the export of uranium-bearing ores and by prohibiting further downstream involvement in the nuclear fuel cycle, including enrichment or other value-added processes.

Pancon sold in August its Jabiluka uranium-gold deposit, 15 km north of the Ranger Mine, to ERA for \$95 million. Pancon owned 65% of Jabiluka outright and exercised its option to acquire from Texaco Oil Development Corp. of the United States its 35% interest in the deposit to sell the entire share to ERA. Pancon was established on the strength of the Jabiluka deposit, the largest undeveloped uranium deposit known in Australia and considered one of the world's richest large deposits, about 20 years ago. Pancon, holder of the property since its discovery, had been planning the start of production when the "three mines" policy went into effect in 1983, blocking development. All necessary mining and environmental approvals had been approved for the project to proceed when it was held up by Federal policy. The project has been on perpetual standby ever since. The Jabiluka deposit is within the boundaries of, but excised from, Kakadu National Park.⁷²

After a 9-month feasibility study, the joint-venture partners of the polymetallic (copper, gold, silver, and uranium) Olympic Dam Mine in SA announced in February the decision to proceed with the stage 2, \$50 million expansion program. The expansion will increase uranium oxide output to 1,400 mt/a from 1,200 mt/a by yearend 1992. The expansion, envisioned at the outset when the mine was first being developed in 1985, included increasing ore hoisting capacity and ore handling equipment; enlarging the concentrator, hydrometallurgical plant, smelter, and refinery; upgrading water and power supply facilities and enlarging the tailings retention system; and constructing new housing for an expanded work force.⁷³

The Olympic Dam joint venture signed new contracts with Teollisuuden Voimo Oy

of Finland, Tokyo Electric Power Co. Inc., and an unnamed Japanese power utility in 1991 for the supply of uranium oxide.⁷⁴ All of Olympic Dam's uranium oxide is exported to Asia, Europe, and the United States.

Reserves

Australia has a sound resource base of a diverse range of minerals. It is self-sufficient in most minerals of economic importance. However, in spite of extensive exploration, the country still appears to be deficient in chromite, mercury, mica, platinum-group metals, and sulfur. Major minerals with known reserves adequate for domestic demand and exports include bauxite, clays, coal, copper, diamond, gold, iron ore, lead, manganese, mineral sands, natural gas, nickel, salt, silver, tin, uranium, and zinc. (See table 6.)

INFRASTRUCTURE

The communications-transportation infrastructure of Australia was well developed. There was 837,872 km of roads, including 243,750 km paved; 228,396 km gravel, crushed stone, or stabilized-soil surface; and 365,726 km unimproved earth. Inland waterways, of which there was about 8,368 km usable for mainly small, shallow-draft craft, were of little importance to the transportation industry.

The Government-owned railway system consisted of 40,478 km of track, 16,201 km of which was standard gauge. There was 1,130 km of electrified rail. A few hundred km of rail was privately owned, most of which served the iron ore industry in WA. There were 270 principal airports with permanent-surface runways out of an aggregate of 747 in the country. International shipping ports included Adelaide, Brisbane, Cairns, Darwin, Devonport, Fremantle, Geelong, Hobart, Launceston, Mackay, Melbourne, Sydney, and Townsville. The merchant marine fleet included 16 petroleum, oils, and lubricant tankers; 1 chemical tanker;

4 liquefied gas tankers; 1 combination ore-oil tanker; and 30 bulk ore freighters.

Pipelines included 5,600 km for natural gas; 2,500 km for crude oil; and 500 km for refined oil products. Electric generating capacity in 1990 was 38,000 MW.

In remote areas where mines, mills, or smelters are usually located, an individual mining company must provide its own infrastructure, such as housing, roads, railways, port facilities, and various community services.⁷⁵

OUTLOOK

Many sectors of the Australian mining industry, including aluminum, coal, copper, gold, iron ore, lead-zinc, manganese, mineral sands, nickel, tin, and tungsten, face an uncertain future owing to weak commodity prices, rising costs of production, large inventories on world markets, and/or insufficient infrastructure. However, Australia was expected to remain a significant world supplier of these and other mineral resources in which it is abundantly endowed well into the 21st century.

Probably the largest single potential detriment to the resource sector in the years ahead is the strong environmental movement in the country. Although ores and processed minerals have been accounting for almost one-half of export income, increasingly strong antimining sentiment continues to impede investment in the mining and minerals sector, with the result that exploration and development activities are decreasing as they become more difficult to conduct. This will have a very significant effect on the development of large greenfield projects that will be needed to maintain the impetus of the mining and processing sectors.

Declining gold prices, a shortage of exploration funds, and the end of the Federal gold tax exemption will likely bring to an end the Australian gold boom built during the 1980's. This boom, which saw the rise of annual gold production from a base of just 5 tons at the beginning of the decade to the record-

high output of more than 240 tons in 1990, was primarily based on the mining of near-surface, low-grade deposits of limited life. The boom also resulted from reworking old deposits that became economically viable again by the treatment of the tailings of past mining operations using modern, especially carbon-in-leach and carbon-in-pulp, technology. Many of these gold deposits and tailings areas have neared the end of their economic lives because of high-grading at many operations to beat the gold tax, as well as the exhaustion of reserves at many locations.

The gold tax and other impediments, such as increasingly restricted access to lands either for environmental reasons or land rights issues to conduct proper exploration programs, will also mean even fewer funds will be available for exploration and capital investment, and this will translate into a reduction in production.

¹South-East Asia Mining Letter (Hong Kong). V. 3, No. 2²⁴, Dec. 19, 1991, p. 2.

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³Australia's fiscal year begins on July 1 and ends on June 30 of the year stated.

⁴Resource Information Unit Ltd. Register of Australian Mining, 1992/93. 1992, p. 302, Subiaco, Western Australia.

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⁷———. No. 7640, Dec. 12, 1991, p. 5.

⁸———. No. 7637, Dec. 2, 1991, p. 7.

⁹Mining Journal (London). V. 317, No. 8152, Dec. 13, 1991, p. 444.

¹⁰Metal Bulletin (London). No. 7674, Apr. 13, 1992, p. 9.

¹¹———. No. 7673, Apr. 9, 1992, p. 5.

¹²Mining Journal (London). V. 318, No. 8176, June 5, 1991, p. 405.

¹³Metal Bulletin (London). No. 7610, Aug. 29, 1991, p. 7.

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¹⁵Page 191 of work cited in footnote 4.

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¹⁹———. V. 6, No. 55, Apr. 1991, p. 34.

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²²Mining Journal (London). V. 317, No. 8131, July 19, 1991, p. 41.

²³———. V. 317, No. 8152, Dec. 13, 1991, p. 438.

²⁴Metal Bulletin (London). No. 7702, July 30, 1992, p. 19.

²⁵———. No. 7635, Nov. 25, 1991, p. 27.

²⁶Page 23 of work cited in footnote 13.

²⁷Metal Bulletin Monthly (London). V. 250, Oct. 1991, pp. 53, 55.

²⁸Mining Journal (London). V. 317, No. 8139, Sept. 13, 1991, p. 181.

²⁹Australian Mining (Chippendale, New South Wales). V. 83, No. 6, June 1991, p. 54.

³⁰Page 199 of work cited in footnote 4.

³¹Page 201 of work cited in footnote 4.

³²Metal Bulletin (London). No. 7579, May. 16, 1991, p. 9.

³³Work cited in footnote 1.

³⁴Metal Bulletin (London). No. 7633, Nov. 18, 1991, p. 13.

³⁵———. No. 7645, Jan. 6, 1992, p. 9.

³⁶American Metal Market (New York). V. 99, No. 39, Feb. 28, 1991, p. 1.

³⁷Page 339 of work cited in footnote 4.

³⁸South-East Asia Mining Letter (Hong Kong). V. 4, No. 1, Jan. 17, 1992, p. 3.

³⁹Mining Journal (London). V. 317, No. 8148, Nov. 15, 1991, p. 365-366.

⁴⁰Page 208 of work cited in footnote 4.

⁴¹Metal Bulletin (London). No. 7657, Feb. 17, 1992, p. 10.

⁴²Page 42 of work cited in footnote 29.

⁴³Australian Journal of Mining (Richmond North, Australia). V. 6, No. 63, Dec. 1991, p. 28.

⁴⁴Mining Journal (London). V. 318, No. 8156, Jan. 17, 1992, p. 38.

⁴⁵Page 212 of work cited in footnote 4.

⁴⁶Metal Bulletin Monthly (London). V. 258, June 1992, pp. 10, 11.

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⁵¹Page 17 of work cited in footnote 14.

⁵²Australia Report (Washington, DC). V. 2, No. 5, Mar. 19, 1991, p. 3.

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⁵⁵American Metal Market (New York). V. 99, No. 23, Feb. 5, 1991, p. 5A.

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⁶⁰The Miner (Sydney). Feb. 1991, p. 5.

⁶¹Mining Magazine (London). V. 165, No. 4, Oct. 1991, p. 188.

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⁶⁵Page 302 of work cited in footnote 4.

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⁷³The Miner (Sydney). Mar. 1991, p. 3.

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⁷⁵U.S. Central Intelligence Agency. The World Fact Book 1990, p. 19, Washington, DC.

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TABLE 1
AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991*	
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	34,102	36,192	38,584	¹ 41,391	² 40,503
Alumina	do.	10,109	10,511	10,800	11,231	² 11,713
Metal, refined:						
Primary	do.	1,004	1,150	1,244	1,234	² 1,235
Secondary		39,000	46,800	48,400	32,900	² 22,500
Antimony, Sb content of ores and concentrates		1,231	1,320	1,360	1,420	² 1,300
Bismuth, mine output, Bi content*		350	400	500	400	400
Cadmium:						
Mine output, Cd content		2,249	1,709	1,685	² 1,100	2,500
Metal, smelter (refined)		944	855	696	638	² 1,076
Cobalt:						
Mine output, analytic content of:						
Nickel ore		2,274	2,104	² 2,000	2,000	2,000
Nickel concentrate		368	⁴ 400	³ 300	300	300
Zinc concentrate		73	70	⁷ 75	75	100
Total		2,715	² 2,574	² 2,375	2,375	2,400
Recoverable cobalt*		1,261	1,200	1,000	1,000	1,200
Columbium-tantalum concentrate, gross weight		159	226	555	555	600
Copper:						
Mine output, Cu content	thousand tons	233	238	296	³ 330	³ 311
Metal:						
Smelter:						
Primary	do.	173	178	204	192	² 197
Secondary		⁸ 5,000	10,506	10,000	10,000	10,000
Refined:						
Primary	thousand tons	179	196	210	247	² 252
Secondary		28,843	26,667	25,000	27,000	² 24,000
Gold:						
Mine output, Au content	kilograms	110,696	156,951	203,563	² 244,137	² 234,218
Metal:						
Refined:						
Primary	do.	116,272	140,384	197,382	254,583	250,000
Secondary	do.	³ 1,110	10,235	18,220	18,670	20,000
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	101,748	96,064	105,810	¹ 110,508	² 117,134
Fe content	do.	64,798	61,244	67,313	⁶ 69,766	⁶ 68,732
Metal:						
Pig iron	do.	5,569	5,730	6,094	6,125	⁵ 6,647
Ferrous alloys:³						
Ferromanganese		51,465	58,000	67,000	70,000	55,000
Ferrosilicon*		18,000	18,000	20,000	20,000	20,000
Silicomanganese		42,725	⁴ 44,000	⁴ 45,000	45,000	40,000
Total*		112,190	120,000	132,000	135,000	115,000
Steel, crude	thousand tons	6,129	6,399	6,735	6,666	⁶ 6,018

See footnotes at end of table.

TABLE 1—Continued
AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ^a	
METALS—Continued						
Iron and steel—Continued:						
Metal—Continued:						
Semimanufactures ^a	6,000	6,000	6,500	3,000	3,000	
Lead:						
Mine output, Pb content	thousand tons	489	465	495	¹ 565	² 571
Metal:						
Primary:						
Bullion, for export	do.	197	191	183	195	² 182
Refined	do.	202	¹ 168	¹ 178	212	² 220
Total	do.	399	³ 359	³ 361	407	402
Secondary excluding remelt	do.	15	17	18	20	² 18
Manganese ore (metallurgical):						
Gross weight	do.	1,853	1,985	2,124	1,998	² 1,482
Mn content	do.	881	945	1,011	911	² 701
Nickel:						
Mine output, Ni content	do.	75	62	¹ 67	67	² 69
Metal, smelter (refined Ni and Ni content of oxide)	do.	45	¹ 42	¹ 44	45	² 46
Platinum-group metals:^a						
Palladium, Pd content	kilograms	490	411	400	400	400
Platinum, Pt content	do.	130	106	100	100	100
Total	do.	620	517	500	500	500
Rare-earth metals, monazite concentrate:						
Gross weight		12,813	11,872	¹ 13,000	¹ 11,000	⁵ 5,000
Monazite content		¹ 11,900	11,039	¹ 12,000	10,200	¹ 10,000
Silver:						
Mine output, Ag content		1,119	1,117	1,075	1,138	¹ 1,180
Metal, refined		309	297	376	419	⁴ 400
Tin:						
Mine output, Sn content ^d		7,691	7,009	7,709	7,377	² 5,700
Metal, refined:						
Primary		563	439	424	312	² 268
Secondary ^a		300	300	300	200	300
Titanium concentrates, gross weight:						
Ilmenite	thousand tons	1,498	1,610	1,696	1,602	² 1,363
Leucoxene		11,290	11,742	18,000	19,000	² 18,000
Rutile		246,263	230,637	243,000	245,000	² 201,000
Tungsten, mine output, W content		1,152	1,261	1,371	1,086	² 237
Uranium, mine output, U content		3,780	3,531	3,656	3,529	³ 3,776
Zinc:						
Mine output, Zn content	thousand tons	778	759	803	937	² 1,048
Metal, smelter:						
Primary	do.	308	302	294	304	³ 304
Secondary ^a		4,500	3,700	² 5,500	5,550	6,000
Zirconium concentrates, gross weight	thousand tons	457	480	511	437	292

See footnotes at end of table.

TABLE 1—Continued
AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ^a	
INDUSTRIAL MINERALS						
Abrasives, natural:						
Beach pebble	1,036	*1,000	*1,000	1,500	2,000	
Garnet	16,837	*16,000	*16,000	20,000	25,000	
Barite	10,363	10,970	*11,000	11,000	11,000	
Cement, hydraulic	thousand tons	5,869	6,400	*6,500	6,500	6,750
Clays:						
Bentonite and bentonitic clay	30,392	*35,000	*35,000	35,000	35,000	
Brick clay and shale	thousand tons	*6,105	8,483	*8,500	8,000	8,000
Cement clay and shale	do.	*450	*450	*500	500	500
Damourite clay	106	*100	*100	100	100	
Fire clay ⁵	24,215	*25,000	*25,000	25,000	25,000	
Kaolin and ball clay ⁵	176,958	*180,000	*185,000	200,000	180,000	
Other ⁵	thousand tons	717	*1,000	*1,000	1,000	1,000
Diamond:						
Gem	thousand carats	13,650	17,413	17,540	17,331	² 17,978
Industrial	do.	16,683	17,413	17,540	17,331	² 17,978
Total	do.	30,333	34,826	35,080	34,662	35,956
Diatomite	10,263	11,117	*12,000	10,000	11,000	
Feldspar including nepheline syenite	11,418	15,877	*12,500	16,000	16,000	
Gemstones, other than diamond:^a						
Opal	value, thousands	\$62,010	\$50,000	\$60,000	\$90,000	\$85,000
Sapphire	do.	\$13,500	\$15,000	\$15,000	\$20,000	\$10,000
Other	do.	\$2,500	\$2,500	\$3,000	\$800	\$900
Total	do.	\$78,010	\$67,500	\$78,000	\$110,800	\$95,900
Gypsum	thousand tons	1,580	1,634	*1,800	1,800	2,000
Kyanite	1,079	*500	*500	750	800	
Lime ^a	1,100,000	1,100,000	1,500,000	1,500,000	1,500,000	
Magnesite	53,941	56,446	*55,000	60,000	60,000	
Nitrogen: N content of ammonia	413,400	385,800	343,600	385,300	385,000	
Perlite, crude	5,054	4,736	*5,000	5,000	5,000	
Phosphate rock	9,900	13,000	8,000	16,000	² 4,000	
Salt	thousand tons	6,486	7,165	7,069	7,227	² 7,791
Sillimanite ⁶	77	75	*80	100	100	
Spodumene, concentrate	22,279	*30,000	*40,000	40,000	50,000	
Stone, sand and gravel:						
Construction sand ⁷	thousand tons	28,067	*28,000	*30,000	30,000	30,000
Gravel ⁷	do.	15,365	*15,000	*15,000	15,000	15,000
Dolomite	do.	788	859	*1,000	1,000	1,000
Limestone:^a						
For cement	do.	7,250	*5,512	6,000	6,000	6,000
For other uses	do.	3,550	*5,294	6,000	6,000	6,000
Silica in the form of quartz, quartzite, glass sand	do.	2,361	1,969	*2,000	2,000	2,000
Other:⁷						
Crushed and broken stone	do.	65,278	*65,000	*65,000	65,000	65,000
Dimension stone	do.	99	*100	*100	100	100
Unspecified	do.	29,203	*30,000	*30,000	30,000	30,000

See footnotes at end of table.

TABLE 1—Continued
AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991*	
INDUSTRIAL MINERALS—Continued						
Sulfur: Byproduct:						
Metallurgy	thousand tons	194	200	² 200	200	200
Petroleum	do.	9	⁹	¹⁰	10	10
Total	do.	203	²⁰⁹	²¹⁰	210	200
Talc, chlorite, pyrophyllite, steatite		212,901	205,381	^{200,000}	205,000	216,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous and subbituminous	thousand tons	178,567	176,604	190,084	199,212	² 207,395
Lignite	do.	43,517	43,450	48,252	47,725	² 49,569
Total	do.	222,084	220,054	238,336	246,937	256,964
Coke, metallurgical	do.	3,778	3,866	4,073	4,250	4,000
Fuel briquets	do.	814	750	⁷⁵⁰	750	750
Gas, natural, marketed	million cubic meters	^{15,022}	^{15,384}	17,806	20,726	^{21,687}
Natural gas liquids	thousand 42-gallon barrels	^{24,425}	^{24,648}	^{23,701}	^{22,973}	^{22,261}
Peat ⁷		9,042	10,133	^{11,000}	11,000	11,000
Petroleum:						
Crude	thousand 42-gallon barrels	^{200,503}	^{189,570}	^{178,638}	^{210,629}	^{2198,821}
Refinery products:						
Gasoline:						
Aviation	do.	^{1,434}	^{1,207}	^{1,314}	^{1,353}	² 959
Motor	do.	^{97,637}	^{100,530}	101,109	^{103,401}	² 106,576
Jet fuel	do.	^{18,385}	^{20,624}	^{20,027}	^{21,818}	^{23,298}
Kerosene	do.	³⁸³	⁴⁶⁵	358	⁸⁴⁶	³¹⁵
Distillate fuel oil	do.	^{58,105}	^{62,426}	^{64,615}	^{67,523}	^{68,857}
Residual fuel oil	do.	^{14,032}	^{13,240}	^{15,102}	^{15,673}	^{17,374}
Lubricants	do.	^{3,874}	^{3,900}	3,969	^{4,208}	^{4,226}
Liquefied petroleum gas	do.	^{4,843}	^{4,944}	^{5,101}	^{4,851}	^{5,646}
Bitumen	do.	3,157	^{3,371}	3,780	^{3,550}	^{3,288}
Unspecified	do.	7,013	^{7,076}	^{6,328}	^{5,558}	^{6,760}
Refinery fuel and losses	do.	^{3,918}	^{5,755}	^{5,132}	^{2,314}	^{5,763}
Total	do.	^{212,781}	^{223,538}	^{226,835}	^{231,095}	243,062

*Estimated. ⁷Revised.

¹Includes data available through Aug. 30, 1991.

²Reported figure.

³Data are for years ending Nov. 30 of that stated for plants owned by the Broken Hill Pty. Co. Ltd.

⁴Excludes tin content of copper-tin and tin-tungsten concentrates.

⁵Excludes production from Western Australia.

⁶In addition, about 7,000 tons of sillimanite clay, also known as kaolinized sillimanite, is produced, containing 40% to 48% Al₂O₃.

⁷Excludes data from some States.

TABLE 2
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Alumina	Alcoa of Australia Ltd., 100%	Kwinana refinery, WA	1,660
Do.	do.	Pinjarra refinery, WA	1,600
Do.	do.	Wagerup refinery, WA	² 1,480
Do.	Nabalco Pty. Ltd., manager. (Swiss Aluminum Australia Ltd., 70%; and Gove Aluminum Ltd., 30%)	Gove refinery, QLD	³ 1,600
Do.	Queensland Alumina Ltd., operator. (Comalco Ltd., 30.3%; Kaiser Aluminum and Chemical Corp. (Australia) Ltd., 28.3%; Alcan Australia Ltd., 21.4%; and Pechiney Australia Pty. Ltd., 20%)	Gladstone refinery, WA	3,000
Do.	Worsley Alumina Pty. Ltd., manager. (Reynolds Australia Alumina Ltd., 50%; The Shell Co. of Australia Ltd., 37.5%; Kobe Alumina Associates (Australia) Pty. Ltd., 10%; and Nissho Iwai Alumina, 2.5%)	Worsley refinery, WA	1,400
Aluminum	Alcan Australia Ltd., 100%	Kurri Kurri smelter, NSW	150
Do.	do.	Point Henry smelter, VIC	165
Do.	do.	Portland Island smelter, VIC	300
Do.	Boyne Island Smelters Ltd., manager. (Comalco Ltd., 30%; Australia Metall., 20%; Sumitomo Light Metal Industries, 17%; Kobe Steel Ltd., 9.5%; Yoshida Kogyo KK, 9.5%; and Sumitomo Aluminum Smelting Co. Ltd., 4.5%)	Boyne Island smelter, QLD	23
Do.	Comalco Aluminium (Bell Bay) Ltd. (Operator and 82.6% owner; and Tasmanian Government, 17.4%)	Bell Bay smelter, TAS	117
Do.	Tomago Aluminium Co. Pty. Ltd., manager. (Gove Aluminium Finance Ltd., 35%; Pechiney Australia Pty. Ltd., 35%; Australian Mutual Provident Society, 15%; VAW Australia Pty. Ltd., 12%; and Hunter Douglas Ltd., 3%)	Tomago smelter, NSW	⁴ 420
Bauxite ⁵	Nabalco Pty. Ltd., manager. (Swiss Aluminium Australia Ltd., 70%; and Gove Aluminium Ltd., 30%)	Gove Mine, NT	⁶ 6,100
Do.	Comalco Aluminium Ltd., 100%	Weipa operations, QLD	11,000
Do.	Alcoa of Australia Ltd., 100%	Huntly, Jarrahdale, and Willowdale Mines, WA	22,000
Do.	Worsley Alumina Pty. Ltd., manager. (Reynolds Australia Alumina Ltd., 50%; The Shell Co. of Australia Ltd., 37.5%; Kobe Alumina Associates (Australia) Pty. Ltd., 10%; and Nissho-Iwai Alumina, 2.5%)	Mount Saddleback (Worsley) Mine, WA	3,850
Cement	Adelaide Brighton Cement Ltd., 100%	Birkenhead Plant, SA	1,000
Do.	Australian Portland Cement Ltd., 100%	Geelong Plant, SA	800
Do.	Blue Circle Southern Cement Ltd., 100%	Berrima Plant, NSW	1,200
Do.	Cockburn Cement Ltd., 100%	South Coogee Plant, WA	1,000
Do.	Goliath Cement Holdings Ltd., 100%	Railton Plant, TAS	1,000
Do.	The Queensland Cement and Lime Co. Ltd., 100%	Darra Plant, QLD	700
Coal, black	Austen and Butta Ltd., 100%	South Bulli underground mine, NSW	3,000
Do.	BHP Steel Collieries Division	Appin underground mine, NSW	2,250
Do.	do.	Cordeaux underground mine, NSW	2,800
Do.	do.	Tower underground mine, NSW	1,200

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Coal, black—Continued:	Camberwell Coal Pty. Ltd., operator. (Navidale Pty. Ltd., 50%; Toyota Tsusho Corp., 40%; and Dia Coal Ltd., 10%)	Camberwell open cut, NSW	7,400
Do.	Capricorn Coal Management Pty. Ltd., operator. (Shell Co. of Australia Ltd., 38.08%; Minproc Energy Pty. Ltd., 26.06%; Jena Pty. Ltd., 13.03%; Coal Developments (German Creek) Pty. Ltd., 12.06%; and Ruhrkohle Australia Pty. Ltd., 10.77%)	German Creek open cut and underground mine, QLD	6,000
Do.	Central Queensland Coal Associates, 100%. (BHP Australia Coal Ltd., 44.72% and operator; QCT Resources, 27.78%; Mitsubishi Development Pty. Ltd., 13.33%; AMP Society, 8.61%; and Pancontinental Mining Ltd., 5.56%)	Blackwater open cut, QLD	5,000
Do.	do.	Goonyella open cut, QLD	5,500
Do.	do.	Norwich Park open cut, QLD	4,500
Do.	do.	Peak Downs open cut, QLD	5,500
Do.	do.	Saraji open cut, QLD	4,700
Do.	Coal and Allied Industries Ltd., 100%	Hunter Valley No. 1 open cut, NSW	5,300
Do.	do.	Hunter Valley No. 2 open cut, NSW	5,200
Do.	Clutha, Ltd., 100%	Brimestone No. 1 underground mine, NSW	2,400
Do.	Curragh Queensland Mining Ltd., operator. (ARCO Coal Australia Inc., 60%; R.W. Miller Ltd., 30%; and Mitsui Coal Development (Australia) Ltd., 10%)	Curragh open cut, QLD	5,300
Do.	Pacific Power (formerly Electricity Commission of New South Wales), 100%	Angus Place underground mine, NSW	1,300
Do.	do.	Awaba underground mine, NSW	1,000
Do.	do.	Cooranbong underground mine, NSW	1,200
Do.	do.	Munmorach underground mine, NSW	1,200
Do.	do.	Myuna underground mine, NSW	1,500
Do.	do.	Newstan underground mine, NSW	2,200
Do.	do.	Wyee underground mine, NSW	1,750
Do.	Electricity Trust of South Australia, 100%	Leigh Creek open cutmine, SA	3,000
Do.	FAI Mining Ltd., 100%	Teralba underground mine, NSW	1,200
Do.	do.	West Wallsend underground mine, NSW	2,400
Do.	Kembla Coal and Coke Pty. Ltd., 100%	Fahmoor underground mine, NSW	1,800
Do.	do.	West Cliff underground mine, NSW	3,000
Do.	MIM Holdings Ltd., 75%, and AGIP Australia Pty. Ltd., 25%	Newlands open cut, QLD	5,000
Do.	Oakbridge Ltd., 100%	Gretley underground mine, NSW	1,000
Do.	do.	Ellalong underground mine, NSW	2,000
Do.	Oakbridge Ltd., 80%, manager. Sumitomo Coal Mining Co. Ltd., 20% (Japan)	Baal Bone underground mine, NSW	2,500
Do.	Oakbridge Ltd., 80%, manager. Kyodo Oil 10% (Japan); and Yukong Ltd., 10% (Republic of Korea)	Clarence underground mine, NSW	1,700

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Coal, black—Continued:	Pacific Coal Pty. Ltd., 57.195%, operator; ARCO Coal Australia Inc., 17.527%; ARCO Resources Ltd., 13.889%; and Electric Power Development Co.-Japan Coal Development, 11.389%	Blair Athol open cut, QLD	8,000
Do.	Ulan Coal Mines Ltd., 100%	Ulan No. 2 underground mine, NSW	4,600
Do.	Wambo Mining Corp. Pty. Ltd., 100%	Wambo underground mine, NSW	3,000
Coal, brown	The State Electricity Commission of Victoria, 100%	Latrobe Valley open cut mines (Loy Yang, Morwell, Yallourn), VIC	48,000
Copper	Copper Refineries Pty. Ltd., 100%	Townsville refinery, QLD	⁸ 155
Copper, gold	Poseidon Gold Ltd., 100%	Gecko Mine, NT	⁹ 16,000 ¹⁰ 800
Copper, gold, silver	Renison Goldfields Consolidated Ltd., 100%	Mount Lyell Mine, TAS	¹¹ 1,500
Copper, gold, palladium, platinum, selenium	Southern Copper Ltd., manager. (Enterprise Metals Ltd., 60%; Furakawa Co. Ltd., 30%; and Nissho-Iwai Corp., 10%)	Port Kembla refinery-smelter, NSW	¹¹ 80
Copper, lead, zinc, gold, silver	Denehurst Ltd., operator, 100%.	Woodlawn Mine, NSW	¹⁶ 600
Do.	Cobar Mines Pty. Ltd., 100%	Cobar (CSA) Mine, NSW	¹⁹ 900
Copper, zinc	Macquarie Resources Ltd., 100%	Benambra Mine, VIC	¹² 70,000 ¹³ 15,000
Copper, gold, silver, uranium	Roxby Mining Corp. Pty. Ltd., 51%, and BP Australia Ltd., 49%	Olympic Dam Mine, smelter, and refinery, SA	¹⁴ 66 ¹⁰ 850 ¹⁵ 555 ¹⁶ 1,400
Copper, nickel	AGIP Australia Pty. Ltd., 100%	Radio Hill Mine, WA	¹⁷ 11
Diamond	Argyle Diamond Mines Pty. Ltd., manager. CRA Ltd., 59.7%; and Ashton Mining Ltd., 40.3%	Argyle Mine (AK-1 pipe and alluvial deposits), WA	¹⁸ 35,000
Do.	Poseidon Ltd., 100%	Bow River Mine, WA	¹⁸ 1,000
Gold ¹⁰	ACM Gold Ltd., 100%	Golden Crown Mine, WA	1,150
Do.	do.	Wirralie Mine, QLD	3,200
Do.	ACM Gold Ltd., 50%; and Placer Pacific Ltd., 50%	Big Bell Mine, WA	5,000
Do.	Alcoa of Australia Ltd., 100%	Hedges Mine, WA	4,875
Do.	Asarco Australia Ltd., 100%	Wiluna Mine, WA	4,225
Do.	Australian Gold Refineries, 100% (State of Western Australia agency)	Kalgoorlie refinery, WA	¹⁹ 46,000
Do.	do.	Perth refinery (Newburn), WA	¹⁹ 5,000
Do.	Newcrest Mining Ltd., 100%	Tuckabianna Mine, WA	1,700
Do.	Aztec Mining Co. Ltd., operator, 62%; and Forrestania Gold NL, 38%	Bounty Mine, WA	2,500
Do.	Pajingo Gold Mine Pty. Ltd., 100%	Pajingo Mine, QLD	1,900
Do.	Newcrest Mining Ltd., 100%	Ora Banada Mine, WA	2,650
Do.	Central Coast Exploration NL, manager, 66.67%, and Pancontinental Mining Ltd., 33.33%	Croydon Mine, QLD	4,700
Do.	Dominion Mining Ltd., 100%	Cosmo Howley Mine, NT	1,700
Do.	do.	Gabanintha Mine, WA	2,300
Do.	Niugini Mining Ltd., 100%	Red Dome Mine, QLD	2,000

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Gold ¹⁰ —Continued:	Forsyth NL, operator, 50%; and Reynolds Australia Mines Ltd., 50%	Mount Gibson Mine, WA	3,450
Do.	Golden Kilometre Mines Joint Venture, manager. (Southern Resources Ltd., 55%; Square Gold and Minerals Ltd., 25%; Black Flag Consolidated, 20%)	Golden Kilometre Mine, WA	1,750
Do.	Hampton Areas Australia Ltd., 100%	Jubilee Mine, WA	2,300
Do.	Homestake Gold of Australia, 100%	Fortnum Mine, WA	1,500
Do.	Kalgoorlie Consolidated Gold Mines Pty. Ltd., manager. (Gold Mines of Kalgoorlie Ltd., 50%; and Homestake Gold of Australia Ltd., 50%)	Kalgoorlie Super Pit, WA (Amalgamation of Fimiston, underground, Mount Charlotte, and Paringa operations)	9,350
Do.	Kidston Gold Mines Ltd., manager, 100%	Kidston Mine, QLD	7,100
Do.	Newcrest Mining Ltd., 100%	Telfer Mine, WA	9,350
Do.	Newmont Australia Ltd., manager, 80%; and Mount Martin Gold Mines NL, 20%	New Celebration Mine, WA	3,750
Do.	North Flinders Mines Ltd., 100%	Granites Mine, NT	3,500
Do.	Mount Leyshon Gold Mines Ltd., 100%	Mount Leyshon Mine, QLD	6,000
Do.	Perseverance Corp. Ltd., 100%	Nagambie Mine, VIC	1,250
Do.	Renison Goldfields Consolidated Ltd., 100%	Pine Creek Mine, NT	3,100
Do.	Placer Pacific Ltd., manager, 60%; and Delta Gold NL, 40%	Granny Smith Mine, WA	7,300
Do.	Plutonic Resources Ltd., 100%	Plutonic Mine, WA	5,000
Do.	Renison Goldfields Consolidated Ltd., 100%	Lucky Draw Mine, NSW	1,500
Do.	Sons of Gwalia NL, 100%	Sons of Gwalia Mine, WA	2,000
Do.	Western Mining Corp., 50%; and Central Norseman Gold Corp., 50%	Stawell Mine, VIC	1,100
Do.	Zapopan NL, 100%	Tanami Mine, NT	1,900
Gold, copper	Cyprus Gold Australia Corp., manager, 50%; Arimco NL, 25%; Elders Mining Pty. Ltd., 25%	Selwyn (Starra) Mine, QLD	3,600 9 ¹⁰ 10,000
Do.	Worsley Alumina Pty. Ltd., manager. (Reynolds Australia Metals Ltd., 40%; Billiton Australia Gold Pty. Ltd., 30%; Newcrest Mining Ltd., 20%; and Kobe Alumina Associates (Australia) Pty. Ltd., 10%)	Boddington Mine, WA	14,000 20 ¹⁰ 10,000
Gold, copper, lead, zinc	Enterprise Metals Ltd., 100%	Peak Mine, NSW ²¹	3,100 9 ² 2,250 22 ⁴ 8,850 23 ³ 6,600
Gold, silver	MIM Holdings Ltd., 100%	Pacific precious-metals refinery, NSW	19 ¹ 1,900 13 ⁵ 500
Do.	Paragon Resources NL., 100%	Temora Mine, NSW	2,250 15 ² 2,250
Iron ore	BHP Minerals Ltd., 100%	Koolan Island (Yampi) Mine, WA	4,000
Do.	BHP Iron Pty. Ltd., 55%; BHP Australia Coal Pty. Ltd., 30%; CI Minerals Australia Pty. Ltd., 8%; and Mitsui and Iron Ore Corp. Pty. Ltd., 7%	Kennedy Gap, Nimingarra, Shay Gap, Sunrise Hill, and Yarrie deposits	6,500
Do.	BHP Minerals Ltd., 85%; CI Minerals Australia Pty. Ltd., 8%; and Mitsui Iron Ore Corp. Pty. Ltd., 7%	Yandi (formerly Yandicoogina) ²¹ Mine, WA	5,000

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Iron ore—Continued:	Channar Management Services, manager. (Hamersley Iron Pty. Ltd., 60%; and CMIEC (Channar) Pty. Ltd., 40%, China Government agency)	Channar Mine WA	3,000
Do.	Hamersley Iron Pty. Ltd., 100%	Mount Tom Price and Paraburdoo Mines, WA	42,000
Do.	BHP Minerals Ltd., 55%; Pilbara Iron Ltd., 30%; Mitsui-C. Itoh Pty. Ltd., 10%; CI Minerals Australia Pty. Ltd., 5%	Mount Whaleback (Mount Newman) Mine, WA	30,000
Do.	do.	Orebody 29, WA	5,000
Do.	Robe River Iron Associates, manager. (North Broken Hill-Peko Ltd., 53%; Robe River Mining Co. Pty. Ltd., 30%; Mitsui Iron Ore Development Pty. Ltd., 20%; Pannawonica Iron Associates, 10%; and Cape Lambert Iron Associates, 5%)	Pannawonica-Deepdale Mines, WA	27,000
Do.	Savage River Mines, operator. (Pickands Mather and Co. International, 100%)	Savage River Mines, TAS	1,300
Lead	MIM Holdings Ltd., 100%	Mount Isa smelter, QLD	²⁴ 210
Lead, zinc, silver	do.	Mount Isa Mine, QLD	⁵⁴ 600
Do.	do.	Hilton Mine QLD	⁵¹ 200
Do.	Pasminco Ltd., 100%	Broken Hill (North Operation, formerly North Mine and South Operation, NSW)	⁵² 900
Lead, zinc, silver, gold, cadmium	do.	Port Pirie refinery-smelter, SA	²² 235
Lithium	Gwalia Consolidated Ltd., 100%	Greenbushes Mine, WA	²⁶ 84
Manganese	Groote Eylandt Mining Co. Pty. Ltd., 100%	Groote Eylandt Mine, NT	⁵² 000
Manganese alloys	Tasmanian Electro Metallurgical Co. Pty. Ltd., 100%	Bell Bay smelter, TAS	²⁷ 190
Mineral sands	RGC Mineral Sands Ltd., 100%	Capel Mine and associated Capel dry processing and synthetic rutile plants, WA	²⁸ 360 ²⁹ 100
Do.	Newcrest Mining Ltd., 100%	Eneabba and Eneabba West Mines and associated Eneabba dry processing and Narngulu dry processing and synthetic rutile plants, WA	³⁰ 170 ³¹ 300 ³² 15
Do.	Newcrest Mining Ltd., 100%	Woodburn Mine (includes Newrybar, Richmond River, Lennox Head, Hastings Point, and Byron Bay) and associated Woodburn dry processing plant, NSW	²⁹ 10 ³¹ 10
Do.	Cable Sands (WA) Pty. Ltd., 100%	Busselton East and Waroona Mines and associated Bunbury dry processing plant, QLD	²⁸ 200 ³² 1 ³¹ 15 ³³ 5
Do.	Consolidated Rutile Ltd., 100%	Amity, Bayside, and Gordon Mines on North Stradbroke Island and associated Pinkenba dry processing plant, QLD	²⁸ 280 ³¹ 85 ²⁹ 100 ³² 1

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Mineral sands	Mineral Deposits Ltd., 100%	Stockton and Viney Creek Mines and associated Hawks Nest dry processing plant, NSW	²⁹ 30 ³¹ 25 ²⁸ 10
Do.	Minproc Chemical Co. Pty. Ltd., manager, 50%; and Kerr-McGee Chemical Corp., 50% (Tiwest Joint Venture)	Cooljarloo Mine and associated Chandala dry processing and synthetic rutile plants; and Kwinana titanium pigment plant, WA	²⁸ 180 ³³ 9 ³² 1 ²⁹ 35 ³⁰ 68 ³¹ 60 ³⁴ 54
Do.	RZM Pty. Ltd., 100%	Nabiac Mine and associated Harrington dry processing plant; 4 miles in Tomago area and associated Tomago dry processing plants, NSW	²⁹ 35 ³¹ 35 ²⁸ 10
Do.	Westralian Sands Pty. Ltd., 100%	North Capel, ³⁵ Yoganup Extended ³⁵ and Yoganup North Mines and associated Capel dry processing and synthetic rutile and North Capel dry processing plants, WA	²⁸ 540 ³¹ 50 ³² 2 ³⁰ 100
Do.	Wimmera Industrial Minerals Pty. Ltd., 100%	WIM 150 (Horsham) Mine, ³⁶ VIC	²⁸ 250 ²⁹ 100 ³¹ 20 ³² 12
Nickel	Outokumpu Metals and Resources Oy, 50%	Mount Keith Mine, ³⁶ WA	⁵ 6,600
Nickel, cobalt	MEQ Nickel Pty. Ltd., manager, 72%; and Nickel Resources North Queensland Pty. Ltd., a subsidiary of the Queensland Government, 28%	Greenvale Mine, QLD	⁵ 1,300
Do.	do.	Yabulu refinery, QLD	³⁷ 23 ³⁸ 1
Nickel	Western Mining Corp. Ltd., 100%	Kalgoorlie smelter, WA	³⁹ 50
Do.	do.	Kambalda Nickel Operations, WA	⁵ 1,600
Do.	do.	Kwinana refinery, WA	⁴⁰ 35
Do.	do.	Leinster Nickel Operations, WA	⁵ 1,000
Opal	Many small producers	Andamooka and Coober Pedy areas, SA; Lightning Ridge area, NSW	NA
Petroleum ⁴¹	Ampol Refineries Ltd., 100%	Lytton refinery, QLD	74
Do.	BP Refinery (Bulwer Island) Pty. Ltd., 100%	Bulwer Island refinery, QLD	53
Do.	BP Refinery (Kwinana) Pty. Ltd., 100%	Kwinana refinery, WA	120
Do.	Caltex Refining Co. Pty. Ltd., 100%	Kurnell refinery, NSW	108
Do.	Petroleum Refineries (Australia) Pty. Ltd., manager. Mobil Oil Australia Ltd., 100%	Altona refinery, VIC	108
Do.	do.	Port Stanvac refinery, SA	72
Do.	Shell Refining (Australia) Pty. Ltd., 100%	Clyde refinery, NSW	91
Do.	do.	Geelong refinery, NSW	132
Salt	Dampier Salt (Operations) Pty. Ltd., 100%	Dampier and Lake McCleod Fields, WA	⁴² 4,500
Do.	Cargill Australia Ltd., 100%	Leslie Salt operations, WA	2,250
Steel	BHP Steel Ltd., 100%	Newcastle steelworks, NSW	1,800
Do.	do.	Port Kembla steelworks, NSW	3,800

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Steel—Continued:	BHP Steel Ltd., 100%	Whyalla steelworks, SA	1,100
Do.	do.	Sydney Minimill, NSW	2,500
Talc	Three Springs Talc Pty. Ltd., 100%	Three Springs Mines, WA	200
Tin	Renison Goldfields Consolidated Ltd., 100%	Renison Bell Mine, TAS	⁵ 825
Tin, tantalum	Gwalia Consolidated Ltd., 100%	Greenbushes Mine, WA	⁵ 2,200
Uranium	Energy Resources of Australia Ltd., 100%	Ranger Mine, NT	⁴ 3,500
Zinc	Perilya Mines NL, 37.5%; Cove Mining NL, 37.5%; and CRA Exploration Pty. Ltd., 25%	Mount Garnett Mine, QLD ⁴⁴	⁵ 400
Do.	Pasminco Ltd., 100%	Ridson refinery, TAS	⁴⁴ 220
Do.	Sulphide Corp. Pty. Ltd., 100%	Cockle Creek refinery-smelter, NSW	⁴⁴ 70
Zinc, copper	Australian Consolidated Ltd., operator. (Australian Consolidated Minerals Ltd., 45%; Esso Australia Resources, 35%; and Aztec Mining Co. Ltd., 20%)	Golden Grove (Scuddles) Mine, WA	⁵ 800
Zinc, lead	BHP Minerals Ltd., 100%	Cadjebut Mine, WA	⁵ 320
Zinc, lead, copper, silver, gold	Aberfoyle Ltd., 100%	Hellyer Mine, TAS	⁵ 1,250
Do.	do.	Que River Mine, TAS	⁵ 300
Do.	Pasminco Ltd., 100%	Rosebery Mine, TAS	⁵ 505
Do.	do.	Elura Mine, NSW	⁵ 1,250
Zinc, lead, silver	Nicron Resources Ltd., 100%	Woodcutters Mine, NT	⁵ 500

See footnotes at end of table.

TABLE 2—Continued
AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities ¹	Annual capacity
Zinc, lead, silver	Pancontinental Mining Ltd., manager, 50%; Outokumpu Australia Pty. Ltd., 25%; and Agip Australia Pty. Ltd., 25%	Thalanga Mine, QLD	² 550
Zirconia	Z-Tech Pty. Ltd., 100%	Rockingham, WA	⁴ 50

NA Not available.

¹NSW New South Wales; NT Northern Territory; QLD Queensland; SA South Australia; TAS Tasmania; VIC Victoria; WA Western Australia.

²Capacity scheduled for early 1993; 1991 capacity was 850,000 tons of alumina, Al₂O₃.

³Capacity scheduled for early 1992; 1991 capacity was 1,400,000 tons of alumina, Al₂O₃.

⁴Capacity scheduled for mid-1992; 1991 capacity was 240,000 tons of aluminum.

⁵Ore.

⁶Capacity scheduled for early 1992; 1991 capacity was 5,800,000 tons of bauxite.

⁷Production began in Apr. 1991, producing 200,000 tons by yearend; capacity will be 2.4 million tons per year by 1993.

⁸Refined copper.

⁹Tons copper-in-concentrates.

¹⁰Kilograms gold.

¹¹Capacity scheduled for 1992; 1991 capacity was 50,000 tons of refined copper.

¹²Tons copper concentrate.

¹³Tons zinc concentrate.

¹⁴Capacity scheduled for yearend 1992; 1991 capacity was 46,000 tons of refined copper.

¹⁵Kilograms silver.

¹⁶Capacity scheduled for year end 1992; 1991 capacity was 1,200 tons of triuranium octoxide, U₃O₈.

¹⁷Copper-nickel matte.

¹⁸Thousand carats.

¹⁹Kilograms refined gold.

²⁰Tons copper concentrate.

²¹Scheduled to begin production in 1992.

²²Tons zinc-in-concentrates.

²³Tons crude lead containing silver.

²⁴Tons lead-in-concentrates.

²⁵Primary lead.

²⁶Spodumene concentrate.

²⁷Ferromanganese and/or silicomanganese.

²⁸Ilmenite.

²⁹Rutile.

³⁰Synthetic rutile.

³¹Zircon.

³²Monazite.

³³Leucoxene.

³⁴Titanium dioxide, TiO₂, pigment.

³⁵Closed temporarily in late 1990.

³⁶Scheduled to begin production in 1993.

³⁷Nickel in oxides.

³⁸Cobalt in mixed sulfides.

³⁹Nickel matte.

⁴⁰Refined nickel with copper sulfide and mixed nickel-cobalt sulfides.

⁴¹Thousand 42-gallon barrels per day.

⁴²Capacity scheduled for 1992; 1991 capacity was 3.5 million tons of solar salt.

⁴³Tons triuranium octoxide, U₃O₈.

⁴⁴Zinc metal.

⁴⁵Tons high-purity zirconia, ZrO₂, powder.

TABLE 3
AUSTRALIA: LARGEST AUSTRALIAN GOLD MINDS IN 1991

Mine and State	1991 production (kilograms)
1. Boddington, Western Australia	12,395
2. Super Pit, Western Australia	12,182
3. Telfer, Western Australia	10,483
4. Kambalda, Western Australia	7,673
5. Mount Magnet, Western Australia	6,503
6. Granny Smith, Western Australia	6,503
7. Mount Leyshon, Queensland	6,471
8. Kidston, Queensland	5,964
9. Plutonic, Western Australia	5,830
10. Hedges, Western Australia	5,194
11. Big Bell, Western Australia	4,228
12. Mount Charlotte, Western Australia	3,862
13. New Celebration, Western Australia	3,715
14. Starra/Selwyn, Queensland	3,672
15. Wiluna, Western Australia	3,480

Source: Resource Information Unit Ltd.

TABLE 4
SHARES OF IRON ORE EXPORTS IN 1991

(Percent)

Source	Destination						
	Western Europe	Eastern Europe	Japan	Other Asia	North America	Rest of world	World total
Australia	15	—	48	52	—	1	29.1
Latin America	42	12	29	33	34	65	34.7
India	1	7	16	6	—	17	7.9
Canada	13	1	2	2	40	2	7.4
Former U.S.S.R.	3	76	—	—	—	4	6.9
Africa	12	3	4	4	3	—	6.8
Western Europe	14	1	—	2	1	11	5.7
Other	—	—	1	1	22	—	1.5
Total	100	100	100	100	100	100	100

Source: Metal Bulletin.

TABLE 5
AUSTRALIA: COAL EXPORTS, BY STATE AND PORT

(Million metric tons)

State and port	1990	1991
Queensland:		
Abbot Point	5.6	5.3
Brisbane	2.4	¹ 3.2
Dalrymple Bay	16.4	¹ 18.0
Hay Point	19.2	¹ 20.9
Gladstone	17.4	¹ 19.1
Total	<u>²60.9</u>	<u>¹66.6</u>
New South Wales:		
Newcastle	33.1	¹ 37.9
Port Kembla	10.4	¹ 14.7
Sydney	2.2	1.0
Total	<u>45.7</u>	<u>¹53.6</u>
Grand total	<u>106.6</u>	<u>¹120.1</u>

¹Record high.

²Data do not add to totals shown because of independent rounding.

Source: Coalcomm.

TABLE 6
AUSTRALIA: RESERVES OF MAJOR MINERAL COMMODITIES¹
FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Antimony	39.5
Bauxite	6,354
Black coal:	
In situ	71.5
Recoverable	51.4
Brown coal:	
In situ	46.3
Recoverable	41.7
Cadmium	63.3
Cobalt	80
Columbium	3.4
Copper	6.9
Diamond:	
Gem and near gem	569
Industrial	712
Gold	2,145
Iron ore	17.9
Lead	10
Lithium	160
Manganese ore	110
Mineral sands:	
Ilmenite	102.4
Rutile	11.7
Zircon	19.3
Nickel	3.4
Petroleum, recoverable:	
Condensate	78
Crude	264
Liquid petroleum gas	106
Natural gas	853
Platinum-group metals (Pd, Pt)	19
Rare earths (REO plus Y ₂ O ₃)	300
Silver	19.2
Tantalum	6
Tin	165.5
Tungsten	5.1
Uranium, recoverable	474
Vanadium	24
Zinc	16.9

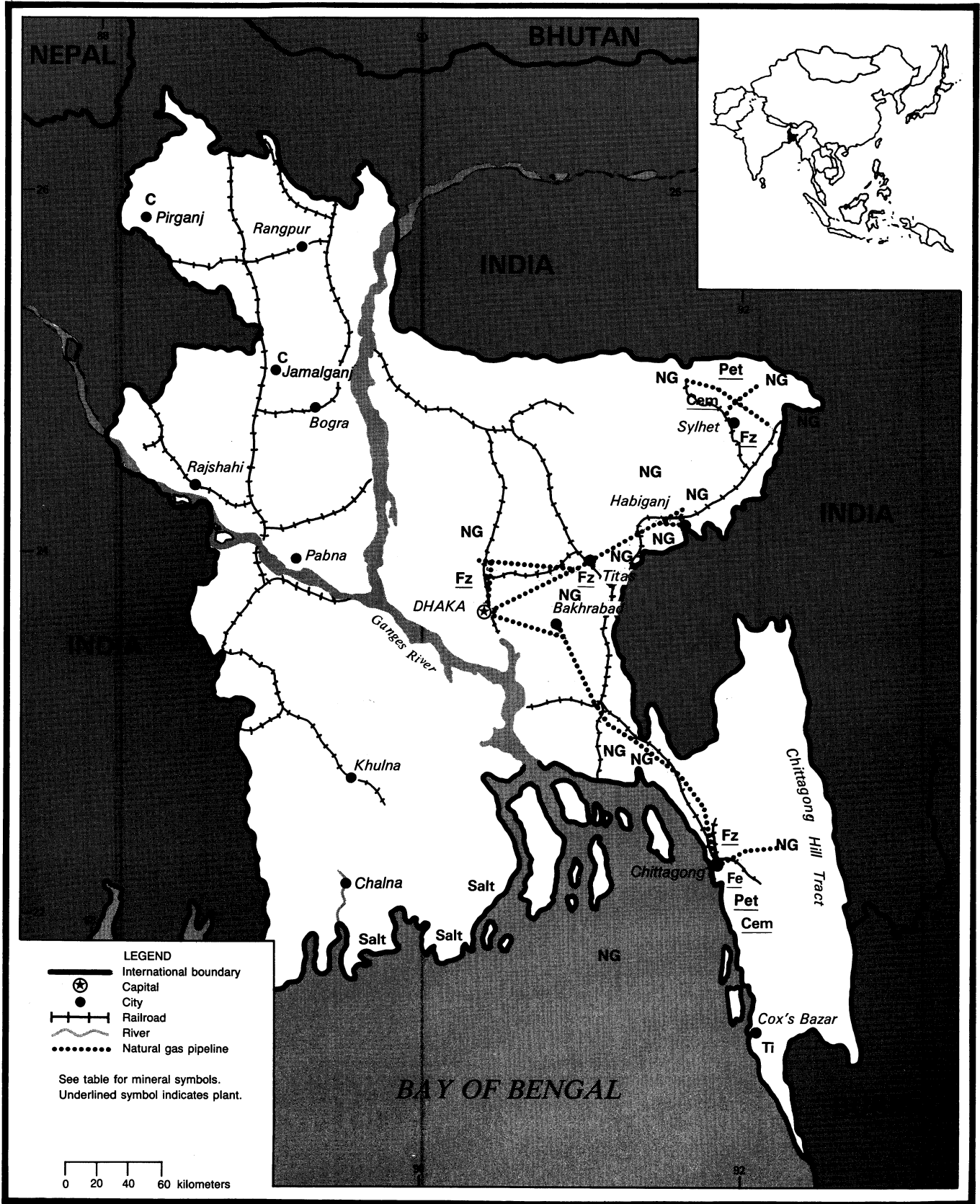
¹As of Dec. 31, 1991.

Source: Minerals Resource Branch, Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia.

BANGLADESH

AREA 144,000 km²

POPULATION 117 million



THE MINERAL INDUSTRY OF

BANGLADESH

By Chin S. Kuo

Bangladesh is one of the world's poorest countries and has a population of 117 million. The GDP at \$23.1 billion¹ in fiscal year 1991 ending June 30 registered a small gain of 3.2% over that of fiscal year 1990. As a result, the GDP per capita was only \$198.65. The country lacks major mineral resources and has to rely on imports of industrial raw materials. Only natural gas and petroleum are the important indigenous energy commodities. Agriculture and services sectors dominated the contribution to the GDP with a share of 83% while industry and commerce contributed only 17%. By work force, the former sectors utilized 89% of the nation's laborers while the latter used only 11%. About 65,000 Bangladesh workers employed in Kuwait and Iraq had to be repatriated before the Gulf War at a great expense to the Government. The unemployment rate of 30% and limited infrastructure hampered the country's industrial development.

A devastating cyclone ravaged the nation's southeast coast in April. Output of a narrow variety of agricultural products, such as jute, sustained the economy. Jute is the main cash crop and has been a major source of export earnings. Bangladesh also exported leather, shrimp, tea, and textiles. The main import items were capital equipment, food, nonfood consumer goods, petroleum and other energy forms, and semiprocessed goods. The major trading partners were the European Community countries, Japan, Middle Eastern countries, and the United States. Owing to lower imports stemming from depressed domestic demand as a result of the slowdown in GDP growth, Bangladesh's current account deficit declined sharply. Despite the discouraging results in the industrial

sector, exports were up 10% due to the accelerated depreciation of the taka.

Foreign aid disbursements were down in fiscal year 1991 and mainly came from the International Monetary Fund, the World Bank, the Asian Development Bank, and other donors. The Government aimed at increasing the contribution drawn from domestic resources to 12.6% of the annual development plan budget and to 35% by fiscal year 1995. Donor-financed projects and the manufacturing sector were stagnant while export-oriented industries continued to expand at a healthy rate. State-owned steel mills and utility companies have been frequent money losers. The Bangladesh Power Development Board suffered an extraordinarily high system loss rate of 42% of electricity. The Government's industrial policy was to privatize the public-sector industries and strengthen private-sector activities with greater deregulation.

The new industrial policy offered generous tax incentives and other matching inducements. Beginning in July, foreign equity participation of up to 100% was allowed on investments anywhere in the country. Foreign investments were to be treated on a par with domestic capital. Specific measures included steps to encourage new businesses, provide tax exemptions to exporters, and reduce the state's role in the economy. Financial liberalization measures allowed foreign companies to repatriate profits without Government approval. The country was in need of foreign and local investment in power generation and transmission equipment and oil and gas drilling services. (See table 1.)

Relief efforts were offered to Bangladesh in the form of tenders for

35,000 tons of triple superphosphate under Dutch aid, 25,000 tons under a Saudi Flood Reparation Grant, and 100,000 tons under a Japanese Relief Grant. Mitsubishi Heavy Industries, Ltd. of Japan constructed a 1,700-mt/d urea plant for Jamuna Fertilizer Co. in Jamalpur. The plant was reportedly completed in 1991.

A Chinese team of experts was brought in to assess the Boropukuria coalfield in northern Diapjur District. The team reportedly had confirmed the existence of a coal resource of 300 Mmt of good quality at depths of above 150 m. The Asian Development Bank was interested in financing development of the coalfield.

The Government-owned Eastern Refinery Ltd. let a \$40 million contract to Technip of France to expand its 31,200-bbl/d refinery at Chittagong. The project was to include construction of a visbreaker, a hydrocracker, and hydrogen units and would take 30 months to complete. The modernization scheme received financial support from the World Bank.

Dubai, UAE-based Scimitar Exploration Co. discovered natural gas-condensate in its Jalalabad one well, which was drilled to 2,876 m deep on a previously undrilled structure. The well flowed gas at a combined rate of 2 Mm³/d from three of five main sands. Condensate flow was 840 to 1,050 bbl/d of 42 to 52 degrees of gravity.

About \$508 million was slated to be invested in the oil and gas sector over fiscal years 1992 through 1994 on the procurement of exploration, drilling, and production equipment to be financed by the World Bank and the Asian Development Bank. The World Bank was waiting for private-sector participation in drilling before approving new loans for drilling.

¹Where necessary, values have been converted from Bangladesh taka to U.S. dollars at the rate of 9=US\$1.00 for 1991.

TABLE 1
BANGLADESH: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ^P	
Cement, hydraulic ³	310,000	³ 310,077	³ 343,990	³ 337,359	274,551	
Clays: Kaolin ³	12,272	10,097	7,092	⁷ 7,223	7,338	
Gas, natural, marketed ^{3 4}	million cubic meters	³ 3,549	⁴ 4,113	⁴ 4,413	⁴ 4,754	4,893
Iron and steel: Metal: ³						
Steel, crude (ingot only)	82,081	⁷ 70,036	86,274	⁷ 75,029	57,520	
Steel products	129,986	⁷ 114,420	⁷ 109,161	⁸ 87,422	95,016	
Nitrogen: N content of urea, ammonia, and ammonium sulfate	435,900	673,400	775,000	⁷ 700,500	667,300	
Petroleum:						
Crude	thousand 42-gallon barrels	2,050	1,687	1,287	1,191	¹ 1,200
Refinery products	do.	⁷ 7,610	7,411	7,688	⁷ 7,500	⁷ 7,600
Salt, marine ^{3 3}	416,000	409,000	415,000	³ 350,000	300,000	
Stone: Limestone ³	45,667	32,933	29,457	³ 38,008	42,484	

^PEstimated. ^PPreliminary. ^RRevised.

¹Table includes data available through Aug. 21, 1992.

²In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

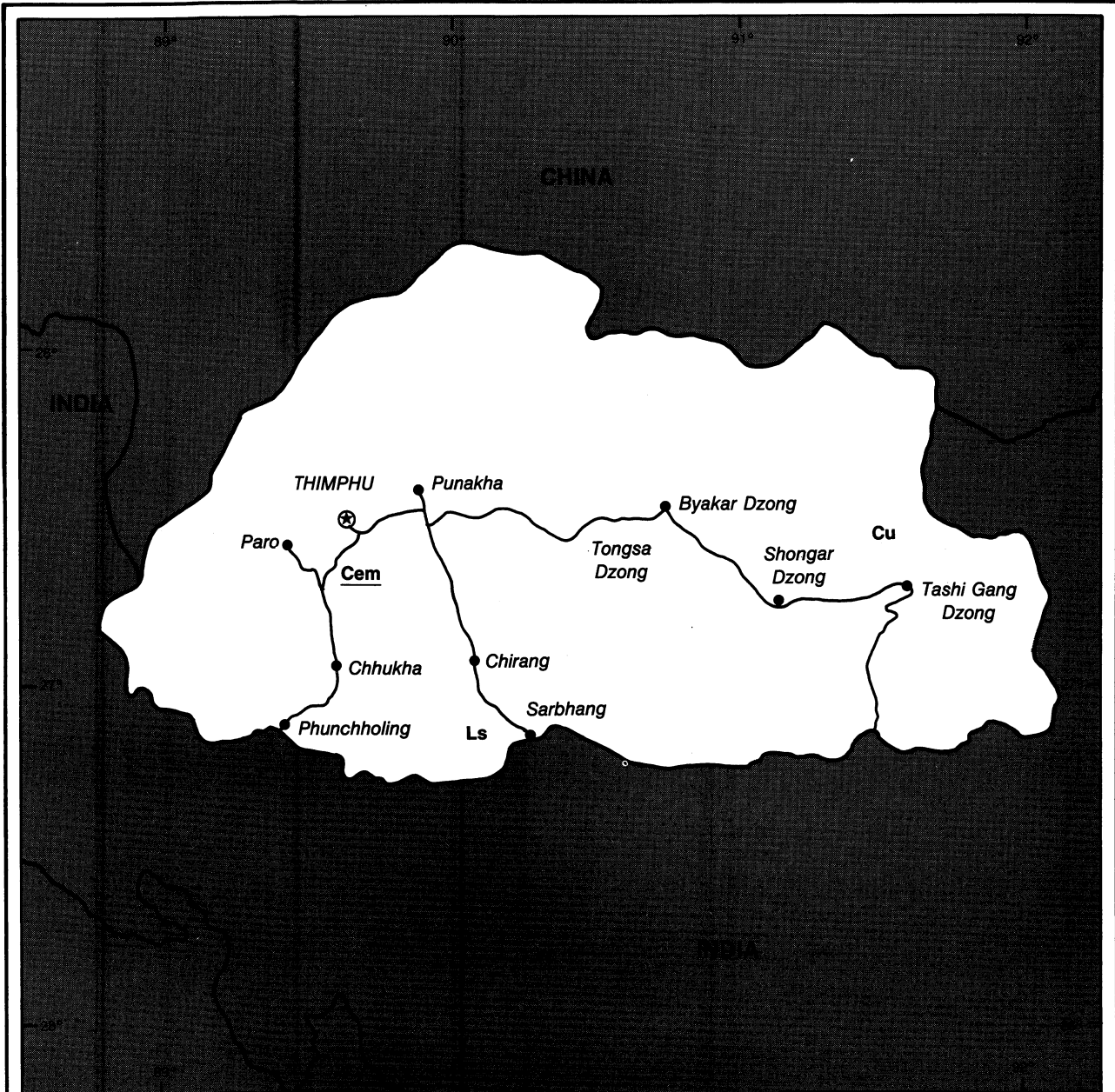
³Data are for years ending June 30 of that stated.

⁴Gross production is not reported; the quantity vented, flared, or reinjected is believed to be negligible.

BHUTAN

AREA 47,000 km²

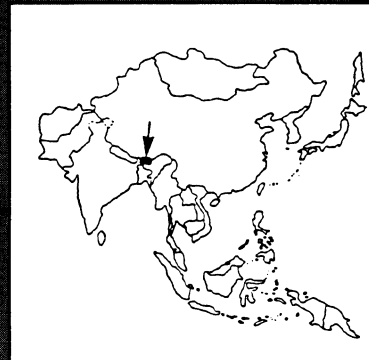
POPULATION 1.6 million



- LEGEND
- International boundary
 - Capital
 - City
 - Road

See table for mineral symbols.
Underlined symbol indicates plant.

0 10 20 30 kilometers



THE MINERAL INDUSTRY OF BHUTAN

By John C. Wu

The Kingdom of Bhutan is a mountainous, landlocked state buffered between India and China. It is an agrarian-based economy. Mineral production is not notable in terms of quantity. A Himalayan country of great physiographic relief, Bhutan offers spectacular scenery for tourism as well as excellent sites for the construction of dams for the generation of hydroelectricity. In the past, the country was almost totally dependent on India for economic assistance. Bhutan has broadened its economic development with financial and technical aid from countries in Europe and the Far East, as well as that from international organizations.¹

The Government initiated a series of 5-year plans starting in 1961. The Sixth 5-Year Plan, which ends in 1991, emphasized programs and activities dealing with forestry, agriculture, and animal husbandry. No specific plans are known for the mining sector. In the past, mineral exploration was carried out by the Geological Survey of India.

Mine production of minerals in Bhutan is limited both in terms of variety and quantity. There is small output of limestone, dolomite, gypsum for cement manufacture, slate for use as a dimension stone, and construction materials such as sand, gravel, and crushed stone. Coal is the only mineral fuel believed to be mined.

Bhutan's major exports are forestry and agricultural products and electricity. The country imports sugar, rice, diesel oil, lubricants, gasoline, machinery, and various manufactures. All trade is conducted through India, which is the dominant trading partner, as expected.

No information is known on the structure of the mineral industry or on the mining companies and mining districts. It is believed that mining activities are

under the administration of the Ministry of Trade and Industries.

There is mine production of carbonate minerals (dolomite and limestone) and gypsum for the manufacture of cement. The cement plant is in Gomptu, about 50 km south of the capital, Thimphu. The plant is estimated to have an output capacity of 155,000 mt/a. Slate is quarried for use as a dimension stone.

No information is available on reserves. Geologic mapping and exploration is still largely in an incipient stage, due largely to the difficulty of access to much of the country, with its high relief and lack of roads. The Himalayas are known to include thick sequences of carbonate rocks, and Bhutan's mineral resources of dolomite and limestone may be large.

Bhutan has a total of 1,304 km of highways, composed of 418 km surfaced, 515 km improved, and 371 km of unimproved earth or loose-surface roads. The country has two airports, both with runways 1,220 to 2,439 m long. Only one has a permanent-surface runway, probably the airport at Paro.

With an installed capacity totaling a little more than 353 MW, power generation for the country is primarily by two hydroelectric plants at Chhukha and Puntholing. There are two small hydroelectric stations at Dagana and Chanchey Chu, each with a capacity of 200 kW.

Bhutan's economy is one of the least developed in the world. Its development is dependent on foreign financial and technical assistance. The country's economic development will require the construction of additional roads, followed by dams, powerplants, and related infrastructure. Further mineral exploration could stimulate mining and industrial growth.

¹Asia 1992 Yearbook. Far Eastern Economic Review, Hong Kong. Dec. 1991, pp. 82-85.

TABLE 1
BHUTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991
Cement	75,000	75,000	75,000	75,000	75,000
Dolomite	75,000	50,000	50,000	50,000	50,000
Gypsum	10,000	10,000	10,000	10,000	10,000
Limestone	100,000	100,000	100,000	100,000	100,000

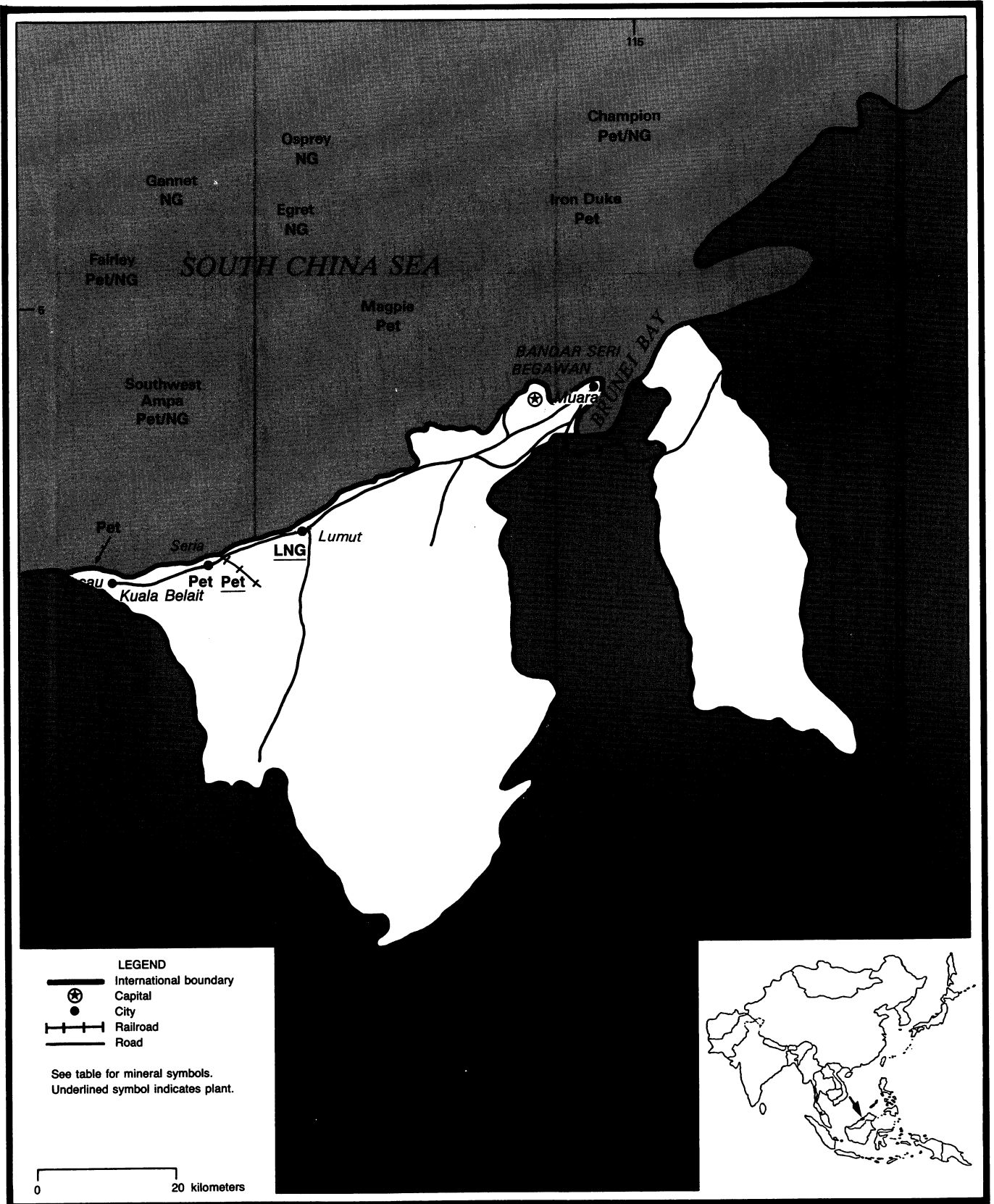
¹Table includes data available through Dec. 22, 1992.

²In addition to the commodities listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

BRUNEI

AREA 5,770 km²

POPULATION 398,000



THE MINERAL INDUSTRY OF

BRUNEI

By John C. Wu

Brunei, on the northwest coast of Borneo Island, has extensive reserves of petroleum and natural gas. Brunei, despite its small area, was the fourth largest producer of LNG in the world, the sixth largest producer of crude petroleum, and the seventh largest producer of natural gas in Asia and the Pacific region.

The mining industry of Brunei involved only production and processing of crude petroleum and natural gas. The oil and gas industry, which employed about 6,000 workers or 7% of the total work force, contributed about 60% of Brunei's GDP and provided more than 50% of the Government revenue. Brunei's GDP was estimated to have grown by 4% to \$3.8 billion¹ owing mainly to increased output of crude petroleum in 1991.

Brunei remained a net minerals exporter in 1991. Exports of crude petroleum, natural gas (in the form of LNG), and refined petroleum products accounted for about 95% of Brunei's export earnings. In 1991, Brunei's export earnings were estimated at \$2.1 billion, of which about 47% was from exports of LNG, 42% from exports of crude petroleum, and 6% from exports of refined petroleum products. Japan remained the dominant buyer of Brunei's crude petroleum and LNG. The Republic of Korea, Singapore, and Thailand were other important crude petroleum buyers in 1991. Brunei's imports totaled about \$1.4 billion, of which about \$275 million were for machinery, \$153 million for manufactured goods, and \$100 million for food.² The United Kingdom remained the major supplier of machinery, while Malaysia and Singapore were the two dominant suppliers of manufactured goods and food.

According to oil and gas industry sources, Brunei's estimated proven

reserves of crude petroleum and natural gas, as of January 1991, were 1.35 billion bbl and 317.15 billion m³, respectively. Most of the proven oil and gas reserves were in the South West Ampa and Champion Fields.

Production of oil and gas was from six offshore fields—South West Ampa, Champion, Magpie, Fairley, Fairley-Batam, and Gannet; and from two onshore fields in Serai and Rasau. Brunei Shell Petroleum Co. Sdn. Bhd., a 50-50 joint venture of Royal Dutch Shell Group Co. and the Government of Brunei, was the country's only producer of crude petroleum and natural gas. To meet domestic demand for refined petroleum products, Brunei Shell also operated a 10,000-bbl/d petroleum refinery at Seria.

Production of crude petroleum rose by 9% to an average of 146,000 bbl/d in 1991, of which about 65% was from the South West Ampa and Champion Fields. The 1991 production level was within the 1988 self-imposed conservation policy of the 150,000-bbl/d limit. Production of natural gas decreased slightly to about 9.1 billion m³, of which more than 95% was from South West Ampa, Champion, and Fairley Fields. Brunei LNG Sdn. Bhd. purchased natural gas from Brunei Shell and produced LNG at the Lumut LNG plant with a capacity of 5 Mmt/a. Brunei LNG was owned 50% by the Government of Brunei and 25% each by Brunei Shell and Mitsubishi Corp. of Japan. Brunei exports all of the LNG to Japan under a 20-year contract, which will expire in 1993. Brunei exported about 5.4 Mmt in 1990 and 5.2 Mmt in 1991.

In April, Elf Aquitaine Offshore Asia BV, a joint venture of Elf Aquitaine of France and Jasra International Petroleum and other Bruneian interests, announced that it made a new oil and gas strike in

block B, 50 km off the coast of Brunei. Jamalulalam-1 flowed 6,000 bbl/d of crude petroleum, 1,730 bbl/d of condensate, and 1.8 M m³/d of natural gas. This new oil and gas strike was the second important discovery in the 1,572-km² block, following earlier strikes made at Jurangan, Maharaja, Lela, and Perdana Selantan. The first important discovery in the area was made at the Perdana Selantan, which tested at more than 10,000 bbl/d of crude petroleum in May 1990.³

In September, Brunei Shell awarded a \$16 million marine construction service contract to Offshore Pipeline International of the United States. The contract called for work to install a 26-km pipeline, to provide maintenance, and to perform other projects in the offshore fields of Iron Duke, Champion, and Ampa. Offshore Pipeline International reportedly began construction in October.⁴

¹Where appropriate, values have been converted from Brunei dollars (B\$) to U.S. dollars at the rate of B\$1.7454=US\$1.00 in 1991.

²Far Eastern Economic Review (Hong Kong). Asia Yearbook, 1992, p. 88.

³South-East Asia Mining Letter (London). V. 3, No. 9, May 10, 1991, p. 8.

⁴—, V. 3, No. 18, Sept. 27, 1991, p. 6.

TABLE 1
BRUNEI: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990 ^P	1991 ^P
Gas, natural:					
Gross ^o million cubic meters	9,209	9,153	9,069	9,447	9,200
Marketed do.	<u>8,501</u>	<u>8,444</u>	<u>8,337</u>	<u>8,692</u>	<u>8,500</u>
Natural gas liquids:^o					
Condensate thousand 42-gallon barrels	5,500	5,460	5,400	3,814	4,000
Natural gasoline do.	300	295	290	285	290
Liquefied petroleum gas do.	100	95	100	90	90
Total do.	<u>5,900</u>	<u>5,850</u>	<u>5,790</u>	<u>4,189</u>	<u>4,380</u>
Petroleum:					
Crude do.	<u>50,808</u>	<u>50,480</u>	<u>51,830</u>	<u>49,008</u>	<u>53,290</u>
Refinery products:^o					
Gasoline do.	650	625	650	625	630
Distillate fuel oil do.	450	432	450	440	450
Residual fuel oil do.	10	9	10	10	10
Other including refinery fuel and losses do.	350	336	355	340	345
Total do.	<u>1,460</u>	<u>1,400</u>	<u>1,465</u>	<u>1,415</u>	<u>1,435</u>

^oEstimated. ^PPreliminary.

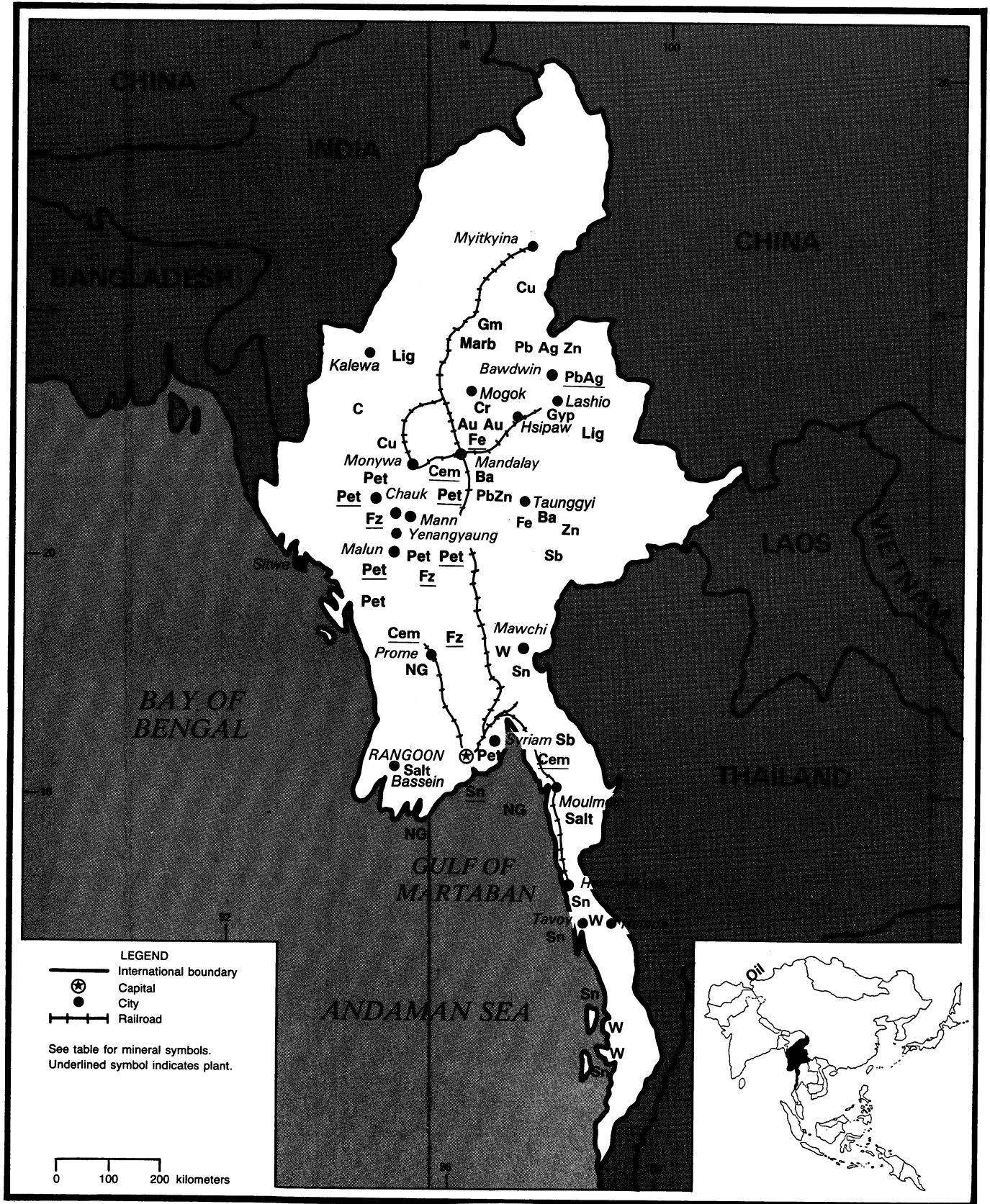
¹Table includes data available through July 15, 1992.

²In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

BURMA

AREA 678,500 km²

POPULATION 42.3 million



THE MINERAL INDUSTRY OF

BURMA

By Pui-Kwan Tse

Burma has significant mineral wealth and the latent potential for its development. However, the production of most mineral commodities has decreased in recent years as a result of political strife and generally poor economic conditions. In the mining sector, deposits of copper, nickel, and various gemstones were being evaluated for exploitation.

Since its formation as an independent republic in 1948, the country has experienced political dissent and upheaval. Subsequently, Burma became a socialist state in 1974.¹ Since 1988, the country has been governed by a military junta—19-member State Law and Order Restoration Council (SLORC). General elections were held in 1990 with the opposition party winning by a landslide. SLORC disregarded the election results, placed the opposition leader under house arrest, and continued its military rule of the country.²

Burma had introduced an open-door policy in 1988 to entice foreign investments for economic development. However, there is international concern about the postelection action by SLORC as well as renewed scrutiny and suspicion of Burma's open-door economic policy. Lacking capital, technology, and outside assistance, there has been little growth or development in the country's mining and minerals processing sector.

GOVERNMENT POLICIES AND PROGRAMS

Burma's economic open-door policy was introduced by SLORC in September 1988. Since that time, about 4,000 companies have registered with Government authorities. In July 1991, the Government announced restrictions for spending foreign exchange earnings

by businesses. Under the ruling, companies could allocate only 90% of profits toward exports, of which 20% must be spent on items stipulated by the Government. Moreover, companies were to be restricted to certain types of exports or to specific items.

PRODUCTION

In terms of world significance, Burma's mine output of minerals is small in volume and limited in array. There is small mine output of metallic ores of chromium, copper, lead-zinc, and tungsten. Mine production of industrial minerals includes small quantities of barite, various clays, dolomite and limestone, gemstones, graphite, gypsum, and soapstone. Output of mineral fuels includes limited amounts of lignite, oil, and natural gas.

The decline in the value of the output of the mining sector was attributed to decreased production of natural gas, nickel speiss, tin concentrates, tungsten concentrates, mixed tin-tungsten-scheelite concentrate, and refined tin metal. Specifically, the decrease in the output of the mixed tin-tungsten-scheelite concentrate was a result of insufficient water supply as well as the lack of electrical power and spare parts for operating mining equipment.³

TRADE

Most of Burma's foreign trade is conducted on a barter basis and valued on an inflated currency exchange rate. In September 1991, the black-market exchange rate was Kyat 100 to US\$1. This compares with an official average rate of Kyat 6.25 to US\$1 in 1991. Based on this rate, total exports were valued at \$421 million and imports at

\$649 million, a net trade deficit of \$228 million in 1991.

Burma is an agrarian-based economy, and naturally its principal exports are agricultural products. The value of base metals and ores exported totaled only \$4.2 million in 1991. The most valuable mineral shipment is gemstones, which either are exported officially or are smuggled out of the country. Value data for these exports are not available. Imports are comprised of consumer and capital goods that are not manufactured locally.

STRUCTURE OF THE MINERAL INDUSTRY

The Government controls all mineral exploration, extraction, regulation, and planning through the Ministry of Mines, which is comprised of six enterprises and two departments, all headquartered in Rangoon, the capital. Specifically, these are Mining Enterprise No. 1—copper, lead, silver, and zinc; Mining Enterprise No. 2—gold, tin, and tungsten; Mining Enterprise No. 3—coal, industrial minerals, iron and steel, and nickel; Myanmar Gems Enterprise—precious and semiprecious gemstones; Myanmar Salt and Marine Enterprise—potash and salt; Myanmar Pearl Enterprise—pearls; Department of Geological Survey & Exploration; and the Department of Planning & Inspectorate—planning, licensing, and mine survey.

Each enterprise is responsible for the development and production throughout Burma of the minerals and metals for which it is assigned responsibility. Each receives a yearly operation budget from the central Government, and all revenues from production and sales go the Government. Individual enterprises have limited latitude in the administration of

their operations. Moreover, the central Government sets policy and authorizes major decisions such as the approval of foreign participation as well as the approval of joint-venture partners.

COMMODITY REVIEW

Metals

Antimony.—Burma has several significant deposits of antimony. The largest mine is in the Thabyu locality south of Moulmein. However, this area is controlled by insurgents, and the status of mining activity is unknown. There is a small antimony concentrating plant at Kalaw, near Taunggyi; for treating ore received from various small-scale workings in the general area. Production data for antimony were not available.

Copper.—Burma's only copper mine and concentrator is in the Monywa District. The reserves at Monywa are estimated at 130 Mmt grading 0.75% to 0.78% copper. The designed capacity of the operation was to process 8,000 mt/d of ore to yield 200 mt/d of concentrates, equivalent to 2.4 Mmt/a of ore and 60,000 mt/a of concentrate. However, the Monywa operation has continually produced at a rate significantly below capacity. Concentrate output in 1991 was about 35,000 tons compared with 30,000 tons in the previous year. There is a copper deposit about 5 km from the Monywa Mine at Letpadaung, 80 km west of Mandalay. Estimated reserves of this deposit are 160 to 180 Mmt, grading 0.66% copper.

Gold.—There are widely distributed deposits of gold, mostly placer, throughout Burma. Exploitation is in the form of small operations. The Government was considering the development of four gold prospects as a means to obtain foreign exchange currency. The lode mineralizations included the Kyaukpahtoe deposit in Sagaing, the Phayaung Taung deposit in Patheingyi, and the Thayet Khone deposit in Pyinmana. The fourth is a placer

prospect at Shwegyin in the Pegu Division. Gold output has fluctuated annually. Production was 31 kilograms in 1988, 124 kilograms in 1989, 26 kilograms in 1990, and 145 kilograms in 1991.

Iron and Steel.—Burma has a 40,000-mt/a direct-reduced iron operation and a 30,000-mt/a rolling mill at Anisakan. The old Ywama mill near Rangoon has melting and rolling facilities. The total national capacity for steel production is 30,000 mt/a of billets and 15,000 mt/a of scrap melting. In 1990, the production of steel billets was only 10,800 tons. In 1991, the production of steel billets was 12,000 tons, a marginal increase. The major problems for the steel sector are inadequate transportation infrastructure and the lack of foreign exchange to purchase raw material consumables.

Lead and Zinc.—Production of lead and zinc is from the open pit mine at Bawdwin and the underground mine at Namtu in northern Shan State. Silver is a valuable coproduct of these operations. The reserves at Bawdwin were estimated at 10 Mmt grading 5.1% lead, 4% zinc, and 93 g/mt of silver. Tailings dumped on the riverbank were estimated to contain 3% to 4% lead, 2% to 3% zinc, and 85 g/mt of silver. The reserves at Namtu were estimated to contain 7.5% lead, 3.5% zinc, and 93 to 124 g/mt of silver. Furthermore, the stockpile of slag generated by the blast furnace at Bawdwin contains 2.5% lead, 17.2% zinc, and 591 g/mt of silver. It is believed that the reprocessing of this slag resulted in the peak output of 25,000 kilograms of silver in 1987.

Nickel.—Burma has been a very small producer of nickel, and output has decreased annually since 1990. Output is by the Bawdwin Mine in northern Shan State. There were recent finds of nickel occurrences at Dagaungtaung and Kalewa, the latter in a remote area. However, there has not been sufficient foreign interest in developing these deposits.

Tin and Tungsten.—The historical tin-tungsten producing area in the country is the Tennasserim Peninsula in southern Burma. The operations in the area produce a tin concentrate, a tungsten concentrate, a mixed tin-tungsten concentrate, and a mixed tin-tungsten-scheelite concentrate. Mixed tin-tungsten concentrate is treated to produce a tin concentrate. This 65% concentrate is upgraded to 67%, which is used in the production of tin metal. In addition, a 65% tungsten concentrate is generated that is upgraded to 67%. Both the mixed tin-tungsten concentrate and the mixed tin-tungsten-scheelite concentrate are made available for export.

Industrial Minerals

Barite.—Mine output of barite is from workings near Maymyo and Kyaukse outside Mandalay and from Taunggyi, 150 km southeast of Mandalay in central Burma. Since 1988, annual production has been less than 15,000 mt/a. The low level of output reflects the decline in demand for barite as a drilling mud inasmuch as oil exploration in Burma has generally been disappointing.

Cement.—Production of hydraulic cement by three plants was more than 435,000 tons in 1991. The gypsum requirement for cement manufacture was from the mine at Hsipaw, 160 km northeast of Mandalay. Gypsum output in 1991 was about 14,000 tons.

Gemstones.—In March 1990, the Government abolished the State monopoly on mining gemstones. Subsequently, Myanmar Gems Enterprise awarded 217 concessions for mining gemstones. By the summer of 1990, there were reportedly 159 private mines in operation. The premier mining area is Mogok located in northern Mandalay, which is described as the source of the world's best rubies and sapphires. There are eight State-run mining operations—seven for rubies and sapphires and one for peridots. Two of the ruby/sapphire operations are hard-rock tunnel mines.

These and the peridot mine are worked by blasting. The other State mines dump material into a wet pit, and the sludge is pumped onto separation screens for gem recovery. The ruby/sapphire sites are very rich and produce at least 20 gem varieties, including spinels and amethysts. Output of sapphire in the mines near Bo Ploi in Kanchanburi Province has been declining. Mining operations in this area are characterized as (1) using mechanized equipment, (2) individual diggings occasionally assisted with mechanized equipment, and (3) small operations using only hand tools for extraction. The larger operations were being forced to dig deeper for the gems, often below the water table.

In 1991, Burma's mine production of jade was estimated at 101,600 kilograms and for gemstones at 716,500 carats. In 1991, Myanma Gem Emporium generated sales proceeds of \$11,490,000. Exports of gemstones in 1990 were valued at \$15,800,000. There is a long history in Burma of illegal gem mining and smuggling. In 1990, the Government recovered 30,729 carats of smuggled rubies and other gems that included the 496.5-carat SLORC ruby and a 4,230-carat uncut sapphire. The Government opened private mining ventures as an attempt to increase control over national resources and to obtain additional revenue. However, it may not be able to control illegal mining and smuggling in the high-value gems trade.

Mineral Fuels

Lignite.—Coal resources thus far discovered in Burma are of relatively low thermal value, in the subbituminous or lignite category. The two principal workings are the underground Kalewa Mine in northwest Burma and the opencast mine at Namma, 50 km south of Lashio. The Kalewa output is used by the Bawdwin smelter and is also used for power generation and tobacco drying. The Namma lignite is used by the Anisakan iron and steel plant. Both operations were believed to be working at near capacity inasmuch as provisional

data listed production of 56,000 mt in 1991, compared with 30,900 mt in 1990.

Petroleum, Crude.—Output of crude oil in 1991 was 5,700,000 barrels, an increase of almost 8% over the previous year. Production was from the onshore fields at Ayadaw, Chauk, Mann, Myanaung, Prome, Shwepyitha, and Yenangyaung. The Government's solution for the country's economic crisis was to invite foreign investment. During the past 3 years, about 40 foreign firms have invested around \$660 million in Burma with 10 oil companies accounting for approximately 65% of the total.

The main interest in onshore exploration is the crustal rift basin extending from the upper Chindwin River, in the Hukawng Valley of northern Burma, southward through west-central Burma past Mandalay to Moulmein at the beginning of the southern peninsula. Exploration has been difficult and was running behind schedule due to logistical problems as a result of lack of infrastructure and road access to concession areas. In addition, transportation of heavy equipment into the hinterland is by rivers and waterways, many times navigable only in the rainy seasons. Moreover, the rains resulted in waterlogged concession blocks adding more difficulties to the operators. The offshore blocks virtually line the entire coastline of Burma from the Bay of Bengal, around the Gulf of Martaban, to the Andaman Sea, with the principal area of interest in the mouth of the Irrawaddy Delta.

Foreign operators include Petro-Canada; Amoco and Unocal of the United States; Idemitsu Oil of Japan; Yukong of the Republic of Korea; Kirkland Resources, Premier Oil and a joint venture between Croft Exploration and Clyde Petroleum of the United Kingdom; and Royal Dutch Shell and Broken Hill Pty. of Australia. However, enthusiasm on Burma's oil prospect has dimmed based on early disappointing drilling results.

Natural Gas.—Production of natural gas has decreased and averaged about 950 Mm³ in 1990 and 1991. Because of the energy shortage in the country, little gas

is believed to be flared. The principal producer is the Prome Gasfield, about 225 km north-northwest of Rangoon. Promising prospects for development in the country are gas occurrences at Martaban, Natmi, and Payagon.

Reserves

Data on Burma's mineral reserves are sparse and from various sources and times. Information may be outdated as well as not verified. Moreover, systematic future delineation may increase the country's resource of mineral wealth. One of Burma's prized natural resources is gemstones. These include amethyst, aquamarine, citrine, jadeite, peridot, ruby, sapphire, spinel, and zircon. However, meaningful reserve data are not available for these stones. (See table 3.)

INFRASTRUCTURE

Burma's road network, comprised of 3,200 km of hard-surface and 17,700 km of improved secondary roads, affords fair access to most of the country. In many areas, however, tracks or trails must be utilized for the final 10 to 60 km of travel to remote sites, as might be necessary for mineral exploration. The country has slightly more than 3,990 km of railroad, all Government-owned. There are 3,878 km of 1,000-meter gauge and 113 km of narrow-gauge industrial lines. Only 362 km is double track. This provides access northward from Rangoon through Mandalay to Bawdwin, and also from Mandalay farther north to the Namponmao area, more than 1,000 km north of Rangoon. Not the least part of Burma's transportation system is 12,899 km of inland waterways, of which 3,200 km is navigable by commercial vessels. These navigable waters are utilized for moving crude petroleum to refineries and some of the resulting refinery products back to the originating area. There is 1,343 km of pipeline for crude petroleum and 330 km for natural gas. The present condition of the pipelines is unknown, and the structures may have deteriorated.

The four major seaports are Rangoon, the capital; Bassein and Moulmein, more

than 150 km west of Rangoon in the Irrawaddy Delta; and Sitwe, about 100 km south of the Bangladesh border. There are 79 usable airports; only three have runway lengths between 2,400 m and 3,659 m and 37 have runways 1,200 m to 2,439 m. The principal air facilities are at Rangoon; Meiktila in Mandalay State about 100 km south of the city of Madalay; and at Namponmau, about 10 km southwest of Myitkyina.

OUTLOOK

Since 1948, Burma has experienced political instability as a result of strife and changes in government philosophy. It is a poor country with a per capita GDP of only about \$400. Burma has not been able to achieve any substantial earnings for its major commodity exports, which are agricultural products. Lacking domestic investment resources and up-to-date technology and expertise, Burma cannot develop its indigenous mineral resources without foreign assistance. The country and its political factions must demonstrate stability and initiate economic reforms to inspire confidence on the part of international investors and foreign entrepreneurship. The extent of Burma's minerals wealth is largely unknown. Upgrading of the nation's existing operations and systematic exploration and development of new mineral deposits, especially oil and natural gas, will benefit Burma's economic development.

¹Burma is divided into mutually exclusive States (Shan, Kayah, Kachin, and Kawthule), Districts (Sagaing, Arakan, Magwe, Mandalay, Irrawaddy, Pegu, Tenasserim), and one other entity, the Chin Special District. States tend to be ethnically distinguishable whereas districts are not recognizably so.

²Far Eastern Economic Review (Hong Kong). Asia 1992 Yearbook, Dec. 1992, pp 89-93.

³Ministry of Planning and Finance (Rangoon). The Union of Myanmar, 1992, 315 pp.

⁴U.S. Embassy, Rangoon, Burma. State Dep. Telegram 00821, American Gemologist Visits Fabled Mogok Ruby Mines, Feb. 15, 1991, 1 p.

OTHER SOURCES OF INFORMATION

Agencies

Ministry of Mines
Kanbe Road, Yankin
Rangoon 1108, Burma

Ministry of Energy
Rangoon, Burma

Publications

Ministry of Planning and Finance Central
Statistical Organization, Rangoon, Selected
Monthly Economic Indicators, Statistical
Paper No. 3, bimonthly.

TABLE 1
BURMA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ^P
METALS					
Chromium: Chromite, gross weight	1,000	5,000	*5,000	*1,000	*1,000
Copper:					
Mine output, Cu content	10,600	4,700	5,080	*4,400	5,670
Matte, gross weight	234	224	200	*108	150
Gold, mine output* kilograms	100	100	126	150	130
Iron and steel: Pig iron	624	688	*2,946	*568	*1,000
Lead:					
Mine output, Pb content	4,600	6,000	5,200	4,400	4,700
Metal:					
Refined	3,985	4,402	3,443	*1,688	2,177
Antimonial lead (18% to 20% Sb)	305	160	300	*300	*300
Nickel					
Mine output, Ni content*	20	26	20	23	20
Speiss, gross weight	50	104	*184	*98	50
Silver, mine output kilograms	26,096	9,207	6,843	*4,386	4,791
Tin, mine output, Sn content:					
Of tin concentrate	256	102	172	*258	176
Of tin-tungsten concentrate	683	427	329	443	430
Total	939	529	501	*701	606
Metal: Refined	309	110	*171	*286	157
Tungsten, mine output, W content:					
Of tungsten concentrate	25	14	8	*13	7
Of tin-tungsten concentrate	468	293	225	304	270
Total	493	307	233	*317	277
Zinc, mine output, Zn content	2,561	1,600	1,400	*3,462	2,766
INDUSTRIAL MINERALS					
Barite ³	17,243	12,678	*11,278	*9,468	*9,000
Cement, hydraulic	389,605	348,981	394,000	*330,115	435,189
Clays: ³					
Ball clay	218	247	203	*100	200
Bentonite	297	418	711	*416	600
Fire clay ⁴	2,193	3,473	3,150	*1,404	2,540
Industrial white clay	—	600	—	*779	—
Feldspar ³	5,260	4,938	4,257	*2,476	*2,500
Graphite ³	—	—	—	*45	36
Gypsum ³	22,895	31,716	31,534	*32,952	*30,000
Nitrogen: N content of fertilizer	117,501	112,178	120,000	*125,000	*130,000
Precious and semiprecious stones: Jade ³ kilograms	98,623	*131,777	*660,200	*242,200	101,600
Salt, all types: ³ thousand tons	257	246	262	*—	260
Stone: ³					
Dolomite	4,612	938	1,930	*3,980	*2,000
Limestone, crushed and broken thousand tons	1,321	1,118	1,219	*1,320	1,860

See footnotes at end of table.

TABLE 1—Continued
BURMA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ^P
MINERAL FUELS AND RELATED MATERIALS					
Coal, lignite	39,334	30,258	37,594	30,815	56,690
Gas, natural:					
Gross ^o million cubic meters	1,188	1,108	1,133	1,034	950
Marketed ³ do.	1,140	1,064	1,088	993	*900
Petroleum:					
Crude (gross wellhead) ³ thousand 42-gallon barrels	6,200	4,800	5,600	4,745	5,700
Refinery products ^{o 3} do.	3,849	3,137	3,287	3,200	3,800

^oEstimated. ^PPreliminary. ^RRevised.

¹Table includes data available through Dec. 22, 1992.

²In addition to the commodities listed, pottery clay, common sand, glass sand, other varieties of crude construction stone, and other varieties of gemstones are produced, but available information is inadequate to make reliable estimates of output levels.

³Data are for fiscal years beginning Apr. 1 of that stated.

^oIncludes fireclay powder.

³Brine salt production (in metric tons) as reported by the Burmese Government was as follows: 1987—57,847; 1988—59,768; 1989—60,229; 1990—49,670; and 1991—41,560.

TABLE 2
BURMA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity*
Cement	Ceramic Industries Corp.	Kyangin, southern outskirts of Mandalay	240
Do.	China Hsin Cement Corp.	Pa-an, 160 kilometers east of Rangoon (under repair)	240
Do.	do.	Thayetmyo, 300 kilometers north-northeast of Rangoon on Irrawaddy River	200
Copper, in concentrate	Mining Enterprise No. 1	Monywa	12
Fertilizer, N content	Petrochemical Industries Corp.	Kyaw Zwa, 230 kilometers north-northwest of Rangoon	91
Do.	do.	Pagan, south of Yenangyuang	31
Do.	do.	Sale, 190 kilometers southwest of Mandalay	31
Iron	Mining Enterprise No. 3	Anisakan, 15 kilometers from Maymyo, 45 kilometers east of Mandalay	40
Steel	do.	do.	35
Lead, silver, and zinc ore	Mining Enterprise No. 1	Bawdwin	390
Lead and silver metal:			
Lead	do.	do.	10
Silver	kilograms	do.	122,000
Petroleum, refined	Petrochemical Industries Corp.	Mann	25,000
Do.	do.	Syriam, across river, east of Rangoon	26,000
Tin:			
Concentrate	Mining Enterprise No. 2	Heinda	1
Metal	do.	Syriam, across river, east of Rangoon	1
Tin and tungsten concentrate:			
Tin	do.	Heinze Basin	.6
Do.	do.	Tavoy	1
Do.	do.	Tenasserin Division coastline (five mines under development)	.9
Tungsten	do.	Heinze Basin	NA
Do.	do.	Tavoy	1
Do.	do.	Tenasserin Division coastline (five mines under development)	NA
Tungsten and tin concentrate:			
Tungsten	do.	Mawchi	.2
Tin	do.	do.	NA

*Estimated. NA Not available.

TABLE 3
BURMA: RESERVES OF MAJOR
MINERAL COMMODITIES
FOR 1991

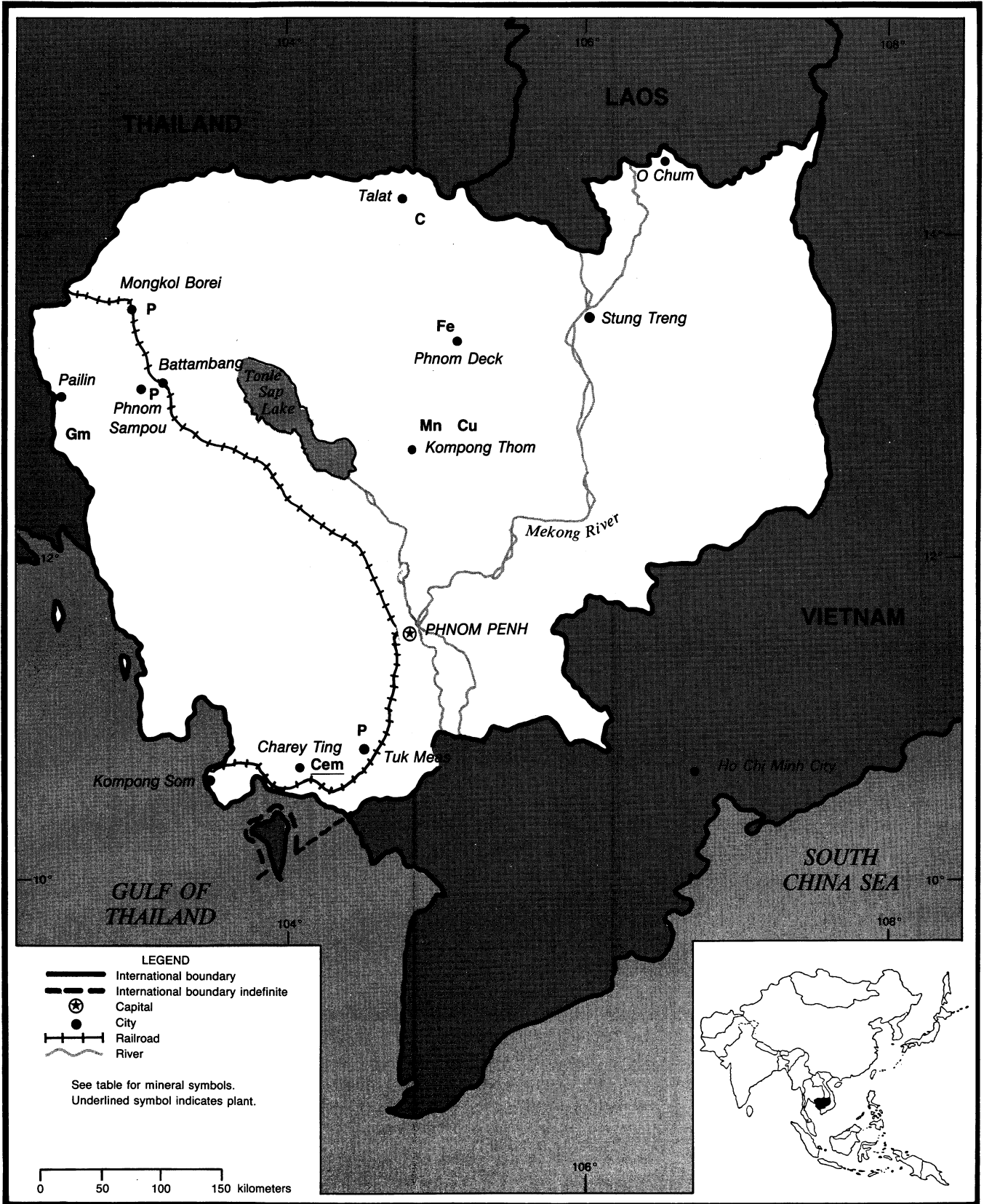
(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Copper	20,000
Lead, in ore	300
Lignite	30,000
Nickel, in ore	22,000
Natural gas million cubic meters	267,200
Petroleum, crude thousand barrels	51,300
Silver, in ore kilograms	750
Tin, in ore	20
Zinc, in ore	500

CAMBODIA

AREA 181,040 km²

POPULATION 7.1 million



THE MINERAL INDUSTRY OF

CAMBODIA

By Travis Q. Lyday

Attempts by the Government and the United Nations Security Council to effect a peace settlement continued through 1991. As in other sectors, mineral development stagnated. The exception was localized efforts to satisfy the need for construction materials, fertilizer, and salt. The Khmer Rouge and related groups fought on. Diplomacy endeavoring to define the various factions' interests and to strike compromises and balances continued to appear of little avail.

The Government struggled to maintain financial stability in spite of interference in production and trade by warring factions. Inflation was strong, based on both cost-push and demand-pull factors. The real cost of producing even simple goods increased continuously, while demand burgeoned as the population suffered from almost complete demoralization from war and destruction throughout the country.

Although technically a Communist state, the Government initiated a policy that all money-losing enterprises be converted to private management, essentially as rentals to the private sector. Hence, a number of small operations relied on their own financial performance rather than Government subsidy.

As Cambodia endeavored to cope with the destruction of war, it rebuilt what it could with what was available. Brick clays, gravel, and stone for construction were produced where possible and consumed locally as needed.

No Cambodian mineral commodities were known to be exported with the possible exception of smuggled gemstones. Trade has been primarily with Vietnam and the former U.S.S.R. on a barter basis. Imports included petroleum products and occasionally clinker for cement manufacture as well as

corrugated iron sheet and chemical fertilizer. Exports were principally agricultural commodities.

Cambodia's mineral industry is erratically distributed and operated irregularly. One small plant of unknown capacity at Charey Ting, about 70 km southwest of Phnom Penh, was thought to produce cement intermittently. Highly localized utilization of clays for brickmaking represented an industry of sorts. The technology used was simple and widely applied in many districts and Provinces.

Cambodia has gem-quality corundum mineralization in several parts of the country, ranging from Pailin near the western border with Thailand to the eastern border area between Stung Treng in Cambodia and Pleiku in Vietnam. High-quality rubies have been found, but true cornflower-blue sapphire of high quality has been the most valuable gemstone produced thus far in Cambodia.

A phosphate plant at Tuk Meas in Kampot Province was essentially a grinding and roasting operation for locally dug phosphate rock. The treatment enhanced the solubility of the phosphate for application as fertilizer. Little information was available on salt production, which was from numerous, small operations. Estimated production for the past several years was about 40,000 mt/a.

Information on mineral reserves in Cambodia is scant. The country was known to have coal, copper, iron, and manganese deposits, but their quality and quantity have not been determined. Reportedly, the country also has deposits of gold, lead, and zinc to the east and northeast of Stung Treng, but the prospects made years ago have never been evaluated.

Cambodia had 13,351 km of roads. Of this total, 2,622 km had bituminous pavement; 7,105 km had crushed stone, gravel, or other loose surface; and 3,624 km had unimproved earth or dirt track. Roads in many places were in disrepair from both neglect and the results of battle. The country had a little more than 600 km of 1-m-gauge railroad, Government-owned, but of uncertain operating condition. Inland waterways included 282 km navigable to craft drawing 1.8 m and 3,700 km navigable to craft drawing 0.6 m. Principal ports were Kompong Som, on the coast of the Gulf of Thailand, and Phnom Penh, inland on the Mekong River.

The country had 22 airports, but only 9 of them in operating condition. Of these, six had paved runways. Two had runways 2,440 to 3,659 m in length, and four had runways 1,220 to 2,439 m long.

Cambodia had an electric-power generating capacity of 126 MW and produced power at the approximate level of 20 kW•h per capita. There is a hydroelectric power generation project in northeastern Cambodia at O Chum where a 1,000-kW plant is in construction with assistance from Vietnam.

Cambodia will remain one of the poorest and most demoralized countries in the world until political stability is achieved. The immediate need for any modernization of the country is fuels and power generation, accompanied by improvement of the national infrastructure. Construction of roads, railroads, and a power grid could then support industrial development.

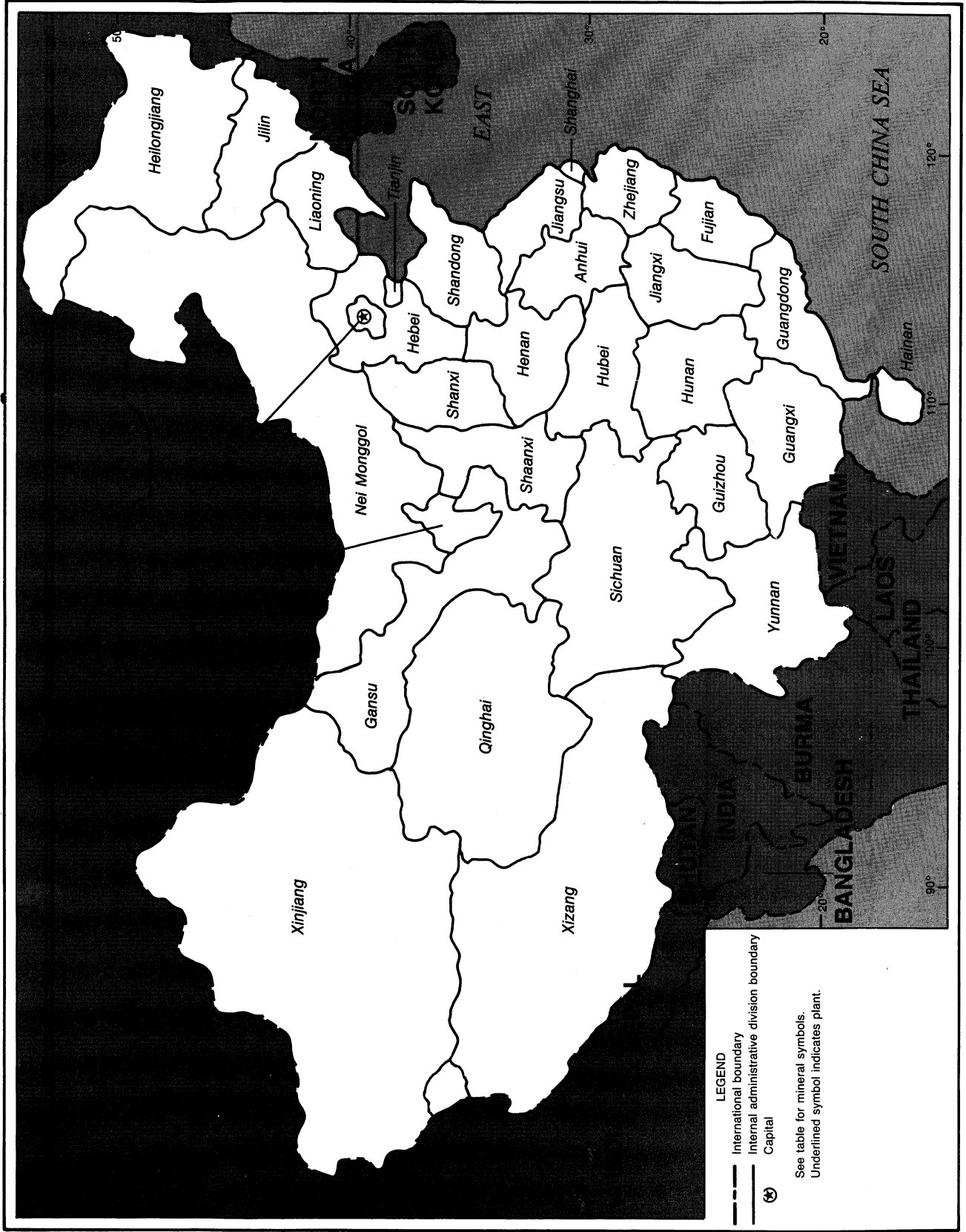
Because of its location, Cambodia has the potential to develop agricultural production, fisheries, and mining. The Southeast Asian peninsula is endowed with minerals. Hence, Cambodia could have the potential to develop and benefit

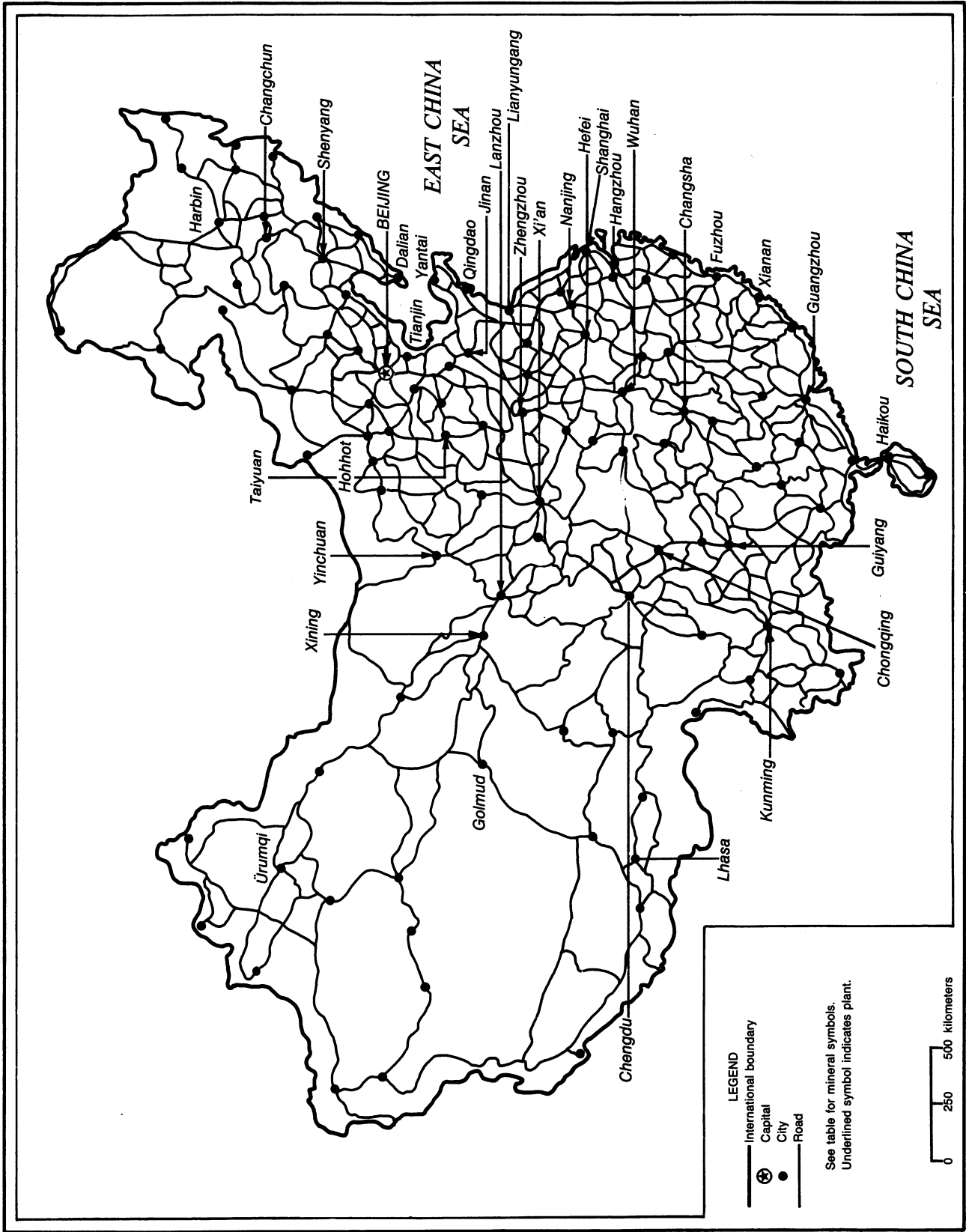
accordingly in the production of mineral commodities. Coal, petroleum, metals, and industrial minerals are prospects that could help to make the country economically self-sufficient and perhaps even an exporter of mineral commodities. However, any development will require political stability and removal of explosive mines planted throughout the country.

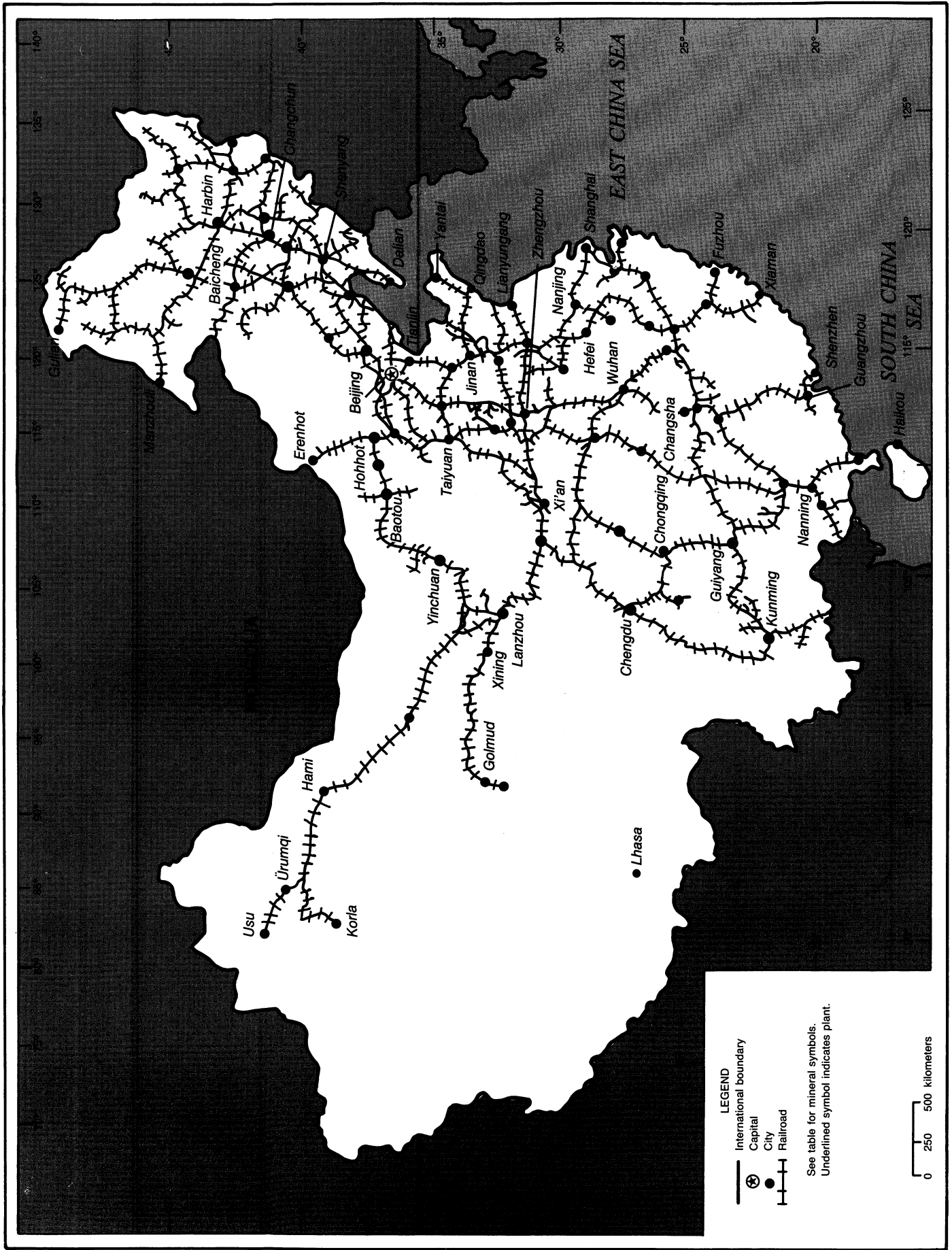
CHINA

AREA 9,596,960 km²

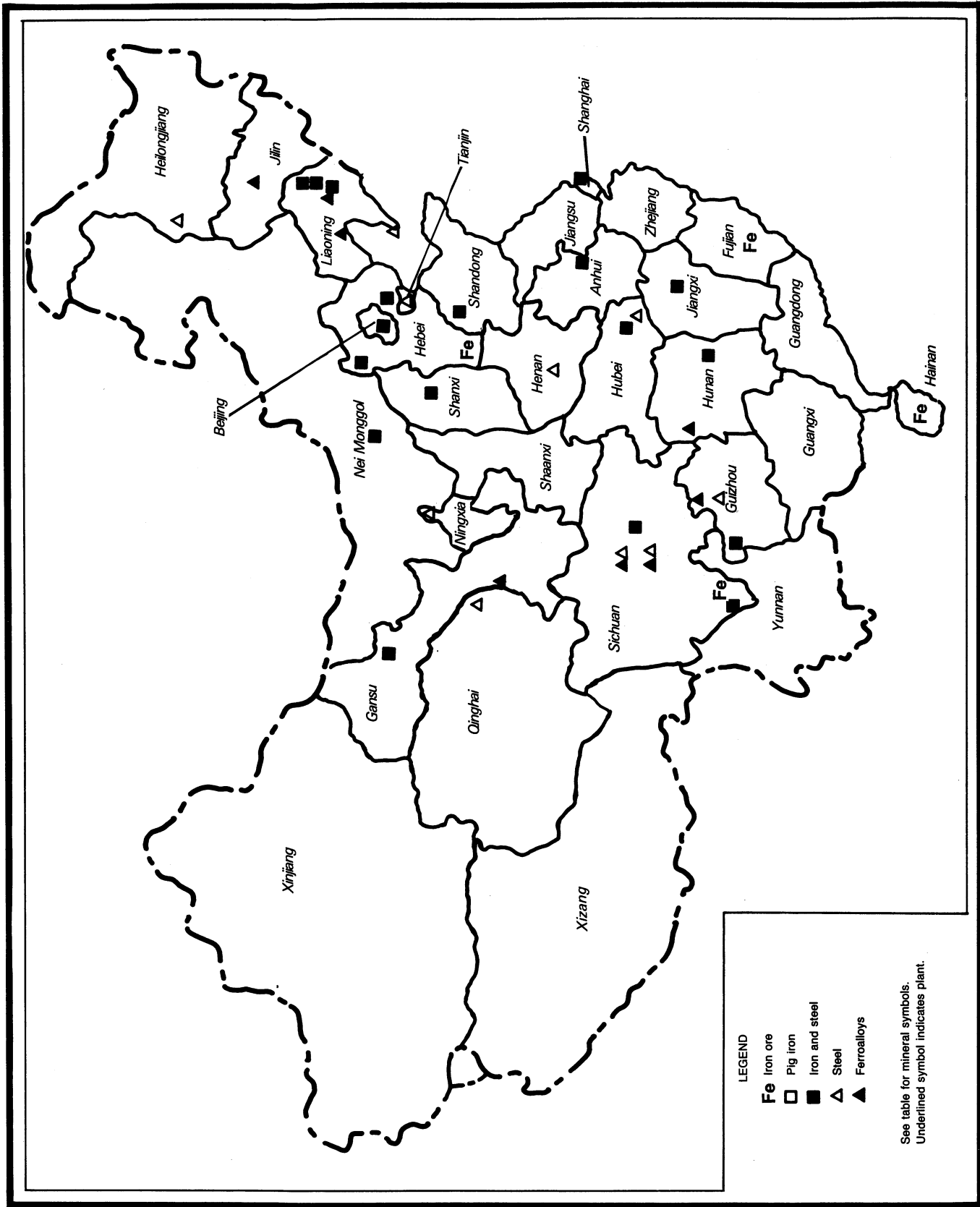
POPULATION 1.16 billion



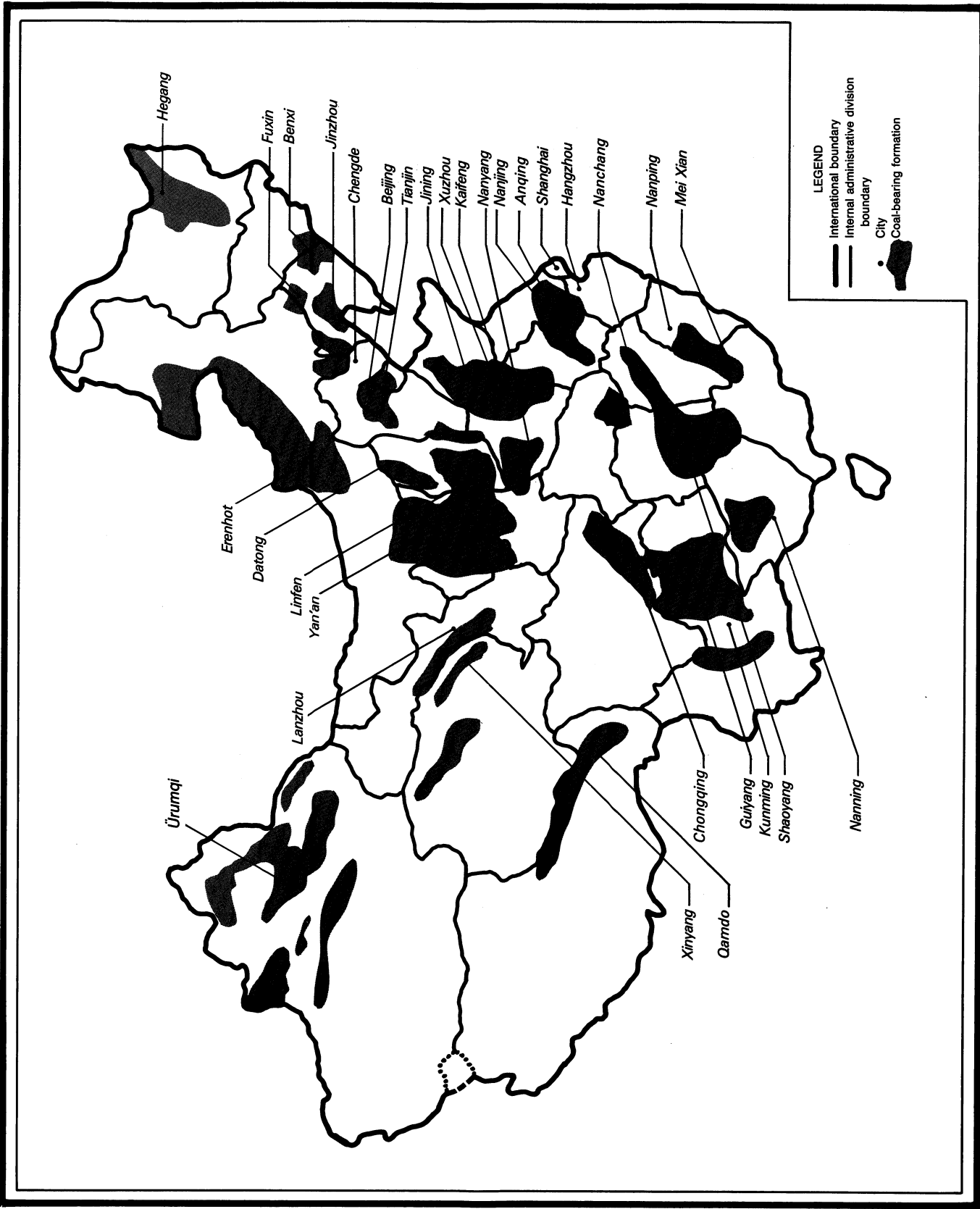




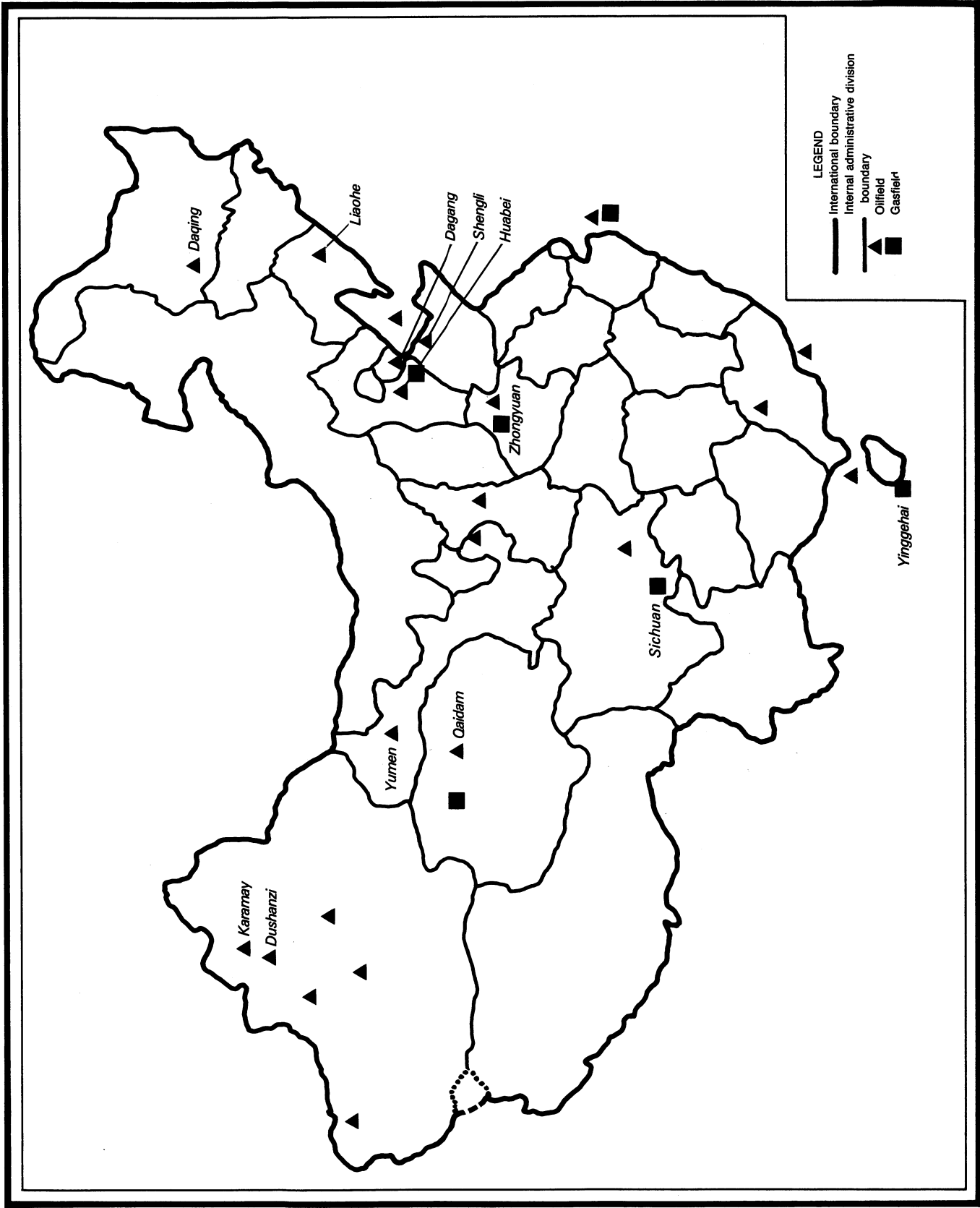
PRINCIPAL RAILWAYS IN CHINA



LOCATION OF MAJOR ORE DEPOSITS AND IRON AND STEEL WORKS IN CHINA



COAL RESOURCES IN CHINA



OIL AND NATURAL GAS RESOURCES IN CHINA

THE MINERAL INDUSTRY OF

CHINA

By Pui-Kwan Tse

The Chinese Government used effective macrocontrols to cool its overheated economy since the mid-1980's. The inflation rate was reduced to less than 3% in 1990 and by 7% in 1991. The Government economic reform program, which faltered after June 1989, has been resumed. During his trip to Guangdong and Shanghai in January 1992, Deng Xiaoping proposed "to learn from capitalism and fight leftist tendencies." In early March 1992, the Political Bureau of the Central Committee of the Communist Party of China (CPC), the highest decisionmaking organ in China, discussed issues regarding accelerating reform and development. The issues were also reconfirmed at the National People's Congress (NPC) in late March that reform should be conducted in a down-to-earth way—centering on the enterprise reform by changing the enterprise mechanism.

State-owned enterprises were the most destructive problem in China's economic operation. Their performance resulted in a gridlock of a tangle of debts between enterprises because of the poor quality of products produced. The State Administration of Industry and Commerce and the China Consumers' Association tested 222 brands of goods and found 40% did not meet the quality specification. One-third of 40,000 enterprises had incurred losses and another one-third would be in financial trouble if their receivables were realistically written down.

State-owned enterprises have not changed greatly in adjusting to a market economy. It was estimated that about \$35 billion was lost every year due to shoddy and poor-quality commodities produced throughout the entire country. Stockpiles of unsold, poor-quality products have devoured a great amount of China's

precious raw materials, energy, and funds. About one-fourth of the total amount of the working capital of China was locked in warehouses by the end of September 1991. Most of these goods probably will never be sold in the marketplace, and enterprises and the state coffers will have to bear the losses. Enterprises had to rely more on state financing by state-owned banks to stay in business. By November 1991, enterprises had received \$100 billion additional working capital from banks. In mid-1991, the State Council tried to clear the debt defaults of enterprises, restrict production, and increase quality control programs. These administrative measures were not very effective. The root cause for this is in the system and its mechanisms. Mandatory planning control is still prevalent. There is excessive Government administrative interference. The decisionmaking power granted by the Enterprise Law to enterprises is not ensured. Also, the price control system does not represent a free market mechanism. The oil and coal industries have been running in the red for years because of irrationally low prices. At the end of 1991, the oil price was allowed to be adjusted to a high of \$35 per ton, which was one-fourth of the international market price. Finally, the large and medium enterprises have not eliminated the egalitarian practice of "eating from the same big pot" that has dampened the enthusiasm of enterprise employees.

In contrast to the poor performance of most state-owned enterprises, the private sector has been booming for the past 5 years. The average annual growth rate of private enterprises is 48%, compared with 15% for state-owned enterprises and 22% for collective-owned enterprises. Labor productivity and the profitability

rate of private enterprises are higher than those of state-owned enterprises.

If state-owned enterprises in the red were to shut down, millions of people would lose their jobs, another problem for the Government. The official nationwide unemployment rate is about 4%, but this statistic excludes millions of jobless peasants. Early in 1992, hundreds of thousands of unskilled peasants went to cities such as Beijing, Chongqing, the large coastal cities, and to Guangdong to look for work where there is already a labor surplus.

In 1991, the value of GNP was \$337 billion, up 7% from that of 1990. Even though severe natural disasters hit the central and northeast region in China, the gross agricultural output value grew by 3%, reaching \$138 billion in 1991. The output of grain dropped slightly from that of the previous year to 435 Mmt, but was still the second highest production in history. The output of cotton, oil-bearing crops, and sugar hit new highs.

The output value of the industrial sector grew 14.2% over that of 1990, reaching \$487 billion. The state-owned industry was up 8.4%, and the growth of collective enterprises was up 18%. The joint-venture enterprises and cooperative and foreign enterprises increased by 55.8%. In 1991, the output value of light industry was \$238 billion, up 14.5%, while the output value of heavy industry increased to \$764 billion, a growth of 13.9%. The largest growth area in commodity production was in electronic equipment, cement, and motor vehicles.

Chinese authorities devalued the renminbi (RMB) against the U.S. dollar gradually during 1991. At the end of 1991, the official exchange rate was \$US1 to RMB 5.8. The value of the RMB to the U.S. dollar is expected to continue to fall during 1992. The trading

of the U.S. dollar and the Hong Kong dollar was very active in the black markets of Shenzhen, Shanghai, and Beijing.

In 1991, the Chinese Government's funding crisis was significantly worse than any other in the past 10 years. The official budget deficit was expected to surpass \$1.9 billion. Using conventional accounting methods that exclude domestic and foreign loans and bond issues from revenues, the actual deficit for 1991 would be more than \$10 billion. Domestic debt service and repayment will reach \$6.9 billion, and about \$8 billion of foreign debt will also fall due in 1992. The State Debt Management Department, under the Ministry of Finance, plans to issue more than \$5 billion worth of treasury bonds in 1992, nearly tripling 1991's \$1.85 billion.

The total population of China was estimated at 1.16 billion by the end of 1991, an increase of 14.9 million over that of 1990. The total industrial work force was 144 million in 1991, an increase of 3.4 million. The annual average monetary wage of an urban employee was \$407.7 in 1991, a real growth of 5.1% if the increase in prices were deducted. The per capital net income of farmers was \$122.4, up 3.5% or a real growth of 2%.

Major reforms were also being made in China's foreign trade system, which includes abolition of state export subsidies and gradually placing the trade firms in the position of equal competition in 1991. Trade firms are fully responsible for their own profits and losses. According to customs statistics, China's foreign trade in 1991 increased to \$135.7 billion, up 17.6% from that of the previous year. Exports were up 15.8% to \$71.9 billion, and imports were up 19.5% to \$63.8 billion over that of 1990.

The Chinese Government is pushing the development of the coastal economy with the establishment of a dozen free trade zones (FTZ). Chinese FTZ's are areas where investors are exempt from import and export duties, production taxes, and industrial consolidation taxes if their products are sold outside of China. The Waigaoqiao FTZ in Shanghai was

scheduled to go in operation in March 1992. Three similar zones—Tianjin Port in north China and Futian and Shatoujiao in the Shenzhen Special Economic Zone in south China, will soon be in operation. China is expected to approve more in 1992—Dalian in Liaoning Province; Guangzhou, Shantou, and Zhuhai in Guangdong Province; Yangpu and Jinpan in Hainan Province; Xiamen in Fujian Province; Qingdao and Yantai in Shandong Province; and Ningbo in Zhejiang Province.

GOVERNMENT POLICIES AND PROGRAMS

Beginning in 1992, the state government has launched major economic reform tasks for state-owned enterprises. The long-standing headache of the so-called three irons: the iron rice bowl (life employment) for the workers, the iron post (lifelong tenure) for cadres, and the iron wages (guaranteed pay) for all employees will be eliminated. The income tax rate of state-owned enterprises will be reduced from 55% to 33%, and a fair taxation system for each economic sector will be introduced to encourage fair competition among enterprises. At the present time, besides paying income tax, a state-owned enterprise must pay further levies in the form of contribution to the "energy and transportation fund" (equal to 15% of its profit) and to the "budget adjustment fund" for another 10%. Even worse, the amount of annual turnover to the Government by an enterprise is contingent on the decision by Finance Ministry officials who habitually ignore tax laws or the legality of contracts. The key points are giving enterprises autonomy in management, employment, and distribution; and retaining well-run enterprises but closing down the poorly run enterprises. This would also relieve burdens of the state-owned enterprises so that they can concentrate on revitalizing their production and management.

Because of rising costs and the growing budget deficit, the Chinese Government decided to eliminate the two-tier price system for raw materials, to end free

health care, and to reform the housing system. The existing two-tier price system means that there is a lower price for state planning use and a higher price for the same material in the market place. The price reform will replace the two-tier system with one price system, either that of the state planned price or the market-price. Materials that are in plentiful supply and are likely to be dominated by just a few producers will be removed from the state price and be subject to market supply-demand fluctuations. Raw materials such as crude oil and coal, which are essential to the national economy, will have a state-controlled price.

State and local governments now face runaway medical spending costs and enterprises can no longer afford to offer free health care. The State Council is currently trying out reforms in four cities, Dandong in Liaoning Province, Siping and Changchun in Jilin Province, and Chongqing in Sichuan Province, to set limits to medical charges paid by the state, the employers, and employees. The patient will pay 10% to 20% of the cost for medical treatment. The state government plans to set a fixed subsidy for each employee and retiree and let them be responsible for their own medical costs. The Chinese Government also plans to set up a commodity housing system instead of the present welfare-type distribution system for accommodations. At present, the bulk of the country urban residents are provided housing either by the Government or the enterprise. The state government spends more than \$6 billion per year for housing construction and repair. The reform system intends to increase the rent of present housing to a level that would cover maintenance, management, and depreciation costs by the end of 1995 and put the newly constructed Government houses up for sale.

PRODUCTION

Despite a constant growth in output, China must commit a large amount of its foreign exchange to import quality iron and steel products. In 1991, China

consumed 12% more rolled steel than that in 1990. As a result, the increase in demand of steel products has tightened supply.

China continued to be in short supply of cold-rolled silicon steel sheet, galvanized plate, tinplate, quality steel plate and pipe, as well as steel for the construction sector. This is expected to continue due to the lack of sufficient capacity in the country to produce these products. In addition, cold-rolled sheet with a thickness of more than 0.6 mm, ship-building plate, and light rails are also in short supply. The domestic supply is expected to be 25% short, even though China produces 6 Mmt of sheet steel per year. China is self-sufficient for cold-rolled plates with thicknesses of more than 0.8 mm. However, China still needs to import plates of high-performance varieties. Cold-rolled steel sheet with a thickness of less than 0.6 mm must still be imported. China is 90% short in tinplate and 72% short in cold-rolled silicon steel sheet. China will continue to import small steel shapes and steel wire.

The oil and gas industry needs an average of 2.6 Mmt of rolled steel for special oil pipe and heavy-caliber oil and gas pipe in regard to both quality and variety in the next several years. The Ministry of Communications expects to use 420,000 tons of rolled steel in 1992. The China National Ship-Building Corp. plans to build a total of 1-Mmt loading capacity for ships and needs 600,000 tons of rolled steel.

In Hebei Province, rolled steel has been in great demand and its price has gone up. The price for some steel wire, corrugated steel, and round bars for building purposes has doubled. In Liaoning Province, there was no substantial increase in sales of quality rolled steel, but trading of cold-rolled sheet, steel plates, tinplate, and galvanized sheet was active. The demand of steel billet was heavy, and the supply of rolled steel was tight, causing an increase in the price of rolled steel outside the state plan in Zhejiang Province. In Jiangsu Province, wire stock, formed steel and wire, and heavy-caliber seamless steel tubes were in great

demand. The price of welded tube has increased substantially. The steel market in Guangdong Province has picked up. The demand for building steel in Guangzhou increased, and its price has gone up. The price for rolled steel outside state plans has increased steadily in Fujian Province. The supply of corrugated steel and tinplate in Fuzhou was tight. Supply of steel wire and corrugated steel was strained, and trading of bars was kept active with rising prices in Heilongjiang Province. The demand for tinplate exceeds supply. There was no shortage of steel products in Shanghai, but the supply of corrugated steel (12 mm to 25 mm) was expected to become tight as demand from Hong Kong buyers increases before the construction of the new airport in Hong Kong begins.

China's supply-demand gap for copper continued to widen. The 1991 output of copper was equal to that of 1990. However, consumption grew 17.8%, drawing down inventory. The shortage was made up by imports. At the end of 1991, China was very active in the copper trading market. Although the international market was sluggish and copper had a falling price, the domestic market price of copper was stable.

The state had drawn up a strategic plan giving priority to increase aluminum production in the mid-1980's. By 1991, the supply of aluminum was in excess of demand. Because the international aluminum market was sluggish and the domestic production rapidly increased (by 14% in the first 8 months of 1991), the domestic price of aluminum had fallen from \$4,428 per ton in 1988 to \$1,587 per ton in 1991. The 1989 national retrenchment program has brought a cutback in the construction sector, which hit the aluminum industry hard in China.

In 1991, domestic zinc consumption rose by 21% compared with an increase in production of 23%. The supply and demand for zinc is expected to remain in balance in 1992. Because of large-scale imports in 1989, there is a long-term stockpile of lead. The production of lead grew only slightly in 1991 compared with that of 1990. The gap between the supply and demand of nickel remains large in

China. In 1991, China consumed about 60,000 tons of nickel while production was less than one-half of the consumption. Total production of nickel is mostly in Jinchuan, Gansu Province, supplemented by a small output from small refineries. The domestic nickel price rose to \$10,000 per ton, causing a marked increase in Chinese inquiries for nickel in the international market. Supply of tungsten well exceeds an estimated domestic demand of only about 18,000 mt/a.

The Ministry of Chemical Industry made a decision to cut the production of soda ash from the original production target of 4 Mmt to 3.8 Mmt in 1992. The consumption of soda ash by the glass industry, the largest user of soda ash, has decreased substantially. The tonnage of soda ash held in inventory had reached 860,000 tons, and the Ministry of Chemical Industry called on the soda ash producers to increase exports. The State Building Materials Bureau has also limited the production of plate glass because stocks have accumulated in recent years. In another move, the Bureau also proposed decontrolling the sale of cement under the mandatory plan.

TRADE

The Customs Tariff Commission, under the State Council, plans to eliminate an "adjustment tax" on imports beginning April 1, 1992. The adjustment tax was a flat 80% surcharge introduced in 1985 on 18 items. However, the landed cost of some items will rise. Scrapping the adjustment tax is a part of China's campaign to regain membership in the GATT.

In 1991, Hong Kong remained China's top trading partner, followed by the United States, Taiwan, the former U.S.S.R., the Republic of South Korea, and Canada. Hong Kong is also the source of approximately two-thirds of the direct foreign investment in China.

Since 1984, Hong Kong has become an important source of loans (both direct and syndicated) to China. In 1987, about 64% of the total commercial loans to China were through Hong Kong, or 36% of the

total foreign loans. The share of Hong Kong in China's total utilization of foreign capital in 1989 was about 42%. Before the adoption of the open-door policy in 1979, capital account transactions between Hong Kong and China tended to be one-sided—China invested in Hong Kong on a considerable scale in the absence of Hong Kong investment in China. Hong Kong is an efficient and flexible instrument for the promotion of trade and investment in China. Hong Kong plays a crucial role in China's reform drive, especially in the Pearl River cities. The dynamism of the Hong Kong market directly activates market forces in China. The presence of Hong Kong exerts pressure on China to decentralize its trade, as many localities and enterprises are able to trade with the outside world covertly through their Hong Kong connections. State-owned enterprises from China poured money into Hong Kong in the 1980's and 1990's. Through merger, share purchases, and new setups, China has expanded its business in Hong Kong from trade and banking to leasing, insurance, tourism, transportation, manufacturing advertising, and wholesale and retail sales. China's major import and export commodities are shown in tables 4 through 7.

STRUCTURE OF THE MINERAL INDUSTRY

All Chinese large minerals and metals enterprises are state-owned. However, there is considerable overlapping of authority over various mineral and metals commodities. The Ministry of Metallurgical Industry (MMI) is responsible for barite, iron ore, iron, manganese, and steel production, as well as some magnesite and dolomite mines and plants. The China National Nonferrous Metals Industry Corp., (CNNC) is in charge of nonferrous metals and byproduct output of bismuth, gold, and silver. Gold production is under the supervision of the China National Gold Corp. The Ministry of Chemical Industry has responsibility for boron,

potassium, phosphate, salt, sulfur, various inorganic salts, and chemical fertilizers. The China Nonmetallic Mineral Industry Corp. is responsible for mines and processing facilities operation for a wide array of industrial minerals and its subordinate processing enterprises. The State Administration of Building Materials is responsible for cement, dolomite, limestone, sand and gravel, and stone aggregates used for construction. For the energy sector, China National Coal Corp. (coal), China Oil and Natural Gas Corp. (onshore oil and natural gas), China National Offshore Oil Corp., (oil and natural gas) and China National Nuclear Corp. (uranium) are responsible for all aspects of energy exploration, production, or mining.

COMMODITY REVIEW

Metals

China's nonferrous metals industry is a highly centralized sector. The Government supplies all of the money for the cost of production and buys back all the output through its operating arm, CNNC. The pretax profits for CNNC dropped 13% in 1991 over that in the previous year. In a recent national management conference, radical reforms were proposed. A group of 10 companies was selected to be free from mandatory state plans for production and sales and were to copy management techniques of foreign enterprises and joint ventures. CNNC will delegate complete decisionmaking autonomy to these companies, except in the hiring of managers. Another 10 companies will be selected to enter the international arena to sell their products abroad. They will be encouraged to introduce foreign funds and cooperate with their overseas partners in joint ventures. CNNC will let another 10 companies reduce the Government's mandatory price quotas for which products were to be sold at a lower price. The recovered revenue will be invested to upgrade technology. Chinese authorities thought that these changes were essential to ensure the sustained growth of the nonferrous metals industry over the next

10 years. In 1991, China produced 2.52 Mmt of 10 nonferrous metals—aluminum, antimony, copper, lead, magnesium, mercury, nickel, tin, titanium, and zinc. CNNC plans to produce 3 Mmt of these nonferrous metals in 1995.

China opened its metals exchange market at Shenzhen, Guangdong Province, on January 18, 1992. The exchange is cosponsored by CNNC and several other state-owned enterprises. The exchange was designed to interrelate China's planned socialist commodity economy to a more advanced world market mechanism in the production and consumption of nonferrous metals. It is expected that the exchange will be used mainly as a market for sales and purchases between China's domestic producers and consumers, at least in the initial stage. The Shenzhen metal exchange market lists eight metals for trade—aluminum, antimony, copper, lead, magnesium, nickel, tin, and zinc.

Aluminum.—CNNC and the People's Government of Guangxi Zhuangzu Zizhiqu jointly invested \$470 million for a project of the Guangxi Pingguo Aluminum Co. After completion of the first-stage construction in 1994, the company will have an annual capacity to mine 650,000 tons of bauxite and produce 300,000 tons of aluminum oxide and 100,000 tons of aluminum metal. The company will have a self-owned power station with an installed capacity of 250,000 kW. The bauxite deposit is in Pingguo County along the Youjiang Valley in Guangxi Zhuangzu Zizhiqu. The Pingguo bauxite reserves are estimated at more than 800 Mmt. The bauxite deposit is high grade, shallowly buried, and thus easy to exploit. The first-phase construction site covers an area of 430 acres and contains bauxite reserves estimated to exceed 200 Mmt. The construction of the main highway for access to and within the site, a 35-kV power supply line and a distribution station, a 250,000-kW power station, 20,000 m² of permanent housing area, and 35,000 m² of semipermanent housing area for 8,000 residents have been

completed. In addition, the Yantan Hydropower Station and Tianshengqiao Hydropower Station on the Hongshui River, with capacities of 120,000 kW and 880,000 kW, respectively, have been completed and were put into operation in 1991. The 500,000-v EHV transmission line between the hydropower station and the self-owned 250,000-kW station were also completed. The building of a 120-km railway from Nanning to the Pingguo plant has been started and will be completed in 1993. The main equipment and technology for producing aluminum oxide and aluminum metal are to be imported from France, Sweden, Holland, and Denmark. The cost for the purchase of technology and equipment will be paid through preferential loans from the Governments of the four countries.

The second-phase construction of China's largest aluminum oxide plant in Hejin County, Shanxi Province, is in progress. The first phase was completed, and a plant was put in operation in 1987 with an annual capacity of 200,000 tons of aluminum oxide. The second phase, which costs \$545 million, is expected to be fully operational in 1993 with an annual designed capacity of 1 Mmt of aluminum oxide. After the second-phase completion, the plant's total output will account for 38% of China's total aluminum oxide production. The plant has used \$40 million in foreign funds to import equipment and technology from Denmark, Germany, and the United States.

The second-phase expansion project for the Qingtongxia aluminum plant in Ningxia Huizu Zizhiqu was completed, and the plant has passed Government quality control testing. The project was a joint venture of CNNC, Tianjin municipal government, and Ningxia Huizu Zizhiqu. The project uses imported technology in the production of 50,000 tons of aluminum metal per year. The plant is expected to launch a third-phase expansion project before 1995, which will add capacity to produce a total of 100,000 tons of aluminum per year.

A thin aluminum sheet rolling line based on imported key processing equipment has been put into production at

the Xinan aluminum processing plant in Chongqing Shi, Sichuan Province. The processing line has an annual output capacity of 92,000 tons of variable thicknesses of aluminum sheet and foil mainly used by the beverage, food, and pharmaceutical industries.

Copper.—China's largest and most efficient copper producer, Jiangxi Copper Co., plans to expand its copper production capacity from a current level of 70,000 mt/a to 140,000 mt/a in 1993. Jiangxi Copper Co. was founded 11 years ago. Its operations include six copper mines scattered around Poyang Lake. The company's copper reserves account for one-third of the total reserves of the country. One of them, Dexing, the largest copper mine in China, has a reserve of 1.6 billion tons. The operation also produces gold, molybdenum, silver, and tungsten as products.

The Chilean Government approved the Shanghai Huada Electrical Co. Ltd., a Sino-Hong Kong joint venture, to invest \$268,000 in Chile to produce copper wire and cable. The first phase of factory construction was completed in 1991 and will enable the company to turn out products worth \$5 million per year by using Chinese machinery and equipment. By the end of 1993, the second phase of the project will be completed, doubling the value of output to \$10 million.

China North Industries Corp. and the Philippines' Philcopper Gold Mining Co. are negotiating a joint venture for a beneficiation plant to recover 10,000 to 20,000 mt/d of copper and 500 to 1,000 mt/d of gold at Benguet Province in the Philippines. The Chinese side is to supply mining, milling, and auxiliary machinery and equipment for the turnkey project.

China Metallurgical Corp. (CMC) won a contract for the construction of a copper project in the Saindak area of Daluchistan Province in Pakistan. The construction project includes copper ore mining, ore dressing, and smelting. Construction is to be completed in 4 years. The plant will produce 15,000 to 16,000 mt/a of blister copper, which will be transported to China for further processing, with the metal values sent back to Pakistan.

Iron and Steel.—China plans to boost its annual output of steel and steel products to 72 Mmt and 59.5 Mmt, respectively, by the end of 1995. The iron and steel industry produced 67.2 Mmt of pig iron and 70.6 Mmt of crude steel in 1991. During the next 4 years of the Eighth Five-Year Plan, the state will invest billions of dollars to expand its iron and steel industry. The money will help the industry continue to increase its output and improve the quality and variety of iron and steel products. Most of the money will be in the form of bank loans and foreign investments. The key projects include the Baoshan Iron and Steel Complex, the Wuhan Iron and Steel Complex, the Panzhihua Iron and Steel Complex, the Ma'anshan Iron and Steel Complex, the Tianjin seamless tubing mill, and the Jianshan iron mine of Taiyuan Iron and Steel Co. Other new projects included the upgrading of the Jinbeizhuang iron mine of Xuanhua Iron and Steel Co., the Pinchuan iron mine of Chongqing Iron and Steel Co., the Qidashan iron mine of the Anshan Iron and Steel Complex, Meishan Iron and Steel Co., and Benxi Iron and Steel Co. In addition to the expansion plans, China plans to lower the energy consumption for making 1 ton of steel from 1.63 tons of coal to 1.55 tons by 1995. This will require the iron and steel industry to introduce advanced technology and equipment.

Another key task for the iron and steel industry is to increase the variety and improve the quality of products. Of the 100 varieties of major steel products urgently needed in China, the industry can now produce only 42 kinds to meet its basic needs. During the Eighth Five-Year Plan period, the industry plans to satisfy the domestic market with 67 kinds of domestically made products. The iron and steel industry plans to improve the output steel products to meet international standards from 40% in 1990 to 50% in 1995. In addition, the continuous casting rate of the industry was to increase from 22.4% at present to 35% by the end of 1995. An assessment of China's top iron and steel firms is shown in table 9.

Shijiusuo in Shangdong was selected as the site of a new steel mill under a recommendation from Japan's five major steelmakers on September 25, 1991. The port city affords an easy access to overseas markets for both the receipt of materials supply and for export shipments. The planned annual production capacity of the mill is 3 Mmt of crude steel in the first phase, with possible eventual expansion to 10 Mmt. Construction of the mill will get underway in 1995. The mill would be a joint venture between China and Japan.

China is looking to open a second joint venture in Australia. China and Western Australia were conducting a feasibility study in the construction of a gas-based direct-reduced-iron plant, making a product suitable for making high-quality steel. The proposed \$199.5 million processing plant would be in Western Australia's Pilbara region. The 500,000-mt/a direct-reduced iron feasibility study undertaken by the Chinese and the regional Western Australia government will be completed early in 1992. Two steelworks from China are looking for a source of between 200,000 and 500,000 mt/a of direct-reduced iron.

Anshan Iron and Steel Corp., the largest iron and steel producer in China, is planning to invest \$700 million in a joint venture with the Malaysian Government with a 49-51 equity split to revive the old Bukit Besi iron ore mine near Dungun at Terengganu Province in Malaysia, which has been abandoned for the past 15 years. A steel mill included in the proposal will also be built near the mine site. Technical experts from Anshan Iron and Steel Corp. have estimated that the mine contains more than 30 Mmt of iron ore. About 40% of the iron ore output from the mine will be exported to China and the remainder will be used by the new mill. The mill will be used to produce steel slab with an output capacity of 1 Mmt/a. All the steel slab produced will be exported to China.

Anshan Iron and Steel Corp. is also building two additional steel mills in Haikow, Hainan Province, near two steel rolling mills that were just put into production. The completed rolling mills

have a total capacity of producing 35,000 tons of steel tube and 5,000 tons of steel cable products. After completion, the four mills will have an annual total production capacity of 75,000 tons of rolled steel and 50,000 tons of galvanized tube.

Anshan Iron and Steel Corp. is seeking loans from the Italian and Japanese Governments to renovate outdated equipment. Anshan will use a \$27.5 million loan from Japan to install medium-sized steel plate equipment with an annual capacity of 1 Mmt. A \$403 million loan to be obtained in 1993 from the Italian Government will be used to import rolling equipment to produce 500,000 tons of seamless steel pipe.

Construction of Benxi's cold-rolling mill, financed by a commercial loan from a Japanese banking group, is underway. After completion of the \$520 million mill, which is expected in 1995, the facility will have the capacity to produce 700,000 tons of cold-rolled plates per year. The contract was awarded to a Franco-Austrian consortium, composed of Clecim and Andritz-Ruthner. Benxi also awarded a \$43 million contract to Mannesmann Demag Sack and Siemens of Germany to supply a 200,000-mt/a hot-dip galvanizing line. The line, which is expected to be completed by the beginning of 1995, will supply galvanized sheet and coil to the domestic automotive, appliance, and construction industries.

China's steel policymakers made a decision to invest \$3.8 billion in a third-phase expansion of the Baoshan Iron and Steel Complex outside Shanghai. The expansion plan includes a blast furnace, a sintering plant, a coke battery, a steel plant equipped with two 250-ton converters, a mill employing continuous casting for two 1.35-mm continuous casting units, one hot roller, and three cold rollers. A 350,000-kw-power-generating unit and a 138,000-kw gas turbine power-generating unit are also included in the expansion plan. The third-phase expansion is expected to be completed by the end of this century. After completion, Baoshan will be able to produce 10 Mmt of steel, 7.13 Mmt of rolled steel, 400,000 tons of tin-coated steel plate, and 375,000 tons of cold-

rolled silicon steel. Both tinplate and silicon steel are presently in short supply in China.

The Chinese Government used a United Nations' \$8.4 million grant to upgrade the computerized management and machinery maintenance systems at Anshan Iron and Steel Corp. The computer system was purchased from IBM Corp. of the United States. Since 1988, the UN Development Program has given grants totaling \$11 million in upgrading the systems at Anshan and Wuhan Iron and Steel Co. in Hubei Province. The Wuhan plant is undertaking a series of technical renovations designed to boost annual output of silicon steel to 265,000 tons from the current 70,000-mt/a level.

Tianjin Iron and Steel Works is to invest \$1.15 billion to import equipment from Demag Co. of Germany, Itaipianti Co. of Italy, and PMC of the United State for its seamless tube project. According to the design, it will produce 600,000 tons of refined steel and 500,000 tons of medium seamless pipes to be used in the petroleum and minerals extraction industries.

Lead and Zinc.—CNNC and Yunnan Province have signed a letter of agreement for a joint venture to invest \$190 million on a 50-50 basis in the development of the Yunnan Lanping lead and zinc mine. According to the development plan, when the first-phase construction is completed in 1995, the daily ore output will be 3,000 tons and the ore milling capacity will be 2,500 tons. The refinery will produce 60,000 tons of zinc metal and 5,000 tons of lead metal per year. With further expansion, output of zinc will increase to 200,000 mt/a and lead to 20,000 mt/a at the end of the century. The mine life is estimated at 35 years. The mine is in the mountainous northwestern part of Yunnan. A 131-km highway is being built from Lanping to Jianchuan County, which is east of the mine. The highway is expected to be opened in 1993. A 225-MW powerplant has already been built in Dali to provide power for the Lanping mine.

In 1991, Australia's Broken Hill Pty. signed a letter of intent to explore for lead and zinc in Sichuan Province in partnership with subsidiaries of MMI and CNNC.

Nickel.—China's largest nickel producer, Jinchuan Nonferrous Metals Corp., invested \$390 million for its second-phase construction program. The second phase will integrate over a land area of 402 ha and will integrate the operation from mining through ore dressing and smelting. A flash furnace that is 31.5 m in length, 25 m in height, and 6 m in diameter, with a capacity for producing 50 mt/h of nickel concentrate will be south of the existing operation. Construction, to be completed in 1993, will enable the company to double its present output of 20,000 mt/a of nickel to 40,000 mt/a. The annual output of copper and sulfuric acid will increase to 20,000 tons and 400,000 tons, respectively. It will also produce small amounts of gold, palladium, and platinum as byproducts. Flash smelter technology was imported from Finland's Outokumpu Oy and Australia's Western Mining Corp. Most of the mining equipment will be imported from Austria, Finland, Germany, Sweden, and the United States.

Tungsten.—China plans to reduce the production of tungsten in 1992. The national production quota for refined tungsten will be 40,000 tons for 1992, 30,000 tons less than the 1990 quota. At the same time, exports of tungsten products will be reduced from 52,000 tons in 1990 to 25,000 tons in 1992.

The Chinese State Council published a new policy forbidding the construction of any new plants producing intermediate tungsten products. Small plants producing intermediate tungsten products with a high raw materials consumption and with poor quality control will be closed. There are 72 plants in China specializing in the production of ammonium paratungstate and tungstic oxide. However, there are only four to five plants whose annual capacity exceeds 1,000 tons and others with only 100 to 300 mt/a.

Other Metals.—A silver deposit was discovered in Chende Prefecture, Hebei Province. A Hebei metal enterprise group and local partners will provide \$8 million to develop the mine with a capacity of 300 mt/a of silver ore.

Industrial Minerals

Fluorspar.—China's Ministry of Chemical Industry selected Quzhou City in Zhejiang Province to construct China's largest fluoride plant. The Quzhou area has 50% of China's 100 Mmt of fluorspar reserves. Quzhou Chemical Corp., also produces chlorine, sulfuric acid, and methanol, which are important ingredients to its halogen operation and in the production of other chemicals. Construction started July 1, 1991, and equipment installation will begin in March 1992. Trial operation of the plant is planned for the end of 1992. After the completion of phase-one construction, the plant will turn out 57,000 tons of fluoride products annually. Phase-two, to be completed in 1995, focuses on the production of 300 tons of high-grade fluoride products annually. Advanced equipment will be imported from Japan, Sweden, and the United States.

Fuels

In 1991, the total energy output, in terms of standard fuel equivalence, was up 0.8% from that of 1990. By sector, coal accounted for 1.09 billion tons, up 0.9%; crude oil, 139 Mmt, up 0.9%; natural gas, 15.2 billion m³, the same as that of last year; and electricity, 675 billion kW•h, up 8.7% (hydroelectricity 123.5 billion kW•h, down 2.5%). China's first nuclear powerplant with a capacity of 300 MW located at Qinshan, Zhejiang Province, began trial operation on December 18, 1991. It is currently running at 5% of its designed capacity. It is expected that it will take half of a year before the plant reaches full capacity and begins commercial operation.

The Chinese Government has launched a new nationwide energy drive to conserve energy in the face of a worsening energy situation. Energy

shortages threaten to hamper economic growth of the country for the next 10 years. China has an annual shortage of 30 Mmt of coal, 5 Mmt of oil, and 50 mkW of electricity. The energy shortage is so serious that it hampers 20% to 30% of the country's overall industrial production capacity. The Government has planned a 6% overall industrial growth rate in the Eighth Five-Year Plan period, but energy production is estimated to grow only 2.4%. During the past decade, energy prices have been raised several times, but energy prices remain unreasonably low and prevent the energy industry from expanding. Oil products are also in critically short supply, as more petroleum-based ethylene plants are being built. In addition, more cars are being imported, and any new fuel resources remain largely undeveloped.

China's energy industry mainly relies on state funding for development. The Chinese Government, through the Ministry of Energy Resources (MER), will invest \$31 billion for the power industry and \$15.9 billion for the coal industry during the coming 5 years. The petroleum industry is expected to receive equal funding to that of the power industry. According to the Eighth Five-Year Plan, the combined energy primary output in 1995 should reach 1.172 billion tons of standard coal.² Production targets set by the state for 1995 are as follows: 1.23 billion tons of raw coal, 810 billion kW•h of electricity; 145 Mmt of crude oil, including 5 Mmt from offshore, and 20 m³ of natural gas.

China is one of the richest countries in the world for hydropower resources. China's hydropower potential is estimated at 378,000 MW but only 9% of this has been harnessed. According to a plan of the Ministry of Energy, 60 large- and medium-sized hydropower projects will be launched between 1992 and the year 2000, with a total designed capacity of 70,000 MW. In addition, construction of many small hydropower stations, with a combined capacity of 8,000 MW, will be started during the same period.

Currently, 65 hydropower projects having a total generating capacity of 16,000 MW are being built in China. Of

the 60 large- and medium-sized projects, 14 of them will have a generating capacity of 1,000 MW or more each. Priority will be given to projects on the upper and middle reaches of the Huang He, the main course and tributaries of Chang Jiang, and the Lancang Jiang in the southwest. Key hydropower projects include Ertan in Sichuan Province, Yantan in Guangxi Zhuang Autonomous Region, Manwan in Yunan Province, Geheyan in Hubei Province, Wuqiangxi in Hunan Province, Yamzho Yumco in Xizang Autonomous Region, and Lijia Xia in Qinghai Province. In April 1992, NPC approved the construction of the largest hydropower project in China—the Three Gorges Project on the middle reaches of the main course of Chang Jiang. The Three Gorges Hydropower project has a designed capacity of 17,680 MW and will require the relocation of millions of people just in Sichuan Province alone.

Coal.—China is the world's largest coal producer. State-run coal mines only account for 45% of the country's total coal production. According to the MER, 95% of the state-owned firms are running at a loss, and most large mines are operating well below production capacity. An estimated 50% of the mines run by local governments was also in the red. The problems lie in the default of debt payments. Coal mines are owed billions of RMB by other state-owned enterprises. Moreover, coal prices are unreasonably low. The top 10 producing coal mines are shown in table 10.

According to the State Statistical Bureau, the death rate in state-owned mines decreased to almost 1 worker per Mmt of coal produced in 1991, compared with 13.83 workers in 1960, 7.28 in 1970, 4.53 in 1980, and 1.43 in 1990. However, the death rate in local coal mines remained as high as six in 1991. Currently, Chinese authorities are drawing up a national mining law to specify safety conditions, safety protection, miners' rights and responsibilities, safety inspection, and routine supervision as well as the duties of the enterprises. China's problems with

mine safety will continue for some time because of inadequate industrial facilities, limited financial and technical resources, and substandard training of managers and miners.

Canada and China have signed a contract for a coal gasification plant that is expected to help set a standard to improve China's energy efficiency and to help to reduce air pollution. An Ontario-based firm, Joe Ng Engineering, was awarded the contract to design and equip a coal gasification plant for Kunming, Yunnan Province. The project is supported by a \$5 million loan from the Canadian Export Development Corp. to the Bank of China. The Kunming plant is scheduled to be completed in 2 years and will produce about 220,000 m³ of gas per day.

Currently, coal is produced in many Provinces of north, northeast, and southwest China, with Shanxi Province as the leading producer. The Ministry of Energy is planning to move coal production to the coal-rich northwest Provinces of Shaanxi and the western part of Nei Monggol. This area has some of the richest coal resources in China. Chinese geologists estimate proven deposits of coal at more than 569.5 billion tons, accounting for about 62% of the country's known reserves. Current construction of major coal mines include those in Junggar, Dongsheng, Wanlichuan, Wuda, and Haibowan in Nei Monggol, Shenfu-Dongsheng on the Shaanxi-Nei Monggol border, and Binchang and Dabaodang in Shaanxi.

In 1991, the central Government approved the construction of one of the largest coalfields in the world with a proven reserve of 223.6 billion tons—Shenfu-Dongsheng Coalfield straddling the border of Shaanxi and Nei Monggol. Total planned investment in this gigantic project is \$5 billion, of which \$2.2 billion will go to construct coal mines, \$2.2 to construct three special railways with a total length of 1,000 km, and the rest to be used to build a large port Huanghua port in Hebei Province. The money will include funds from the central Government, foreign Governments, and foreign commercial loans. Construction

of the coal mine is divided into three phases. The first phase will be completed in 1993 with an annual output capacity of 12 Mmt of low ash and low sulfur coal. The national output of clean coal is a very small proportion of the total production. The second phase is scheduled to be completed in 1997 when annual output will be raised to 30 Mmt. The third phase will be completed by the year 2000, increasing output capacity to 60 Mmt annually. Of the total output, 40 to 45 Mmt will be for export.

Petroleum.—China's oil development started in the west with the discovery of the Yanchang, Yumen, and Karamay Oilfields in the 1950's. However, the discovery of the Daqing Oilfield shifted China's oil production center to the east. Since the 1960's, China has successfully constructed a number of large- and medium-sized oilfields such as the Daqing, Shengli, Dagang, Liaohe, and Huabei Oilfields in the east. About 100 Mmt of the crude oil produced, or 75% of the country's total output, was produced by these oilfields. Although China's oil output has increased over the past few years, most oilfields in the east have entered the water injection stage to maintain their production levels. In particular, oil-bearing strata are flooded at Daqing to force oil out to maintain a production level of 55 Mmt/a. The added production costs to maintain production levels increase the financial burden to these enterprises, most of which are running in the red.

The strategy of China's oil industry is stabilizing production in the east and developing production in the west as quickly as possible. But the harsh weather and environmental extremes in the west deter accelerated rate of development. Oil deposits in the west are deep, usually more than 5,000 m underground. Moreover, it requires more preparation time to sink a test well in remote areas. Since large-scale prospecting started in the region in 1989, the state has used more than \$550 million prospecting there. For development, the Government is looking to foreign investments in the west. Crude oil produced in the west will

be sold on the international market to earn foreign exchange for repayment of debts. The search for oil is concentrated in three basins in Xinjiang Province: Tarim, Turpan-Hami, and Jungar, which are estimated to contain more than 50% of China's total oil resources.

Chinese and foreign geologists believe that basins in the South and East China Seas and Bohai may have rich oil-bearing structures. Foreign oil companies have invested a total of \$3 billion in China's offshore areas since 1982, when China first accepted an international bid. While major western companies, including British Petroleum, Shell, Occidental, and ACT (Agip, Chevron, and Texaco), are drilling in the South China Sea and Bohai, the East China Sea is still closed to foreign oil companies. Beginning in 1992, officials of the Shanghai-based East Offshore Oil Corp., affiliated with China National Offshore Oil Corp., announced that the East China Sea will soon be opened to foreign companies for bidding. Preliminary work done included division of the bidding area, initial appraisal of geological formation, and general engineering studies. International bidding will be invited as soon as the State Council gives approval.

Reserves

China is the world leader in proven reserves of antimony, barite, molybdenum, rare earths, titanium, tungsten, and vanadium. China has 55 billion tons of iron ore, albeit with an average grade of only 30% to 35% elemental content. Moreover, only 5% of the ore reserves contain 35% to 50% iron. Major deposits occur in Anhui, Hebei, Liaoning, and Nei Monggol. Major gold deposits are in Hebei, Heilongjiang, Henan, Hunan, Jilin, Nei Monggol, and Shandong. Bauxite deposits occur in Guangxi, Guizhou, Henan, and Shandong. Lead and zinc deposits are in Fujian, Gansu, Guangdong, and Guangxi.

With the exception of some commodities such as chromium, copper, and potash, China produces significant quantities of a wide array of minerals and

metals, based on its production and/or export capability for these commodities.

INFRASTRUCTURE

An inadequate transportation sector and telecommunications system are major factors hindering economic growth in China. In 1991, China invested \$8 billion to build and/or upgrade 309 km of double-track railway, electrify 849 km of railway, and install 6.09 Mmt of cargo-handling capacity at harbors.

To improve its telecommunications system with other countries, China's Ministry of Post and Telecommunications has invested \$64.3 million and, with the cooperation of Japan and the United States will construct its first international submarine cable line between Shanghai and Kyushu in Japan. After its completion in 1993, China's telecommunications system will be easier to access from a global system. The Government also invested \$373 million to update its long-distance telephone communication systems between Beijing and other major cities in China.

OUTLOOK

China is one of the world's leading producers in industrial minerals, metals, and fuels. It plans to increase output capacity of cement, copper, fertilizer, iron and steel, lead, nickel, salt, soda ash, and zinc. Despite an extensive minerals base, constraints based on a lack of both hard currency and advanced technology have forced the Chinese Government to delay capital investments in mine and plant construction and plant expansion. China has also opened the interior of the country for foreign exploration and development in an effort to increase the production of its fuel and nonfuel minerals sectors. China is expected to continue to be a major force in the world market for such commodities as antimony, barite, fluorspar, magnesite, rare earths, and tungsten. As the result of industrial development being achieved under its ambitious modernization program, China's industry will be technologically better suited to the

production of value added manufactures and advanced materials, meeting international quality specifications. By the end of this century, China hopes to become a newly industrialized country.

¹Where necessary, values have been converted from renminbi (RMB) to U.S. dollars at the rate of RMB5.8 = US\$1.00 for 1991.

²Standard coal equivalent (SCE) with thermal equivalent of 7,000 kilocalories per kilogram. The conversion is as follows (figures in bracket refer to thermal equivalent): 1 kg of coal (5,000 kcal) = 0.71 kg of SCE; 1 kg of crude oil (10,000 kcal) = 1.43 kg of SCE; 1 cubic meter of natural gas (9,310 kcal) = 1.33 kg of SCE.

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TABLE 1
CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991
METALS					
Aluminum:					
Bauxite, gross weight	2,200,000	2,300,000	2,388,000	2,400,000	2,600,000
Alumina, gross weight	1,200,000	¹ 1,300,000	¹ 1,350,000	¹ 1,460,000	1,600,000
Metal, refined, primary	615,000	710,000	⁷ 750,000	850,000	860,000
Antimony, mine output, Sb content	⁴ 40,000	⁴ 46,000	⁵ 50,000	⁵ 50,000	45,000
Bismuth, mine output, Bi content	600	750	⁸ 850	¹ 1,000	1,100
Cadmium, smelter	680	750	800	¹ 1,100	1,200
Copper:					
Mine output, Cu content	250,000	282,000	276,000	300,000	300,000
Metal:					
Smelter, primary and secondary	300,000	400,000	450,000	⁵ 559,000	600,000
Refined, primary and secondary	400,000	510,000	540,000	560,000	560,000
Gold, mine output, Au content	70	80	90	100	120
Iron and steel:					
Iron ore, gross weight	161,430	167,700	171,850	168,300	176,070
Pig iron	55,030	57,040	⁵ 58,200	⁶ 62,380	67,200
Ferroalloys	1,846	1,804	2,382	2,400	2,550
Steel, crude	56,280	59,430	61,200	66,100	70,570
Steel, rolled	43,900	47,000	48,700	51,200	55,500
Lead:					
Mine output, Pb content	267,000	312,000	308,000	³ 364,000	380,000
Metal, refined, primary and secondary	245,000	245,000	260,000	² 296,000	330,000
Magnesium metal, primary	³ 3,000	3,200	³ 3,500	⁵ 5,900	6,100
Manganese ore, gross weight	2,600	3,200	3,200	³ 3,300	3,400
Mercury, mine output, Hg content	700	940	880	800	800
Molybdenum, mine output, Mo content	12,000	14,400	15,700	15,700	16,000
Nickel:					
Mine	25,000	32,743	34,250	³ 33,000	36,000
Smelter	22,500	24,700	25,600	² 27,000	27,500
Silver, mine output, Ag content	100	110	125	130	150
Tin:					
Mine output, Sn content	20,000	38,000	40,000	⁴ 42,000	43,000
Metal, smelter	20,000	29,500	29,500	³ 35,000	38,000
Tungsten, mine output, W content	² 21,000	³ 30,000	³ 30,200	³ 32,000	25,000
Zinc:					
Mine output, Zn content	458,000	528,000	538,000	619,000	650,000
Refined, primary and secondary	383,000	420,000	451,000	⁵ 550,000	526,000
INDUSTRIAL MINERALS					
Asbestos	150,000	150,000	150,000	150,000	150,000
Barite	1,250	1,500	1,750	1,750	1,800
Cement, hydraulic	186,250	210,140	207,000	203,000	248,000
Fluorspar	1,000,000	1,100,000	1,750,000	¹ 1,700,000	1,600,000
Graphite	185,000	200,000	200,000	200,000	200,000
Gypsum	7,200	8,100	8,100	8,000	8,200
Kyanite and related materials	2,500	2,500	2,500	2,500	2,500

See footnotes at end of table.

TABLE 1—Continued
CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991
INDUSTRIAL MINERALS—Continued					
Lithium minerals, all types	15,000	15,000	15,000	15,000	15,500
Magnesite thousand tons	2,630	2,610	2,600	2,600	2,600
Nitrogen: N content of ammonia do.	16,000	¹ 16,500	¹ 17,000	¹ 17,500	18,000
Phosphate rock and apatite, P ₂ O ₅ equivalent do.	4,470	5,470	6,000	6,200	6,500
Potash, marketable, K ₂ O equivalent do.	40	40	40	¹ 60	60
Salt do.	18,000	22,000	28,000	20,000	25,500
Sodium compounds: Soda ash, natural and synthetic do.	<u>2,363</u>	<u>2,609</u>	<u>2,983</u>	<u>3,750</u>	<u>3,800</u>
Sulfur:					
Native do.	300	300	300	320	320
Content of pyrite do.	3,700	3,900	4,270	4,400	4,500
Byproduct, all sources do.	500	550	600	650	650
Total do.	<u>4,500</u>	<u>4,750</u>	<u>5,170</u>	<u>5,370</u>	<u>5,470</u>
Talc and related materials	<u>1,700,000</u>	<u>1,900,000</u>	<u>2,100,000</u>	<u>2,200,000</u>	<u>2,300,000</u>
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite thousand tons	170,000	175,000	190,000	170,000	190,000
Bituminous and lignite do.	750,000	770,000	850,000	883,460	900,000
Total do.	<u>920,000</u>	<u>945,000</u>	<u>1,040,000</u>	<u>1,053,460</u>	<u>1,090,000</u>
Coke, all types do.	45,000	47,000	¹ 66,200	¹ 73,280	80,000
Gas, natural:					
Gross billion cubic meters	14	14	15	15	15
Marketed do.	12	13	13	13	13
Petroleum:					
Crude (including crude from oil shale) thousand 42-gallon barrels	978,200	999,200	1,004,000	1,008,000	1,014,700
Refinery products do.	710,000	725,000	725,000	730,000	800,000

¹Revised.

¹Table includes data available through June 3, 1992.

TABLE 2
CHINA: SUPPLY AND DEMAND MINERALS AND METALS

(Thousand metric tons)

Item	Purchase			Sales			Inventory volumes			Turnover days		
	1985	1989	1990	1985	1989	1990	1985	1989	1990	1985	1989	1990
Ferrous metals:												
Pig iron	4,238.6	4459.6	5109.5	4,258.1	4566.1	4986.6	374.1	358.4	477.9	32	29	35
Scrap steel and iron	2,380.6	3,921.4	4,591.2	2,323.4	3,938.2	4,611.0	541.4	881.0	834.3	85	82	66
Steel products:	26,628.3	24,854.3	35,729.0	25,936.8	33,788.7	35,159.0	4,066.6	5,799.1	6,613.9	57	63	69
Heavy rails	46.5	87.7	95.9	47.6	92.8	97.4	9.1	23.9	23.1	70	94	87
Light rails	125.5	168.7	195.9	131.4	179.8	183.8	23.7	28.4	40.7	66	59	81
Large section steel	293.6	561.6	406.8	273.0	533.5	475.0	92.0	273.3	207.2	124	187	159
Medium section steel	1,771.1	2,561.0	2,299.2	1,740.5	2,510.2	2,401.9	330.3	678.2	587.7	69	99	89
Small section steel	8,206.4	10,013.2	10,484.7	7,722.8	9,795.6	10,203.1	1,061.9	1,219.5	1,585.4	50	45	57
Strip steel	76.2	291.8	292.8	76.8	288.4	300.4	7.3	25.0	19.5	35	32	24
Wire rod	4,618.7	5,338.6	6,741.3	4,407.8	5,251.7	6,583.1	388.9	374.5	581.5	32	26	32
Thick steel plate	53.0	46.5	35.0	66.8	41.6	44.8	4.9	7.9	7.7	27	69	62
Medium-thick steel plate	2,583.3	4,196.8	4,385.9	3,052.4	4,065.1	4,163.1	486.2	670.3	908.7	58	60	80
Thin steel plate	3,697.2	5,236.1	4,247.8	3,707.6	4,772.1	4,289.4	654.6	1,244.0	1,245.9	64	95	106
Silicon steel sheet	285.6	405.5	408.9	334.5	379.3	383.6	47.8	84.0	109.6	52	81	105
Quality rolled steel	1,587.9	1,998.4	1,885.7	1,560.2	1,955.8	1,994.9	308.5	528.1	478.7	72	99	90
Seamless steel pipe	1,072.4	1,163.7	1,225.5	1,008.6	1,158.5	1,168.3	353.4	205.4	254.3	128	65	79
Welded steel pipe	1,670.6	2,350.2	2,557.7	1,653.6	2,336.1	2,472.8	234.6	406.0	506.7	63	63	75
Other steel	540.3	434.5	475.9	154.9	427.6	447.4	13.4	30.6	57.2	32	26	47
Nonferrous metals:												
Copper	406.9	319.2	453.8	382.7	326.1	456.9	93.8	63.7	62.7	89	71	50
Aluminum	543.8	566.9	470.5	505.7	485.2	487.4	111.8	164.4	146.0	81	124	109
Lead	126.2	175.4	144.4	153.0	152.0	153.7	33.9	54.7	45.8	81	131	109
Zinc	282.9	260.7	328.7	251.9	266.8	357.1	101.6	71.2	43.2	147	97	44
Tin	10.2	12.0	11.6	10.7	12.2	11.7	4.2	4.7	4.2	144	141	133
Copper products	64.0	47.6	43.9	62.8	47.2	45.1	27.5	17.5	16.1	160	135	130
Aluminum products	54.7	49.0	34.0	50.5	45.3	34.6	16.9	14.1	14.2	122	113	150
Lead products	1.9	3.2	1.7	2.1	3.0	1.4	.6	.8	.7	94	101	107
Industrial minerals:												
Caustic soda	501.6	891.4	673.0	510.8	871.2	671.5	53.5	90.0	93.8	38	38	51
Soda ash	1,487.1	2,101.1	1,520.9	1,434.6	2,043.3	1,484.8	162.5	189.3	230.4	41	34	57
Cement	32,698.9	31,442.4	27,524.0	32,551.7	30,916.1	27,627.0	964.7	1,469.8	1,377.7	11	17	18
Fuel:												
Coal	222,120	265,940	270,350	215,430	250,490	259,630	23,630	28,680	36,100	40	42	51

TABLE 3
CHINA: MATERIALS CONSUMPTION IN THE FERROUS AND NONFERROUS SECTORS

Item	Unit	1985	1989	1990
Ferrous:				
Iron ore consumed in iron smelting	kilograms/ tons	1,820	1,779	1,786
Fuel consumption in iron smelting (coke ration equivalent)	do.	568	610	611
Coke consumption in iron smelting (coke ratio)	do.	519	584	577
Pig iron and scrap consumption for steelmaking by open-hearth furnace	do.	1,105	1,120	1,123
Pig iron consumption	do.	802	853	847
Pig iron and scrap consumption for steelmaking by electric furnace	do.	1,040	1,046	1,047
Pig iron consumption	do.	155	90	87
Pig iron and scrap consumption for steelmaking by side-blow converter	do.	1,177	1,242	1,198
Pig iron consumption	do.	1,101	1,061	964
Pig iron and scrap consumption for steelmaking by top-blow converter	do.	1,133	1,135	1,131
Pig iron consumption	do.	1,026	1,019	1,015
Wet coal consumed for cokemaking	do.	1,440	1,411	1,424
Electricity consumption for steelmaking by electric furnace	kilograms/ tons	626	647	689
Electricity consumption for ferrosilicon production	do.	8,889	9,078	NA
Nonferrous:				
Metal recovery rate in ore dressing:				
Copper	percentage	85.80	85.27	83.83
Lead	do.	83.10	81.00	81.00
Zinc	do.	88.10	84.70	86.50
Nickel	do.	82.20	83.70	83.60
Tin	do.	58.30	58.70	58.40
Tungsten	do.	81.60	82.00	83.40
Molybdenum	do.	77.70	83.10	NA
Metal recovery rate in smelting:				
Copper	do.	97.27	97.40	97.46
Lead	do.	95.10	90.90	95.20
Zinc	do.	95.62	94.00	95.69
Tin	do.	95.61	96.19	95.11
D.C. consumption in electrolytic aluminum process	kilograms/ tons	15,047	15,036	14,916
Alumina consumed in electrolytic aluminum process	kilograms/ tons	1,953	1,956	1,958

NA Not available.

TABLE 4
CHINA: EXPORTS OF SELECTED MINERAL COMMODITIES IN 1991

(Metric tons except where otherwise noted)

	Quantity	Value (thousand)	Percentage change from 1990	
			Quantity	Value
Metals:				
Aluminum:				
Bauxite	541,554	\$30,080	(20.4)	(31.8)
Metal and alloys:				
Unwrought	68,556	103,950	5.2	.1
Semimanufacturers	27,300	55,660	53.6	36.2
Antimony metal, unwrought	29,373	47,440	(11.9)	(16.7)
Barium:				
Barium carbonate	81,056	17,170	7.5	2.0
Barium sulfate	1,124,726	33,400	(22.0)	(17.7)
Copper:				
Metal and alloys, unwrought	8,711	20,180	(51.6)	(56.2)
Semimanufacturers	33,655	108,100	33.4	39.5
Iron and steel:				
Ferrosilicon	319,997	164,030	30.9	26.3
Pig iron and cast iron	620,000	89,950	66.0	61.3
Steel:				
Bars and rods	1,115,033	308,260	39.2	37.1
Shapes and sections	401,597	113,760	35.2	34.6
Sheets and plates	456,775	146,110	(11.3)	(10.2)
Tube and pipe	182,022	143,470	4.0	1.8
Other	231,439	106,790	36.7	32.4
Tin:				
Metal and alloys, unwrought	15,692	87,100	54.8	34.3
Tungsten:				
Metal, unwrought	420	2,840	25.2	9.3
Ore	6,071	14,200	(63.0)	(69.3)
Zinc:				
Metal and alloys, unwrought	6,284	6,880	(62.4)	(69.7)
Industrial minerals:				
Cement	10,735,945	442,890	57.2	72.1
Clay and other refractory minerals	2,851,725	201,980	17.4	1.6
Fluorspar	933,694	65,840	(14.6)	(21.2)
Talc	948,196	50,360	9.0	(3.3)
Fuels:				
Coal	20,000,000	748,480	15.6	14.4
Coke, semicoke	1,080,000	80,380	(16.9)	(19.7)
Petroleum:				
Crude oil	22,600,000	2,956,790	(5.7)	(13.0)
Refinery products	4,810,000	822,930	(8.5)	(6.2)

Source: China's Customs Statistics (1992.1).

TABLE 5
CHINA: IMPORTS OF SELECTED MINERAL COMMODITIES IN 1991

(Metric tons, except where otherwise noted)

	Quantity	Value (thousand)	Percentage change from 1990	
			Quantity	Value
Metals:				
Aluminum:				
Alumina	685,525	\$165,290	17.7	(17.4)
Metal and alloys, unwrought	43,711	66,370	(39.1)	(48.0)
Semimanufactures	65,028	215,950	48.2	40.2
Chromium: Chromite	544,648	71,700	(15.0)	(27.0)
Copper:				
Ore	309,786	155,630	27.9	23.7
Metal and alloys, unwrought	113,966	259,260	183.1	152.5
Semimanufactures	52,167	177,779	38.1	27.3
Iron and steel:				
Iron ore	18,549,433	565,860	29.3	43.5
Pig iron and cast iron	360,000	49,850	(72.2)	(74.7)
Scrap (iron and steel)	240,000	33,170	30.3	13.8
Wire (iron and steel)	21,749	23,260	(49.3)	(18.2)
Steel:				
Bars and rods	90,000	44,600	(77.0)	(70.5)
Billets and forgings	120,000	30,000	(55.8)	(56.5)
Seamless pipe	1,100,000	953,810	62.3	69.6
Shapes and sections	60,000	24,420	(69.1)	(62.8)
Sheets and plates	2,040,000	1,317,320	(14.2)	(8.7)
Wire rod	90,000	30,410	(78.1)	(78.1)
Zinc: metal and alloys, unwrought	11,705	14,310	182.6	151.0
Industrial minerals:				
Cement	160,000	7,620	(60.2)	(56.6)
Compound fertilizers	4,629,397	964,860	13.9	6.0
Potassium chloride	2,072,805	243,100	85.5	75.9
Sodium:				
Sodium bichromate	12,900	10,920	49.4	40.5
Sodium carbonate	54,220	10,440	(74.2)	(75.1)
Sodium hydroxide	3,631	2,130	(91.0)	(88.2)
Sodium tetraborate	2,727	1,030	677.6	631.2
Superphosphate	202,542	32,860	51.3	42.9
Titanium dioxide	22,732	44,520	(3.3)	(22.6)
Urea	7,005,128	1,216,430	(13.8)	5.4
Fuels:				
Coal	1,370,000	47,200	(31.7)	(36.3)
Electric current thousand kilowatt hours	3,110	171,460	61.4	46.5
Petroleum:				
Crude oil	5,970,000	926,380	104.3	118.5
Refinery products	4,610,000	901,910	45.9	47.8

Source: China's Customs Statistics (1992.1)

TABLE 6
CHINA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	NA	1,408	605	Japan 289; Norway 172; Netherlands 105.
Aluminum:				
Ore and concentrate	thousand tons	21,492	680	221 Netherlands 128; Japan 78; West Germany 65.
Oxides and hydroxides	NA	566,148	114,734	Netherlands 112,874; Japan 70,533.
Metal including alloys:				
Scrap	NA	1,715	—	Japan 1,444; Hong Kong 200.
Unwrought	13,411	65,125	—	Japan 23,953; Republic of Korea 23,860; Hong Kong 11,456.
Semimanufactures	6,299	17,764	222	Hong Kong 11,656; Indonesia 1,498.
Antimony:				
Oxides and hydroxides	NA	13,014	3,920	Hong Kong 3,338; Japan 2,376.
Metal including alloys, all forms	NA	33,368	11,557	Netherlands 6,347; Hong Kong 4,609.
Arsenic:				
Ore and concentrate	NA	1,570	—	Hong Kong 1,567; Japan 3.
Oxides and acids	NA	2,704	1,568	Hong Kong 633; New Zealand 141.
Bismuth: Metal including alloys, all forms	NA	609	10	Hong Kong 553; Netherlands 26.
Cadmium: Metal including alloys, all forms	NA	568	17	Hong Kong 435; Netherlands 115.
Chromium:				
Ore and concentrate	NA	2,448	—	Japan 2,000; Hong Kong 448.
Oxides and hydroxides	NA	2,622	52	Netherlands 946; Hong Kong 405; West Germany 189.
Cobalt:				
Oxides and hydroxides	NA	170	—	Netherlands 89; West Germany 26; Hong Kong 21.
Metal including alloys, all forms	NA	32	—	Hong Kong 19; Sweden 13.
Columbium and tantalum: Tantalum metal including alloys, unwrought	NA	10	—	Hong Kong 6; Australia 2.
Copper:				
Sulfate	NA	4,296	17	Canada 1,323; Netherlands 684; Hong Kong 567.
Metal including alloys:				
Scrap	NA	248	—	All to Hong Kong.
Unwrought	11,770	18,003	51	Republic of Korea 11,690; Japan 4,166.
Semimanufactures	16,479	25,229	503	Hong Kong 20,505; Republic of Korea 1,831.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	2,766	561	([†])	Japan 454; Thailand 88.
Pyrite, roasted	kilograms	58,600	—	
Metal:				
Scrap	185,007	112,469	17	Hong Kong 52,303; Japan 22,805; Thailand 18,209.
Pig iron, cast iron, related materials	thousand tons	533	378	([†]) Japan 273; Thailand 40; Republic of Korea 31.
Ferroalloys:				
Ferrochromium	NA	11,463	300	Japan 4,381; Republic of Korea 2,120; Netherlands 1,850.
Ferromanganese	NA	70,497	8,786	Republic of Korea 9,280; Japan 9,206; Hong Kong 9,104.
Ferromolybdenum	NA	6,629	548	Netherlands 3,804; Hong Kong 747; Sweden 565.
Ferrosilicomanganese	NA	97,303	500	Japan 65,296; Hong Kong 18,245; Indonesia 3,625.
Ferrosilicon	NA	244,286	3,786	Japan 158,572; Hong Kong 31,210; Republic of Korea 12,928.
Unspecified	193,259	18,150	658	Netherlands 7,254; Japan 5,448.

See footnotes at end of table.

TABLE 6—Continued
CHINA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued:				
Metal—Continued:				
Steel, primary forms	79,101	521,032	74	Thailand 193,067; Hong Kong 95,700; Taiwan 90,948.
Semimanufactures:				
Bars, rods, angles, shapes, sections	392,155	1,183,682	1,623	Hong Kong 413,646; Thailand 377,358.
Universals, plates, sheets	286,238	515,007	36	Japan 178,081; Thailand 105,122.
Hoop and strip	10,759	20,109	—	Singapore 5,951; Hong Kong 3,624.
Rails and accessories	5,996	13,330	—	Botswana 10,386; North Korea 1,622.
Wire	145,276	169,237	84	Hong Kong 44,078; Singapore 16,438.
Tubes, pipes, fittings	228,819	291,580	59,356	Hong Kong 64,600; Japan 33,623.
Castings and forgings, rough	20,468	46,434	8,643	Japan 15,692; Hong Kong 9,644.
Lead:				
Ore and concentrate	19,198	1,978	—	Japan 1,860; Singapore 118.
Oxides	NA	5,106	—	Japan 2,835; Hong Kong 1,040; Bangladesh 393.
Metal including alloys:				
Scrap	NA	177	177	
Unwrought	1,839	37,981	929	Japan 11,989; Singapore 10,190; Hong Kong 7,493.
Semimanufactures	192	3,093	—	Hong Kong 1,293; Japan 1,047.
Magnesium: Metal including alloys, all forms	NA	523	—	Japan 521; Hong Kong 2.
Manganese:				
Ore and concentrate	28,769	27,998	—	North Korea 18,998; Japan 5,592; Bangladesh 1,028.
Oxides and hydroxides	NA	5,867	—	Hong Kong 3,098; Singapore 670; Japan 449.
Metal including alloys, all forms	NA	42,524	260	Hong Kong 14,795; Japan 13,746; Netherlands 10,223.
Mercury	NA	330	—	Hong Kong 122; Netherlands 97; Australia 32.
Molybdenum:				
Ore and concentrate	NA	370	—	Netherlands 168; Belgium-Luxembourg 102; Chile 100.
Oxides and hydroxides	NA	381	77	Netherlands 270; United Kingdom 34.
Metal including alloys, all forms	NA	178	60	Netherlands 79; Japan 12.
Nickel:				
Ore and concentrate	18	—	—	
Metal including alloys:				
Unwrought	54	(^c)	—	All to Japan.
Semimanufactures	1,044	326	—	Hong Kong 320; West Germany 3.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	871	1,129,602	588,938	Hong Kong 410,062; Canada 75,772.
Rare-earth metals:				
Ores and concentrates	NA	327	1	Netherlands 175; Macau 58; Hong Kong 30.
Oxides and other compounds	NA	2,530	155	Japan 1,831; Hong Kong 148.
Metals including alloys, all forms	NA	1,327	193	Japan 773; Netherlands 111.
Selenium: Elemental	—	5	—	All to Hong Kong.
Silver:				
Ore and concentrate ⁴ kilograms	5,883	1,055	—	All to Australia.
Waste and sweepings ⁵	NA	177	121	Hong Kong 46; United Kingdom 10.
Metal including alloys, unwrought and partly wrought kilograms	2,450	7,153	—	All to Hong Kong.

See footnotes at end of table.

TABLE 6—Continued
CHINA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Tin:				
Ore and concentrate	21,828	9,583	—	Hong Kong 3,925; Singapore 3,068; Japan 1,528.
Metal including alloys:				
Scrap				
Unwrought	9,874	10,135	4,087	Japan 2,230; Hong Kong 1,663; Netherlands 1,164.
Semimanufactures	4,284	4,904	500	Japan 3,087; Hong Kong 1,306.
Titanium:				
Oxides	NA	630	—	Hong Kong 463; Japan 100.
Metal including alloys, all forms	NA	634	226	United Kingdom 245; Hong Kong 57.
Tungsten:				
Ore and concentrate	NA	16,450	4,992	U.S.S.R. 7,302; Czechoslovakia 1,228.
Oxides and hydroxides	NA	2,111	426	Japan 1,016; Netherlands 314.
Metal including alloys, all forms	6,1485	335	140	Netherlands 109; West Germany 56.
Uranium and thorium:				
Ore and concentrate	NA	17	—	All to Malaysia.
Oxides and other compounds	value, thousands	NA	\$21,806	—
Metal including alloys, all forms	kilograms	4,235	—	France \$21,725; Sri Lanka \$30.
Zinc:				
Ore and concentrate	115,266	76,228	—	Japan 57,873; Hong Kong 8,480; Republic of Korea 7,095.
Oxides and hydroxides	NA	44,431	1,393	Hong Kong 20,059; Netherlands 5,091; Japan 2,158.
Metal including alloys:				
Scrap				
Unwrought	20,109	16,711	200	Japan 6,596; Hong Kong 3,975.
Semimanufactures	1,507	6,003	520	Hong Kong 2,485; Japan 2,161.
Other:				
Ores and concentrates	93,910	38,189	40	Japan 29,742; Hong Kong 8,174.
Oxides and hydroxides (iron, lead, zinc, etc.)	62,210	(¹)		
Ashes and residues	8,072	16,690	60	Hong Kong 11,525; Singapore 4,400.
Base metals:				
Scrap				
Unwrought and semimanufactures	107,144	20,351	2,661	Japan 12,054; Netherlands 2,413.
Metalloids, unspecified ²	NA	129,897	18,850	Japan 61,653; Hong Kong 26,993.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.				
	value, thousands	\$20,838	\$7,646	\$114 Japan \$3,516; Hong Kong \$1,752.
Artificial:				
Corundum	NA	71,812	4,922	Japan 38,572; Hong Kong 19,636.
Silicon carbide ³	NA	55,073	10,113	Japan 17,508; West Germany 8,114.
Dust and powder of precious and semiprecious stones including diamond				
	value, thousands	NA	\$227	\$40 Hong Kong \$102; Belgium-Luxembourg \$22.
Grinding and polishing wheels and stones	do.	\$10,221	\$10,794	\$622 Hong Kong \$4,801; Singapore \$1,083.
Asbestos, crude	1,889	7,135	—	Iran 6,715; Cuba 400.
Barite and witherite	thousand tons	NA	1,443	915 West Germany 136; Japan 113.

See footnotes at end of table.

TABLE 6—Continued
CHINA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Boron materials:				
Crude natural borates	NA	18	—	All to Italy.
Oxides and acids	NA	6,554	—	Bulgaria 1,500; Czechoslovakia 1,000; Finland 960.
Cement	436,486	6,829,558	1,020	Republic of Korea 2,437,510; Hong Kong 1,646,482.
Clays, crude:				
Chamotte earth	NA	161,736	—	Japan 49,718; Hong Kong 42,426; Netherlands 16,264.
Unspecified	NA	814,497	200	Hong Kong 493,741; Macau 181,459; Japan 59,483.
Cryolite and chiolite	NA	69	—	North Korea 29; Republic of Korea 18; Japan 17.
Diamond: Natural:				
Gem, not set or strung	value, thousands	\$54,668	\$81,650	\$1,191 Hong Kong \$58,878; Thailand \$9,220.
Industrial stones	do.	\$4,828	\$6,444	\$21 Hong Kong \$6,097; Belgium-Luxembourg \$326.
Diatomite and other infusorial earth	NA	19,528	(^o)	Hong Kong 6,248; Netherlands 6,141; Japan
Feldspar, fluospar, related materials:				
Feldspar	NA	222,945	—	Hong Kong 200,271; Taiwan 12,500; Japan 4,505.
Fluospar	NA	1,094,047	216,228	Japan 438,460; U.S.S.R. 165,682.
Unspecified	NA	154	—	All to Japan.
Fertilizer materials:				
Crude, n.e.s.				
	551	1,878	—	Japan 1,559; Hong Kong 319.
Manufactured:				
Ammonia	NA	3,801	—	Hong Kong 3,776; Macau 24.
Nitrogenous	41,878	76,713	—	Malaysia 38,708; Thailand 19,440; Hong Kong 5,059.
Phosphatic	121,133	168,359	—	Japan 86,042; Sri Lanka 35,847; North Korea 26,619.
Potassic	13	28	—	Pakistan 15; Hong Kong 10.
Unspecified and mixed	1,128	2,643	—	Japan 2,350; Hong Kong 190.
Graphite, natural	NA	141,234	17,882	Japan 77,910; Netherlands 9,871; West Germany 7,632.
Gypsum and plaster	NA	130,798	—	North Korea 109,722; Macau 16,602.
Lime	80,179	71,325	—	Hong Kong 59,884; Macau 9,711; Singapore 1,240.
Magnesium compounds: Magnesite, including calcined				
	thousand tons	NA	1,306	170 Japan 345; Netherlands 169; Canada 113.
Meerschaum, amber, jet	NA	4,869	—	Japan 4,795; Republic of Korea 44; Hong Kong 30.
Mica:				
Crude including splittings and waste				
	NA	24,879	—	Japan 11,653; United Kingdom 10,792; West Germany 525.
Worked including agglomerated splittings				
	value, thousands	NA	\$444	\$138 Hong Kong \$128; Japan \$88; Pakistan \$20.
Pigments, mineral:				
Natural, crude				
	NA	2,217	—	Pakistan 920; Japan 654; Singapore 428.
Iron oxides and hydroxides, processed				
	NA	26,796	2,961	Hong Kong 4,707; Netherlands 3,045.
Precious and semiprecious stones other than diamond:				
Natural				
	value, thousands	\$29,699	\$84,437	\$2,104 Hong Kong \$77,662; Thailand \$1,796.
Synthetic				
	do.	\$6,521	\$5,669	\$827 Hong Kong \$1,982; Japan \$1,157.
Pyrite, unroasted	230,312	207,078	—	Japan 207,057; Belgium-Luxembourg 21.
Quartz, mica, feldspar, etc.	1,341,673	(^o)		
Salt and brine	thousand tons	371	481	(^o) North Korea 153; Hong Kong 131; U.S.S.R. 86.

See footnotes at end of table.

TABLE 6—Continued
CHINA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Sodium compounds, n.e.s.:				
Soda ash, manufactured	NA	86,775	—	Hong Kong 19,223; Bangladesh 12,885; Indonesia 11,100.
Sulfate, manufactured	NA	342,763	60	Republic of Korea 114,061; Indonesia 47,416; Hong Kong 44,847.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	value, thousands	\$27,890	\$30,704	\$234 Japan \$22,715; Hong Kong \$3,946.
Worked	do.	\$88,571	\$105,369	\$8,060 Japan \$51,326; Hong Kong \$31,350.
Dolomite, chiefly refractory-grade		—	5,293	— Japan 4,733; Hong Kong 500; Singapore 30.
Gravel and crushed rock	thousand tons	5,382	5,875	(¹) Hong Kong 5,148; Macau 636; Japan 83.
Limestone flux and calcareous stone		¹¹ 123,629	8,890	— Hong Kong 8,704; Thailand 150.
Quartz and quartzite		NA	34,686	(¹) Japan 24,690; Hong Kong 8,887.
Sand other than metal-bearing	thousand tons	5,856	3,970	18 Macau 2,264; Hong Kong 1,498.
Sulfur:				
Elemental:				
Crude including native and byproduct		8,451	85	— Japan 33; Netherlands 28; Malaysia 20.
Colloidal, precipitated, sublimed		NA	6	— All to Burma.
Sulfuric acid		NA	7,486	10 Hong Kong 7,391; Macau 85.
Talc, steatite, soapstone, pyrophyllite		NA	869,855	7,586 Japan 531,840; Republic of Korea 119,563; Hong Kong 67,694.
Other:				
Crude		2,214,376	66,467	34 Japan 48,703; Hong Kong 12,938.
Refractory minerals		² 2,306,427	(¹²)	
Slag and dross, not metal-bearing		6,508	17,784	507 Japan 12,026; Hong Kong 2,459.
MINERAL FUELS AND RELATED MATERIALS				
Carbon:				
Carbon black		NA	28,863	10 Thailand 7,569; Indonesia 3,778; Hong Kong 3,100.
Gas carbon		NA	424	— All to Hong Kong.
Coal:				
Anthracite	thousand tons	1,330	1,527	— Japan 464; Republic of Korea 416; France 317.
Bituminous	do.	14,008	15,766	(¹) Japan 4,819; North Korea 1,702; Republic of Korea 1,527.
Briquets of anthracite and bituminous coal		1,136	2,752	— Taiwan 2,348; United Kingdom 370.
Coke and semicoke	thousand tons	¹³ 1,662	1,303	(¹) Romania 279; Brazil 205; India 171.
Peat including briquets and litter		4	86	— All to Republic of Korea.
Gas, natural: Gaseous	cubic meters	8,137	—	
Petroleum:				
Crude	thousand 42-gallon barrels	178,035	175,044	29,231 Japan 99,749; Singapore 24,234; North Korea 7,757.
Refinery products:				
Liquefied petroleum gas	value, thousands	\$1,707	\$2,610	— Hong Kong \$1,704; Macau \$808.
Gasoline:				
Aviation	thousand 42-gallon barrels	NA	1,352	167 Singapore 1,135; Japan 43.
Motor	do.	¹⁴ 17,103	13,916	1,280 Singapore 11,518; Japan 754.
Naptha including white spirit	do.	NA	4,745	— Japan 4,043; Hong Kong 317.
Mineral jelly and wax	do.	1,093	1,509	90 Singapore 240; Hong Kong 146; Philippines 113.
Kerosene and jet fuel	do.	3,276	3,420	— Japan 2,178; Hong Kong 1,029.
Distillate fuel oil	do.	11,119	11,946	— Singapore 5,125; Hong Kong 3,618; Japan 2,310.

See footnotes at end of table.

TABLE 6—Continued
CHINA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued:					
Refinery products—Continued:					
Lubricants	thousand 42-gallon barrels	1,856	2,077	231	Japan 544; Thailand 462; Hong Kong 280.
Residual fuel oil	do.	3,634	3,839	—	Japan 2,422; Hong Kong 1,417.
Bitumen and other residues	do.	¹⁵ 898	192	—	Japan 179; Hong Kong 5.
Bituminous mixtures	do.	NA	203	—	Japan 202.
Petroleum coke	do.	NA	899	—	Japan 879; Republic of Korea 11.

NA Not available.

¹Data presented in this table are from China's Customs Statistics Yearbook. Table prepared by Audrey D. Wilkes.

²Includes alumina.

³Less than 1/2 unit.

⁴May include other precious ores and concentrates.

⁵May include platinum-group metals.

⁶Includes tungsten, molybdenum, tantalum, and magnesium.

⁷Individual commodity data are listed for 1990.

⁸Elemental arsenic, phosphorus, and tellurium.

⁹Not further identified.

¹⁰Includes boron carbide.

¹¹Calcareous stones, not further identified.

¹²Individual refractory minerals data are listed for 1990.

¹³Includes retort carbon.

¹⁴Includes aviation gasoline.

¹⁵Includes bituminous mixtures and petroleum coke.

TABLE 7
CHINA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	NA	2,650	21	West Germany 986; U.S.S.R. 985.
Aluminum:				
Ore and concentrate	298,006	57	—	Australia 50; Hong Kong 7.
Oxides and hydroxides	NA	583,012	1,458	Australia 535,276; Japan 15,968.
Metal including alloys:				
Scrap	NA	5,490	1,423	Hong Kong 2,518; Mongolia 1,150.
Unwrought	175,510	71,771	2,913	U.S.S.R. 30,910; West Germany 11,002.
Semimanufactures	70,812	43,858	3,048	Hong Kong 7,448; Japan 6,847.
Antimony:				
Ore and concentrate	NA	53	—	Mainly from Burma.
Oxides	NA	9	3	Japan 3; West Germany 1.
Metal including alloys, all forms	NA	50	—	Hong Kong 49; Sweden 1.
Arsenic: Oxides and acids	NA	4	—	Japan 3; Hong Kong 1.
Beryllium: Metal including alloys, all forms	NA	3	—	Mainly from Hong Kong.
Bismuth: Metal including alloys, all forms	NA	72	—	Mexico 37; Hong Kong 13; United Kingdom 10.
Cadmium: Metal including alloys all forms	NA	9	—	Japan 8; Hong Kong 1.
Chromium:				
Ore and concentrate	NA	641,267	4,671	India 192,840; Albania 80,728; Turkey 77,974.
Oxides and hydroxides	NA	234	—	U.S.S.R. 100; West Germany 74; Hong Kong 31.
Cobalt:				
Oxides and hydroxides	NA	5	—	Hong Kong 4; Japan 1.
Metal including alloys, all forms	NA	498	3	Zaire 465; Canada 20.
Columbium and tantalum: Tantalum metal including alloys, all forms kilograms				
	NA	867		All from West Germany.
Copper:				
Ore and concentrate	178,166	242,197	59,675	Portugal 52,705; U.S.S.R. 40,764; Indonesia 22,461.
Sulfate	NA	4,219	1	U.S.S.R. 4,127; Sweden 59.
Metal including alloys:				
Scrap	NA	21,729	16,589	Hong Kong 2,191; Mongolia 1,040.
Unwrought	70,082	40,251	2,616	U.S.S.R. 5,663; Philippines 4,939.
Semimanufactures	38,568	37,761	1,845	Hong Kong 9,919; Poland 7,704; Japan 7,456.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	thousand tons	12,252	14,343	—
Pyrite, roaste		341,063	—	Australia 10,168; Brazil 2,390; North Korea 599.
Metal:				
Scrap		119,923	183,354	58,656
Pig iron, cast iron, related materials		687,737	1,309,484	83
Ferroalloys:				
Ferrosilichromium	NA	201	154	Japan 45.
Unspecified	5,499	172	21	Netherlands 40; United Kingdom 40.
Steel, primary forms	199,420	454,841	11	U.S.S.R. 295,507; Republic of Korea 35,187.

See footnotes at end of table.

TABLE 7—Continued
CHINA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued:				
Metal—Continued:				
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,396,352	991,782	1,714	Japan 262,377; U.S.S.R. 138,640; Romania 106,835.
Universals, plates, sheets	6,008,697	2,379,525	50,109	Japan 1,311,246; U.S.S.R. 247,226.
Hoop and strip	154,502	83,621	354	Japan 41,443; West Germany 11,676.
Rails and accessories	7,497	14,015	—	Republic of Korea 6,879; Japan 3,954; U.S.S.R. 3,084.
Wire	41,986	42,925	8	Brazil 14,962; Hong Kong 7,257.
Tubes, pipes, fittings	1,216,925	733,217	7,872	Japan 430,861; West Germany 119,424.
Castings and forgings, rough	1,094	1,433	12	Austria 371; Taiwan 337.
Lead:				
Ore and concentrate	604	470	—	All from Burma.
Oxides kilograms	NA	821	—	Hong Kong 300; Japan 270; West Germany 227.
Metal including alloys:				
Scrap	NA	665	665	
Unwrought	36,374	1,773	—	Bulgaria 1,000; Australia 500.
Semimanufactures	430	793	9	Australia 500; Japan 184.
Magnesium: Metal including alloys, all forms	NA	374	267	Norway 60; U.S.S.R. 42.
Manganese:				
Ore and concentrate	424,803	357,021	15,400	Australia 178,738; Gabon 113,765.
Oxides	NA	462	—	Hong Kong 242; Belgium-Luxembourg 100.
Metal including alloys, all forms	NA	468	3	Hong Kong 265; Belgium-Luxembourg 100.
Molybdenum: Metal including alloys, all forms	NA	6	—	United Kingdom 5.
Nickel: Metal including alloys:				
Scrap	NA	9	9	
Unwrought	526	35	—	Japan 24; Norway 6.
Semimanufactures	3,772	418	4	Japan 116; Hong Kong 103; Canada 67.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	2,589	7,561	106	Japan 5,118; U.S.S.R. 1,855.
Rare-earth metals:				
Ores and concentrates	NA	59	—	Mainly from Japan.
Oxides and other compounds kilograms	NA	10,630	399	France 10,010; West Germany 220.
Metals including alloys, all forms do.	NA	251	—	Taiwan 200; United Kingdom 51.
Selenium, elemental	NA	151	—	Japan 82; Canada 28; U.S.S.R. 25.
Silver:				
Ore and concentrate ³ kilograms	103,708	9	—	All from Burma.
Metal including alloys, unwrought and partly wrought do.	21,304	7,955	—	North Korea 4,998; Hong Kong 1,259; Japan 1,086.
Tin:				
Ore and concentrate	148	109	—	All from Burma.
Metal including alloys:				
Unwrought	50	116	15	Hong Kong 42; Thailand 30; Malaysia 25.
Semimanufactures	470	251	6	Hong Kong 182; Taiwan 21.

See footnotes at end of table.

TABLE 7—Continued
CHINA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Titanium:				
Ore and concentrate	NA	60,524	224	Canada 40,818; Switzerland 6,017.
Oxides	NA	3,812	1,381	Japan 2,075; West Germany 154.
Metal including alloys, all forms	NA	80	(*)	U.S.S.R. 66; Japan 12.
Tungsten:				
Oxides and hydroxides	kilograms	NA	230	—
				All from Japan.
Metal including alloys, all forms	do.	NA	821	660
				Japan 130.
Uranium and thorium:				
Ore and concentrate	do.	339,750	—	
Oxides and other compounds	value, thousands	NA	\$598	—
				All from France.
Metal including alloys, all forms	kilograms	—	10	—
				All from Japan.
Zinc:				
Ore and concentrate		30	21	—
				Iran 20; Taiwan 1.
Oxides		NA	2,332	(*)
				Yugoslavia 1,399; Hong Kong 852.
Metal including alloys:				
Scrap		NA	4	—
				All from Hong Kong.
Unwrought		19,198	4,141	100
				North Korea 1,964; Hong Kong 490; Canada 397.
Semimanufactures		1,450	737	(*)
				Japan 356; Hong Kong 313.
Other:				
Ores and concentrates		608,971	2,151	(*)
				Morocco 2,052; Japan 42.
Oxides and hydroxides		4,201	1,106	23
				Japan 713; Hong Kong 279.
Ashes and residues		857	1,337	—
				New Zealand 798; North Korea 322.
Metalloids, unspecified ⁵		NA	332	1
				U.S.S.R. 181; West Germany 141.
Base metals including alloys, all forms		29,096	3,070	2,588
				Japan 291; Italy 60.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.				
	value, thousands	\$1,628	\$3,079	\$71
				Hong Kong \$1,438; Japan \$503; Indonesia \$409.
Artificial:				
Corundum		NA	71	(*)
				France 40; Italy 10; Japan 10.
Silicon carbide ⁷	kilograms	NA	1,761	1,499
				Netherlands 150; Japan 112.
Dust and powder of precious and semi-precious stones including diamond				
	value, thousands	NA	\$1,579	—
				Canada \$1,500; Hong Kong \$29.
Grinding and polishing wheels and stones	do.	\$8,258	\$9,189	\$599
				Japan \$4,129; Hong Kong \$1,790.
Asbestos, crude		500	1,083	—
				Canada 700; Zimbabwe 383.
Barite and witherite		NA	29	—
				Hong Kong 28; Japan 1.
Boron materials:				
Crude natural borates		NA	231	—
				Japan 147; Turkey 84.
Oxides and acids		NA	1,537	—
				U.S.S.R. 1,517; Hong Kong 9.
Cement	thousand tons	1,233	397	(*)
				North Korea 204; Hong Kong 103.
Chalk		NA	17	—
				All from Hong Kong.
Clays, crude:				
Chamotte earth		NA	31	—
				Mainly from Taiwan.
Unspecified		NA	18,585	5,822
				Morocco 9,948; United Kingdom 932.
Cryolite and chiolite	kilograms	NA	950	—
				All from Hong Kong.

See footnotes at end of table.

TABLE 7—Continued
CHINA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Diamond:					
Natural:					
Gem, not set or strung	value, thousands	\$56,048	\$89,421	\$24	Hong Kong \$46,098; Belgium-Luxembourg \$31,476.
Industrial stones	do.	\$2,666	\$1,546	\$259	Belgium-Luxembourg \$542; Ireland \$449.
Synthetic: Gem, not set or strung	do.	NA	\$1,291	\$307	Ireland \$601; Austria \$127.
Diatomite and other infusorial earth		NA	765	520	France 99; Hong Kong 94; Taiwan 40.
Feldspar, fluorspar, related materials:					
Feldspar		NA	111	—	Hong Kong 98; Japan 12.
Fluorspar		NA	421	—	Hong Kong 384; Japan 19.
Unspecified		NA	44	—	Canada 36; Republic of Korea 5.
Fertilizer materials:					
Crude, n.e.s.					
		11,769	10,158	—	Hong Kong 10,072; Malaysia 80.
Manufactured:					
Ammonia					
		NA	29	—	Hong Kong 26; Thailand 2.
Nitrogenous	thousand tons	8,134	8,634	455	U.S.S.R. 3,517; Iraq 554; Norway 547.
Phosphatic	do.	248	202	—	U.S.S.R. 100; Tunisia 33; Morocco 20.
Potassic	do.	1,477	2,793	85	Canada 1,088; Jordan 309; U.S.S.R. 291.
Unspecified and mixed	do.	4,074	3,610	2,699	U.S.S.R. 599; Norway 246.
Graphite, natural		NA	12	(*)	Japan 7; Hong Kong 3; North Korea 2.
Gypsum and plaster		NA	1,362	33	Taiwan 617; Thailand 280; Hong Kong 229.
Iodine including bromine and fluorine					
	value, thousands	NA	\$8,408	\$499	Japan \$4,907; Chile \$926.
Lime		43	254	—	Singapore 87; Hong Kong 85; Taiwan 71.
Magnesium compounds: Magnesite, crude including calcined					
		NA	658	—	Japan 639; Hong Kong 16.
Mica:					
Crude including splittings and waste					
		NA	10	1	Taiwan 8.
Worked including agglomerated splittings					
	value, thousands	NA	\$60	\$11	Hong Kong \$40; Japan \$8.
Nitrates, crude		NA	18,818	—	Chile 17,755; U.S.S.R. 1,063.
Phosphates, crude		211,046	203,882	5	Syria 56,507; Monaco 54,588; Morocco 49,365.
Pigments, mineral: Iron oxides and hydroxides, processed					
		NA	1,104	72	Japan 498; Singapore 304.
Potassium salts, crude		—	9	9	
Precious and semiprecious stones other than diamond:					
Natural					
	value, thousands	\$75,247	\$83,169	\$127	Hong Kong \$48,997; Burma \$30,836.
Synthetic					
	do.	\$2,358	\$796	\$99	Hong Kong \$180; Ireland \$159.
Pyrite, unroasted		37,610	—		
Salt and brine		63,505	11,257	6	U.S.S.R. 7,888; Hong Kong 2,962.
Sodium compounds, n.e.s.:					
Soda ash, manufactured					
		NA	210,520	99,682	Romania 37,445; Bulgaria 25,225.
Sulfate, manufactured					
		NA	294	19	Hong Kong 177; West Germany 50.

See footnotes at end of table.

TABLE 7—Continued
CHINA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	\$58	\$208	—	Hong Kong \$190.
Worked	do.	\$18,695	\$18,797	\$268	Italy \$12,765; Hong Kong \$3,984.
Dolomite, chiefly refractory-grade		NA	47	2	Hong Kong 18; Taiwan 15; Italy 11.
Gravel and crushed rock		278	360	80	Hong Kong 184; Taiwan 72.
Limestone other than dimension		NA	41	—	Japan 35; Taiwan 6.
Quartz and quartzite		NA	57	—	West Germany 50; Hong Kong 5.
Sand other than metal-bearing		27,401	330	9	Taiwan 178; Japan 83; Hong Kong 59.
Unspecified		837	—		
Sulfur:					
Elemental:					
Crude including native and byproduct		126,553	92	—	Taiwan 47; Hong Kong 25.
Colloidal, precipitated, sublimed		NA	37,863	7,928	Canada 29,919.
Dioxide		NA	61	—	Taiwan 60.
Sulfuric acid		NA	345	5	Hong Kong 338.
Talc, steatite, soapstone, pyrophyllite		NA	207	(^c)	Taiwan 97; Hong Kong 62; Indonesia 20.
Other:					
Crude		\$2,649	631	500	Hong Kong 115.
Refractory minerals ⁹		21,475	—		
Slag and dross, not metal-bearing		70,506	64,893	—	North Korea 64,872; Netherlands 17.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		NA	6	—	Philippines 4; Hong Kong 2.
Carbon black		NA	1,299	890	West Germany 136; Japan 69; Hong Kong 68.
Coal:					
Anthracite	thousand tons	1,522	1,202	—	North Korea 1,172; Australia 29.
Bituminous	do.	670	784	—	Australia 376; Canada 178; Indonesia 78.
Lignite including briquets	do.	99	17	—	All from U.S.S.R.
Coke and semicoke		(^c)	50	—	All from Hong Kong.
Gas, natural: Gaseous	cubic meters	23,192	5,104	—	Hong Kong 3,719; North Korea 1,158.
Petroleum:					
Crude	thousand 42-gallon barrels	24,202	21,658	—	Indonesia 9,044; Oman 6,299; Malaysia 2,594.
Refinery products:					
Liquefied petroleum gas	value, thousands	\$14,550	\$27,094	\$728	Japan \$8,168; Singapore \$7,389.
Gasoline	thousand 42-gallon barrels	4,068	1,437	16	Singapore 1,077; U.S.S.R. 234.
Mineral jelly and wax	do.	11	5	1	Hong Kong 2.
Kerosene and jet fuel	do.	61	5	3	Singapore 1.
Distillate fuel oil	do.	29,359	16,791	494	Singapore 11,456; Japan 1,611.
Lubricants	do.	810	688	237	Hong Kong 153; Japan 87.
Residual fuel oil	do.	5,376	4,242	13	Singapore 3,997; Hong Kong 221.
Bitumen and other residues	do.	NA	235	—	Albania 157; Singapore 76.

See footnotes at end of table.

TABLE 7—Continued
CHINA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued:					
Refinery products—Continued:					
Bituminous mixtures	thousand 42-gallon barrels	NA	65	(*)	Albania 61; Singapore 3.
Petroleum coke	do.	¹⁰ 886	161	133	Republic of Korea 22.

NA Not available.

¹Data presented in this table are from China's Custom Statistics Yearbook. Table prepared by Audrey D. Wilkes.

²Includes alumina.

³May include other precious ores and concentrates.

⁴Less than 1/2 unit.

⁵Elemental arsenic, phosphorus, and tellurium.

⁶Includes tungsten, molybdenum, tantalum, and magnesium.

⁷Includes boron carbide.

⁸Includes feldspar, mica, and quartz.

⁹Not further identified.

¹⁰Includes retort carbon.

TABLE 8
CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum:			
Bauxite	China National Nonferrous Metals Industry Corp.	Guangxi, Pingguo	650
Do.	do.	Guizhou, Guiyang	400
Do.	do.	Hunan, Zhengzhou	500
Metal	do.	Anhui, Hefei	25
Do.	do.	Gansu, Baiyin	50
Do.	do.	Gansu, Lanzhou	30
Do.	do.	Guangxi, Pingguo	40
Do.	do.	Guizhou, Guiyang	110
Do.	do.	Henan, Jiaozuo	30
Do.	do.	Henan, Sanmenxia	30
Do.	do.	Hebei, Wuhan	35
Do.	do.	Hunan, Changsa	15
Do.	do.	Jilin, Changchun	15
Do.	do.	Liaoning, Fushun	100
Do.	do.	Nei Monggol, Baotou	20
Do.	do.	Ningxia, Qingtongxia	100
Do.	do.	Ningxia, Yinchuan	30
Do.	do.	Qinghai, Xining	100
Do.	do.	Shaanix, Tongchuan	10
Do.	do.	Shandong, Qingdao	15
Do.	do.	Shandong, Zibo	100
Do.	do.	Shanxi, Taiyuan	25
Do.	do.	Yunnan, Kunming	15
Asbestos	China National Nonmetallic Minerals Industry Corp.	Nei Monggol, Baotou Shanxi, Lai Yuan Shanxi, Lu Liang	130
Barite	do.	Guizhou, Xiangshou	NA
Coal	China National Coal Corp.	Hebei	70,000
Do.	do.	Heilongjiang	70,000
Do.	do.	Henan	85,000
Do.	do.	Liaoning	50,000
Do.	do.	Shandong	60,000
Do.	do.	Shanxi	240,000
Do.	do.	Sichuan	60,000
Cobalt	China National Nonferrous Metals Industry Corp.	Hainan, Changjiang	5
Copper, refined			
Do.	do.	Anhui: Tongling No. 1	30
Do.	do.	Tongling No. 2	30
Do.	do.	Gansu: Baiyin	110
Do.	do.	Hezheng Xian	35
Do.	do.	Wu Wei	35
Do.	do.	Henan, Zhuzhou	10
Do.	do.	Hubei, Daye	30

See footnotes at end of table.

TABLE 8—Continued
CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper, refined—Continued:			
Do.	China National Nonferrous Metals Industry Corp.	Jiangxi, Guixi	90
Do.	do.	Liaoning, Shenyang	50
Do.	do.	Shanghai	65
Do.	do.	Shanxi, Taiyuan	35
Do.	do.	Tianjin	100
Do.	do.	Yunnan, Kunming	45
Gas, natural billion cubic meters	China National Petroleum Corp.	Sichuan	10
Gold, refined thousand kilograms	China National Gold Corp.	Henan, Kingbao	3
Do.	do.	Shandong, Laizhou	15
Do.	do.	Shandong, Zhaoyuan	6
Graphite	China National Nonmetallic Minerals Industry Corp.	Shandong, Laixi Shandong, Pingdu	190
Iron and steel:			
Iron ore	Maanshan Iron and Steel Co.	Anhui, Maanshan	8,000
Do.	Shoudu Iron and Steel Co.	Beijing	18,000
Do.	Meishan Metallurgical Co.	Shanghai	1,700
Do.	Jiuquan Iron and Steel Co.	Gansu, Jiayuguan	2,700
Do.	Hainan Iron Mine	Hainan, Changjiang	4,600
Do.	Handan-Xingtai Metallurgical Bureau	Hebei, Handan	3,200
Do.	Tangshan Iron and Steel Co.	Hebei, Tangshan	1,800
Do.	Wuhan Iron and Steel Co.	Hubei, Wuhan	5,100
Do.	Banshigou Iron Mine Mining Co.	Jilin, Hunjiang	1,400
Do.	Anshan Iron and Steel Co.	Liaoning, Anshan	26,800
Do.	Benxi Iron and Steel Co.	Liaoning, Benxi	13,700
Do.	Baotou Iron and Steel Co.	Nei Monggol, Boatou	7,800
Do.	Taiyuan Iron and Steel Co.	Shanxi, Taiyuan	3,400
Do.	Dabaoshan Mining Co.	Guangdong, Qujiang	1,670
Do.	Panzhuhua Mining Co.	Sichuan, Panzhuhua	8,260
Do.	Kuming Iron and Steel Co.	Yunnan, Kuming	1,400
Ferroalloy	Maanshan Iron and Steel Co.	Anhui, Maanshan	30
Do.	Shoudu Iron and Steel Co.	Beijing	30
Do.	Northwest Ferroalloy Co.	Gansu, Yongdeng	60
Do.	Zunyi Ferroalloy Co.	Guizhou, Zunhi	100
Do.	Hunan Ferroalloy Co.	Hunan, Xiangxiang	70
Do.	Jilin Ferroalloy Co.	Jilin, Jilin	190
Do.	Jinzhou Ferroalloy Co.	Liaoning, Jinzhou	50
Do.	Liaoyang Ferroalloy Co.	Liaoning, Liaoyang	50
Do.	Shanghai Steel Co.	Shanghai	180
Do.	Emi Ferroalloy Co.	Sichuan, Emei	40
Crude steel	Maanshan Iron and Steel Co.	Anhui, Maanshan	1,900
Do.	Shoudu Iron and Steel Co.	Beijing	4,000
Do.	Tangshan Iron and Steel Co.	Hebei, Tangshan	1,600
Do.	Wuhan Iron and Steel Co.	Hubei, Wuhan	4,700

See footnotes at end of table.

TABLE 8—Continued
CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Iron and steel—Continued:			
Crude steel—Continued:			
Do.	Anshan Iron and Steel Co.	Liaoning, Anshan	8,100
Do.	Benxi Iron and Steel Co.	Liaoning, Benxi	2,500
Do.	Baotou Iron and Steel Co.	Nei Monggol, Baotou	2,300
Do.	Baoshan Iron and Steel Co.	Shanghai	6,800
Do.	Shanghai Steel Co.	Shanghai	5,700
Do.	Taiyuan Iron and Steel Co. No. 2.	Shanxi, Taiyuan	1,800
Do.	Panzhuhua Iron and Steel Co.	Sichuan, Panzihua	1,850
Do.	Tianjin Iron and Steel Co.	Tianjin	1,500
Lead	China National Nonferrous Metals Industry Corp.	Fujian, Lianchang	10
Do.	do.	Gansu, Baiyan	50
Do.	do.	Guangdong, Shaoquan	15
Do.	do.	Guangxi, Changpo	5
Do.	do.	Hunan, Songbai	20
Do.	do.	Hunan, Zhuzhou	50
Do.	do.	Liaoning, Shenyang	50
Do.	do.	Shanghai	5
Do.	do.	Yunnan, Lanping	20
Nickel, refined	do.	Gansu, Jinchuan	20
Petroleum, crude	China National Petroleum Corp.	Hebei, Shengli	33,350
Do.	do.	Heilongjiang, Daqing	55,000
Do.	do.	Liaoning, Liaohe	15,000
Do.	China National Offshore Oil Corp.	Beibu, Wan Bohai Wan Nanhai	950
Potash	Ministry of Chemical Industry	Qinghai	40
Rare earth	Ministry of Metallurgical Industry	Nei Monggol, Baiyunebo	12
Do.	China National Nonferrous Metals Industry Corp.	Jiangxi, Ganan	1
Do.	do.	Guangdong, Nanshanhai	5
Do.	do.	Shandong, Weishan	2
Salt	Ministry of Chemical Industry	Anhui	200
Do.	do.	Qinghai	320
Talc	China National Nonmetallic Mineral Industry Co	Guangxi, Longshen	130
Do.	do.	Liaoning, Haicheng	50
Do.	do.	Shandong, Qixia	5
Tin, smelter	China National Nonferrous Metals Industry Corp.	Guangxi, Dachang	5
Do.	do.	Yunnan, Geijiu	15
Tungsten concentrate	do.	Guangdong	30
Do.	do.	Guangxi	
Do.	do.	Hunan	
Do.	do.	Jiangxi	
Do.	do.	Zhejiang	
Zinc	do.	Fujian, Liancheng	15
Do.	do.	Gansu, Baiyan	100
Do.	do.	Guangdong, Shaoquan	30
Do.	do.	Guangxi, Changpo	20

See footnotes at end of table.

TABLE 8—Continued
CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Zinc—Continued:	Industry Corp.	Hunan, Zhuzhou	135
Do.	do.	Liaoning, Huludao	60
Do.	do.	Liaoning, Shenyang	20
Do.	do.	Yunnan, Lanping	40

NA Not available

TABLE 9
CHINA: OUTPUT OF THE 10 MAJOR IRON AND STEEL ENTERPRISES

(Million metric tons)

Name	Pig iron		Steel	
	1980	1990	1980	1990
Anshan, Liaoning	6.70	7.41	6.97	7.71
Wuhan, Liaoning	3.44	4.51	2.78	4.72
Shoudou, Beijing	2.94	3.58	1.55	4.36
Baoshan, Shanghai	—	3.30	—	3.87
Baotou, Nei Mongol	1.28	2.51	1.23	2.52
Benxi, Liaoning	3.10	2.75	.90	2.37
Ma'anshan, Jiangsu	1.78	2.24	1.09	2.04
Panzhuhua, Sichuan	1.95	1.33	1.62	1.91
Taiyuan, Shanxi	.92	1.33	1.15	1.79
Tangshan, Hebei	.19	.69	1.15	1.58

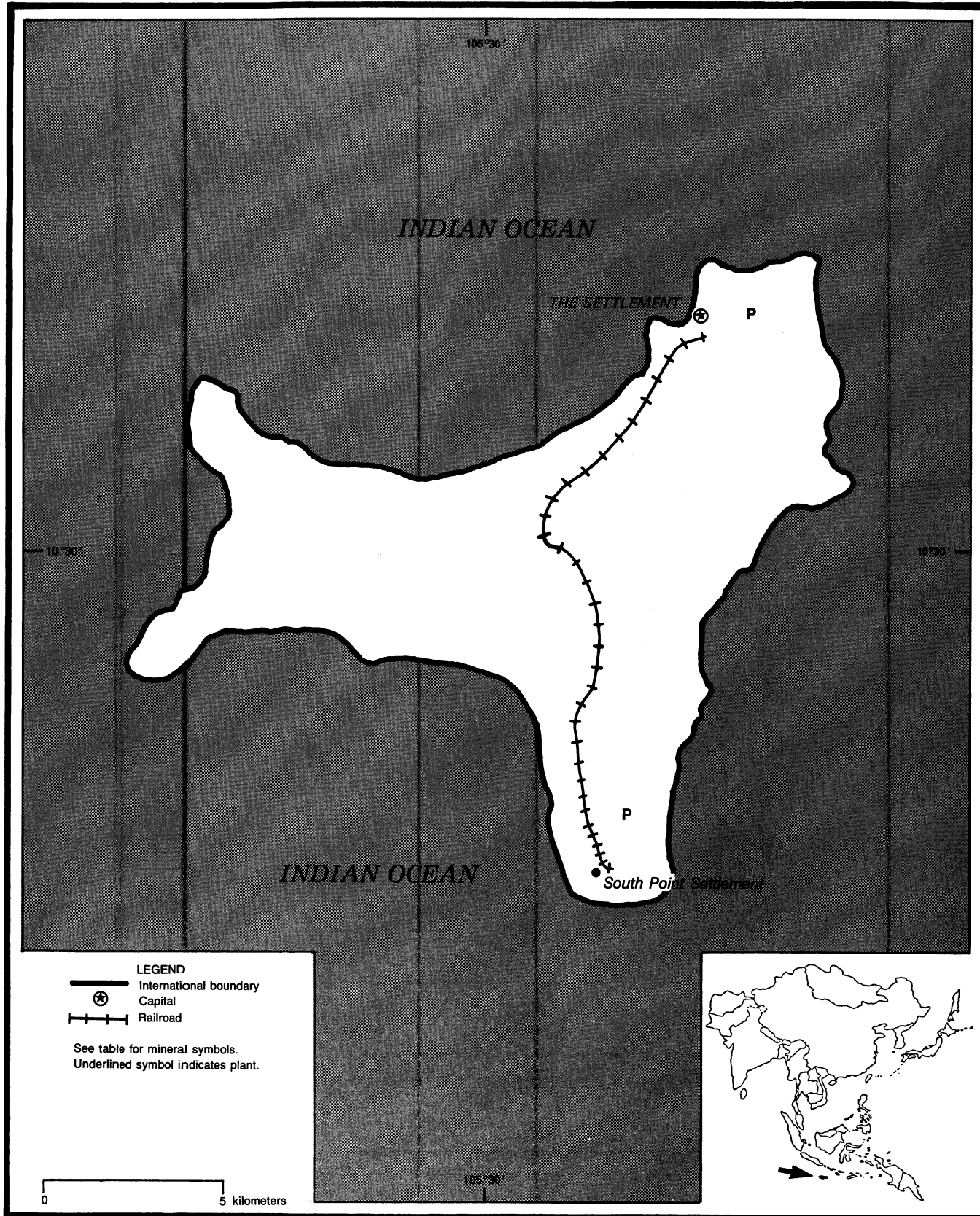
TABLE 10
CHINA: THE TOP 10 PRODUCING COAL MINES

Name	Province	Recoverable reserves (metric tons)	Initial design capacity (metric tons per year)	1990 output (metric tons)
Datong	Shanxi	2,579	19.9	29.9
Kailuan	Hebei	1,330	19.0	17.8
Pingdingshan	Henan	673	14.7	17.5
Yangquan	Shanxi	2,470	11.9	16.2
Hegang	do.	977	13.4	15.7
Jixi	Heilongjiang	992	10.4	15.7
Xishan	Shanxi	1,670	14.6	15.2
Huaibei	Anhui	990	11.8	14.9
Xuzhou	Jiangsu	780	9.8	13.2
Fengfeng	Hebei	535	8.9	11.2

TERRITORY OF CHRISTMAS ISLAND (Australia)

AREA 135 km²

POPULATION 1,000



THE MINERAL INDUSTRY OF

CHRISTMAS ISLAND

By Travis Q. Lyday

From 1897 until mining ceased in 1987, guano-base phosphate rock was the mainstay of the economy of the Territory of Christmas Island, an island territory of Australia in the Indian Ocean. The mining operation, owned by the Phosphate Mining Co. of Christmas Island, a wholly Australian Government-owned firm headquartered in Perth, was closed primarily because of the exhaustion of high-grade phosphate reserves. The area where what high-grade

phosphate reserves remain has been classified as a national park to preserve the few remaining tall trees in the rain forest and, therefore, the natural habitat for the rare bird species on the island. Resources of lower grade phosphate rock containing 74% to 76% bone phosphate of lime are minable in less sensitive parts of the island.

In 1991, the Australian Government contracted Phosphate Resources NL to renew phosphate mining on the island, but

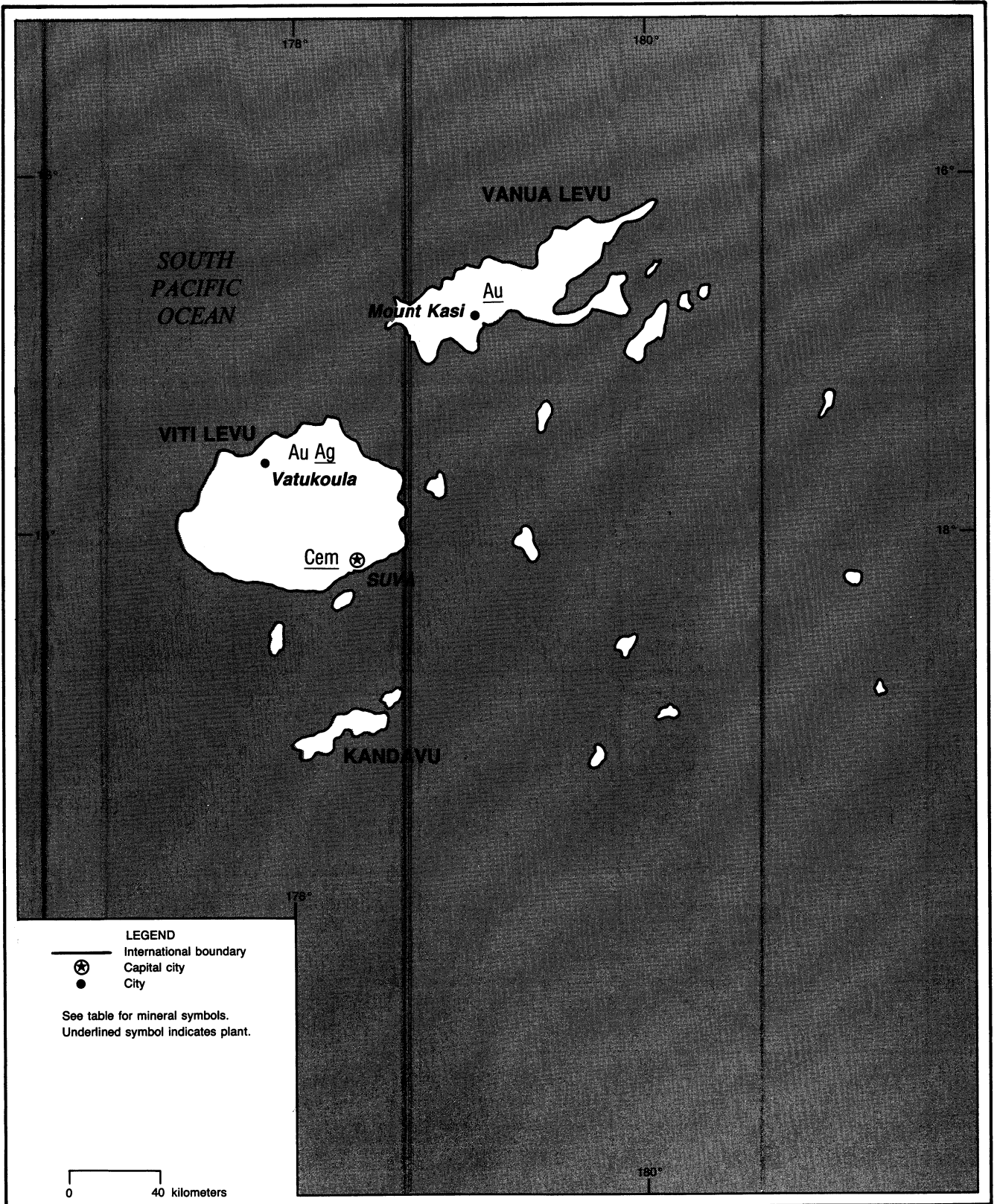
no mining has occurred since December 1987. Phosphate Resources was owned by Clough Engineering Ltd., 51%; the citizens of Christmas Island, 40%; and Saley Investments Pty., 9%.

There is one permanent-surface airport on the island and one shipping port, Flying Fish Cove. Electric generating capacity in 1990 was 11,000 kW.

FIJI

AREA 18,270 km²

POPULATION 744,000



THE MINERAL INDUSTRY OF

FIJI

By Travis Q. Lyday

Fiji's economy continued to be basically agrarian, depending mainly on the sugar industry. Moreover, it has a large subsistence sector. The mineral industry remained small, contributing less than 1% to the GDP of the country. The GDP expanded by only 0.4% in 1991 following 2 years of strong growth. The economy was hampered by recession in the major foreign markets, the mine workers' strike at the Emperor Mine, and the sugarcane farmers' boycott.¹ Fiji's mineral industry consisted of two operating gold-silver mines, the Emperor at Vatukoula, and the Tavua Basin Mine in the Tavua gold field, operating in close proximity to each other on the main island of Viti Levu; a cement plant near Suva; and several quarries for the production of stone and crushed gravel, limestone, and coral and river sands.

GOVERNMENT POLICIES AND PROGRAMS

Fiji entered into the South Pacific petroleum market by establishing in December 1990 the Fiji National Petroleum Co. (FINAPECO), which was to become the sole importer of petroleum products into the country.

PRODUCTION

Gold production continued to be the dominant minerals industry business, but only accounted for less than 1% of the country's GDP. Historically, gold mining has been carried out only at the Emperor Mine at Vatukoula in the northern part of Viti Levu. Since 1987, an ever-increasing amount has been produced from the Tavua Basin Mine, about 2.5 km south of the main Emperor workings. Both mines

were also producers of silver. (See table 1.)

TRADE

The unrefined gold and silver produced in Fiji was the country's third largest foreign exchange earner, after sugar and tourism, but represented less than 15% of the total.

STRUCTURE OF THE MINERAL INDUSTRY

The main mineral operations of Fiji are the underground/opencut gold operations at the Emperor and Tavua Basin Mines at Vatukoula, about 100 km northwest of the capital at Suva on Viti Levu Island. Both mines produce silver as a byproduct and, until 1980, the Emperor Mine also recovered significant amounts of selenium and tellurium oxide from the telluride ore. Fiji has one cement plant at Lami, just outside Suva. Other mineral industry operations in Fiji include quarries for stone and crushed gravel, limestone for the cement and lime industry, and coral and river sand dredging, all exclusively for domestic use. (See table 2.)

COMMODITY REVIEW

Metals

Gold has been mined continuously since 1935 from the Emperor Mine at Vatukoula on Viti Levu. Beginning in 1987, gold output from the Emperor Mine was supplemented by production from the nearby Tavua Basin Mine.

Emperor Gold Mining Co. Ltd. (EGM), a subsidiary of the United Kingdom-registered Emperor Mines Ltd., purchased in January both the 20%

interest in the Emperor Mine and the 50% interest in the Tavua Basin Mine held previously by its former joint-venture partner, Western Mining Corp. (Fiji) Ltd. (WMCF), a wholly owned subsidiary of Australia's Melbourne-based Western Mining Corp. Holdings Ltd. Although the two mines are solely owned and operated by EGM, WMCF continued to provide technical and managerial services.²

A protracted industrial dispute over housing, wages, safety conditions, and recognition of the Fiji Mineworkers Union resulted in the dismissal of 440 striking underground workers and a substantial reduction in gold production at the Emperor Mine in 1991. The striking workers were replaced in March, and the new workers brought output back to prestrike levels by October. EGM employed a work force of more than 1,100. Under Fiji law, a company must recognize a union when more than 50% of its employees become union members.³

After successfully negotiating in 1990 with the Government's Mineral Resources Department for an exploration permit, Placer Exploration Ltd., a wholly owned subsidiary of Australia's Placer Pacific Ltd., began reexamining in April the copper-gold deposit at Namosi in southern Viti Levu. Placer was planning to proceed with a more detailed evaluation, including a drilling program, if the results of this work showed promise.⁴

Pacific Sovereign Mint Ltd., established at Vatukoula and owned 80% by EGM, began minting legal-tender gold coins from gold mined at the Emperor Mine. The Government-owned Fiji Development Bank, holding the remaining 20% interest, approved a maximum minting of 5,000 coins of each of three

denominations: F\$100, F\$50, and F\$25 containing 1 ounce, one-half ounce, and one-quarter ounce of unrefined gold, respectively. The coins, bearing unique aspects of Fijian culture, were primarily sold to buyers in Europe and the United States.⁵

Mineral Fuels

Fiji planned to enter into the South Pacific petroleum market by creating in December 1990 a Government monopoly, FINAPECO, to be the exclusive importer of petroleum products into the country. The imported petroleum was to be used both for internal use and for supply to smaller countries of the region. Fiji, through Shell Fiji Ltd., Mobil Oil, and British Petroleum, acted as a central depot for shipping fuel to the Cook Islands, Kiribati, Niue, Tonga, and Tuvalu.

FINAPECO's plan was to purchase 10,000 bbl/d of crude oil from Malaysia's PETCO, a subsidiary of the Malaysian Government-owned Petroleum Nasional Bhd., for refining by Esso Singapore Pte. Ltd. in Singapore. FINAPECO expected to import 2.52 Mbbl/a, worth about \$105 million,⁶ in 12 monthly shipments. The first shipments were to have begun in April, but none had actually been received by yearend.⁷ Reportedly, FINAPECO was the initial step toward establishing a Fijian-based petroleum product industry, including a possible refinery, shipping terminals, and tanker farms.⁸

Reserves

Metallic mineralization is widespread in Fiji, occurring as polymetallic base metal sulfide deposits, disseminated porphyry copper deposits, epithermal precious-metal deposits, residual bauxite deposits, and manganese and heavy-mineral sand deposits. However, gold, and associated silver, is the only mineralization being mined at present.

Proven recoverable reserves at the Emperor Mine are 1.2 Mmt of ore grading 6.4 g of gold per ton. The Tavua Basin deposit in the Tavua goldfield has

proven recoverable reserves of 300,000 tons of ore grading 14 g of gold per ton.

Australian-based Climax Mining Ltd. reported an indicated resource of 500,000 tons of ore grading 7 g of gold per ton at its Faddys gold prospect in western Viti Levu, and Newmont Pty. Ltd. and Range Resources Ltd. reported a geological resource of 2.5 Mmt of ore grading 2.5 g of gold per ton at the Mount Kasi prospect in southwestern Vanua Levu.⁹

The Namosi copper-gold prospect area was reported to have copper deposits containing about 600 Mmt of ore averaging 0.47% copper and containing about 0.15 g/mt of gold.¹⁰

INFRASTRUCTURE

Essential elements of the islands' infrastructure include 644 km of narrow-gauge railroad belonging to the Government-owned Fiji Sugar Corp.; 3,300 km of roads, including 390 km paved; 1,200 km bituminous-surface treated; 1,290 km gravel, crushed stone, or stabilized-soil surface; and 420 km unimproved earth. Inland waterways consist of 203 km, of which 122 km is navigable by motorized craft and 200-ton barges. There are 4 ports for international shipping and 26 airports in the country, 2 with permanent-surface runways. Electric generating capacity in 1990 was 215,000 kW, about 430 kW · h per capita.¹¹

Generally, infrastructure for mineral industry operations are regarded as adequate.

OUTLOOK

Although there was a severe industrial dispute through much of the year at the Emperor Mine, which caused a substantial reduction in gold and silver production, there had not been any other adverse impact on exploration and mining in the country since the military coups in 1987. Normal mining operations at the EGM facilities were expected to be maintained in the future. Exploration programs, especially for gold and silver mineralization, were expected to continue. About 45% of the country's land area of 18,000 km² was under active

exploration, governed by more than 80 exploration licenses.

¹South Seas Digest (Sydney). V. 12, No. 5, May 22, 1992, p. 1.

²Mining Journal (London). V. 316, No. 8105, Jan. 18, 1991, p. 51.

³Pacific Islands Monthly (Suva, Fiji). V. 61, No. 5, May 1991, pp. 47-48.

⁴South-East Asia Mining Letter. V. 3, No. 21, Nov. 8, 1991, p. 2.

⁵Islands Business Pacific (Suva, Fiji). V. 17, No. 3, Mar. 1992, pp. 47-48.

⁶Where necessary, values have been converted from the Fijian dollar (F\$) to U.S. dollars at the rate of F\$1.48=US\$1.00.

⁷Islands Business Pacific (Suva, Fiji). V. 18, No. 1, Jan. 1992, p. 18.

⁸Pacific Islands Monthly (Suva, Fiji). V. 61, No. 10, Oct. 1991, p. 11.

⁹Australian Journal of Mining (Richmond North, Australia). V. 4, No. 37, Oct. 1989, p. 64.

¹⁰South Seas Digest (Sydney). V. 10, No. 22, Feb. 1, 1991, p. 3.

¹¹U.S. Central Intelligence Agency. The World Factbook 1990, p. 100.

OTHER SOURCES OF INFORMATION

Department of Mineral Resources
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Fax: +679 370 039

TABLE 1
FIJI: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991 ^P
Cement, hydraulic		58,700	44,200	58,000	*80,000	*90,000
Gold, mine output, Au content	kilograms	2,962	4,273	4,221	4,115	2,827
Lime ²		—	—	*2,000	—	—
Silver, mine output, Ag content	kilograms	843	995	1,055	775	494
Stone, sand and gravel:						
Coral sand for cement manufacture	cubic meters	*50,642	*38,529	*48,809	*64,997	71,664
River sand for cement manufacture	do.	*14,349	*8,377	*15,009	*8,393	19,386
River sand for gravel, n.e.s.	do.	254,713	210,000	230,780	838,756	*800,000
Quarried stone	do.	66,832	49,711	65,849	152,455	73,771

¹Estimated. ^PPreliminary. ^RRevised.

²Table includes data available through June 15, 1992.

³Produced from an unreported amount of domestically quarried limestone.

TABLE 2
FIJI: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

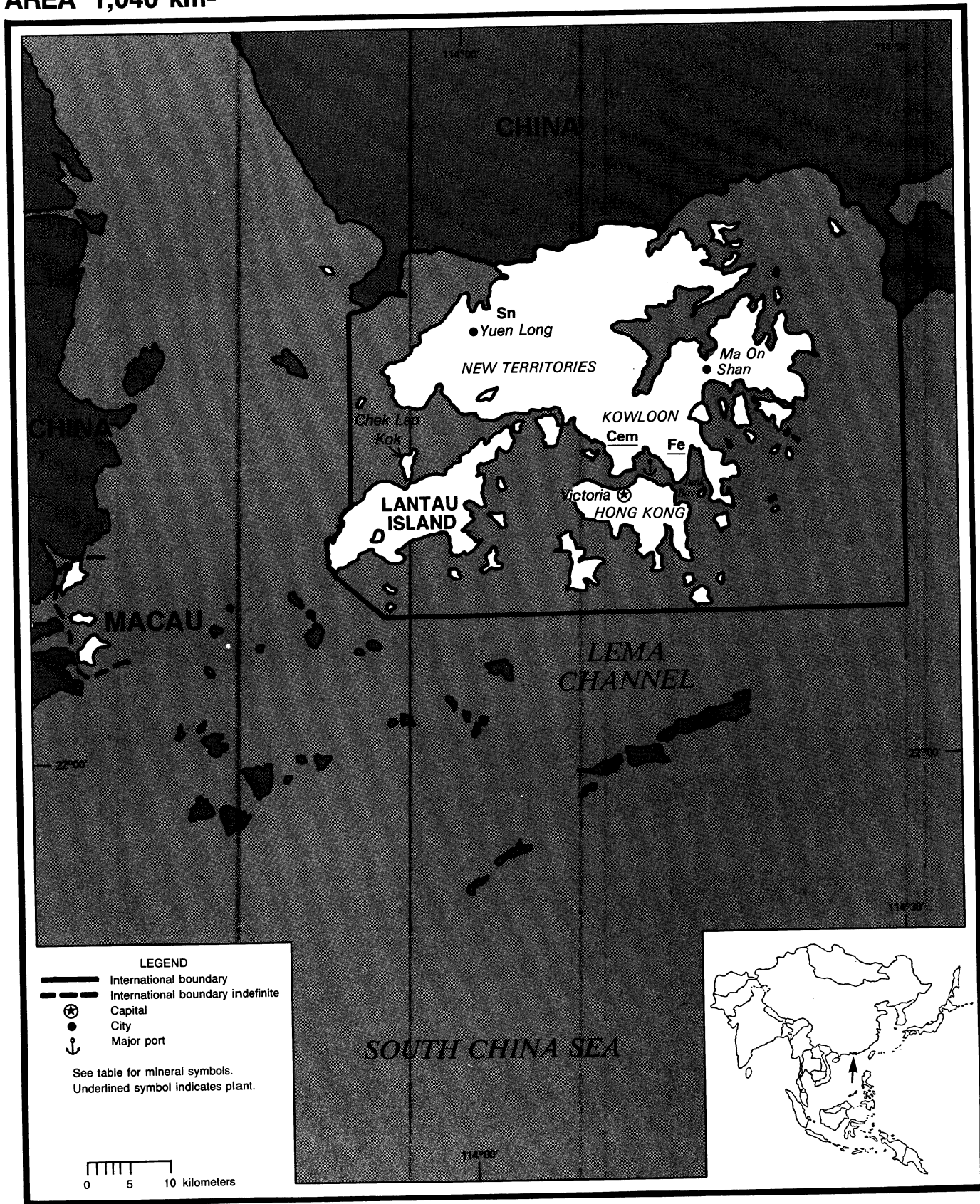
Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Fiji Industries Ltd., 100%, operator and manager	Suva, Viti Levu Island	105
Gold	Emperor Gold Mining Co. Ltd., 100%, operator and manager	Emperor Mine, Viti Levu Island	600
Do. kilograms	do.	Tuvua Basin Mine, Viti Levu Island	1,710

¹Throughput to the mill.

HONG KONG AND MACAU

AREA 1,040 km²

POPULATION 5.9 million



THE MINERAL INDUSTRY OF HONG KONG AND MACAU

By Pui-Kwan Tse

Hong Kong and Macau have limited natural resources; therefore, they depend on imports for virtually all their requirements, including food, consumer goods, raw materials, capital goods, fuel, and water. To pay for these imports, Hong Kong and Macau must export on a sufficient scale to generate foreign exchange earnings. Domestic exports by both countries are still concentrated in a number of major groups—textiles, electronics, wearing apparel and clothing accessories, and metal products. There has been continuous upgrading of quality and diversification of items within these groups. In the past decade, the competitiveness in the manufacturing sector in the region has intensified because of increasing wages. Hence, most of the relatively labor-intensive production processes have shifted to southern China.

Because of rapid economic growth over the past decade in the region, its strategic location, and its well-established transport and communications network, Hong Kong became the business center in north Asia. Within the service sector, the most noticeable increase in employment was in wholesale, retail, and trade sales; restaurants; and hotels. The total employed work force increased from 16% in 1971 to 19% in 1981 and to 23% in 1991. An increase also was reflected in finance, insurance, real estate, and business services, with its employment share rising from 3% in 1971 to 5% in 1981 and to 11% in 1991.

Since China's adoption of an open-door policy in 1978, the economic relationship between Hong Kong, Macau, and China has undergone rapid growth and development. Hong Kong is China's largest trading partner. In 1991, the total value of trade between Hong Kong and

China amounted to \$64.5 billion,¹ representing an increase of 27% over that of 1990. China is the largest market for, as well as supplier of, Hong Kong's reexports. More than 80% of the goods reexported through Hong Kong are destined for or originating from China.

In addition to trading goods, Hong Kong and Macau also serve as important service centers for China, particularly south China. These services include infrastructural facilities such as the port and airport and institutional support such as financial and related business services.

In addition to trade, Hong Kong is a major funding center for China. Most of China's fundraising activities in Hong Kong have taken the form of syndicated loans. Even though Hong Kong is not the direct source of funds, it serves as a window through which China can have access to external borrowing. These loans are mostly for financing China's own economic development, but some of them are used by China's interest companies in Hong Kong to finance their investment activities in Hong Kong or abroad.

The economy of Hong Kong continued to grow steadily in 1991. Local investment activity showed a marked improvement throughout the year. Consumer price index was up 12% in 1991 over that of 1990. The GDP was up 13.3% to \$14,157 in 1991 over that in 1990.

In 1991, the value of exports was 2% higher than in 1990. Exports to China rose significantly while exports to the United States and Japan continued to decline. Although the United States remained Hong Kong's largest exports market, its share fell to 27% in 1991 from 32% in 1990. Exports of electronic components recorded the fastest growth

(23%), followed by metal manufactures (8%). However, exports of electrical appliances declined by 7% in 1991 over that of 1990.

Imports grew 21% in terms of value in 1991 over that of 1990. The major sources of Hong Kong's imports were China, Japan, Taiwan, the United States, the Republic of Korea, and Singapore. Most of the growth in imports was attributed to the continued surge in reexport trade and to a lesser extent as a result of local consumption.

Hong Kong's labor market remained tight. The unemployment rate was 1.8% in 1991. Labor resources continued to shift from the manufacturing sector to the service sector. Despite the decrease in the labor force in the manufacturing sector, the production output increased by 1%. This was attributed partly to increased investment in plant and machinery and partly to the relocation of the more labor-intensive production processes to China.

In early 1992, Chinese authorities in Beijing formally approved the Draft Basic Law setting the constitutional framework under which Macau, as a Special Administrative Region within China, will be governed after July 1, 1999. The Basic Law provides Macau the right to exercise a high degree of autonomy for 50 years up to the year 2049, with the current economic system remaining basically unchanged except in specific areas such as foreign affairs and defense.

Hong Kong's Legislative Assembly held its first direct elections for 18 of the 60 seats in September 1991. Of the remaining 42 seats, half were indirectly elected through functional constituencies, and the other half were appointed by the Governor. The Governor still plays a dominant role as that office is responsible

for appointing members of the Executive Council.

In 1991, the consumption of steel bar was 1 million tons by the construction sector. The local market was dominated by two companies—Shiu Wing Steel Work and Tung Wing Co. warehousing firm, which supplied about 70% of Hong Kong's demand. Shiu Wing Steel Work is a family-owned company with a production capacity of 375,000 mt/a of steel billet. It operates with two electric arc furnaces, the first of which was commissioned in 1980; the second started up in 1990.

Hong Kong's service sector will continue to grow if China maintains its open-door policies in the 1990's. Hong Kong is China's window to the outside world.

¹Where necessary, values have been converted from Hong Kong dollars (HK\$) to U.S. dollars at the rate of HK\$7.77=US\$1.00 for 1991.

OTHER SOURCE OF INFORMATION

Publication

Census and Statistics Department,
Hong Kong: Hong Kong digest of
Statistics, monthly.

TABLE 1
HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	165	71	1	Taiwan 35; Japan 15; China 14.
Aluminum:				
Ore and concentrate	16,654	14,461	—	Taiwan 13,738; Philippines 232.
Oxides and hydroxides	133,729	38	—	Republic of Korea 33; Philippines 5.
Metal including alloys:				
Scrap	30,240	32,999	—	Japan 20,304; China 10,273.
Unwrought	26,412	17,381	4	China 6,904; Taiwan 2,619; Thailand 2,264.
Semimanufactures	51,176	44,197	2,529	China 26,046; Taiwan 5,766.
Arsenic: Oxides and acids	228	765	68	Australia 136; Indonesia 90; Malaysia 90.
Chromium:				
Ore and concentrate	—	2,260	—	All to China.
Oxides and hydroxides	755	1,038	5	China 430; Netherlands 159; West Germany 130.
Cobalt: Oxides and hydroxides	33	50	—	China 21; Norway 19; Singapore 4.
Columbium and tantalum:				
Tantalum metal including alloys, all forms	8	14	4	China 10.
Copper:				
Oxides and hydroxides	252	226	—	All to China.
Sulfate	1,367	585	125	China 189; Canada 128; Taiwan 66.
Metal including alloys:				
Scrap	69,625	80,878	20	China 39,022; Japan 26,380.
Unwrought	6,598	5,483	23	China 2,719; Taiwan 762; Republic of Korea 631.
Semimanufactures	40,964	49,564	233	China 44,552; Taiwan 1,123.
Gold:				
Waste and sweepings	value, thousands	\$6,795	\$25,076	\$14 West Germany \$14,071; Switzerland \$4,862.
Metal including alloys, unwrought and partly wrought	kilograms	15,112	15,874	606 Vietnam 5,045; Singapore 3,661; Japan 2,375.
Iron and steel: Metal:				
Scrap	474,286	479,971	84	Taiwan 239,167; Indonesia 111,754.
Pig iron, cast iron, related materials	1,770	3,413	—	China 1,521; Republic of Korea 998; Taiwan 886.
Ferrous alloys:				
Ferromanganese	8,585	10,340	—	North Korea 6,407; Taiwan 1,039; Indonesia 1,014.
Ferrosilicon	38,408	42,066	—	Republic of Korea 17,500; Taiwan 9,136.
Unspecified	18,697	33,079	150	Japan 8,628; Indonesia 8,085; Taiwan 4,890.
Steel, primary forms	7,444	1,643	—	Taiwan 1,582; China 61.
Semimanufactures:				
Bars, rods, angles, shapes, sections	177,743	147,029	18	China 64,325; Macau 44,415.
Universals, plates, sheets	342,105	354,119	2	China 332,589; Thailand 3,221.
Hoop and strip	94,156	124,128	14	China 121,353; Indonesia 654.
Rails and accessories	1,238	1,181	—	Thailand 1,100; China 81.
Wire	35,949	33,304	30	China 28,179; Indonesia 2,549.
Tubes, pipes, fittings	47,275	56,451	2,634	China 26,042; Japan 15,663.
Castings and forgings, rough	3,930	7,713	2,237	Taiwan 2,686; Republic of Korea 1,321.
Lead:				
Ore and concentrate	5,083	47	—	All to China.
Oxides	152	947	—	Indonesia 285; Romania 200; Republic of South Africa 100.

See footnotes at end of table.

TABLE 1—Continued
HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Lead—Continued:				
Scrap	3,476	2,737	—	China 1,769; Taiwan 404.
Unwrought	2,071	17,380	—	Taiwan 9,074; Singapore 2,325.
Semimanufactures	165	224	—	China 154; Japan 56.
Magnesium: Metal including alloys:				
Scrap	6	17	—	All to Taiwan.
Unwrought	157	11	—	China 6; India 5.
Manganese:				
Ore and concentrate	461	1,190	—	All to Republic of Korea.
Oxides	3,949	2,801	6	China 935; Japan 443; Vietnam 361.
Mercury	73	116	—	Australia 31; Philippines 29; India 24.
Molybdenum: Metal including alloys:				
Unwrought	15	10	10	
Nickel:				
Oxides and hydroxides	81	101	—	Japan 72; China 23.
Metal including alloys:				
Scrap	252	56	—	Japan 55.
Unwrought	5,301	2,509	22	Taiwan 1,050; Thailand 424.
Semimanufactures	159	163	8	China 111; Japan 20.
Platinum-group metals:				
Waste and sweepings	value, thousands	\$10,773	\$8,538	\$6,126 United Kingdom \$1,271; Japan \$1,057.
Metals including alloys, unwrought and partly wrought	kilograms	1,101	1,131	79 China 453; Taiwan 310.
Silver:				
Ore and concentrate	do.	—	75,505	75,505
Waste and sweepings	value, thousands	\$6,410	\$5,226	— United Kingdom \$3,722; Singapore \$1,102.
Metal including alloys, unwrought and partly wrought	kilograms	42,361	31,126	360 Thailand 11,880; Taiwan 7,825.
Tin:				
Ore and concentrate		18,449	9,088	— Malaysia 4,635; Republic of Korea 1,891.
Oxides	kilograms	146	6,400	— China 4,400; Taiwan 2,000.
Metal including alloys:				
Scrap		122	45	— Taiwan 24; Japan 20.
Unwrought		6,048	4,511	1,618 Japan 1,171; Netherlands 858; Taiwan 368.
Semimanufactures		1,279	1,247	(^c) China 639; Singapore 296; Taiwan 144.
Titanium: Oxides		14,544	8,698	373 China 5,159; India 1,155.
Tungsten:				
Ore and concentrate		3,925	2,516	670 Republic of Korea 962; Japan 445.
Metal including alloys: Scrap		8	1	1
Uranium and thorium: Oxides and other compounds		321	228	1 Japan 126; Spain 31; Taiwan 21.
Zinc:				
Ore and concentrate		7,042	—	
Oxides		9,046	17,819	2,139 China 5,517; Taiwan 1,934; Netherlands 1,724.
Blue powder		42	291	— Mainly to Taiwan.

See footnotes at end of table.

TABLE 1—Continued
HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued:				
Zinc—Continued:				
Metal including alloys:				
Scrap	3,911	9,537	—	China 8,637; Taiwan 603.
Unwrought	37,922	57,606	900	China 21,478; Republic of Korea 15,331; Taiwan 10,764.
Semimanufactures	332	3,037	—	Japan 2,076; Taiwan 441; China 428.
Other:				
Ores and concentrates	12,891	10,034	—	Republic of Korea 3,153; China 3,105.
Metalloids, unspecified ³	24,287	26,096	5,917	Taiwan 4,235; Japan 3,575.
Ashes and residues	4,385	5,431	—	China 4,286; Japan 284.
Base metals including alloys, all forms	5,943	15,986	1,142	India 5,005; Republic of Korea 2,330.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	28,394	32,453	15	China 24,339; Macau 5,133.
Artificial:				
Corundum	39,384	27,498	36	Republic of Korea 10,584; Taiwan 10,360.
Silicon carbide	6,620	3,711	—	Taiwan 1,335; Republic of Korea 627.
Dust and powder of precious and semiprecious stones including diamond value, thousands				
	\$2,388	\$6,124	\$748	Taiwan \$4,650; Canada \$254.
Grinding and polishing wheels and stones	3,126	2,915	103	Indonesia 1,176; China 615.
Asbestos, crude	23	5	—	All to China.
Barite and witherite	5,400	4,150	224	Republic of South Africa 795; United Kingdom 648.
Boron materials:				
Crude natural borates	—	294	—	All to China.
Oxides and acids	299	588	—	China 185; Malaysia 179; New Zealand 68.
Bromine including fluorine kilograms	—	1,158	—	Saudi Arabia 958; China 200.
Cement thousand tons	922	504	—	Macau 303; China 110; Taiwan 75.
Clays, crude:				
Kaolin	325,633	213,896	—	Taiwan 180,729; Republic of Korea 20,445.
Unspecified	31,896	118,246	—	Taiwan 93,667; Republic of Korea 18,907.
Diamond: Natural:				
Gem, not set or strung carats	1,590,197	1,895,397	472,065	Belgium-Luxembourg 453,074; Thailand 333,444.
Industrial stones do.	117,865	193,154	70,667	Taiwan 44,900; Italy 40,000.
Diatomite and other infusorial earth	1,972	1,403	42	China 1,292; Sri Lanka 35.
Feldspar, fluorspar, related materials	105,673	146,487	—	Taiwan 134,031; Indonesia 7,711; Republic of Korea 4,226.
Fertilizer materials:				
Crude, n.e.s.	175	30	—	China 29; Japan 1.
Manufactured:				
Ammonia	145	179	—	China 140; Macau 35.
Nitrogenous	92,804	4,506	—	China 2,247; Philippines 1,781.
Potassic	273	45	—	All to Philippines.
Unspecified and mixed	4,972	802	1	China 637; Vietnam 108.
Graphite, natural	3,840	1,576	—	Indonesia 635; Republic of Korea 444.
Gypsum and plaster	19,859	7,736	4	Macau 4,826; China 1,841.

See footnotes at end of table.

TABLE 1—Continued
HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Iodine kilograms	12,763	2,076	—	North Korea 1,600; Cyprus 396; China 80.
Lime	30	949	—	All to China.
Magnesium compounds:				
Magnesite, crude	22,380	9,973	—	Taiwan 4,018; Indonesia 2,972; Nigeria 1,196.
Oxides and hydroxides	6,229	3,170	—	Taiwan 1,488; Philippines 912; China 427.
Mica:				
Crude including splittings and waste	1,135	552	—	Taiwan 412; Indonesia 103.
Worked including agglomerated splittings	456	382	(^c)	China 354; Taiwan 9.
Nitrates, crude	394	287	—	China 90; Japan 80; India 77.
Phosphates, crude	—	114	—	Republic of Korea 98; Taiwan 16.
Pigments, mineral:				
Natural, crude	268	152	—	Philippines 84; Dominican Republic 45.
Iron oxides and hydroxides, processed	9,565	7,811	39	China 1,882; Indonesia 1,843; United Kingdom 1,546.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	\$222,660	\$400,528	\$46,798	Thailand \$169,069; Japan \$116,596.
Synthetic do.	\$3,553	\$3,669	\$805	Taiwan \$621; China \$497; United Kingdom \$345.
Salt and brine	4,745	6,150	4	China 5,751; Thailand 228.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	191,156	77,822	—	China 76,846; Vietnam 654.
Sulfate, manufactured	9,899	17,689	—	Indonesia 7,191; Republic of Korea 3,400; Philippines 1,642.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	63,337	94,699	467	Taiwan 46,774; United Kingdom 38,100.
Worked	16,051	24,223	2,590	China 8,937; Taiwan 4,736.
Dolomite, chiefly refractory-grade	—	32	—	Taiwan 20; China 12.
Gravel and crushed rock	4,345	4,183	2	China 3,590; Taiwan 487.
Limestone other than dimension	2,175	1,786	—	China 1,076; Philippines 253; Lesotho 213.
Quartz and quartzite	4,010	2,018	865	Taiwan 704; Indonesia 197.
Sand other than metal-bearing	3,622	7,061	—	Taiwan 6,004; China 649.
Sulfur:				
Elemental:				
Crude including native and byproduct	—	823	—	Indonesia 770; China 40.
Colloidal, precipitated, sublimed	169	62	—	China 45; Indonesia 14.
Sulfuric acid	373	311	—	China 281; Indonesia 23.
Talc, steatite, soapstone, pyrophyllite	50,991	42,137	—	Taiwan 36,189; Philippines 1,704.
Other:				
Crude	4,433	4,087	23	Taiwan 1,928; Republic of Korea 1,745.
Slag and dross, not metal-bearing	35	18	—	All to China.
MINERAL FUEL AND RELATED MINERALS				
Asphalt and bitumen, natural	10	17	—	Macau 12; China 5.
Carbon black	6,463	3,283	—	Indonesia 1,217; Taiwan 642; Sri Lanka 520.
Coal, all grades including briquets	—	130	—	All to Taiwan.
Coke and semicoke	70	109	—	China 53; Philippines 37; Taiwan 19.
Peat including briquets and litter	—	6,406	—	All to China.

See footnotes at end of table.

TABLE 1—Continued
HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS—Continued:					
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	324	494	—	China 366; Macau 128.
Gasoline	do.	737	624	—	China 466; Macau 157.
Mineral jelly and wax	do.	238	334	—	Republic of South Africa 117; Taiwan 59; China 38.
Kerosene and jet fuel including white spirit	do.	355	42	—	Macau 31; China 9.
Distillate fuel oil	do.	9,150	6,441	—	China 6,244; Macau 196.
Lubricants	do.	748	716	—	China 499; Taiwan 107.
Nonlubricating oils	do.	24	55	—	China 32; Indonesia 15.
Residual fuel oil	do.	5,954	7,162	—	China 5,178; Macau 1,399.
Bitumen and other residues	do.	4	13	—	Macau 12; China 1.
Bituminous mixtures	do.	1	1	—	China; ² Macau. ²

¹Table prepared by Audrey D. Wilkes.

²Less than 1/2 unit.

³Reported under SITC item 522.120 as "selenium, tellurium, phosphorus, arsenic, silicon, and boron."

TABLE 2
HONG KONG: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	357	44	(?)	China 31; Japan 8.
Aluminum:				
Ore and concentrate	17,289	12,497	—	All from China.
Oxides and hydroxides	182,850	60	1	China 28; Japan 21; West Germany 10.
Metal including alloys:				
Scrap	5,660	5,693	1,670	China 2,811; Macau 334.
Unwrought	52,889	46,208	2,484	China 14,120; Japan 10,235; Australia 7,338.
Semimanufactures	81,784	65,716	4,228	Republic of Korea 11,636; Japan 11,002.
Arsenic: Oxides and acids	327	660	—	Mainly from China.
Beryllium: Metal including alloys, all forms				
value, thousands	\$162	—		
Chromium:				
Ore and concentrate	—	2,270	—	All from Vietnam.
Oxides and hydroxides	1,279	1,376	63	China 628; Netherlands 402.
Cobalt: Oxides and hydroxides	164	62	—	Republic of South Africa 38; China 19.
Columbium and tantalum: Tantalum metal including alloys all forms	2	13	10	China 4.
Copper:				
Oxides and hydroxides	371	297	28	Norway 203; Sweden 36.
Sulfate	1,644	1,044	26	China 554; France 360.
Metal including alloys:				
Scrap	33,759	46,640	16,068	China 19,525; Taiwan 3,178.
Unwrought	9,207	7,096	2,601	China 2,160; Chile 798; Taiwan 443.
Semimanufactures	111,887	125,882	3,128	Japan 30,663; Taiwan 28,900; China 26,999.
Gold:				
Waste and sweepings	value, thousands	\$5,749	\$2,761	\$2,119 Taiwan \$210; Philippines \$191.
Metal including alloys, unwrought and partly wrought	kilograms	439,173	180,780	39,792 Switzerland 74,714; United Kingdom 24,952.
Iron and steel: Metal:				
Scrap	76,445	81,961	12,481	China 62,995; Japan 1,757.
Pig iron, cast iron, related materials	5,323	4,999	188	North Korea 1,577; China 1,505.
Ferroalloys:				
Ferromanganese	8,923	12,189	—	China 11,583; Republic of South Africa 360.
Ferrosilicon	35,836	39,514	—	China 38,556; Taiwan 424; Norway 416.
Unspecified	21,319	36,455	36	China 34,897; Republic of South Africa 1,500.
Steel, primary forms	108,297	139,318	—	Turkey 42,000; Brazil 27,217; Mozambique 19,613.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,279,432	1,425,775	28	China 387,770; Brazil 237,787; Mozambique 107,071.
Universals, plates, sheets	824,335	804,561	34,852	Japan 356,228; Republic of Korea 84,424.
Hoop and strip	64,135	87,253	1,620	Japan 53,392; Taiwan 9,467; China 8,189.
Rails and accessories ²	2,292	2,619	9	China 892; United Kingdom 765; Japan 423.
Wire	82,015	69,371	244	China 39,234; Japan 7,725.
Tubes, pipes, fittings	209,871	201,768	843	China 62,092; Japan 42,552; Mozambique 33,644.
Castings and forgings, rough	25,007	27,425	123	China 26,075; Australia 846.

See footnotes at end of table.

TABLE 2—Continued
HONG KONG: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Lead:				
Ore and concentrate	5,146	—		
Oxides	271	1,552	—	China 1,410; West Germany 84.
Metal including alloys:				
Scrap	2,241	3,949	558	China 2,179; Japan 725.
Unwrought	5,543	18,327	331	China 16,991; Australia 636.
Semimanufactures	220	904	—	China 573; Netherlands 216.
Magnesium: Metal including alloys:				
Unwrought	56	46	21	Canada 21; China 2.
Semimanufactures	value, thousands	\$2	—	
Manganese:				
Ore and concentrate	580	959	—	All from China.
Oxides	3,336	3,650	—	China 2,260; Japan 561; Greece 425.
Mercury	80	129	(?)	China 124; Netherlands 4.
Molybdenum: Metal including alloys, all forms	5	12	(?)	Mainly from China.
Nickel:				
Oxides and hydroxides	78	123	79	China 23; West Germany 15.
Metal including alloys:				
Scrap	63	41	—	All from China.
Unwrought	6,078	3,836	36	Norway 2,263; Canada 522.
Semimanufactures	250	314	11	Canada 80; France 69; China 63.
Platinum-group metals:				
Waste and sweepings	value, thousands	\$2,843	\$1,768	\$8 Republic of Korea \$1,605; Singapore \$63.
Metals including alloys, unwrought and partly wrought	kilograms	2,085	2,595	88 Canada 813; United Kingdom 619.
Silver:				
Waste and sweepings	value, thousands	\$159	\$3	\$3
Metal including alloys, unwrought and partly wrought	kilograms	173,327	132,490	9,420 Philippines 19,555; Australia 17,076.
Tin:				
Ore and concentrate	20,457	8,710	—	China 8,485; Republic of Korea 123.
Oxides	100	25	—	China 17; United Kingdom 7.
Metal including alloys:				
Scrap	132	87	—	China 60; Malaysia 19.
Unwrought	6,877	7,022	6	China 6,496; Malaysia 183.
Semimanufactures	1,725	1,378	28	Singapore 602; China 426; Taiwan 130.
Titanium: Oxides	24,014	16,046	3,067	China 4,667; Australia 3,331.
Tungsten:				
Ore and concentrate	3,658	2,031	—	China 1,972; Thailand 59.
Metal including alloys:				
Scrap	3	—		
Semimanufactures	14	—		
Uranium and thorium: Oxides and other compounds	620	807	92	China 630; Belgium-Luxembourg 35.
Zinc:				
Ore and concentrate	6,435	1,107	—	China 1,100; Belgium-Luxembourg 7.
Oxides	10,692	19,287	16	China 18,112; Republic of Korea 423.
Blue powder	97	330	—	China 313; Japan 17.

See footnotes at end of table.

TABLE 2—Continued
HONG KONG: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Zinc—Continued:				
Metal including alloys:				
Scrap	3,647	6,407	3,857	China 2,043; Canada 164.
Unwrought	55,237	74,818	17	China 38,029; Australia 15,480.
Semimanufactures	666	4,235	2	China 3,732; West Germany 258.
Other:				
Ores and concentrates	17,401	16,496	—	China 13,423; Republic of South Africa 2,500.
Metalloids, unspecified ⁴	23,327	36,732	28	China 35,891; U.S.S.R. 202.
Ashes and residues	8,290	11,860	21	China 10,600; Singapore 1,119.
Base metals including alloys, all forms	15,744	18,115	22	China 17,457; Netherlands 214.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	88,796	76,239	512	Indonesia 70,673; Turkey 2,518.
Artificial:				
Corundum	39,925	26,531	290	China 24,264; Japan 838.
Silicon carbide	6,026	2,615	22	China 2,497; Republic of Korea 32.
Dust and powder of precious and semiprecious stones including diamond value, thousands				
	\$601	\$2,277	\$57	Japan \$1,537; China \$302.
Grinding and polishing wheels and stones	4,608	4,547	137	China 2,950; Taiwan 588; Japan 473.
Asbestos, crude	78	200	—	All from China.
Barite and witherite	6,703	4,783	—	China 4,597; United Kingdom 80.
Boron materials:				
Crude natural borates	—	378	—	All from Japan.
Oxides and acids	737	812	147	China 447; Italy 216.
Bromine including fluorine kilograms	—	19	—	All from West Germany.
Cement thousand tons	4,814	4,270	(⁵)	Japan 2,338; China 1,209; Taiwan 233.
Chalk	8	—	—	
Clays, crude:				
Kaolin	388,503	208,669	928	China 202,099; Taiwan 3,317.
Unspecified	53,934	192,984	2,170	China 187,250; France 1,423.
Diamond: Natural:				
Gem, not set or strung thousand carats	3,115	2,930	201	India 1,085; Belgium-Luxembourg 706.
Industrial stones do.	227	88	(⁶)	Belgium-Luxembourg 41; Netherlands 28.
Diatomite and other infusorial earth	2,716	2,149	2,089	China 59.
Feldspar, fluorspar, related materials	126,087	178,243	—	China 176,143; Taiwan 2,100.
Fertilizer materials:				
Crude, n.e.s.				
	1,103	103	13	Taiwan 80; Canada 10.
Manufactured:				
Ammonia	3,050	2,953	—	China 2,834; United Kingdom 44.
Nitrogenous	71,929	10,404	27	China 4,880; U.S.S.R. 1,442; Italy 935.
Unspecified and mixed	10,969	5,724	146	West Germany 4,405; Taiwan 742.
Graphite, natural	4,593	1,394	35	China 1,266; Switzerland 44.
Gypsum and plaster	132,623	77,441	1,166	Thailand 68,613; United Kingdom 2,726.
Iodine kilograms	11,940	2,780	—	West Germany 1,980; Belgium-Luxembourg 600.
Lime	35,458	43,472	—	China 43,466; United Kingdom 6.

See footnotes at end of table.

TABLE 2—Continued
HONG KONG: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Magnesium compounds:				
Magnesite, crude	22,759	7,120	47	China 6,816; Japan 222.
Oxides and hydroxides	7,611	7,688	285	China 6,058; Taiwan 1,087.
Mica:				
Crude including splittings and waste	317	904	—	China 771; Japan 95.
Worked including agglomerated splittings	1,708	1,644	(?)	Japan 694; Belgium-Luxembourg 610.
Nitrates, crude	814	553	—	China 407; Belgium-Luxembourg 146.
Pigments, mineral:				
Natural, crude	211	91	—	China 90; Australia 1.
Iron oxides and hydroxides, processed	11,441	11,200	1,929	China 5,467; Japan 1,868.
Potassium salts, crude	5	—		
Precious and semiprecious stones other than diamond:				
Natural	value, thousands	\$155,285	\$177,704	\$34,740 Thailand \$32,435; India \$24,082.
Synthetic	do.	\$7,300	\$6,327	\$124 China \$2,486; Japan \$1,769.
Salt and brine		156,456	148,674	32 China 127,808; Israel 6,838.
Sodium compounds, n.e.s.:				
Soda ash, manufactured		245,300	92,572	42,931 China 18,599; West Germany 13,168.
Sulfate, manufactured		63,302	59,452	(?) China 58,303; Taiwan 1,020.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		71,162	78,515	— China 76,990; Italy 505.
Worked		79,106	89,870	146 Italy 48,318; China 23,408.
Dolomite, chiefly refractory-grade		220	22	— All from Taiwan.
Gravel and crushed rock	thousand tons	6,937	8,459	(?) China 8,455.
Limestone other than dimension		43,244	416,818	— Japan 377,969; China 38,681.
Quartz and quartzite		2,267	1,790	— China 1,643; Japan 72; West Germany 54.
Sand other than metal-bearing	thousand tons	1,424	1,396	(?) China 1,394.
Sulfur:				
Elemental:				
Crude including native and byproduct		344	623	— West Germany 455; Thailand 62.
Colloidal, precipitated, sublimed		849	574	— West Germany 263; Republic of Korea 244.
Dioxide	kilograms	—	4,246	596 Taiwan 3,000; Singapore 650.
Sulfuric acid		5,064	5,182	83 China 4,987; West Germany 86.
Talc, steatite, soapstone, pyrophyllite		51,514	52,127	556 China 49,691; Taiwan 1,243.
Other:				
Crude		9,155	12,215	58 China 11,815; Republic of South Africa 140.
Slag and dross, not metal-bearing		491	7,768	— Japan 5,850; China 1,720.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		11	859	— Taiwan 800; Trinidad and Tobago 36.
Carbon black		5,969	3,544	635 China 2,196; Netherlands 229.
Coal:				
Anthracite and bituminous	thousand tons	9,928	8,931	108 Australia 3,003; Republic of South Africa 3,217.
Briquets of anthracite and bituminous coal		—	130	— China 116; Taiwan 14.
Coke and semicoke		587	1,513	— Japan 1,090; Republic of Korea 306.
Peat including briquets and litter		—	1,597	— Netherlands 657; China 499.

See footnotes at end of table.

TABLE 2—Continued
HONG KONG: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

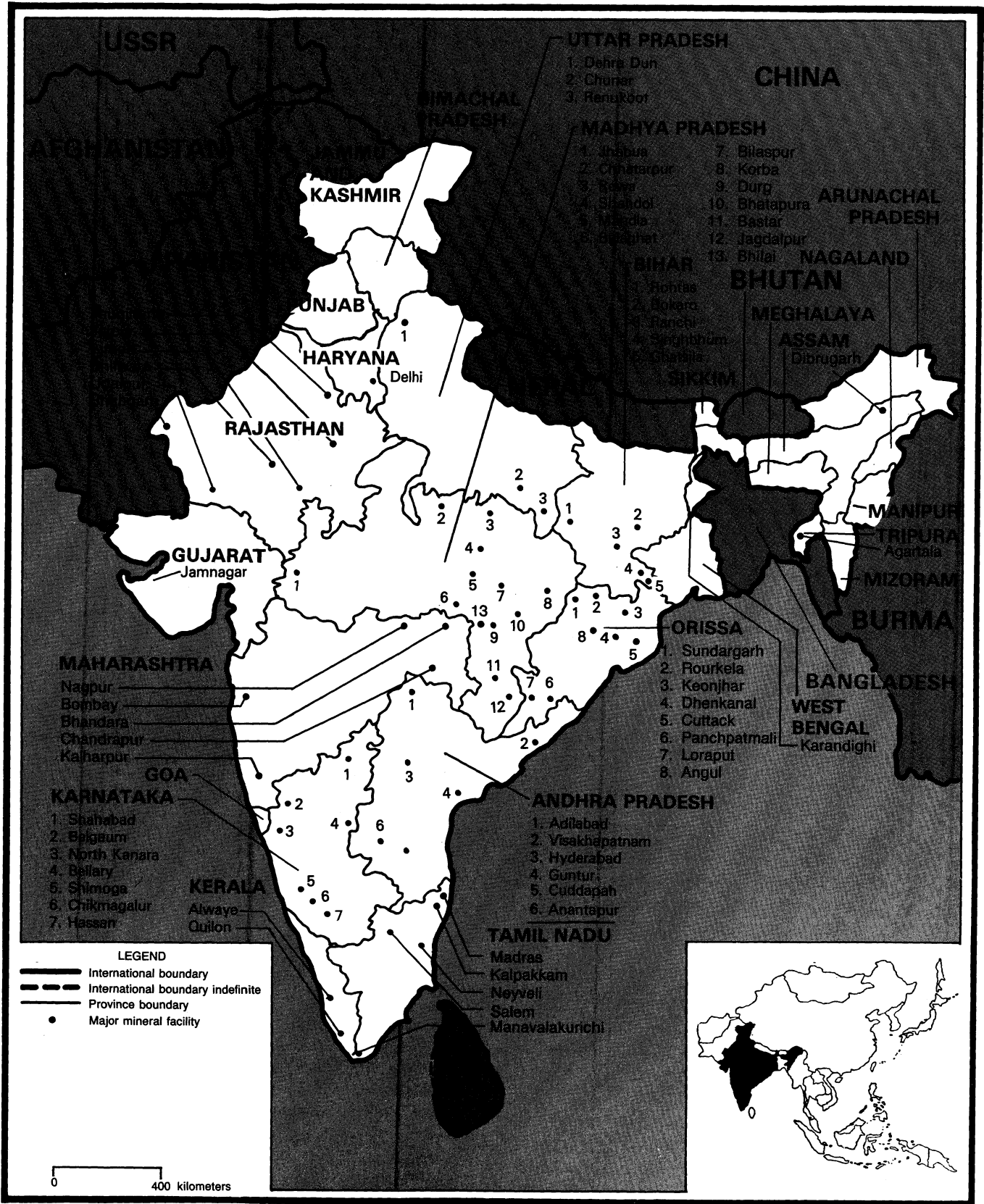
Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Petroleum refinery products:				
Liquefied petroleum gas	thousand 42-gallon barrels	2,375	2,457	(?) Philippines 1,753; Singapore 406.
Gasoline:				
Aviation	do.	1	1	— All from Australia.
Motor	do.	2,699	3,068	— Singapore 2,834; China 145.
Naphtha including white spirit	do.	2,446	3,267	(?) Singapore 3,149; Japan 106.
Mineral jelly and wax	do.	300	406	7 China 388.
Kerosene and jet fuel	do.	13,129	14,523	(?) Singapore 13,068; China 1,074.
Distillate fuel oil	do.	21,243	20,027	54 Singapore 13,512; China 4,998.
Lubricants	do.	1,230	1,229	35 Singapore 540; Australia 281; China 187.
Nonlubricating oils	do.	43	70	3 China 45; Netherlands 12.
Residual fuel oil	do.	19,199	15,818	660 Singapore 10,970; China 1,449.
Bitumen and other residues	do.	349	278	(?) Singapore 129; Taiwan 78.
Bituminous mixtures	do.	4	5	(?) United Kingdom 2; Taiwan 1.

¹Table prepared by Audrey D. Wilkes.

²Less than 1/2 unit.

³Excludes unreported quantities valued at \$904,000 in 1989 and \$1,868,000 in 1990.

⁴Reported under SITC item 522.120 as "selenium, tellurium, phosphorus, arsenic, silicon, and boron."



LOCATION OF MAJOR MINERAL FACILITIES

THE MINERAL INDUSTRY OF

INDIA

By Pui-Kwan Tse

India, the second most populated country in the world, faced another political upheaval in 1991. A new Government formed under Chandra Shekhar, a veteran socialist, who controlled only 66 of Parliament's 524 members in November 1990, collapsed in March 1991, and a general election was called. The party leader of Congress and former prime minister, Rajiv Gandhi, was assassinated in May during last-minute campaigning in Tamil Nadu. P.V. Narasimha Rao became the Congress party leader and led the party to return to power after 1 1/2 years as the opposition. But its 244 seats left it short of an overall majority in 545-seat Lok Sabha, the lower house of the Parliament. The new Government party turned Indian economic policy away from its post-independence autarkic trend toward market-based systems and an integration with the global economy.

In 1991, India's economy continued to falter, reflecting prevailing political uncertainty. The real growth in GDP was 3% in 1991, the lowest in the past decade. Per capita income was estimated to be \$290¹ in 1991. The rupee was devalued by almost 20% in two stages in early July 1991. In March 1991, the Government domestic debt was equal to 55% of the GDP, which had been accumulated by the Government deficits running more than 8% of the GDP during the late 1980's. The Government continued to increase spending by maintaining consumer subsidies and financial support to loss-making public enterprises. In mid-1991, there was a severe shortage of foreign exchange reserves. The Reserve Bank of India was compelled to take drastic steps to arrest a further decline in reserves. The emergency curb was imposed by restricting imports, including a 200%

cash margin on opening a credit line. With major improvement in the foreign exchange reserves, the import restrictions were to be lifted in early 1992. An effort was made by Western aid donors who pledged \$6.7 billion in bilateral and multilateral aid in September 1991, including a total of \$4.5 billion from the World Bank and the Asian Development Bank. The International Monetary Fund extended support on four separate occasions within the year.

GOVERNMENT POLICIES AND PROGRAMS

The Government owned and operated most major mines, processing plants, and mineral-based industries. The fundamental operating rules and procedures for the mineral industries were the Mines Act of 1952 and its amendments, the Minimum Wages Act of 1948 and its amendments, the Mineral Concession Rules of 1960, the Mines Labor Welfare Fund Act of 1976, and the Oil Mines Regulations of 1983.

The national mineral policy for metals and nonnuclear fuel was formulated to strike a balance between conservation and mineral development. The guiding principle in the strategy for developing any mineral deposit at any location would ordinarily be the economic cost. However, under the conservation measure, recycling of metallic scrap and the utilization of low-grade minerals, mineral wastes, and rejects were encouraged.

Thirteen minerals—chrome, copper, diamonds, gold, iron ore, lead, manganese, molybdenum, nickel, platinum-group metals, sulfur, tungsten, and zinc—were exclusively reserved for exploration and processing by the Government. The development of other

minor minerals will be undertaken through the initiative and enterprise of the private sector even though the State will continue to play an active role. The introduction of foreign technology and participation in exploration for high-value and rare minerals would be pursued.

In 1991, the new Government introduced a stringent budget and a new industrial policy. The subsidies for public enterprises were reduced, and defense spending was restrained. The Government increased petroleum and liquefied gas prices and required steeper holding tax and levy rates. The Government began to privatize its public enterprises. In the case of joint ventures, the new Government allowed increasing foreign investments from the previous 40% ceiling to an automatic approval of 51%. The Government will permit the foreign equity ceiling to reach 75% to 100% for selected high-technology, export-oriented, or the tourism industries. The Government has published a list of 34 industries in which foreign investment proposals will be "automatically" approved.

New mining leases will not be granted without proper mining plans, including environmental issues. This condition will apply to both public- and private-sector parties. The environmental safeguards will be approved and enforced by statutory authorities.

The policy also emphasizes certain new aspects such as mineral exploitation in the seabed and the development of an appropriate inventory for mineral resources. The Geological Survey of India has been designated the principal agency for geological mapping and identification of mineral resources, and the Department of Ocean Development is responsible for seabed exploration and mining operations.

PRODUCTION

The overall industrial production growth rate maintained the same level in 1991 as that in 1990. India's steel industry was in a transition phase. With decontrolled prices and a liberal licensing of small plants based on electric arc furnaces using metal scrap, numerous ministeel plants came on-stream. The ministeel plants accounted for 30% of the country's total steel output. An inappropriate product mix, power shortages, and imbalances were responsible for low profitability and idle capacity in the industry. The nonferrous sector was not as well positioned as its ferrous counterpart. With the exception of aluminum, nonferrous metals suffered from supply problems. The shortage of copper was likely to persist because of delays in stepping up domestic production. Lead and zinc were not much better off than copper. A more pronounced rise in lead production was being caused by imported concentrates. The main handicap of the nonferrous metal industry was the shortage of power. The industry was attempting to install captive generating capacity wherever feasible. (See table 1.)

TRADE

The Government of India made significant changes to its trade policy as part of an overall effort to integrate India more closely into the world economy. The new Government has made efforts to shift India away from its self-reliant economic strategies toward more liberal trade and introduce plans to acquire more foreign exchange. In early 1992, India's Minister of Commerce was to announce a new trade policy that would run concurrently with the eighth 5-year economic plan, which begins on April 1, 1992. The new policy seeks to raise the share of trade in India's GDP from 13% to 20% and to remove unnecessary restrictions to the flow of goods and services. Although the Government will continue to restrict imports of consumer goods, the new policy will restrict only

5% of nonconsumer products, down from 40% in the previous trade policy. Furthermore, the number of items that were previously channeled through public-sector import agencies will be reduced from 28 to 8 under the new policy. On the export side, 62 items will be restricted, 7 banned, and 10 channeled by the Government. India imposed a ceiling of 110% on the basic tariff rate, down from 150% under the previous trade policy. India has also committed itself to further tariff reductions and binding tariffs as part of the Uruguay Round market access negotiations. Despite the newly lowered tariff ceiling, India's tariffs remain high, especially for goods that can be produced domestically.

Another aspect of the new policy is reform of the foreign exchange system. In February 1992, the Government replaced the "exim scrip" system introduced in July 1991, by which exporters kept 30% of their foreign earnings as tradeable entitlements to foreign exchange at the official rate. The scrip could be used to import any product from the restricted, limited permissible, and open general import license lists. The Government also allowed the scrip to trade openly in secondary markets at market rates. Banks and other financial institutions in India were quite active in exim scrip, trading at premiums of 20% to 40% of face value. The new system established a two-tiered exchange rate. Foreign exchange earners will be allowed to sell 60% of their earnings at market-determined exchange rates. The remaining 40% of foreign exchange earnings must be sold to India's central bank at an official rate. It will be used to finance the Government's purchases of essential commodities or other official trade transactions.

India's trade deficit was \$2.5 billion for the fiscal year 1991-92, compared with \$5.45 billion 1 year before. Exports were \$18.1 billion and imports were \$20.6 billion. The major uncertainty was the continued willingness of individuals in the former U.S.S.R. to sell oil for rupees. The Government was planning to import wheat and edible oil to help manage food prices.

STRUCTURE OF THE MINERAL INDUSTRY

India has two main categories of ownership and management in the mining industry: Government owned and privately owned. The Indian mining industry produces more than 70 mineral commodities, representing various ores, metals, industrial minerals, and fuels. The entire industry is in various stages of expansion, and the rate of growth depends on several factors: location of resources, capital investment, and the accessibility of advanced technologies in mining, processing, and production.

There were more than 4,200 operating mines in India in 1991. However, the majority of these mines were small, manually operated surface pits with relatively low output, accounting for approximately 70% of industrial minerals, 18% of metallic minerals, and 12% of mineral fuels.

In the nonfuel sector, more than 300 underground mines were producing such minerals as chromite, copper, gold, lead-zinc, and manganese in the metals sector, and apatite, barite, fluorspar, graphite, mica, and steatite in the industrial minerals sector. Most of these are manual operations. The coal sector has been gradually undergoing a transition from manual to semimechanized operations.

Total employment in the mining and quarrying sector exceeded 1 million, 4.5% of the employed labor force. The public sector employs about 90% of the total. Employment in the private sector has been increasing in the past several years. (See table 2.)

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—The continuous problem of power shortage and absence of cheap hydroelectric power has hindered the growth of India's aluminum industry. Electricity from the regional grids is always in short supply, so producers are forced to increase their

reliance on captive power even though it is more expensive. In the first nine months (April to December 1991) of fiscal year 1991-92, the Indian aluminum industry produced 382,441 tons of aluminum and 2.4 Mmt of alumina. India had a total smelter capacity of 610,000 mt/a accounted for by National Aluminium Co. (NALCO), 218,000 mt/a; Bharat Aluminium Co. (BALCO), 100,000 mt/a; Hindalco Industries Ltd. (HINDALCO), 150,000 mt/a; Indian Aluminium Co. (INDAL), 117,000 mt/a; and Madras Aluminium Co. (MALCO), 25,000 mt/a.

Bauxite reserves in captive mines of BALCO at Phutkapahar and Amarkantak have been depleted faster than anticipated and are on the verge of exhaustion. The company was making efforts to get the mining leases for deposits at Hazaridadar, Mainpat, Jamirapat, and Andhra Pradesh to establish a captive bauxite source so that the raw material crisis can be overcome in the future. Currently, BALCO is purchasing bauxite from private sources and NALCO to meet its demand.

BALCO set an aluminum output target of 95,000 tons at its Korba Aluminium Plant for fiscal year 1991-92. However, due to the unavailability of requisite steady power supply, power restrictions, and operational problems associated with cell leakages, the capacity utilization remained at 90% in 1991.

In 1991, NALCO was operating its aluminum smelter at about 62% of designed capacity because of a fire at its captive powerplant in March 1990. Several potlines were idled. The problem was overcome in July 1991. Output scheduled for 1991-92 was 2.34 Mmt of bauxite, 780,000 tons of alumina, and 190,000 tons of aluminum. NALCO planned to invest \$975 million to expand its mines, smelter, and refinery capacity in Orissa. The annual designed capacity and expansion locations are: 2.4 Mmt of bauxite at Panchpatmali in the Koraput District, 800,000 tons of alumina at Damanjodi in the Koraput District, 218,000 tons of aluminum at Angul in the Dhenkanal District, and a 600-MW captive powerplant also at Angul.

Engineers India Ltd. has been appointed as a consultant to prepare the integrated detailed project report incorporating all inputs. Aluminum Pechiney of France will provide technological input for expansion. Development of the bauxite mine and construction of the alumina plant were expected to be completed by December 1996, and the aluminum refinery and captive powerplant were scheduled to be in operation by June 2000.

HINDALCO had sought Government approval to double its aluminum production to 300,000 mt/a, considered to be the optimum economic size. This would require corresponding increases in the production of alumina and semi-fabricated products. New cold-rolling mills expected to be commissioned in 1992 will help the company to manufacture a wide range of products for sophisticated end uses, meeting the demand of quality specifications for the export market.

Copper.—Hindustan Copper Ltd. (HCL), a State-owned company and the sole primary copper producer in India, has an integrated operation, from detailed exploration of mineral deposits to the development of the mines, to smelting and refining copper as well as the recovery of byproducts.

Demand for copper in 1991-92 was estimated at 160,000 tons. HCL was entrusted with the responsibility for meeting consumer demand. Domestic production was only about 47,000 tons in 1991-92. It is believed that another 40,000 tons of copper was obtained through the company's imports from Chile and Zambia. However, imports other than HCL's also declined during 1991 since the government agency for channeling trade was not able to contract adequate quantities of metal because of a severe exchange shortage.

Gold.—In 1991, India produced 1,973 kg of gold, the same as last year. Gold remains the single largest item on the smugglers' list. Even though the Indian Government lifted its ban on gold imports and allowed nonresidents of India to bring

in as personal baggage up to 250 g of gold in 1990, the demand and higher domestic gold price made smuggling continuously lucrative.

The Geological Survey of India continued surveying for gold deposits in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra, Madhya Pradesh, and West Bengal. In the Hutti Maski schist belt in Karnataka, a probable reserve of 0.85 Mmt of gold ore having an average grade of 3.96 g/mt with widths from 1 m to 1.33 m and a strike length of 385 m has been established. In Andhra Pradesh, exploration for gold is in progress in a number of blocks in the Ramagiri-Penakacheria schist belt.

Iron and Steel.—There has been a continual severe shortage of hot-rolled steel sheet, alloys, and special steels in India. Steel consumers complained about the irregular supply and quality of materials. The Government continued to make periodical reviews of distribution policy to ensure timely fulfillment of the consumer requirements, particularly the priority sectors of the economy. However, producers in the integrated sector argued that they could not meet the consumers' expectations unless they were given full freedom to arrange their production to suit market requirements and price the products based on their actual costs. Both the Steel Authority of India Ltd. (SAIL) and Tata Iron and Steel Co. (TISCO) have been pleading for decontrol of the steel industry. The Government was finally to decontrol steel prices in early 1992.

The output of iron ore of India is produced by a combination of large mechanized mines in the public sector and several small mines operated on a manual or semimanual basis in the private sector. The mining operations can be categorized in three groups: captive mines, owned and operated by individual steel plants (mainly for internal use); public-sector mechanized mines, owned and operated by the central and state government (for export and internal consumption of steel plants); and small mines, owned and operated by private parties, manual and semimechanized of

mining operation (for export and internal consumption).

In 1991, the output of iron was approximately 57.6 Mmt, 8% higher than that of the previous year. The Gao region continued to be the leading producer of iron ore, followed by Madhya Pradesh, Bihar, and Orissa. In 1991, the domestic iron ore consumption was about 24.7 Mmt, while exports of iron ore were 32 Mmt.

SAIL, the State-owned iron and steel company, operating four integrated steel plants at Bhilai, Bokaro, Durgapur, and Rourkela and a subsidiary of the Indian Iron and Steel Co. Ltd., had difficulty meeting its production target because of power problems, scarcity of coking coal, and various other production bottlenecks. In addition, devaluation of the rupee adversely affected the import costs of raw materials and mechanical parts.

At Durgapur, SAIL was investing \$1 billion to increase the plant crude steel output capacity from 1.15 Mmt to 1.88 Mmt. A major part of the financing came from the United Kingdom and an international consortium of banks led by Deutsche Bank of Luxembourg. The project was scheduled to be completed in March 1993. SAIL also signed a \$21 million credit pact with Finnish Export Credit Ltd. of Finland to construct its continuous casting plant, which was expected to be put into operation in September 1992.

SAIL invested \$650 million to modernize its plant at Bokaro. The plan included the reconstruction of two converter plants, installation of a continuous casting plant, and the upgrading of the hot strip mill. Initially, the modernization plan was scheduled to be completed in 1991. However, constraints on generating adequate internal financial resources were likely to postpone completion until 1992.

SAIL was under pressure to undertake anti-pollution measures in its plants. SAIL will invest \$5 billion in various plants in the next few years to lower pollution to meet environmental standards set by the Government.

TISCO, the only integrated steel plant in the private sector, was to complete its

phase 3 modernization in 1994. It was to increase its annual salable steel production to 2.7 Mmt. The modernization project included a 1-Mmt hot strip mill, a coke oven battery, an oxygen plant, two captive powerplants, and the expansion and modernization of raw materials handling facilities and transportation system. In addition, TISCO was to install a 1-Mmt/a blast furnace. In the first 9 months of 1991-92, TISCO produced 1.76 Mmt of pig iron, 1.76 Mmt of crude steel, and 1.5 Mmt of salable steel.

There were 216 licensed electric arc furnace steel mills in India with an aggregate capacity of 8.97 Mmt. Of these, 175 mills with a total licensed annual capacity of 6.8 Mmt have been commissioned. Mini-steel mills played an important role in the overall production of the steel industry in the country. They contributed about 30% of the country's total crude steel production in 1991. The indigenous availability of scrap was not sufficient to meet the requirement of this sector. The restricted availability of foreign exchange also hindered the import of large quantities of scrap. The Government was making efforts to increase the production of direct-reduced iron as a substitute for melting steel scrap.

Lead and Zinc.—The domestic lead and zinc per capita consumption was 83 g and 138 g, respectively. It is expected that per capita consumption will increase to 170 g of lead and 281 g of zinc by the end of the century. In 1991, India had the installed output capacity of 78,000 tons for lead and 135,100 tons for zinc. In 1991-92, the demand for lead and zinc was 94,000 tons and 180,000 tons, respectively, while the target output was only 53,400 tons and 104,950 tons, respectively. Demand for lead and zinc was expected to grow at an annual rate of 7% during the eighth 5-year plan period. Therefore, India will continue to depend on imports to meet its domestic demand.

Hindustan Zinc Ltd. was planning to introduce a pressure leaching technology so that it would be able to treat a higher quantity of zinc concentrates, particularly

those with higher silica content. Sheritt Gordon Corp., a Canadian firm, completed a contract for a prefeasibility engineering study in December 1990. Further studies on the removal of fluoride by acid preleaching are being conducted.

Binani Zinc, formerly known as Cominco Binani Zinc Ltd., resolved a 10-month-long strike caused by a wage dispute with its workers. After more than 50 rounds of negotiations, a settlement was finally reached in March 1991. The company resumed its plant production at Alwaye in Kerala. Production loss during the strike period was estimated at 17,000 tons. The company was expected to produce 18,000 tons of zinc in 1991-92.

According to India's Ministry of Mines, the identified lead and zinc resources currently stand at 383 Mmt. Out of this, 167 Mmt containing 2.17% of lead and 8.16% of zinc falls into the category of minable ore reserves. A major multimetal deposit of lead and zinc was discovered in the Rampura Agucha belt in the Bhilwara District of Rajasthan. Estimated ore reserves were 60.35 Mmt containing 1.93% of lead and 13.48% of zinc.

Titanium.—Indian Rare Earths Ltd. (IREL) is the major producer, supplier, and exporter of ilmenite and rutile. IREL has mineral separation plants at Chavara and Quilon in Kerala, Manavalakurichi in Tamil Nadu, and Chatrapur in Orissa with a collective annual output of 320,000 tons of ilmenite and 14,000 tons of rutile. Titanium oxide production is mainly carried out by Kerala Minerals and Metals Ltd. and Travancore Titanium Products with a total output of 15,000 mt/a.

Industrial Minerals

In fiscal year 1991-92, India produced 7.30 Mmt of nitrogen and 2.56 Mmt of P₂O₅ fertilizers, an increase of 308,000 tons and 500,000 tons, respectively, over that of the previous year. During this period, India increased its installed production capacity of N and P₂O₅ by 82,000 tons and 23,000 tons to 8.23 Mmt

and 2.72 Mmt, respectively. In 1991, the demand for N and P₂O₅ was 8.4 Mmt and 3.6 Mmt, respectively; the balance of domestic demand was met by imports. To keep the fertilizer demand and supply gap within reasonable limits, India's Planning Commission recommended that the demand and supply gap for nitrogen should be less than 1 Mmt/a. Because India does not have significant sources of phosphate rock and sulfur, the Planning Commission recommended that the production of phosphatic fertilizers increase the efficiency rate to 85% or higher. The Government plans to de-channel imports of raw materials and intermediates to allow direct import by the fertilizer-consuming sector at market exchange rates in fiscal year 1992-93.

Mineral Fuels

Coal.—India produced 229 Mmt of anthracite and bituminous coal in 1991, an increase of 8.3% over 1990. Production was targeted to increase to 300 Mmt by 1995 and 400 Mmt by the year 2000. Insufficient coal production has adversely limited power generation in India.

India's coal production is dominated by the public-sector Coal India Ltd. (CIL) and its seven subsidiaries—Eastern Coalfields Ltd., Bharat Coking Coal Ltd., Central Coalfields Ltd., Northern Coalfields Ltd., Western Coalfields Ltd., South Eastern Coalfields Ltd., and North Eastern Coalfields Ltd., which together accounted for 89% of the country's total coal production. Neyveli Lignite Corp. (NLC) and Singareni Collieries Co. Ltd., a joint venture of the Government of India and the Government of Andhra Pradesh, made up the balance in production.

NLC engaged in mining lignite at Neyveli for utilization in power generation. The company has two lignite mines, two thermal power stations, a fertilizer plant based on fuel oil, and a briquetting and carbonization plant. Even though NLC is a Government enterprise, it has relied heavily on market borrowing instead of budgetary support. In 1990-91, it raised \$162 million by issuing

bonds. The expansion of a second mine and second thermal power station was completed in December 1991. The capacity of the second mine was expanded from 4.7 Mmt/a to 10.5 Mmt/a. The power generation capacity for the second power station was increased from 630 MW to 1,470 MW. In 1991, the Government gave approval to NLC to invest \$335 million for the construction of an integrated lignite mine and power station at Barsingsar in the Bikaner District of Rajasthan. The project proposal included the development of a 1.7-Mmt/a lignite mine and the construction of a 240-MW-capacity thermal power station. The mine was to be put in operation in 1995 and the power station in 1996.

Despite record coal production, the leading coal-consuming sectors continued to experience periodic shortages of coal. The main reason was the inadequate availability of railroad wagons to move coal from the pithead to the consuming areas. As a result of the erratic availability of wagons and the nonlifting of coal allocation to consumers, pithead stocks rose to 41.6 Mmt in March 1991 compared with 37.4 Mmt 1 year before.

Imports of coal are confined mainly to metallurgical-grade coal and coking coal because domestic coal contains as high as 30% ash content. In 1991, the Government imported 5.5 Mmt for the steel sector. The Government decided on open general licensing for coal and was studying a proposal to reduce the coal tariff from 90% to 40%. However, coking coal imports will continue to be channeled through SAIL.

CIL and Singareni authorities have been petitioned for a price increase of about \$2.5 per ton to offset higher operation costs. In 1990-91, the cost of coal production was \$14.6 per ton. CIL operated in the red every year except 1981-82 and 1989-90. Finally, the Government issued a notification to increase the coal price by \$2.83 per ton to be effective on December 28, 1991.

Oil and Gas.—In 1991, India produced 32.5 Mmt of crude oil, a decrease of 800,000 tons from that of 1990. The

country is heading for an energy crisis. Imports of crude oil and products are rising and domestic production is contracting. A bilateral trade agreement with the former U.S.S.R., under which India could pay for crude oil and product imports in rupees and goods, came to an end in December 1991. Under the agreement, the former U.S.S.R. supplied up to 5 Mmt of crude oil and 3 Mmt of refinery products, about one-quarter of the country's total oil imports. Due to mismanagement of India's premier oilfield and gasfield, the Bombay High, during the past several years, reduced the production by 4 Mmt in 1991. The deficit will have to be made up by hard currency purchases of imports. In 1991, India imported an estimated 20 Mmt of crude oil and 10 Mmt of refinery products.

Domestic refining is experiencing similar difficulties. In 1991, the refinery output was running at least 60,000 bbl/d below the 1990 level as the result of the shortage of imported crude oil and deterioration in refinery efficiency.

Under pressure from international financial communities, the Indian Government is speeding reforms, moving toward a more market-oriented economy, and opening up to greater direct foreign participation in the energy sector. In September 1991, the Government of India announced the fourth round of bidding for 33 onshore and 39 offshore blocks. The blocks range in size from 81 km² to 93,070 km² and represent most of India's sedimentary basins, including the Andaman Islands. The hottest contested areas will be the four blocks west of the mainstay Bombay High offshore oilfield. Others will be in the Kutch area of Gujarat, in the Rajasthan Desert, and in the Ganges River basin. The contracts are for a production-sharing agreement with the Government of India, the Oil and National Gas Commission, Oil India Ltd., and the exploration company. The terms for production-sharing have improved from the initial 60:40 to 70:30 in a company's favor. Contract length is set at 25 years for oil, with a possible 5-year extension, and 35 years for natural gas.

Reserves

The country's mineral resources have not been fully delineated and in many areas large deposits of oil, gas, coal, limestone, bauxite, and iron ore are still likely to be found. Iron ore deposits, mainly in the form of hematite or magnetite, occur in Bihar, eastern Madhya Pradesh, Orissa, Karnataka, and Tamil Nadu. Bauxite deposits are mainly in Orissa and Andhra Pradesh. They also occur in Maharashtra, Tamil Nadu, Bihar, and Gujarat. Low-grade copper deposits are located in Rajasthan, Madhya Pradesh, Bihar, and Andhra Pradesh. Lead and zinc deposits are in Rajasthan and Bihar. Nickel and chromium ore reserves exist in Orissa. Gold is produced only in small amounts in Karnataka, and diamonds are mined in Madhya Pradesh. Ilmenite sands in Kerala and Tamil Nadu contain a large amount of thorium. (See table 3.)

INFRASTRUCTURE

India's road network includes 515,000 km of hard-surface two-lane roads and approximately 1.12 Mkm of gravel, loose-surface, or prepared-earth routes having at least one lane and, in many stretches, two lanes. This secondary system is not well drained in all places but generally can accommodate passing of vehicles headed in opposite directions. As in many Asian countries, access to some remote areas is by cart tracks, current or abandoned.

The railroad system comprises 33,600 km of broad-gauge 1.676-m track, 24,000 km of 1-m-gauge track, and 4,250 km of narrow-gauge, 0.762-m and 0.610-m track. The total track length of all gauges is approximately 61,850 km, 12,617 of it double track and 6,500 km having been electrified. The mixed-gauge trackage introduces complexities such as loss of time in transshipment and multiple stocking of spare parts. The rail system has much old equipment that is unreliable and expensive to maintain. At the end of 1991, detailed plans were revealed for upgrading the railroads through the use of heavier rails of higher

tensile strength, welded rails, and prestressed concrete sleepers to improve track structure. Modern electronic devices would improve reliability of signals and telecommunications. In addition, locomotives would be upgraded to higher horsepower and greater fuel efficiency, coaches would be of lighter weight and have greater speed potential, and freight cars would be constructed of a better payload-to-weight ratio.

The country has about 16,200 km of inland waterways, with 3,630 km navigable by large vessels. Principal seaports are Bombay, Calcutta, Cochin, Kandla, Madras, New Mangalore, and Port Blair in the Andaman Islands, with a newer port at Visakhapatnam growing rapidly and showing signs of becoming India's most active port in the next 5 to 10 years. Cochin port has endured labor problems and suffered losses of traffic to other ports. Madras port has recently earned a reputation as the cleanest and most efficient port in India. India has a total of 345 airports, 292 presently usable. Of these, 202 have paved runways, 2 of them with runways 2,440 m to 3,659 m long, and 91 of them with runways 1,220 m to 2,439 m in length. Air service utilizes about 93 large transport aircraft.

The electric power system has a present capacity of about 65,000 MW. Some of its major industrial on-site capacity is dedicated to specific plants, particularly in the copper and aluminum sectors. By the year 2000, India plans to have an installed capacity of 10,000 MW of nuclear power. Total production of public-sector power in 1988 was 221 billion kW•h versus a demand of 238 billion kW•h.

Pipelines, relatively new to India, consist of 3,497 km for petroleum crude, 1,703 km for refined products, and 902 km for natural gas, totaling 6,102 km in all. Pipelines are undergoing further development and expansion as new routes and terminals are being proposed with increasing urgency.

OUTLOOK

India entered what showed signs of becoming a period of political instability as various ideological entities vied for election, mostly to earn only pluralities rather than commanding majorities. The socialist mindset of the Nehru era contended with proponents of free enterprise wanting fewer restrictions on entrepreneurial venturing and development, all with a rich mixture of religious and caste distinctions that made for what the world has come to know as the Indian style of government. Meanwhile, the country has steadily increasing population, expectations of social progress, and desire for an improved quality of life. Against this background, India was short of electric power and increasingly short of petroleum products. Demand for virtually all mineral commodities increased steadily and, for some, greatly exceeded supply. The country has benefited from widespread mineral exploration within a very complex variety of geological terrains. The promise of additional mineral wealth awaits further, and increasingly sophisticated, search. Shortfalls in the supply of mineral commodities, such as in ores of copper, gold, and nickel; and industrial fertilizer minerals such as phosphate, potash, and petroleum, can be paid for with the production of minerals with which India is endowed, such as bauxite, chromite, iron ore, and manganese among the metals; gemstones, granite, graphite, mica, and talc among the industrial minerals; and coal, to name a few. But India's formidable and confusing plexus of trade regulations and restrictions, including virtually senseless tariff schedules, will defeat the kind of trade relations that the country will increasingly need if it is to survive and progress.

¹Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs24.70=US\$1.00.

OTHER SOURCES OF INFORMATION

Agencies

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Ministry of Steel and Mines
27 Jawaharlal Nehru
Calcutta 700 016, India

Indian Bureau of Mines
New Secretariat Building
Nagpur 440 001, India
National Mineral Development Corp.
Hyderabad 500 004, India

Oil and Natural Gas Commission
Bombay Offshore Project
12 Floor, Express Towers, Nariman Point
Bombay 400 021, India

Oil India Limited (OIL)
Allabad Bank Building
17 Parliament Street
New Delhi 110 001, India

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TABLE 1
INDIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³	
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	2,779	3,961	4,768	*4,852	4,738
Alumina, Al ₂ O ₃ equivalent	do.	425	776	1,947	1,601	1,700
Metal, primary		265,000	375,000	423,400	433,270	50,400
Cadmium metal		214	237	275	277	207
Chromium: Chromite, gross weight		623,591	820,863	1,002,659	939,000	994,674
Copper:						
Mine output, Cu content		56,529	55,429	57,376	*58,200	55,380
Metal, primary:						
Smelter		32,923	44,284	42,456	40,667	47,000
Refinery:						
Electrolytic (cathode)		30,027	38,914	41,041	40,598	45,000
Fire refined		780	1,186	802	*1,000	*1,000
Total		30,807	40,100	41,843	41,598	46,000
Gold metal, smelter	kilograms	1,864	1,942	1,827	1,983	2,095
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	51,018	49,961	53,418	*54,579	56,915
Iron content	do.	31,937	31,226	33,440	*34,200	35,600
Metal:						
Pig iron	do.	10,893	11,735	12,080	*12,600	14,180
Ferrous alloys:						
Ferromanganese		93,944	140,262	135,000	122,000	128,000
Ferromanganese		173,259	138,331	*157,776	*201,194	197,000
Ferrosilicon		12,321	2,769	11,384	*7,000	8,800
Ferrosilicon		50,747	46,721	*74,472	*64,035	52,100
Silicomanganese		37,504	52,895	*72,229	*57,361	61,600
Silicon metal		1,445	686	—	—	—
Other		529	445	386	*400	*450
Steel, crude:						
Steel ingots	thousand tons	12,605	12,682	12,452	*14,000	15,100
Steel castings	do.	278	340	330	*350	*400
Total	do.	12,883	13,022	12,782	*14,350	*15,500
Semimanufactures ³	do.	8,600	9,501	9,241	*10,50	*11,600
Lead:						
Mine output, Pb content		*26,900	*21,677	*24,300	*23,220	25,000
Metal, refined:						
Primary		20,669	18,833	21,260	24,747	33,140
Secondary		12,126	9,889	13,469	14,090	20,260
Total		32,795	28,722	34,729	38,837	53,400
Manganese:						
Ore and concentrate, gross weight	thousand tons	1,302	1,333	1,334	1,385	1,401
Mn content		484,865	493,058	496,861	512,000	630,450
Rare-earth metals: Monazite concentrate, gross weight ³		4,000	4,000	4,300	4,500	4,000
Selenium	kilograms	4,026	5,103	4,261	3,840	*3,500

See footnotes at end of table.

TABLE 1—Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
METALS—Continued					
Silver, mine and smelter output kilograms	37,946	40,958	35,499	33,206	34,539
Titanium concentrates, gross weight:					
Ilmenite	*214,750	*229,693	*240,656	*280,000	311,537
Rutile	*8,470	*9,584	*9,931	*11,000	13,635
Tungsten, mine output, W content	26	19	12	*10	11
Zinc:					
Mine output, concentrate:					
Gross weight	104,809	118,056	127,043	137,649	163,474
Zn content	54,500	61,389	65,384	*73,970	85,000
Metal:					
Primary	68,899	68,940	71,572	79,093	104,950
Secondary*	200	200	200	200	200
Total*	69,099	69,140	71,772	79,293	105,150
Zirconium concentrate: Zircon, gross weight*	16,000	16,000	17,200	*17,500	17,500
INDUSTRIAL MINERALS					
Abrasives, natural, n.e.s.:					
Corundum, natural	469	669	254	410	64
Garnet	*6,699	4,311	5,652	4,422	8,984
Jasper	4,407	3,915	5,535	*4,650	5,013
Asbestos	29,110	31,123	37,894	*26,053	28,479
Barite	247,000	445,604	553,000	*633,000	615,000
Bromine, elemental	1,182	1,242	1,272	*1,300	*1,300
Cement, hydraulic thousand tons	36,980	40,700	4,600	49,000	51,000
Chalk	101,641	109,782	119,000	128,000	128,424
Clays:					
Ball clay	279,912	330,126	266,000	245,000	316,522
Diaspore	11,018	10,901	15,301	7,701	9,248
Fire clay	634,000	596,835	618,000	445,000	477,881
Kaolin:					
Direct salable, crude thousand tons	602	471	520	516	632
Processed do.	94	107	110	104	113
Total do.	696	578	630	620	745
Other* do.	100	100	100	100	14
Diamond:*					
Gem thousand carats	16	11	12	15	19
Industrial do.	3	3	3	3	3
Total do.	19	14	15	18	22
Feldspar	49,663	57,656	59,000	*54,135	65,089
Fluorspar:					
Concentrates:					
Acid-grade	*10,135	8,823	10,300	*10,399	9,700
Metallurgical-grade	*5,580	6,772	12,589	*13,042	14,439
Total	*15,715	15,595	22,889	*23,441	24,139
Other fluorspar materials, graded	5,790	4,797	5,176	*3,900	6,357
Gemstones excluding diamond:					
Agate including chalcedony pebble	752	812	788	631	549

See footnotes at end of table.

TABLE 1—Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
INDUSTRIAL MINERALS—Continued					
Gemstones excluding diamond—Continued:					
Garnet kilograms	2,007	1,390	2,483	2,005	1,187
Graphite ⁵	42,589	57,325	58,000	61,000	69,922
Gypsum	1,733,720	1,424,674	1,564,000	1,657,000	1,563,065
Kyanite and related materials:					
Andalusite	122	—	—	—	—
Kyanite	39,959	35,773	40,009	38,313	23,742
Sillimanite	12,756	15,377	17,398	17,072	11,600
Lime ⁶	700,000	750,000	790,000	800,000	820,000
Magnesite	430,000	507,873	491,000	544,000	534,379
Mica:⁴					
Crude	4,240	3,839	4,195	3,860	3,607
Scrap and waste	6,307	3,694	3,108	2,822	1,922
Total	10,547	7,533	7,303	6,682	5,529
Nitrogen: N content of ammonia ⁷ thousand tons	5,300	6,205	6,661	7,022	7,200
Phosphate rock including apatite	679,419	739,000	703,716	659,000	562,771
Pigments, mineral: Natural: Ocher	145,245	151,781	173,366	*126,387	155,563
Pyrites, gross weight	36,000	29,656	38,867	*40,000	*42,000
Salt:					
Rock salt thousand tons	1	4	3	*3	3
Other do.	9,900	*9,200	*9,600	*9,500	*9,500
Total do.	9,901	*9,204	*9,603	*9,503	*9,503
Sodium carbonate	969,600	1,098,200	1,343,500	*1,400,000	*1,500,000
Stone, sand and gravel:⁸					
Calcite	37,194	32,951	40,326	55,000	90,236
Dolomite thousand tons	2,233	2,211	2,417	2,505	2,459
Limestone do.	57,170	62,998	64,032	66,931	73,268
Quartz and quartzite do.	299	305	326	285	251
Sand:					
Calcareous do.	147	63	106	175	136
Silica do.	1,016	1,606	1,239	1,139	1,924
Other do.	3,639	1,195	1,242	*1,300	1,652
Slate	6,637	7,732	*25,963	*39,563	23,578
Sulfur:					
Content of pyrites	*35,889	*29,656	*38,867	*35,000	35,000
Byproduct:					
From metallurgical plants ⁹	120,000	125,000	125,000	125,000	130,000
From oil refineries	*7,953	*10,420	*10,200	*10,315	12,261
Total ⁹	*163,842	*165,076	*174,067	*170,315	177,261
Talc and related materials:					
Pyrophyllite	51,724	64,923	93,000	80,000	84,557
Steatite (soapstone)	359,448	417,493	414,286	*416,000	406,479
Vermiculite	2,439	4,052	3,075	1,769	1,768
Wollastonite	31,021	34,286	44,042	61,386	61,358

See footnotes at end of table.

TABLE 1—Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³	
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	thousand tons	177,220	189,000	199,000	213,000	224,699
Lignite	do.	8,311	12,600	13,400	14,000	15,150
Total	do.	185,531	201,600	212,400	227,000	239,849
Coke:⁴						
Coke oven and beehive	do.	13,000	13,000	13,000	13,000	13,000
Gashouse	do.	100	100	100	100	100
Other, soft	do.	200	200	200	200	200
Total	do.	13,300	13,300	13,300	13,300	13,300
Gas, natural:						
Gross	million cubic meters	*9,918	8,813	10,493	10,245	11,744
Marketable ⁵	do.	6,338	7,457	6,700	*6,560	*7,500
Petroleum:						
Crude	thousand 42-gallon barrels	220,929	230,680	250,700	227,800	232,900
Refinery products:						
Liquefied petroleum gas	do.	18,130	19,905	*20,500	*20,000	*20,000
Gasoline	do.	22,585	22,950	*23,200	*23,000	*23,000
Kerosene and jet fuel	do.	54,152	53,697	*54,000	*53,000	*53,000
Distillate fuel oil	do.	122,777	122,337	*123,000	*122,000	*122,000
Residual fuel oil	do.	57,416	56,803	*57,200	*56,000	*56,000
Lubricants	do.	3,549	4,039	*4,100	*4,000	*4,000
Other	do.	66,201	67,286	*68,000	*67,000	*67,000
Total	do.	344,810	347,017	*350,000	*345,000	*345,000

*Estimated. *Preliminary. *Revised.

¹Table includes data available through Nov. 20, 1992.

²In addition to commodities listed, other clays (bentonite, common clays, and fuller's earth), other gemstones (aquamarine, emerald, ruby, and spinel), and uranium are produced but output is not reported, and available information is inadequate to make reliable estimates of output levels. Reported production of sand and gravel and stone are clearly only partial figures and exclude a number of types of stone; the amounts reported are inadequate to provide sufficient aggregate for production of concrete from domestically produced and consumed cement, nor do they provide for other supplies of aggregate for road metal and other construction uses.

³Excludes production from steel miniplants.

⁴Official Indian Bureau of Mines figure is believed to be production from Government-owned operations. Private Indian production brings 1987 total to more than 20,000 tons.

⁵India's marketable production is 10% to 20% of mine production.

⁶The disparity between amounts of mica produced versus amounts exported is based on (a) stockpile, (b) illicit mines, and (c) occasional mining by others seeking additions to income nominally derived from other sources.

⁷Data are fiscal year beginning Apr. 1 of that stated.

⁸Partial figures; for details, see footnote 2.

⁹Includes reinjected gas.

TABLE 2
INDIA: EXPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	85,148	147,402	—	United Arab Emirates 112,742; Saudi Arabia 18,081; Romania 15,900.
Oxides and hydroxides	39,756	7,014	—	U.S.S.R. 6,386; Japan 446; Singapore 99.
Metal including alloys, all forms	7,173	4,594	292	Bangladesh 1,287; Sri Lanka 675; United Kingdom 621.
Chromium:				
Ore and concentrate	119,084	185,196	—	China 88,020; Japan 52,275; Philippines 33,900
Metal including alloys, all forms	6,001	1	—	Mainly to United Arab Emirates.
Copper:				
Ore and concentrate	7,900	18,000	—	Mainly to Taiwan.
Metal including alloys, all forms	337	1,863	347	France 1,000; Hong Kong 135.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	thousand tons	28,226	29,410	— Japan 20,434; Republic of Korea 2,771; Romania 2,101.
Metal:				
Scrap	37,969	33,577	—	Mainly to Philippines.
Pig iron, cast iron, related materials	449	606	211	Saudi Arabia 179; Nepal 90; Kenya 69.
Ferroalloys:				
Ferromanganese	—	1,614	—	East Germany 1,575; Yemen 36.
Ferrosilicon	18	—	—	
Silicon metal	20	8	—	Taiwan 7; Spain 1.
Unspecified	—	76,011	—	Japan 64,855; West Germany 8,075; Netherlands 3,080.
Steel, primary forms	86,844	77,434	34,630	Australia 6,755; United Kingdom 4,691; Saudi Arabia 4,491.
Lead: Metal including alloys, all forms	207	94	—	United Arab Emirates 49; United Kingdom 39; Sri Lanka 5.
Magnesium: Metal including alloys, all forms	120	—	—	
Manganese:				
Ore and concentrate, metallurgical-grade	221,918	225,781	—	Republic of Korea 108,008; Japan 100,962; Romania 16,500.
Oxides	10	582	—	Taiwan 505; Bangladesh 34; Nepal 25.
Nickel: Metal including alloys, all forms	1	246	216	Kuwait 10; United Arab Emirates 9; Japan 8.
Silver: Metal including alloys, unwrought and partly wrought	kilograms	5,540	7,545	— U.S.S.R. 7,519.
Tin: Metal including alloys, all forms	79	561	—	United Arab Emirates 500; West Germany 30; Mauritius 10.
Titanium: Ore and concentrate	14,605	42,532	—	Malaysia 25,022; United Kingdom 12,500.
Tungsten: Metal including alloys, all forms	4	20	—	West Germany 15; Bangladesh 4.
Vanadium: Ore and concentrate ³	100	25,200	—	Japan 15,751; West Germany 9,000; Netherlands 236.
Zinc: Metal including alloys, all forms	39	231	—	Sudan 193; Sweden 14; Sri Lanka 11.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	589	1,046	7	Bangladesh 538; Thailand 327; Japan 76.
Silicon carbide	—	118	—	Netherlands 100; Australia 18.
Asbestos, crude	34	12	—	West Germany 5; Sri Lanka 5.

See footnotes at end of table.

TABLE 2—Continued
INDIA: EXPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Barite and witherite	25,614	123,454	36,534	United Arab Emirates 30,879; U.S.S.R. 19,500; Oman 14,830.	
Baron materials:					
Sodium borate	486	494	—	Sri Lanka 430; Singapore 49.	
Oxides and acids	62	26	—	Sri Lanka 15; Bangladesh 10.	
Cement	26,817	962	—	Mainly to Nepal.	
Chalk	395	137	—	Bangladesh 103; Oman 18; United Arab Emirates 10.	
Clays, crude:					
Bentonite	6,843	39,312	—	Canada 22,000; Oman 5,716; Malaysia 4,270.	
Fire clay	369	2,076	—	Bangladesh 1,750; Kenya 308.	
Fuller's earth	125	148	—	United Arab Emirates 60; Saudi Arabia 40; Sri Lanka 30.	
Kaolin	5,715	16,638	—	Poland 8,669; Bangladesh 7,753.	
Ball clay	611	488	NA	NA.	
Unspecified	89	1	—	Mainly to Kenya.	
Cryolite and chiolite	—	36	NA	NA.	
Diamond: Natural:					
Gem, not set or strung	value, thousands	\$1,541,468	\$1,895,904	\$772,239	Japan \$370,029; Belgium-Luxembourg \$275,107.
Industrial stones	do.	\$47	\$274	—	Belgium-Luxembourg \$120; United Kingdom \$49; Hong Kong \$34.
Feldspar	20,033	44,811	—	Taiwan 23,273; Malaysia 14,094; Indonesia 2,276.	
Graphite, natural	1,028	312	18	Japan 178; Malaysia 35; United Kingdom 17.	
Gypsum and plaster	724	5,879	—	United Arab Emirates 5,522; Sri Lanka 255; Singapore 15.	
Kyanite and related materials: Sillimanite	19	9,054	NA	NA.	
Magnesium compounds: Oxides and hydroxides	2,192	1,832	—	United Kingdom 732; Japan 594; Bangladesh 415.	
Mica:					
Crude including splittings and waste	19,868	13,532	2,364	Belgium-Luxembourg 3,313; U.S.S.R. 2,346; Japan 1,646.	
Worked including agglomerated splittings	18,476	24,562	3,251	West Germany 8,217; Japan 3,588; United Kingdom 2,739.	
Phosphorus, elemental	192	165	91	Mexico 21; Republic of Korea 19; Egypt 18.	
Pigments, mineral:					
Natural, crude	115	429	—	Kenya 312; Bangladesh 67; Malaysia 21.	
Iron oxides and hydroxides, processed	5,029	5,571	—	United Kingdom 1,112; Philippines 907; Kenya 455.	
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	\$11,050	\$12,980	—	United Arab Emirates \$12,125; Hong Kong \$4,067.
Other	do.	\$20,093	\$17,922	\$6,513	Hong Kong \$2,131; Japan \$1,650.
Salt and brine	19,698	43,932	—	Malaysia 18,000; North Korea 8,100; Nepal 6,198.	
Sodium compounds, n.e.s.: Soda ash, manufactured					
	402	319	NA	NA.	
Stone, sand and gravel:					
Dimension stone, all forms	422,271	610,106	29,018	Japan 222,333; Italy 170,100; Netherlands 72,386.	
Dolomite, chiefly refractory-grade	7,569	3,175	—	Bangladesh 2,375; Saudi Arabia 400; United Arab Emirates 400.	
Limestone other than dimension	213,553	258,326	580	Bangladesh 256,584; Sri Lanka 686.	

See footnotes at end of table.

TABLE 2—Continued
INDIA: EXPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued:				
Quartz and quartzite	67,689	69,136	—	Japan 66,210; Bangladesh 2,332.
Sand:				
Other than metal-bearing	390	15,751	—	United Kingdom 13,000; Japan 2,478; United Arab Emirates 83.
Silica sand	2,960	2,926	—	United Arab Emirates 2,608; Yemen 200; Oman 100.
Sulfur: Elemental: Crude including native and byproduct	2	94	NA	NA.
Talc, steatite, soapstone, pyrophyllite	12,340	23,331	—	Bangladesh 6,724; Kenya 4,119; Austria 3,500.
Vermiculite	2,274	1,047	—	United Arab Emirates 345; Saudi Arabia 238; Taiwan 234.
MINERAL FUELS AND RELATED MATERIALS				
Coal, all grades including briquets				
thousand tons	102	150	—	Bangladesh 87; Nepal 63.
Coke and semicoke	6,551	6,549	—	Nepal 6,449; Bangladesh 50; Malaysia 50.
Petroleum refinery products:⁴				
Light distillates:				
Naphtha	thousand 42-gallon barrels	18,870	22,253	NA NA.
Other	do.	145	162	NA NA.
Middle distillates	do.	1,149	1,313	NA NA.
Heavy ends	do.	666	3,989	NA NA.

¹Revised. NA Not available.

²Table prepared by Audrey D. Wilkes.

³Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1991.

⁴May include other unspecified ores.

⁵Defined as provided in data source.

TABLE 3
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	—	57	—	Japan 35; Malaysia 20; Hungary 2.
Oxides and hydroxides	1,196	2,585	163	West Germany 681; Netherlands 631; China 517.
Metal including alloys, all forms	118,431	78,501	—	Norway 16,483; Brazil 12,464; Bahrain 11,313.
Antimony:				
Ore and concentrate	232	252	NA	NA.
Metal including alloys, all forms	949	820	—	China 665; Taiwan 64; Singapore 50.
Beryllium including bismuth				
	—	176	18	Australia 104; Burma 53.
Cadmium: Metal including alloys, all forms				
	50	106	—	Australia 77; West Germany 22; China 6.
Chromium:				
Ore and concentrate	18,496	15	—	All from Belgium-Luxembourg.
Metal including alloys, all forms	52	34	2	United Kingdom 21; Japan 7.
Cobalt: Metal including alloys, all forms				
	244	135	4	Zambia 58; Zaire 41.
Columbium and tantalum: Tantalum metal including alloys, all forms				
	—	1	—	NA.
Copper:				
Ore and concentrate	56	12	NA	NA.
Matte including cement copper	—	1	NA	NA.
Metal including alloys, all forms	114,573	136,358	5,545	Zambia 50,407; Zaire 28,649; Singapore 10,182.
Iron and steel:				
Ore and concentrate	50,767	26,000	NA	NA.
Metal:				
Scrap	2,103,291	1,870,497	981,999	Netherlands 262,726; West Germany 262,503.
Pig iron, cast iron, related materials	44,810	87,322	2,143	China 41,894; Brazil 17,720; Taiwan 17,377.
Ferroalloys:				
Ferrochromium	4,600	828	—	Zimbabwe 745; Japan 70; Switzerland 7.
Ferromanganese	109	157	35	Spain 94; Netherlands 19.
Ferromolybdenum	5	106	—	United Kingdom 45; Belgium-Luxembourg 31; Austria 30.
Ferronickel	29,854	55,370	192	Colombia 39,684; France 4,361; New Caledonia 3,402.
Ferrosilicomanganese	158	84	—	West Germany 32, France 27; Japan 25.
Ferrosilicon	7,342	442	—	Brazil 153; United Kingdom 112; West Germany 75.
Silicon metal	2,291	2,837	—	China 1,313; Hong Kong 374; Sweden 240.
Unspecified	1,293	380	12	Brazil 201; West Germany 41.
Steel, primary forms	3,048,340	2,142,730	29,630	Japan 659,068; West Germany 369,032; United Kingdom 221,439.
Lead:				
Ore and concentrate	6,062	8,607	—	Iran 4,860; Thailand 3,662; Morocco 75.
Metal including alloys, all forms	52,804	40,458	19	Australia 34,307; Saudi Arabia 1,318.
Magnesium: Metal including alloys, all forms				
	633	1,540	127	Norway 846; Singapore 198.
Manganese:				
Ore and concentrate	3,984	1,152	42	Gabon 400; Singapore 350; Brazil 341.
Oxides	350	650	22	Japan 389; Singapore 220.
Metal including alloys, all forms	130	520	52	China 237; Taiwan 109.

See footnotes at end of table.

TABLE 3—Continued
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88	
			United States	Other (principal)
METALS—Continued				
Mercury	287	238	—	China 94; Finland 43; Spain 35.
Molybdenum: Metal including alloys, all forms	4	2	1	United Kingdom 1.
Nickel:				
Ore and concentrate	1,155	3,936	—	Canada 1,073; Australia 932; Cuba 875.
Metal including alloys, all forms	7,168	7,172	—	U.S.S.R. 2,129; Australia 942; Canada 933.
Platinum-group metals: Metals including alloys, unwrought and partly wrought				
kilograms	202	151	1	U.S.S.R. 120; United Kingdom 30.
Selenium, elemental	13	23	1	Japan 14; Finland 3; Bulgaria 2.
Silver: Metal including alloys, unwrought and partly wrought				
kilograms	106	3,506	353	United Kingdom 2,669; France 383.
Tin:				
Ore and concentrate	—	221	—	China 166; Singapore 41; Nigeria 14.
Metal including alloys, all forms	12,274	5,730	1,048	United Kingdom 892; Belgium-Luxembourg 564.
Titanium:				
Ore and concentrate	4	309	NA	Sri Lanka 205.
Oxides	12,103	2,242	789	United Kingdom 544; West Germany 356; France 230.
Tungsten:				
Ore and concentrate	360	343	—	Singapore 78; Thailand 69; Burma 48.
Metal including alloys, all forms	36	68	9	West Germany 45; Japan 6.
Vanadium: Ore and concentrate ³	763	2,784	218	Canada 1,075; United Kingdom 311; Australia 223.
Zinc:				
Ore and concentrate	19,714	10,935	—	All from Peru.
Metal including alloys, all forms	64,510	95,613	1,083	U.S.S.R. 18,104; Australia 13,122; Spain 9,975.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	—	56	—	Hong Kong 53; United Kingdom 3.
Silicon carbide	116	66	3	United Kingdom 46; West Germany 14; U.S.S.R. 2.
Asbestos, crude	72,942	75,703	—	Canada 26,000; Brazil 21,014; U.S.S.R. 14,672.
Boron materials:				
Crude natural borates ⁴	20,557	18,065	11,066	Turkey 6,919; unspecified 80.
Oxides and acids	6	1	NA	NA.
Cement	230,602	19,861	7,751	United Arab Emirates 7,897; Denmark 2,209; Republic of Korea 2,000.
Chalk	—	1	NA	NA.
Clays, crude:				
Bentonite	46	53	19	West Germany 28; United Kingdom 6.
Fire clay	—	155	NA	NA.
Fuller's earth	NA	299	18	West Germany 272; Republic of Korea 9.
Kaolin	111	99	34	United Kingdom 57; West Germany 6.
Ball clay	1,445	1,951	—	United Kingdom 1,020; Japan 332; West Germany 330.
Cryolite and chiolite	260	—	—	—

See footnotes at end of table.

TABLE 3—Continued
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88		
			United States	Other (principal)	
METALS—Continued					
Diamond:					
Gem, not set or strung	value, thousands	\$1,141,324	\$1,510,229	—	Belgium-Luxembourg \$855,734; United Kingdom \$539,077; Israel \$65,643.
Industrial stones	do.	\$427	\$245	\$79	Belgium-Luxembourg \$127; United Kingdom \$13.
Diatomite and other infusorial earth		158	534	510	Spain 23.
Feldspar		—	181	2	Taiwan 106; China 33; Thailand 20.
Fertilizer materials: Manufactured:					
Phosphatic		255,162	—	—	
Potassic		1,176,470	1,045,908	—	Jordan 351,377; East Germany 323,654; West Germany 287,329.
Fluorspar		24,921	19,431	—	Taiwan 17,657; China 1,302; Thailand 368.
Graphite, natural		388	422	62	Sri Lanka 265; Japan 42; West Germany 33.
Gypsum and plaster		509	42	42	
Kyanite and related material		5	87	NA	NA.
Magnesium compounds:					
Magnesite, crude, including calcined		121	6,533	10	Brazil 5,150; Turkey 1,002; Austria 250.
Oxides and hydroxides		31,200	30,272	13	Japan 8,247; Taiwan 7,327; Israel 4,228.
Mica:					
Crude including splittings and waste		—	4	—	NA.
Worked including agglomerated splittings		75	57	2	Austria 21; West Germany 11; U.S.S.R. 10.
Phosphates, crude	thousand tons	2,034	1,819	376	Jordan 965; Morocco 225; Senegal 158.
Phosphorus, elemental		534	232	1	China 176; Taiwan 55.
Pigments, mineral:					
Natural, crude		—	1	NA	NA.
Iron oxides and hydroxides, processed		18	1	NA	NA.
Potassium salts, crude		89,316	—		
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	\$18,062	\$32,920	\$17,227	Switzerland \$4,615; West Germany \$4,372.
Other	do.	\$13,132	\$5,468	\$1,714	West Germany \$1,178; Brazil \$1,141.
Salt and brine		13,539	11,081	—	Pakistan 10,996; unspecified 85.
Sodium compounds, n.e.s.: Soda ash		13,769	21,672	—	Bulgaria 12,159; Poland 7,639; U.S.S.R. 1,000.
Stone, sand and gravel:					
Dimension stone, all forms		444	2,315	NA	Italy 1,136; Nepal 426.
Limestone other than dimension		43,717	108,590	—	United Arab Emirates 86,214; Japan 22,346.
Quartz and quartzite	value, thousands	\$9	\$24	\$22	West Germany \$1.
Sand:					
Other than metal-bearing		2,788	1,588	61	Australia 1,411; United Kingdom 51.
Silica sand		245	98	10	Belgium-Luxembourg 60; West Germany 28.
Sulfur: Elemental:					
Crude including native and byproduct		1,067,140	1,148,785	70,433	Saudi Arabia 499,625; Canada 142,932; Poland 133,507.
Colloidal, precipitated, sublimed		159	501	351	West Germany 150.
Talc, steatite, soapstone, pyrophyllite		114	454	—	Nepal 220; Poland 134; United Kingdom 65.

See footnotes at end of table.

TABLE 3—Continued
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1986-87	1987-88	Destinations, 1987-88	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued:				
Coal, all grades including briquets				
thousand tons	2,347	2,861	—	Australia 2,844; Japan 16.
Coke and semicoke	200,533	107,773	—	Australia 90,741; Japan 16,894.
Petroleum, crude thousand 42-gallon barrels	113,753	132,737	—	United Arab Emirates 31,329; U.S.S.R. 28,055; Iraq 25,035.

NA Not available.

¹Table prepared by Audrey D. Wilms.

²Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1991.

³May include other unspecified ores.

⁴Includes "sodium borate" and "other borates."

TABLE 4
INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Capacity
Aluminum:			
Bauxite	Bharat Aluminium Co. Ltd.	Manla, Madhya Pradesh	200
Do.	do.	Bilaspur, Madhya Pradesh	600
Do.	Bombay Mineral Supply Co. (Pvt.) Ltd.	Jamnagar, Gujarat	150
Do.	Hindustan Aluminium Co. Ltd.	Ranchi, Bihar	300
Do.	do.	Shandol, Madhya Pradesh	300
Do.	Indian Aluminium Co. Ltd.	Kalharapur, Maharashtra	250
Do.	do.	Ranchi, Bihar	250
Do.	Madras Aluminium Co. Ltd.	Salem, Tamil Nadu	150
Do.	Minerals & Minerals Ltd.	Ranchi, Bihar	200
Do.	National Aluminium Co. Ltd.	Panchpatmali, Orissa	2,400
Metal	Bharat Aluminium Co. Ltd.	Korba, Madhya Pradesh	100
Do.	Hindalco Aluminium Co. Ltd.	Renukoot, Uttar Pradesh	150
Do.	Indian Aluminium Co. Ltd.	Alipuram, Kerala	20
Do.	do.	Belgaum, Karnataka	73
Do.	do.	Hirakud, Orissa	24
Do.	Madras Aluminium Co. Ltd.	Metturdam, Tamil Nadu	25
Do.	National Aluminium Co. Ltd.	Angul, Dhenkanal District, Orissa	218
Barite	Andhra Pradesh Mining Corp. Ltd.	Mangampet, Cuddapah District, Andhra Pradesh	350
Do.	C.M. Ramanatha Reddy	Kodur, Anantapur District, Andhra Pradesh	75
Do.	K. Obul Reddy (Pvt.) Ltd.	Cuddapah District, Andhra Pradesh	25
Do.	Pragathi Minerals (Pvt.) Ltd.	Kodur, Anantapur District, Andhra Pradesh	50
Do.	Vijayalaxmi Minerals Trading Co.	do.	50
Cement:			
Public sector	Bihar State Industrial Development Corp.	Rohtas-Palaman, Bihar	760
Do.	Cement Corp. of India Ltd.	Jagdapur, Madhya Pradesh	1,000
Do.	do.	Tandur, Hyderabad District, Andhra Pradesh	1,000
Do.	do.	Yerraguntia, Cuddapah District, Andhra Pradesh	1,120
Do.	Hindustan Steel Ltd.	Rourkela, Orissa	2,140
Do.	Uttar Pradesh State Cement Corp.	Chunar, Uttar Pradesh	840
Private sector	Associated Cement Co. Ltd.	Shahabad, Karnataka	1,076
Do.	Century Spring & Manufacturing Co.	Chandrapur, Maharashtra	1,000
Do.	Coromandel Fertilizers	Kalamalla, Cuddapah District, Andhra Pradesh	1,000
Do.	Jaypee Rewa Cement Ltd.	Rewa, Madhya Pradesh	1,000
Do.	Larsen & Toubro Ltd.	Chandrapur, Maharashtra	1,109
Do.	Modi Cement Ltd.	Bhatapure, Madhya Pradesh	1,000
Do.	Rajasthan Manufacturing & Weaving Mills Ltd.	Bhilwara, Rajasthan	1,042
Do.	Shree Cement Ltd.	Bewar, Ajmer District, Rajasthan	1,200
Chromite	Ferro Alloys Corp. Ltd.	Keonjhar District, Orissa	75
Do.	do.	Dhenkanal District, Orissa	75
Do.	Mysore Minerals Ltd.	Hassan District, Karnataka	125
Do.	Orissa Mining Corp.	Cuttack District, Orissa	200
Do.	do.	Dhenkanal District, Orissa	200
Do.	do.	Keonjhar District, Orissa	100
Do.	Tata Iron & Steel Co. Ltd.	Cuttack District, Orissa	100

See footnotes at end of table.

TABLE 4—Continued
INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Capacity
Coal:			
Bituminous	Coal India Ltd:		
Do.	Bharat Coking Coal Ltd.	105 mines in Bihar, Orissa, and Uttar Pradesh	
Do.	Eastern Coalfields Ltd.	187 mines in Bihar and West Bengal	
Do.	Northern Coalfields Ltd.	61 mines in Madhya Pradesh and Uttar Pradesh	
Do.	Southeastern Coalfields Ltd.	44 mines in Andhra Pradesh and Orissa	160,000
Do.	Western Coalfields Ltd.	55 mines in Madhya Pradesh, Maharashtra, and Orissa	
Lignite	Neyveli Lignite Corp.	Neyveli, Tamil Nadu	8,000
Copper:			
Ore	Hindustan Copper Ltd.	Khetri copper complex, Jhunjhunu District, Rajasthan:	
Do.	do.	Khetri Mine	825
Do.	do.	Kolihan Mine	825
Do.	do.	Chandmari Mine	330
Do.	do.	Indian copper complex, Singhbhum District, Bihar:	
Do.	do.	Mosabani Mine	
Do.	do.	Pathargora Mine	
Do.	do.	Surda Mine	1,800
Do.	do.	Kendadih Mine	
Do.	do.	Rakha Mine	
Do.	do.	Malanjhand, Balaghar District, Madhya Pradesh	2,000
Metal	do.	Khetri smelter, Rajasthan	31
Do.	do.	Maubhandar smelter, Ghatsila District, Bihar	20
Iron:			
Ore and concentrate	Chowgule & Co. Pvt. Ltd.	Goa	
Do.	Dempo Mining Corp. Ltd.	do.	7,000
Do.	V.M. Salgaocar & Bros. Pvt. Ltd.	do.	—
Do.	Indian Iron & Steel Co. Ltd.	Singhbhum District, Bihar	2,500
Do.	Kudremukh Iron Ore Co. Ltd.	Chikmagalur District, Karnataka	7,500
Do.	National Mineral Development Corp. Ltd.	Bellary District, Karnataka	3,000
Do.	Steel Authority of India Ltd.	Singhbhum District, Bihar	3,500
Do.	do.	Bastar and Durg District, Madhya Pradesh	7,000
Do.	do.	Keonjhar District, Orissa	3,000
Do.	Tata Iron & Steel Co. Ltd.	Singhbhum District, Bihar	3,500
Do.	do.	Keonjhar District, Orissa	2,000
Steel, primary	Steel Authority of India, Ltd.	Bhilai, Durg District, Madhya Pradesh	2,680
Do.	do.	Bokaro, Bihar	2,230
Do.	Tata Iron & Steel Co. Ltd.	Jamshedpur, Singhbhum District, Bihar	1,740
Do.	159 private ministeel plants	Countrywide	4,700
Kyanite	Hindustan Copper Ltd.	Lapso, Singhbhum District, Bihar	22
Do.	Maharashtra Mineral Corp. Ltd.	Bahegaon, Bhandara District, Maharashtra	—
Do.	Maharashtra State Mining Corp. Ltd.	Bhandara, Maharashtra	28
Do.	S.M. Khola	do.	—
Lead:			
Concentrate	Hindustan Zinc Ltd.	Gunter District, Andhra Pradesh	10
Concentrate	do.	Udaipur District, Rajasthan	20
Metal, primary	do.	Visakhapatnam, Andhra Pradesh	22

See footnotes at end of table.

TABLE 4—Continued
INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Capacity
Lead—Continued:			
Do.	Hindustan Zinc Ltd.	Tundoo, near Ghatsila, Bihar	8
Magnesite	Burn Standard Co. Ltd.	Salem, Tamil Nadu	
Do.	Dalmia Magnesite Corp.	do.	400
Do.	Tamil Nadu Magnesite Ltd.	do.	
Manganese ore ²	Aryan Mining & Trading Corp.	Sundargarh, Orissa	
Do.	Eastern Mining Co.	North Kanara, Karnataka	
Do.	J.A. Trivedi Bros.	Balaghat, Madhya Pradesh	
Do.	Manganese ore (India) Ltd.	Adilabad, Andhra Pradesh	
Do.	do.	Balaghat, Madhya Pradesh	
Do.	do.	Bhandara, Maharashtra	
Do.	do.	Keonjhar, Orissa	
Do.	Mangilah, Rungta (Pvt.) Ltd.	do.	
Do.	Mysore Minerals Ltd.	North Kanara, Karnataka	
Do.	do.	Shimoga, Karnataka	
Do.	Orissa Manganese & Minerals (Pvt.) Ltd.	Sundargarh, Orissa	1,500
Do.	Orissa Mineral Development Co. Ltd.	Koraput, Orissa	
Do.	Orissa Mining Corp. Ltd.	Keonjhar, Orissa	
Do.	do.	Koraput, Orissa	
Do.	R.B.S. Shreeram Durga Prasad & Falechand Marsingdas	Vizianagaram, Visakhapatnam District, Andhra Pradesh	
Do.	Rungta Mines (Pvt.) Ltd.	Keonjhar, Orissa	
Do.	Sandur Manganese & Iron Ores Ltd.	Bellary, Karnataka	
Do.	Serajuddin & Co.	Keonjhar, Orissa	
Do.	S. Lall & Co.	do.	
Do.	Tata Iron & Steel Co. Ltd.	Keonjhar, Orissa	
Do.	do.	Sundargarh, Orissa	
Phosphate rock	Hindustan Zinc Ltd.	Udaipur District, Rajasthan	
Do.	Madhya Pradesh State Mining Corp. Ltd.	Jhabua, Madhya Pradesh	
Do.	do.	Chhatarpur, Madhya Pradesh	
Do.	Pyrites Phosphates & Chemicals Ltd.	Dehra Dun, Uttar Pradesh	800
Do.	Rajasthan State Mineral Development Corp. Ltd.	Udaipur District, Rajasthan	
Do.	Rajasthan State Mines & Minerals Ltd.	do.	
Titanium, ilmenite concentrate	Kerala Minerals & Metals Ltd.	Chavara, Quilon District, Kerala	100
Do.	Indian Rare Earths Ltd.	do.	200
Do.	do.	Ganjam, Orissa, 100 km south of Dhenkanal	220
Do.	do.	Manavalakurichi, Tamil Nadu	65
Zinc:			
Concentrate	Hindustan Zinc Ltd.	Zawar, Udaipur District Rajasthan	34
Do.	do.	Rajpura-Dariba, Udaipur District, Rajasthan	42
Metal	Comindo Binani Zinc Ltd.	Binanipuram, near Alwaye, Kerala	17
Do.	Hindustan Zinc Ltd.	Debari, Udaipur District, Rajasthan	49
Do.	do.	Visakhapatnam, Andhra Pradesh	30

¹Estimated.

²The annual capacity of the five major Coal India subsidiaries was as follows: 14 mines, more than 1.0 Mmt, for 17% of capacity; 32 mines, 0.5 to 1.0 Mmt, for 17%; 80 mines, 0.3 to 0.5 Mmt, for 24%; 254 mines, 0.1 to 0.3 Mmt, for 39%; and the remaining mines, less than 0.1 Mmt.

³Capacity of clusters of surface mines varies extremely, depending on demand.

TABLE 5
INDIA: ESTIMATED RESERVES
OF MAJOR MINERAL
COMMODITIES FOR 1991

(Thousand metric tons unless
otherwise specified)

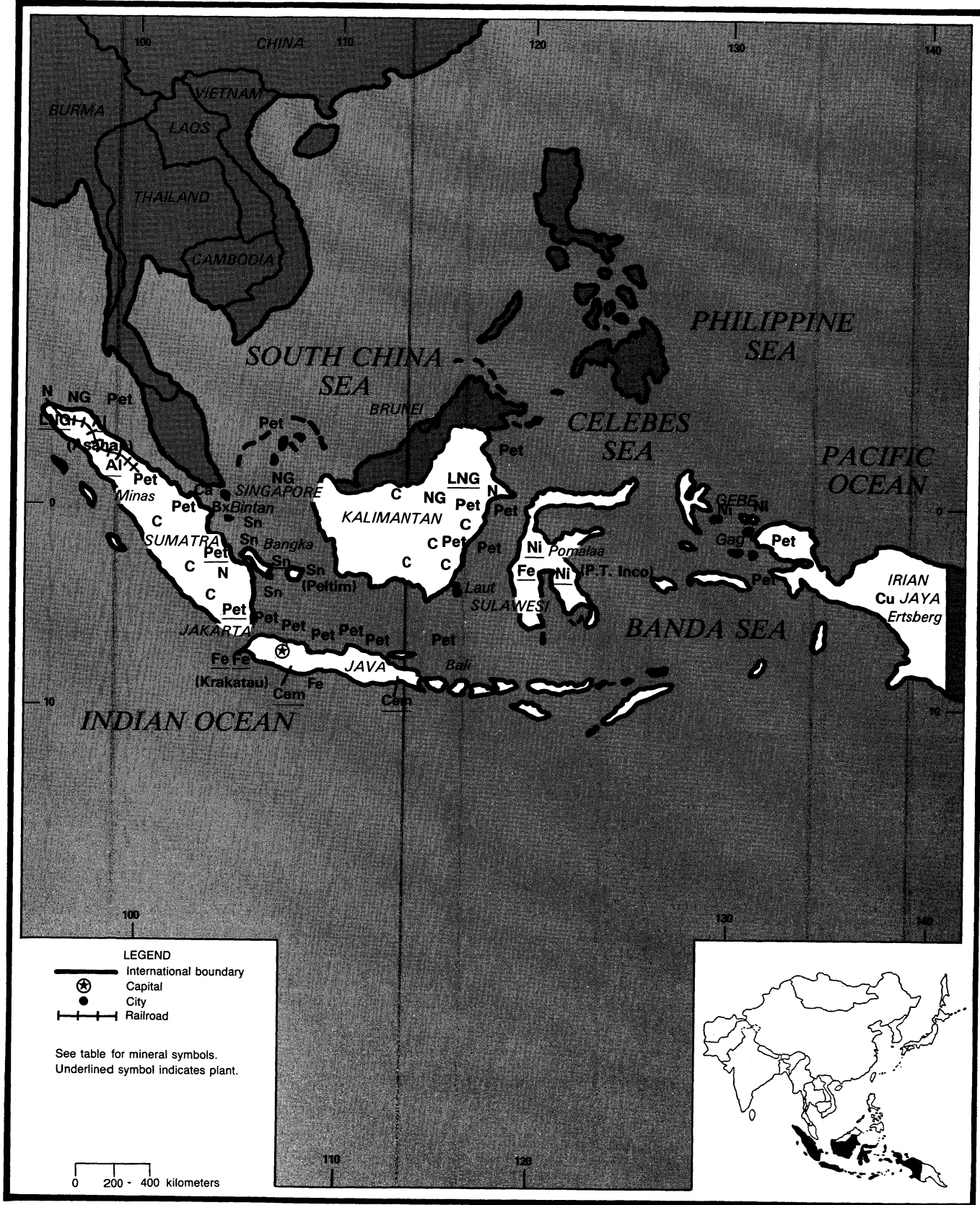
Commodity	Reserves
Bauxite	2,333,000
Barite	35,000
Chromite	108,000
Coal:	
Bituminous	186,044,000
Lignite	5,813,000
Copper, in ore	4,000
Gold	55,000
kilogram	
Graphite	4,648
Iron, in ore	11,000,000
Kyanite group	15,000
Lead, in ore	160,000
Limestone	60,000,000
Magnesite	222,000
Manganese in ore	154,000
Natural gas	
billion cubic meters	648
Petroleum, crude	
million metric tons	726
Phosphate rock	102,000
Salt	(1)
Talc and related minerals	15,000
Titanium	62,000
Zinc	7,488
Zircon	1,420

¹Essentially all from seawater.

INDONESIA

AREA 1,919,440 km²

POPULATION 193.6 million



THE MINERAL INDUSTRY OF

INDONESIA

By Chin S. Kuo

With the Government's efforts to diversify industry, the share of the energy sector in GDP continued to decline. However, the production and export of crude oil and refined products and LNG still grew at a respectable rate. The annual inflation rate stood at 9.5%, the same as that of 1990.

Oil and gas continued to play a large and important role in the economy. Indonesia is the world's 14th largest oil producer. Rising domestic demand and declining prices gradually limited export earnings. Production of natural gas grew at a fast annual rate and helped maintain the country as the world's largest producer of LNG. In the mining sector, the tin industry suffered losses in production and in export revenues as a result of depressed tin prices. Low prices also held down the revenues from the exports of nickel ore, nickel metal, and ferronickel, although export volumes increased.

The investments abroad in the region by Indonesian companies increased to two during the year. P.T. Gunawan Iron and Steel Corp., a major steel manufacturer based in Surabaya, planned to invest \$140 million¹ to build a steel plant at Kemaman, Trengganu, in Malaysia.

P.T. Vietmino Energitama signed a 30-year contract with the Vietnamese state-owned Uong Bi Coal Co. to invest \$27 million over 7 years in mining coal near Vietnam's northeastern coast. Uong Bi was to contribute use of the land. In the initial years, it is expected to produce 500,000 mt/a of coal. Operations were to start in 1992. Vietmino Energitama was to receive 90% of the anthracite mined for export to Japan, the Republic of Korea, Taiwan, and western Europe and Uong Bi the remaining 10%.

GOVERNMENT POLICIES AND PROGRAMS

The mining sector remained high on the priority list. The Government policy on mineral resources was to emphasize marketing as well. The Government planned to reduce tariffs for imports of five types of wire and metal products from the United States. It also simplified the licencing of mining companies in different regions of the country in order to boost investment in the mining sector. However, coal mining projects in the country were still closed to foreign investment, but might be reopened if existing domestic and overseas contractors could not raise output to meet growing demand. In the energy sector, technical cooperation to increase production capabilities and energy uses was to be offered either bilaterally or multilaterally between Indonesia and Asian Pacific countries.

The Government received technical assistance from the United Nations Development Program for improving the safety standards of the mining and energy sectors to achieve higher productivity. The Asian Development Bank also provided technical assistance for work force planning and improvement in both sectors.

PRODUCTION

Bauxite production reached the highest level since 1980 owing to an increase in export demand. On the other hand, aluminum production declined to the lowest level since 1984 owing to a weak world market. Gold production increased 53% and silver 19% from the 1990 levels. Indonesia was the seventh largest nickel producer in the world. The

country was the world's second largest producer of tin, after Brazil, producing about the same amount of tin metal as that in 1990. Exploration efforts in all energy sectors were being encouraged. Coal production was increasing, and the country was soon to join Australia as a significant coal exporter. LNG production was up; the natural gas was from fields offshore Natuna Island. Oil and condensate production was up 8.7% to an average of 1.6 Mbbl/d. (See table 1.)

TRADE

Nippon Steel Corp. won a contract that involved a massive order for 110,000 tons of large-diameter pipes for a 420-km gas pipeline project in east Java. Indonesia might increase its imports of phosphate from Algeria following the signing of a trade agreement between the two countries and reexport some of the phosphate to Brazil and Europe. LNG exports amounted to 20 Mmt/a and were to be expanded to 22 Mmt/a. (See tables 2 and 3.)

STRUCTURE OF THE MINERAL INDUSTRY

The development of the Indonesian mineral industry has been characterized by the participation of private enterprises and state-owned mining companies. However, the role of the latter has declined. Instead, foreign investment and hence ownership makes a major contribution to the industry through contracts of work or production-sharing contracts. The private mining sector still dominates in coal development. Restructuring of state-owned mining companies into more efficient and

competitive entities is undertaken by the Government to achieve national participation in mining. (See table 4.)

The oil and gas industry had the largest number of employees in the mineral industry, followed by industrial minerals, tin, nonferrous metals, and coal industries.

COMMODITY REVIEW

Metals

Aluminum.—P.T. Aneka Tambang planned to expand bauxite production by developing a deposit at Lomesa on Bintan Island. Lomesa was estimated to have about 4 Mmt of bauxite. Aneka Tambang is the only company authorized to exploit bauxite in a 10,470-ha mining concession area under a 30-year contract.

Owing to low aluminum prices, the 225,000-mt/a Asahan smelter cut back production and operated at 77% of its capacity. The Asahan smelter is a joint project between P.T. Inalum and Nippon Asahan Aluminum.

P.T. Javal Aluminium Industries, a joint-venture company formed by Clovis Co. Ltd. (60%) of Bermuda, P.T. Ustraindo (20%), and an Indonesian businessman (20%), planned to build a \$56.2 million plant in Indramayu, west Java, to produce 7,000 mt/a of aluminum foil and 18,000 mt/a of aluminum sheet. Raw materials for the plant were to be supplied by P.T. Inalum in Kuala Tanjung, north Sumatra.

Copper.—Freeport-McMoRan Copper and Gold Inc. planned to cut its ownership from 91.1% to 80% in P.T. Freeport Indonesia Inc., which developed the Grasberg copper and gold deposit in Irian Java. Ten percent of the stock (valued at \$213 million) was to be sold to Indonesian investors and 1.1% to the Government, increasing the Government's share to 10%. Bakrie Brothers was to buy 10% with funds from a consortium of U.S. banks (\$173 million) and International Copper Investment Co. (\$40 million). In exchange, the Government was to grant the company a 30-year extension of its

exclusive drilling rights to 2.63 Mha adjacent to its mine. The new contract with two 10-year extensions was to replace the current one, which had been due to expire in the year 2003. Freeport Indonesia might have to sell an additional 25% of shares on the Jakarta stock exchange to meet conditions laid down by Indonesian law. The regional government of Irian Jaya also approved the company's open pit mining operations in the Province.

Reserves at the Grasberg Mine were 676 Mmt of ore at an average grade of 1.41% copper, 1.80 g/mt gold, and 3.05 g/mt silver as of December 31. The mine has the largest published gold reserve of any single operating mine in the world. The company spent \$511 million on capital improvements to expand its mining and milling operations from 20,000 to 57,000 mt/d of ore in 1991. It produced about 400,000 tons of copper concentrate during the year. Annual output in 1992 was expected to be 272,000 tons of copper and 18,662 kg of gold.

Montague Gold of Australia signed a new joint-venture contract to explore the Gunung Bijih copper-gold prospect near Grasberg in Irian Jaya. Montague Gold was to manage and fund the project with a 10% interest while an Indonesian company was to fund exploration, feasibility, and construction costs with an 80% interest. Two other joint ventures were the Ransiki and Nabire copper-gold prospects in Irian Jaya, in which Montague Gold was to hold 85% interest each.

Nippon Mining Co. (20%) of Japan, Metallgesellschaft AG (55%) of the Federal Republic of Germany, Freeport Indonesia (20%), and P.T. Petrokimia Gresik (5%) submitted proposals to build Indonesia's first copper smelter in Gresik, east Java. The \$580 million smelter was to produce 150,000 mt/a of copper metal in 1994 from Freeport Indonesia's copper concentrate. Seventy percent of the product was to be exported to Japan, Taiwan, and Thailand. Byproduct volume of 240,000 mt/a of sulfuric acid was to be used mostly by P.T. Petrokimia

Gresik, a state-owned petrochemical company.

Gold.—The country expected to produce 13 tons of gold in 1991, of which Freeport Indonesia accounted for 7.1 tons. Estimated gold production was to exceed 25 tons in 1992 and 35 tons in 1993.

Kalimantan Gold of Australia's \$185 million, open pit gold mine at Kelian, Kalimantan, the country's largest gold operation, started processing 6 Mmt/a of ore in July to produce 7,465 kg of gold per year. Reserves were estimated at 53.5 Mmt grading 1.97 g/mt of gold. CRA of Australia has a 67.95% interest in the operation and acts as project manager. The remaining ownership is Kalimantan Gold, 22.05%, and P.T. Buana Jaya Raya Jakarta Mining, 10%. CRA in turn owns more than 56% of Kalimantan Gold. Grants Patch Mining has 35% ownership in Kalimantan Gold.

P.T. Prima Lirang was about to produce gold from its mine on Westar Island with a capacity of 2 mt/a in 1991 while P.T. Kelian Equatorial Mining was to start gold production in East Kalimantan with a capacity of 6 mt/a. P.T. Indomuro Mas Kencana was still conducting a feasibility study.

Pennzoil Co. of the United States agreed to sell its Mount Muro gold project to Ashton Mining of Australia. The gold deposit had estimated reserves of 31,100 kg gold. The sale is subject to approval by Indonesian authorities.

Billiton International Metals of Australia discovered a new gold-barite deposit near the Lerokis Mine at Kali Kunning on Wetar Island. The deposit was expected to provide a significant amount of additional ore for the Lerokis operation, which started gold production in early 1991. Copper mineralization was also discovered at Kali Kunning.

Korea Mining Promotion Corp. was to exploit gold and other mineral deposits at Pacitan in east Java if the deposits were to prove commercially viable.

Iron and Steel.—Krakatau Steel awarded and ratified a contract to Voest

Alpine Industrieanlagenbau of Austria to install an electric furnace steelworks at its Cilegon plant. The expansion project was to increase the total slab capacity from 1.5 Mmt/a to 2.3 Mmt/a. A further contract to raise the output to 5 Mmt/a was being planned to help the company meet an expected growth in demand for flat products.

Krakatau Steel also signed a contract with U.S. Steel Engineers and Consultants, Inc. for licenced production of corrosion-resistant steel. The company was to invest \$700 million in the next 2 years for expansion in the production capacity of sponge iron to 2.5 Mmt/a, steel slab to 1.8 Mmt/a, and steel plate to 1.8 Mmt/a.

P.T. Aneka Tambang was looking for foreign financial support to help double the capacity of its ferronickel plant in Pomalaa, southeast Sulawesi, to 10,000 mt/a. Seventy percent of the \$112 million expansion project was to be financed with foreign loans and the rest of the cost by in-house capital.

P.T. Komatsu Indonesia started production and planned to cast 6,600 mt/a of steel from its new steel foundry outside Jakarta in December. The joint venture is owned by Komatsu (35%), Sumitomo Corp. (9%), and Marubeni Corp. (6%), all of Japan, and P.T. United Tractors (50%).

Nickel.—P.T. Inco temporarily shut down electric furnace No. 3 at its Soroako nickel smelter, south Sulawesi, because of mechanical failure. However, output remained at 34,000 tons for the year. Scheduled shutdown for 5 months of one of its three electric furnaces for a major overhaul and upgrading was scheduled for November. Meanwhile, its expansion program was being tested for an output of 39,900 mt/a of nickel matte. In 1991, the plant had been plagued with technical and other production problems. The company produces nickel matte containing 80% Ni.

Tin.—P.T. Tambang Timah, a state-owned tin company, planned to halve its 24,000 employee work force in March

because of heavy losses and to spend \$182 million to rehabilitate its production facilities in the next 5 years. The company stopped operations of two land dredgers, and some of its 170 onshore mines were closed because of high production costs. It asked the Government to write off its debts of \$31 million to state banks and help with other costs. The company was to move its headquarters from Jakarta to an area near its mining site at Pangkal Pinang, Bangka Island. It was to focus on offshore operations and smelting activities. The company was expected to account for 22,700 tons of Indonesia's 1991 Association of Tin Producing Countries export quota. The 1992 export quota for Indonesia was assigned at 28,000 tons.

Industrial Minerals

Diamond.—After some delays, Indonesian Diamond Corp. Ltd. began diamond production from its Danau Seran channel in southeast Kalimantan at the end of September. A modular plant treated 18,000 m³ month of pay gravel yielding a monthly diamond output of 1,250 to 2,250 carats. A high proportion of the diamonds was expected to be of gem quality. Gold and platinum were also present in the gravels. The primary plant commissioned in November, together with a modular plant, processed a combined volume of 54,000 m³ month. The Danau Seran resource contains 2.9 Mm³ of diamondiferous gravel grading 0.115 carats/m³.

Soda Ash.—Indonesia and China agreed to construct a soda ash plant with a production capacity of 300,000 mt/a in Bontang, east Kalimantan. The \$75 million project was also to produce 300,000 mt/a of ammonium chloride as raw material for P.T. Pupuk Kaltim, a fertilizer company. The plant was to lower the country's complete dependency on imported soda ash and enable a transfer of technology from China.

Zeolite.—Paragon Resources entered two agreements covering exploration and development of high-grade deposits of

zeolite. One farm-out was with Valpar Resources of Canada (up to 50%) to Paragon's 79% interest of all zeolite minerals and 80% of any gold or most other minerals found in Mount Ratal and Tarahan areas. The other was Paragon's farm-in to 80% interest in two other zeolite deposits on the Trans-Sumatra Highway, 20 km south of Panjang.

Mineral Fuels

Coal.—Production was expected to rise to 15.6 Mmt and exports to rise to 6 Mmt in 1991. Coal output was forecast to be 35 Mmt/a by 1995, of which more than one-half was to be exported, replacing oil as the major export of the country. Deepwater coal terminals were under construction at Pulau Laut. P.T. Kaltim Prima's \$570 million mining project, including conveyor and automated load-out facilities, was recently commissioned. The infrastructural and capital upgrade projects were to make Indonesian coal competitive outside its current regional market.

Of the 6 Mmt of total exports, Japan received 1.5 Mmt and Southeast Asian countries took 2 Mmt. Malaysia and Thailand signed new contracts for 300,000 and 180,000 mt/a of coal, respectively.

P.T. Kaltim Prima developed the Pinang deposit where minable coal reserves were estimated at 154 Mmt composed of a premium grade and a lower grade. The project was begun in 1988 and produces currently at 2.5 Mmt/a. Output is expected to reach 6 Mmt/a in 1993 and 7.7 Mmt/a in 1995. Coal was loaded into large vessels (Capesize) at the company's new terminal. Kaltim Prima is poised to become an aggressive competitor in the Asian and European coal markets. The company is owned by Sanggata Holdings (50%) of Cayman Islands and CRA (50%) of Australia. It planned to sell 52% of its shares to Indonesians.

Broken Hill Pty. Co. Ltd. of Australia planned to expand coal production to 8 Mmt/a and build a transshipment facility to load large vessels in Kalimantan. The company operated two mines with a

combined capacity of 2 Mmt/a. The ownerships of the coal reserves are held by P.T. Arutmin Indonesia, in which Broken Hill owns 80% and Indonesia's Bakrie Group owns 20%, and by P.T. Utah Indonesia in which Broken Hill has sole ownership. Broken Hill's interests in both companies may be eventually reduced to 49%.

Ten private companies worked with the state-owned coal company in production in west Sumatra and Kalimantan. Nine overseas contractors were working in the country. P.T. Tambang Batubara Bukit Asam produced 6.4 Mmt of coal, of which about 1.7 Mmt was exported. Berau Coal produced 100,000 tons, and 40% of its output was exported. Mobil Coal Producing Inc. owned and transferred its 60% interest in Berau Coal to United Tractors. Nissho Iwai Corp. of Japan owns the remaining 40%.

Large potential coal deposits were found in four basins in west Sumatra: the Ombilin Basin (162 Mmt), the Jujuhan Sinamar Basin (109 Mmt), the Painan Basin, and part of the Kampar Kanan Basin. NEDO of Japan provided \$6 million toward the \$8 million exploration project in Ombilin and toward technical assistance.

Thailand's Ban Pu Coal Co. and state-run Electricity Generating Authority (EGA) were invited to participate in a Thai-Indonesian joint venture to explore and exploit coal in Indonesia. EGA was assured a major coal reserve to help reduce power generating costs in Thailand.

P.T. Adaro Indonesia, a multinational joint venture between the Governments of Australia, Spain, and Indonesia, planned to explore and mine high-grade coal in the Hulusungai Utara district and neighboring Tabalong in south Kalimantan for export to Japan and Europe. The district was estimated to be capable of producing 1 Mmt/a of coal.

Meanwhile, Adaro Indonesia was to start coal production from four mines at Paringin, Tutupan, Wara, and Warukin in south Kalimantan in September. The Paringin Mine, with proven reserves of 77.5 Mmt, was to produce 1 Mmt/a, and the Tutupan Mine, with proven reserves

of 257.5 Mmt, was expected to raise the company's output to 5 Mmt/a when the construction of production facilities there was completed. The general quality of bulk coal samples tested included very low ash (0.8%) and sulfur (0.06%). The coal was to be exported to the Federal Republic of Germany, Japan, Malaysia, the Philippines, Romania, and the United States.

Liquefied Natural Gas.—P.T. Inti Karya Persada Teknik won a \$750 million contract to build a LNG train in Bontang, east Kalimantan, for Pertamina. The project was to come on-stream in January 1994 with a capacity of 2.25 Mmt/a of LNG. The train was to fill Pertamina's contract to supply Osaka Gas (1.1 Mmt/a), Tokyo Gas (800,000 mt/a), and Toho Gas (100,000 mt/a) beginning in early 1994. Chase Manhattan Bank of the United States and Mitsubishi Bank of Japan arranged for the loan.

Oryx Energy Co. of the United States discovered natural gas on Padang Island in the Malacca Strait, onshore Indonesia. The discovery well tested at 877,800 m³/d of gas and 686 bbl/d of condensate from the Menggala and Pematang formations. Pertamina and Trend East Java Ltd. found onshore oil and gas in the Tuban block of east Java. The wildcat well yielded 779 bbl/d of oil and 124,600 m³/d of gas. Pertamina holds 50% interest with remaining interests split equally among Trend East Java and three other partners.

Chinese Petroleum Corp. of Taiwan was to double imports of LNG from Indonesia to 1.5 Mmt/a. Pertamina signed a 20-year contract to sell LNG to Korea Gas Corp. at 2.3 Mmt/a starting in 1994 from liquefaction plants at Arun and Bontang. Indonesia is the world's largest exporter of LNG, selling under long-term contracts to Japan, the Republic of Korea, and Taiwan.

Petroleum.—Indonesia is a significant oil-producing country. Oil production hit its highest level in 10 years, 1.7 Mbbbl/d, exceeding the country's OPEC production quota of 1.4 Mbbbl/d. Indonesia has oil

reserves of 11 billion bbl. Pertamina awarded 27 oil exploration contracts, and foreign contractors were expected to spend \$3.9 billion in 1991. Indonesian exports of crude oil were to be cut in favor of domestic refining and export of petroleum products.

A dynamite warehouse 3 km from oil wells exploded at one of the largest oilfields, the Duri Field in central Sumatra, run by Caltex Inc. of the United States. Oil production was not affected. The country has eight refinery complexes and a large number of oil and gas wells.

The country awarded Unocal Indonesia Ltd. a 20-year extension of operations in a block off eastern Kalimantan. Unocal Indonesia operates a production-sharing contract to output natural gas for conversion into LNG. It also awarded a 30-year contract to BP Petroleum Development Ltd. for oil and gas exploration off Lombok. Total Indonesia and Indonesia Petroleum Co. of Japan won a contract for a 20-year extension of their joint operations in the Mahakam delta off eastern Kalimantan to produce natural gas for liquefaction. The latest discovery of new oil and gas reserves in the Mahakam permit recorded a cumulative output of 1.4 Mm³/d of natural gas and 980 bbl/d of condensate. It was at a well operated by Total Indonesia in a 50-50 joint venture with Pertamina.

Indonesia and Australia agreed to grant 11 oil exploration contracts to 19 companies from 7 countries in the Timor Gap between the Indonesian Province of East Timor and Australia. With a total investment commitment of \$362 million, the companies were to drill a minimum of 46 seismic wells within 6 years.

Pertamina, British Petroleum, and C. Itoh and Co. of Japan were to build a 120,000-bbl/d oil refinery at Tanjung Uban on Bintan Island. The \$1 billion plus refinery was to process 6 Mmt/a of imported oil from the Middle East. Construction was to start at the end of 1991 and production in 1994. Its output was to be exported mainly to Japan and some to other Asian countries.

Pertamina, Japan Gas Corp., and Foster Wheeler of the United Kingdom

were to build Indonesia's first export-oriented oil refinery in Balongan, west Java, 210 km east of Jakarta. The 125,000-bbl/d, \$1.9 billion oil refinery was scheduled for construction in 1992 and scheduled for completion in 1994.

Pertamina awarded a contract valued at \$500 million to Fluor Daniel of the United States to perform engineering, procurement, and construction for a 15% expansion in output of an existing refinery in Cilacap. The Cilacap refinery's current production capacity is 300,000 bbl/d after expansion in 1983. Pertamina currently has a refining capacity of 830,000 bbl/d.

P.T. Gema SemBrown won a \$20 million turnkey contract to construct offshore oil production facilities for the Attaka Field off Kalimantan, operated by Unocal Indonesia Ltd. The Indonesian joint venture is composed of Sembawang Engineering Pte. Ltd. of Singapore, Brown & Root Inc. of the United States, and Indonesian interests. Work was started in February, and the project is expected to be completed by the first quarter of 1992.

To ease the current tight money situation, Pertamina's projects, whose construction was to be rescheduled, included an export-oriented refinery in Sorong, Irian Jaya; a refinery to be designed for the domestic market; and expansion of a methanol plant in Bunyu, east Kalimantan. The planned refineries were to produce 485,000 bbl/d of oil. However, the establishment of a LNG production plant in Bontang, east Kalimantan; an aromatics plant in Cilacap, central Java; an export-oriented refinery at Balongan, west Java; and the upgrading of the Musi refinery in south Sumatra was to proceed as planned.

Reserves Indonesia's major mineral commodities are bauxite, coal, copper, crude oil, natural gas, nickel, and tin. The country claims to possess the world's second largest nickel reserves, estimated at more than 820 Mmt of nickel-bearing material. Nickel deposits are found primarily in the eastern part of the country. Indonesia has 10.5% of the known world tin resources, which are

estimated to exceed 7.7 Mmt. The country's coal reserves are estimated at 32 billion tons. (See table 5.)

INFRASTRUCTURE

Indonesia's infrastructure serving the mineral industry is, in general, adequate for mine or mill output to meet domestic market demand and for export. However, in some regions such as Kalimantan and Sumatra where gold and coal mining has been active, development of transportation and materials handling systems needs to be accelerated.

The Government owns all 6,964 km of railroads, some of which is double track and some electrified. The total length of highways is 119,500 km, mostly under local jurisdiction. The island country has about 21,600 km of inland waterways. Pipelines to transport crude oil and natural gas are well developed and measured 2,505 km and 1,703 km, respectively. Coal terminals in use or being built are at Tarahan in south Sumatra, Laut Island off south Kalimantan, and Teluk Bayur on the western coast of Sumatra. In addition, an iron ore receiving port at Cigading in west Java is being expanded.

The country is to increase electrical output from the current level of 29 MMW to 42.7 MMW by the end of 1994. The completion date of several new powerplants under construction in Java and Bali has been pushed forward. The first phase construction of the State Electricity Co.'s powerplant in Cresik near Surabaya is scheduled to be completed by the end of 1992.

OUTLOOK

Strong bauxite production and export demand should continue in 1992. Meanwhile, in the short term, the country's interest in building an aluminum plant on Bintan Island declines as a result of lower high-grade reserves and weak aluminum prices. Two gold mining companies will be operational in February 1992, thus increasing gold and silver production by 10 mt/a and 34 mt/a, respectively. It is expected that

Indonesia's gold output will top 30 tons in 1992. Completion of a capital upgrading program, including rebricking and other refining modernization by P. T. Inco, will substantially increase its production capacity of nickel matte to more than 45,000 mt/a. It has been a good year for Indonesia's oil output, and the country expects to continue this trend and produce about 1.5 Mbbbl/d throughout 1992.

¹Where necessary, values have been converted from Indonesian rupiahs (Rp) to U.S. dollars at the rate of Rp1,950=US\$1.00 for 1991.

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Bandung 40122, Indonesia
Directorate General of Oil and Gas
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TABLE 1
INDONESIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²
METALS					
Aluminum:					
Bauxite, gross weight	635	513	862	1,206	1,242
thousand tons					
Metal, primary	202,002	184,859	196,869	185,863	173,000
Chromite sand, dry basis	—	7,636	7,635	*8,000	1,950
Copper, mine output, Cu content	102,058	121,472	143,970	178,115	267,401
Gold, mine output, Au content ²	3,643	4,738	6,155	11,158	16,879
kilograms					
Iron and steel:					
Iron sand, dry basis	193,986	202,748	142,654	145,401	173,242
Metal:					
Ferroalloys: Ferronickel	8,354	26,852	26,058	25,025	*26,000
Steel, crude	1,453,000	2,050,000	*2,000,000	*2,100,000	3,250,000
Manganese ore	1,855	10,957	9,364	9,417	13,253
Nickel:					
Mine output, Ni content ³	57,764	57,982	62,987	68,308	71,681
Metallurgical products:					
Matte: Ni content	26,508	28,864	29,030	24,949	27,433
Ferronickel: Ni content	1,683	4,905	4,964	5,005	5,318
Silver, mine output, Ag content	50,485	58,336	73,884	67,315	80,294
kilograms					
Tin:					
Mine output, Sn content	26,093	29,590	31,263	30,200	30,061
Metal	24,200	28,365	29,916	30,389	30,415
INDUSTRIAL MINERALS					
Cement, hydraulic	11,844	12,242	14,099	13,762	16,153
thousand tons					
Clays:					
Bentonite	7,962	8,266	3,863	5,914	21,512
Fire clay	2,356,327	*2,222,420	1,730,834	*1,800,000	*1,850,000
Kaolin powder	122,046	147,109	157,122	*160,098	139,915
Diamond:⁴					
Industrial stones	22	22	25	23	24
thousand carats					
Gem	7	7	7	7	7
do.					
Total	29	29	32	30	31
do.					
Feldspar	15,019	11,388	13,025	19,779	13,674
Gypsum	1,367	894	449	58	404,310
Iodine	8,227	9,753	14,275	59,820	36,353
kilograms					
Nitrogen: N content of ammonia	2,363,900	2,366,700	2,526,400	*2,600,000	2,706,268
Phosphate rock	3,098	411	10,549	1,600	6,384
Salt, all types ⁵	600	600	600	600	700
thousand tons					
Stone:					
Dolomite	38,492	70,043	68,731	10,537	*10,000
Granite	1,181	1,122	1,195	*1,200	*1,200
thousand tons					
Limestone	15,966	13,430	10,199	9,510	2,573
do.					
Marble	5,645	2,369	1,112	1,013	378
square meters					
Quartz sand and silica stone	877,579	421,126	301,706	165,198	429,251
Sulfur, elemental	3,941	4,321	3,890	3,628	*3,500
Zeolite	—	626	640	*600	*600

See footnotes at end of table.

TABLE 1—Continued
INDONESIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²
MINERAL FUELS AND RELATED MATERIALS					
Asphalt rock, natural	84,889	—	—	—	—
Coal thousand tons	2,979	4,095	8,812	10,769	13,688
Gas, natural:					
Gross million cubic feet	1,731,083	1,846,861	1,975,421	2,158,921	2,035,058
Marketed do.	1,188,358	1,312,090	1,397,873	*1,500,000	*1,400,000
Petroleum:					
Crude including field condensate thousand 42-gallon barrels	479,057	491,509	514,184	533,666	581,232
Refinery products:					
Liquefied petroleum gas do.	3,905	3,130	3,245	3,467	3,453
Gasoline do.	30,007	32,026	36,580	39,003	42,137
Jet fuel do.	3,763	5,795	7,223	5,439	6,580
Naphtha do.	17,309	17,471	12,696	18,471	14,078
Paraffin wax do.	152	192	143	121	183
Kerosene do.	42,207	41,413	43,500	45,630	47,326
Distillate fuel oil do.	77,355	79,628	84,307	72,418	76,592
Lubricants do.	1,574	1,462	1,504	1,641	1,462
Residual fuel oil do.	42,245	47,241	40,565	26,864	26,975
Unfinished oil requiring further processing do.	1,663	1,565	*1,600	41,813	44,251
Refinery fuel and losses do.	12,790	13,677	13,409	15,262	12,490
Unspecified do.	1,806	4,790	2,046	1,074	2,936
Total do.	234,776	248,390	*246,818	271,203	278,463

¹Estimated. ²Preliminary. ³Revised.

⁴Table includes data available through July 8, 1992.

⁵Includes Au content of copper ore and output by Government-controlled foreign contractors' operations. Gold output by operators of so-called people's mines and illegal small-scale mines is not available but may be as much as 18 tons per year.

⁶Includes a small amount of cobalt that is not recovered separately.

TABLE 2
INDONESIA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	843,476	813,637	302,400	Japan 511,237.
Metal including alloys:				
Scrap	167	307	—	All to Japan.
Unwrought	142,885	126,163	—	Japan 121,138; Singapore 2,523.
Semimanufactures	709,578	587,999	1	Singapore 581,375; Japan 3,929.
Chromium: Ore and concentrate	15,198	1,400	—	All to Australia.
Cobalt:				
Ore and concentrate	44,000	—	—	—
Oxides and hydroxides	4	37	—	Japan 29; Singapore 6.
Copper:				
Ore and concentrate	321,745	397,648	—	Japan 223,566; West Germany 49,969; Republic of Korea 39,415.
Metal including alloys, all forms	25,291	16,642	—	Thailand 11,363; Philippines 1,367.
Iron and steel: Metal:				
Scrap	420	847	—	Japan 525; Taiwan 210.
Pig iron, cast iron, related materials	53,687	67,990	—	Japan 42,939; China 20,018; Thailand 5,000.
Ferroalloys:				
Ferromanganese	2,441	7	—	Singapore 5; Hong Kong 2.
Ferrosilicon	4,322	2,646	—	Republic of Korea 1,000; Japan 744.
Ferronickel	25,238	27,709	—	Netherlands 15,419; Japan 12,290.
Unspecified	4	—	—	—
Steel, primary forms	31,452	55,531	—	Japan 19,160; Taiwan 14,424.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	459,067	225,636	—	Japan 130,212; Republic of Korea 35,375.
Clad, plated, coated	35,625	19,154	10	Singapore 10,042; Iraq 5,795; Kuwait 1,450.
Of alloy steel	1,576	165	—	Malaysia 108; Singapore 57.
Bars, rods, angles, shapes, sections	261,748	149,412	3,922	Thailand 72,582; Iraq 32,077.
Rails and accessories	505	77	—	All to Japan.
Wire	279	1,562	346	Iraq 600; Japan 571.
Tubes, pipes, fittings	9,274	9,223	—	Singapore 4,514; Japan 1,790.
Lead:				
Ore and concentrate	20	306	—	Japan 286; Taiwan 20.
Metal including alloys, all forms	4,940	16,706	—	Taiwan 6,325; Japan 6,043; Malaysia 2,635.
Manganese: Ore and concentrate:²				
Metallurgical-grade	16,020	67,027	—	Australia 47,000; Taiwan 13,306.
Molybdenum:				
Ore and concentrate	43,010	—	—	—
Metal including alloys, all forms	—	10,000	—	All to China.

See footnotes at end of table.

TABLE 2—Continued
INDONESIA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Nickel:				
Ore and concentrate	1,081,531	1,364,752	—	Japan 697,372; Australia 658,000.
Matte and speiss	38,166	35,069	—	All to Japan.
Metal including alloys, all forms	3,956	—		
Platinum-group metals:				
Ores and concentrates ² kilograms	—	50	50	
Metals including alloys unwrought and partly wrought value, thousands	\$400	—		
Silver:				
Ore and concentrate kilograms	—	120	120	
Metal including alloys, unwrought and partly wrought value, thousands	\$9	\$6	\$4	France \$1; Hong Kong \$1.
Tin:				
Ore and concentrate	766	368	—	Malaysia 263; United Kingdom 105.
Metal including alloys:				
Unwrought	29,714	28,995	—	Singapore 24,300; Netherlands 4,675.
Semimanufactures	845	—		
Titanium: Oxides	5	41	—	Singapore 37; United Kingdom 4.
Tungsten: Metal including alloys, all forms value, thousands	\$1	—		
Zinc:				
Ore and concentrate	—	503	—	All to Japan.
Oxide	18	—		
Metal including alloys:				
Scrap	109	271	—	Taiwan 140; Japan 105.
Unwrought and semimanufactures	398	127	—	Singapore 107; India 19.
Zirconium: Ore and concentrate	115	—		
Other:				
Ores and concentrates	1,843	47,150	—	Australia 45,500; Singapore 1,650.
Waste and sweepings of precious metals kilograms	—	9,600	—	All to Japan.
Ashes and residues	19	100	—	All to Taiwan.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	119,125	104,473	5,405	Hong Kong 63,254; Taiwan 9,758; Thailand 9,421.
Grinding and polishing wheels and stones	153	51	(³)	Singapore 35; Taiwan 16.
Barite and witherite	7,695	5,246	—	All to Singapore.
Cement thousand tons	4,233	2,564	—	Bangladesh 646; Singapore 385; Thailand 216.
Chalk	17	53	—	Australia 40; Canada 11.
Clays, crude:				
Bentonite	12,114	7,708	—	Singapore 5,338; Malaysia 2,044.
Kaolin	121,468	129,660	—	Taiwan 56,708; Japan 39,544; Malaysia 15,863.
Unspecified	4	26,396	—	Taiwan 25,802; Jordan 200.

See footnotes at end of table.

TABLE 2—Continued
INDONESIA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Cryolite and chiolite	285	95	—	Mainly to Malaysia.
Diamond, natural: Gem, not set or strung value, thousands	\$106	\$39	—	All to Singapore.
Diatomite and other infusorial earth	61	122	—	Taiwan 95; Malaysia 27.
Feldspar, fluorspar, related materials	15	—		
Fertilizer materials:				
Crude, n.e.s.	2,238	4,725	—	Japan 4,334; China 127.
Manufactured:				
Ammonia	315,417	195,870	—	Philippines 97,429; Malaysia 35,155; Taiwan 30,000.
Nitrogenous	1,476,964	1,546,894	—	China 396,230; Philippines 297,830; Malaysia 205,726.
Phosphatic	663	6,826	—	Singapore 6,600; Taiwan 226.
Unspecified and mixed	4,000	89	—	Malaysia 80; Australia 9.
Gypsum and plaster	110,753	81,639	—	Philippines 76,139; Sri Lanka 5,500.
Iodine including fluorine and bromine	13	19	—	Mainly to India.
Magnesium compounds: Oxides and hydroxides	—	180	—	All to Taiwan.
Mica: Crude including splittings and waste	6	13	13	
Phosphates, crude	13,192	3,563	—	Taiwan 1,720; Singapore 1,080; Japan 372.
Pigments, mineral: Iron oxides and hydroxides, processed	40	—		
Precious and semiprecious stones other than diamond: Natural kilograms	7,000	(^o)		
Salt and brine	—	501	—	Japan 262; Hong Kong 177.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	150	—		
Sulfate, manufactured	7,058	4,513	—	Singapore 3,601; Thailand 740.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked thousand tons	983	1,396	(^o)	Singapore 1,384.
Worked	7,725	5,126	1,216	Japan 1,199; Australia 921.
Dolomite, chiefly refractory grade	40	—		
Gravel and crushed rock	4,546	6,259	80	Hong Kong 5,037; Taiwan 151.
Limestone other than dimension	—	500	—	All to Thailand.
Quartz and quartzite	6,390	—		
Sand other than metal-bearing thousand tons	3,664	7,916	—	Singapore 7,894; Taiwan 18.
Sulfur:				
Elemental: Crude including native and byproduct	—	80	—	Bangladesh 40; Malaysia 40.
Sulfuric acid	20	—		
Talc, steatite, soapstone, pyrophyllite	—	941	—	Malaysia 501; Taiwan 410.
Other: Crude	73	—		

See footnotes at end of table.

TABLE 2—Continued
INDONESIA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite and bituminous	thousand tons	2,392	4,351	—	Japan 948; Malaysia 778; Taiwan 736.
Briquets of anthracite and bituminous coal		94,669	96,769	—	Hong Kong 40,000; Japan 31,500; Malaysia 14,269.
Coke and semicoke ⁶		566	1,065	—	All to Singapore.
Gas, natural: Liquefied	thousand tons	19,497	21,332	—	Japan 18,179; Republic of Korea 2,431.
Peat including briquets and litter		25	—		
Petroleum:					
Crude	thousand 42-gallon barrels	287,656	278,159	42,305	Japan 167,725; Republic of Korea 17,137; Taiwan 15,597.
Refinery products:					
Liquefied petroleum gas	do.	26,309	29,585	—	Japan 25,978; Republic of Korea 1,599.
Gasoline	do.	13,818	64,446	5,055	Japan 54,576; Republic of Korea 3,788.
Mineral jelly and wax	do.	23	NA		
Distillate fuel oil	do.	37	—		
Lubricants	do.	71	196	NA	NA.
Residual fuel oil	do.	38,583	—		
Petroleum coke	do.	934	678	—	Japan 543; Netherlands 123.

NA Not available.

¹Table prepared by Audrey D. Wilkes.

²Includes manganese iron ore and concentrate.

³May include other precious metals.

⁴Less than 1/2 unit.

⁵Unreported quantity valued at \$3,000.

⁶Includes retort carbon.

TABLE 3
INDONESIA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	32	14	1	China 12.
Aluminum:				
Ore and concentrate	22	60	—	Mainly from China.
Oxides and hydroxides	432,544	358,063	70	Australia 312,397; India 20,931.
Metal including alloys:				
Scrap	191	185	18	Singapore 58; Canada 51; Hong Kong 31.
Unwrought	7,580	24,778	2,836	Australia 14,920; China 2,501.
Semimanufactures	15,367	16,074	317	Japan 4,007; Singapore 2,821.
Antimony: Metal including alloys, all forms	150	230	—	Hong Kong 136; Taiwan 60.
Beryllium: Metal including alloys, all forms	—	16	—	All from China.
Bismuth: Metal including alloys, all forms	1	1	—	Mainly from Netherlands.
Cadmium: Metal including alloys, all forms	—	1	1	
Chromium:				
Ore and concentrate	95	395	—	West Germany 214; Australia 131.
Oxides and hydroxides	540	2,707	56	China 2,200; West Germany 197.
Metal including alloys, all forms	4	8	—	United Kingdom 7.
Cobalt:				
Ore and concentrate	50	—	—	
Oxides and hydroxides	30	41	—	Japan 17; United Kingdom 9.
Metal including alloys, all forms	10	4	—	United Kingdom 3.
Columbium and tantalum: Tantalum metal including alloys, all forms				
	—	26	—	All from China.
Copper:				
Ore and concentrate	638	3	1	NA.
Metal including alloys:				
Scrap	99	1,806	133	Singapore 1,536; Taiwan 119.
Unwrought	39,867	50,414	3,614	Chile 23,252; Zambia 11,440; Philippines 3,887.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	275,606	158,996	86	India 158,083; Malaysia 541.
Pyrite, roasted	thousand tons 2,123	1,779	—	Brazil 811; Sweden 605; Norway 330.
Metal:				
Scrap	718,653	1,177,669	93,850	Australia 411,952; Vietnam 166,948; Hong Kong 125,351.
Pig iron, cast iron, related materials	283,548	328,325	2	Malaysia 131,534; U.S.S.R. 86,097.
Ferroalloys:				
Ferromanganese	21,565	17,719	—	China 8,939; Australia 6,065.
Ferrosilicomanganese	11,709	13,841	—	China 12,135; Hong Kong 896.
Ferrosilicon	1,415	7,880	—	Trinidad and Tobago 3,877; China 1,328; Australia 1,295.
Unspecified	369	809	33	Japan 347; Brazil 34.
Steel, primary forms	363,987	756,621	25,880	Australia 132,542; Taiwan 124,595; Republic of Korea 99,805.

See footnotes at end of table.

TABLE 3—Continued
INDONESIA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued:				
Metal—Continued:				
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	455,720	562,644	4,155	Japan 372,582; Australia 56,853.
Clad, plated, coated	63,962	96,699	6,267	Japan 61,666; Australia 11,732.
Of alloy steel	27,828	45,992	123	Japan 28,185; Republic of Korea 6,286.
Bars, rods, angles, shapes, sections	139,687	296,072	2,860	Japan 87,213; West Germany 34,086; United Kingdom 34,031.
Rails and accessories	5,236	8,955	7	U.S.S.R. 2,362; Japan 1,551; Republic of Korea 1,416.
Wire	22,294	30,258	17	Republic of Korea 10,543; Japan 6,067.
Tubes, pipes, fittings	193,601	233,595	12,704	Japan 111,905; Mexico 19,838; West Germany 1,841.
Lead:				
Oxides	1,026	1,489	5	Mexico 540; China 383; West Germany 177.
Metal including alloys:				
Scrap	12,044	35,822	382	Japan 11,466; Australia 8,079.
Unwrought	14,517	15,494	714	Australia 11,559; Canada 1,043.
Semimanufactures	359	673	553	West Germany 52; Japan 26.
Magnesium: Metal including alloys, all forms	225	363	71	Norway 173; Japan 47.
Manganese:				
Ore and concentrate: ² Metallurgical grade	1,380	2,803	—	Singapore 2,755; Netherlands 48.
Oxides	17,872	19,821	1	Singapore 14,360; Japan 5,093.
Metal including alloys, all forms	57	112	—	United Kingdom 110; West Germany 1.
Mercury	86	42	—	China 14; Japan 14; Spain 9.
Molybdenum:				
Ore and concentrate	104	2	—	All from Taiwan.
Metal including alloys, all forms value, thousands	—	\$1	—	All from Japan.
Nickel:				
Ore and concentrate	4	—	—	
Matte and speiss	—	271	—	All from Australia.
Metal including alloys:				
Scrap	3	4	—	All from Singapore.
Unwrought	124	214	—	Finland 79; Norway 40.
Semimanufactures	472	2,738	8	West Germany 2,615; Singapore 29.
Platinum-group metals:				
Waste and sweepings value, thousands	—	\$3	—	All from Australia.
Metal including alloys, unwrought and partly wrought do.	\$100	\$52	—	United Kingdom \$45.
Silicon, high-purity ³	767	332	—	Australia 140; China 79; Hong Kong 60.
Silver:				
Waste and sweepings ⁴ value, thousands	—	\$5	—	All from Australia.

See footnotes at end of table.

TABLE 3—Continued
INDONESIA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Silver—Continued:				
Metal including alloys, unwrought and partly wrought do.	\$188	\$1,511	\$5	Belgium-Luxembourg \$509; West Germany \$353.
Tin:				
Ore and concentrate	—	99	—	All from Australia.
Metal including alloys, all forms	653	781	(²)	Singapore 735; Australia 3.
Titanium:				
Ore and concentrate	1,056	1,391	—	Australia 1,265; Taiwan 56.
Oxides	4,645	5,912	148	Republic of Korea 1,272; Australia 974; Japan 730.
Metal including alloys, all forms	(³)	24	2	Australia 22.
Tungsten:				
Ore and concentrate	1	—	—	—
Metal including alloys, all forms value, thousands	(⁴)	\$1	(⁴)	Austria. ⁵
Uranium and thorium:				
Ore and concentrate do.	\$68	—	—	—
Oxides and other compounds do.	\$181	\$1,959	\$26	France \$1,781; Hong Kong \$141.
Zinc:				
Oxides	559	1,865	22	China 713; Republic of Korea 617; Japan 135.
Metal including alloys:				
Scrap	476	195	—	All from Singapore.
Unwrought	44,615	55,314	—	Australia 41,394; Canada 9,340.
Semimanufactures	908	996	16	Singapore 372; Japan 261; China 133.
Zirconium:				
Ore and concentrate	360	329	—	United Kingdom 242; Mozambique 20.
Metal including alloys, all forms	46	(⁶)	—	All from Netherlands.
Other:				
Ores and concentrates	562	1,092	(⁷)	Australia 682; West Germany 210.
Ashes and residues	1,158	2,674	254	Singapore 1,344; Japan 837.
Base metals including alloys, all forms	4	(⁸)	—	NA.
Metalloids ⁷	1,046	177	(⁹)	West Germany 65; Netherlands 59; Canada 19.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	802	1,308	28	China 803; Singapore 135.
Artificial: Corundum	377	769	12	Japan 396; China 286.
Dust and powder of precious and semiprecious stones including diamond value, thousands				
Grinding and polishing wheels and stones	\$36	\$157	—	All from Japan.
Asbestos, crude	4,626	3,991	38	China 1,982; Italy 563; Japan 514.
Asbestos, crude	21,265	28,599	—	Canada 14,058; Zimbabwe 5,900; Brazil 5,560.
Barite and witherite	62,085	82,394	1,215	Thailand 24,848; India 21,146; Singapore 11,999.
Boron materials:				
Crude natural borates	372	431	425	Netherlands 6.
Oxides and acids	611	902	393	Italy 290; Turkey 80.
Cement	2,273	34,619	9	Japan 33,038; Republic of Korea 1,500.
Chalk	2,339	3,551	—	Taiwan 3,260; United Kingdom 286.

See footnotes at end of table.

TABLE 3—Continued
INDONESIA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Clays, crude	77,350	106,941	37,288	China 16,755; Singapore 11,887; Australia 9,612.	
Cryolite and chiolite	18	100	—	All from Australia.	
Diamond, natural:					
Gem, not set or strung	value, thousands	\$40	\$5,113	—	All from Singapore.
Industrial stones	do.	—	\$38	—	Do.
Diatomite and other infusorial earth	1,337	2,071	1,671	Republic of Korea 182; Japan 158.	
Feldspar, fluorspar, related materials	22,677	20,982	—	China 9,629; Australia 5,464.	
Fertilizer materials:					
Crude, n.e.s.	5,885	9,035	76	Malaysia 7,125; Belgium-Luxembourg 1,000.	
Manufactured:					
Ammonia	8	4,957	4,949	Singapore 6.	
Nitrogenous	603	7,466	116	Portugal 5,500; Philippines 1,480.	
Phosphatic	277,611	152,235	46,360	Iraq 43,524; Tunisia 41,925.	
Potassic	364,462	443,960	8,249	Canada 230,576; U.S.S.R. 131,074; Jordan 66,616.	
Unspecified and mixed	84,979	56,043	169	U.S.S.R. 18,742; Belgium-Luxembourg 16,870.	
Graphite, natural	780	1,688	—	China 731; Republic of Korea 674.	
Gypsum and plaster	141,630	248,630	158	Thailand 237,490; France 2,322; West Germany 2,129.	
Iodine ²	21	5	1	Singapore 2; West Germany 1.	
Lime	132	2,849	141	Japan 2,313; Singapore 146.	
Magnesium compounds:					
Magnesite, crude	205	466	1	West Germany 456; Japan 7.	
Oxides and hydroxides	16,690	19,150	1	China 13,752; Japan 1,691.	
Mica:					
Crude including splittings and waste	505	817	318	Singapore 161; China 120.	
Worked including agglomerated splittings	74	46	(³)	Singapore 18; Japan 15.	
Nitrates, crude	3,065	4,408	87	Chile 3,697; Belgium-Luxembourg 286.	
Phosphates, crude	thousand tons	886	899	—	Jordan 480; Morocco 334.
Pigments, mineral: Iron oxides and hydroxides, processed	6,313	7,295	607	West Germany 2,863; China 2,324.	
Potassium salts, crude	10,500	151,633	—	U.S.S.R. 60,383; Jordan 44,100; Canada 41,650.	
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	\$5	\$98	—	Belgium-Luxembourg \$67; Australia \$22.
Synthetic	do.	\$37	\$34	—	Hong Kong \$25; Japan \$8.
Pyrite, unroasted	5	—	—	—	—
Salt and brine	175,809	349,042	13	Australia 347,715; West Germany 376.	
Sodium compounds, n.e.s.:					
Soda ash, manufactured	209,819	275,692	177,008	Poland 33,941; Japan 19,571; China 8,043.	
Sulfate, manufactured	33,951	62,928	135	China 43,345; Belgium-Luxembourg 4,275.	
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	26,184	48,230	—	Italy 22,265; China 8,471.	
Worked	2,664	1,521	27	Italy 508; Taiwan 295; Brazil 140.	
Dolomite, chiefly refractory grade	8,185	5,091	—	Japan 1,790; United Kingdom 1,731.	
Gravel and crushed rock	4,020	4,299	2	France 2,427; Japan 1,010.	

See footnotes at end of table.

TABLE 3—Continued
INDONESIA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued:				
Limestone other than dimension	2,425	5,682	—	Taiwan 3,925; Republic of Korea 1,098.
Quartz and quartzite	477	651	—	China 197; Taiwan 106; Sweden 105.
Sand other than metal-bearing	10,050	14,472	10,565	Taiwan 2,411; Malaysia 1,044.
Sulfur:				
Elemental:				
Crude including native and byproduct	50,143	143,193	1	Canada 100,426; Singapore 38,525.
Colloidal, precipitated, sublimed	250,436	117,131	1	Canada 116,806; Republic of Korea 156.
Dioxide	20	9	—	Malaysia 4; Netherlands 3.
Sulfuric acid	210	78	57	United Kingdom 11; China 5.
Talc, steatite, soapstone, pyrophyllite	28,082	43,770	505	China 36,061; Australia 3,126.
Vermiculite including perlite	1,269	408	37	Singapore 180; Philippines 92.
Other:				
Crude	63,741	63,960	232	West Germany 38,846; East Germany 10,645.
Slag and dross, not metal-bearing	35,942	32,270	202	Japan 28,007; United Kingdom 3,703.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	32,165	18,803	266	Taiwan 14,200; Singapore 3,005.
Carbon black	50,957	55,030	1,597	Republic of Korea 16,979; Australia 11,889.
Coal:				
Anthracite and bituminous	1,311,540	620,717	69	Australia 317,407; China 302,626.
Lignite including briquets	864	1,684	467	Singapore 915; Netherlands 47.
Coke and semicoke	² 42,844	47,362	2	China 26,311; Australia 15,341.
Peat including briquets and litter	—	6	—	All from Finland.
Petroleum:				
Crude thousand 42-gallon barrels	34,693	49,171	—	Iran 19,371; Iraq 10,174; Australia 7,054.
Refinery products:				
Liquefied petroleum gas do.	(³)	(³)	—	NA.
Gasoline do.	5,857	24,300	246	Singapore 14,002; Saudi Arabia 3,842.
Mineral jelly and wax do.	50	110	2	China 55; West Germany 11.
Kerosene and jet fuel including white spirit do.	1,157	NA	—	—
Distillate fuel oil do.	11,384	NA	—	—
Lubricants do.	836	NA	—	—
Residual fuel oil do.	3,422	NA	—	—
Bitumen and other residues do.	1,927	1,129	—	Singapore 1,078; Taiwan 36.
Bituminous mixtures do.	14	17	2	Singapore 11.
Petroleum coke do.	209	200	200	—

NA Not available.

¹Table prepared by Audrey D. Wilkes.

²Includes manganese iron ore and concentrate.

³May include silicon metal.

⁴May include other precious metals.

⁵Less than 1/2 unit.

⁶Unreported quantity valued at \$20,000.

⁷Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

⁸Includes bromine and fluorine.

⁹May include gas carbon.

TABLE 4
INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum:			
Bauxite	P.T. Aneka Tambang (Government)	Kijang, Bintan Island	1,300
Metal	P.T. Indonesia Asahan Aluminium (Nippon Asahan Aluminum Co. of Japan, 59%; and Government, 41%)	Kual Tanjung, north Sumatra	225
Cement	P.T. Indocement	Citeureup, west Java	8,000
Do.	P.T. Semen Cibinong	Narogong, east Java	1,400
Do.	P.T. Semen Gresik	Gresik, east Java	1,500
Do.	P.T. Semen Padang	Indarung, west Java	2,200
Coal	P.T. Allied Indo Coal (Allied Indonesia Coalfields Pty. Ltd. of Australia, 60%; and P.T. Mitra Abadi Sakti of Indonesia, 20%)	Parambahan, west Sumatra	500
Do.	P.T. Tambang Batubara Bukit Asam (Government)	Bukit Asam, south Sumtra	4,000
Do.	Perum Tambang Batubara (Government)	Ombilin, west Sumtra	1,000
Copper, concentrate	P.T. Freeport Indonesia Co. (Freeport McMoRan Copper and Gold Inc. of the United States, 80%; Government, 10%; and others, 10%)	Ertzberg and Grasberg, Irian Jaya	350
Granite	P.T. Karium Granite (subsidiary of P.T. Pandawa Sempurna of Indonesia)	Karium Island	2,000
Petroleum, crude (thousand barrels per day)	Atlantic Richfield Indonesia, Inc. (subsidiary of ARCO of the United States)	Arjuna and Arimbi, offshore west Java	170
Do.	do. Maxus Southeast Asia Ltd. (subsidiary of Maxus Energy of the United States)	Cinta and Rama, offshore southeast Sumatra	95
Do.	do. PERTAMINA (Government)	Jatibarang, west Java, and Bunyu, offshore east Kalimantan	80
Do.	do. P.T. Caltex Pacific Indonesia (Texaco Inc., 50%; and Chevron, 50%, both of the United States)	Minas, Duri, and Bangko, central Sumatra	700
Do.	do. Total Indonesia (subsidiary of Compagnie Francaise des Petroles of France)	Handi and Bakapai onshore and offshore east Kalimantan	180
Gas:			
Natural (million cubic feet per day)	Mobil Oil Indonesia, Inc. (subsidiary of Mobil Corp. of the United States)	Arun, Aceh in north Sumatra	1,700
Do.	do. Roy M. Huffington (subsidiary of HUFFCO of the United States)	Badak, east Kalimantan	1,000
Liquefied	P.T. Arun LNG Co. Ltd. (Government, 55%; Mobil Oil, 30%; and the Japan Indonesia LNG Co., 15)	Balang Lancang, Aceh in north Sumatra	10,000
Do.	P.T. Badak LNG Co. Ltd. (Government, 55%; HUFFCO Group, 30%; and the Japan Indonesia LNG Co., 15%)	Bontang, east Kalimantan	7,900
Nickel:			
In ore	P.T. Aneka Tambang (Government)	Pomalia, south Sulawesi; and on Gebe Island, Moluccas	34
In matte	P.T. International Nickel Indonesia (Inco Ltd. of Canada, 78%; Sumitomo Metal Mining Co. Ltd. of Japan, 20%; other, 2%)	Soroako, south Sulawesi	48
Nitrogen	P.T. Aseah-Aech Fertilizer (Government, 60%; other members of Asean, 40%)	Lhokseumawe, north Sumatra	506
Do.	P.T. Pupuk Iskandar Muda (Government)	do.	506
Do.	P.T. Pupuk Kalimantan Timur (Government)	Bontang, east Kalimantan	1,012
Do.	P.T. Pupuk Sriwijawa (Government)	Palembang, south Sumatra	1,438
Steel, crude	P.T. Krakatau Steel (Government)	Cilegon, west Java	2,000

See footnotes at end of table.

TABLE 4—Continued
INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Tin:			
In ore	P.T. Koba Tin (Government, 25%; Renison Goldfields Consolidated Ltd. of Australia, 75%)	Koba, Bangka Island	6
Do.	P.T. Tambang Timah (Government)	Onshore and offshore islands of Bangka, Belitung, and Singkep	32
Metal, refined	Peleburan Timah Indonesia (Government)	Mentok, Bangka Island	32

TABLE 5
INDONESIA: RESERVES OF
MAJOR MINERAL COMMODITIES
FOR 1991

(Thousand metric tons
unless otherwise specified)

Commodity	Reserves
Bauxite	¹ 396,000
Coal	² 3,000,000
Copper	³ 676,000
Gas, natural billion cubic feet	87,015
Nickel	⁴ 367,000
Petroleum, crude million barrels	8,200
Tin	⁵ 740

¹Includes proven reserves on Bintan Island and west Kalimantan, grading no less than 40% Al₂O₃.

²Includes proven and probable reserves.

³Represents proven and probable reserves, grading 1.6% Cu, in the Ertsberg and Grasberg areas of Irian Jaya.

⁴Represents proven and probable reserves on Gag Island, Gebe Island, in the Polmalaa and Soroako areas of south Sulawesi, grading between 1.5% to 2% Ni.

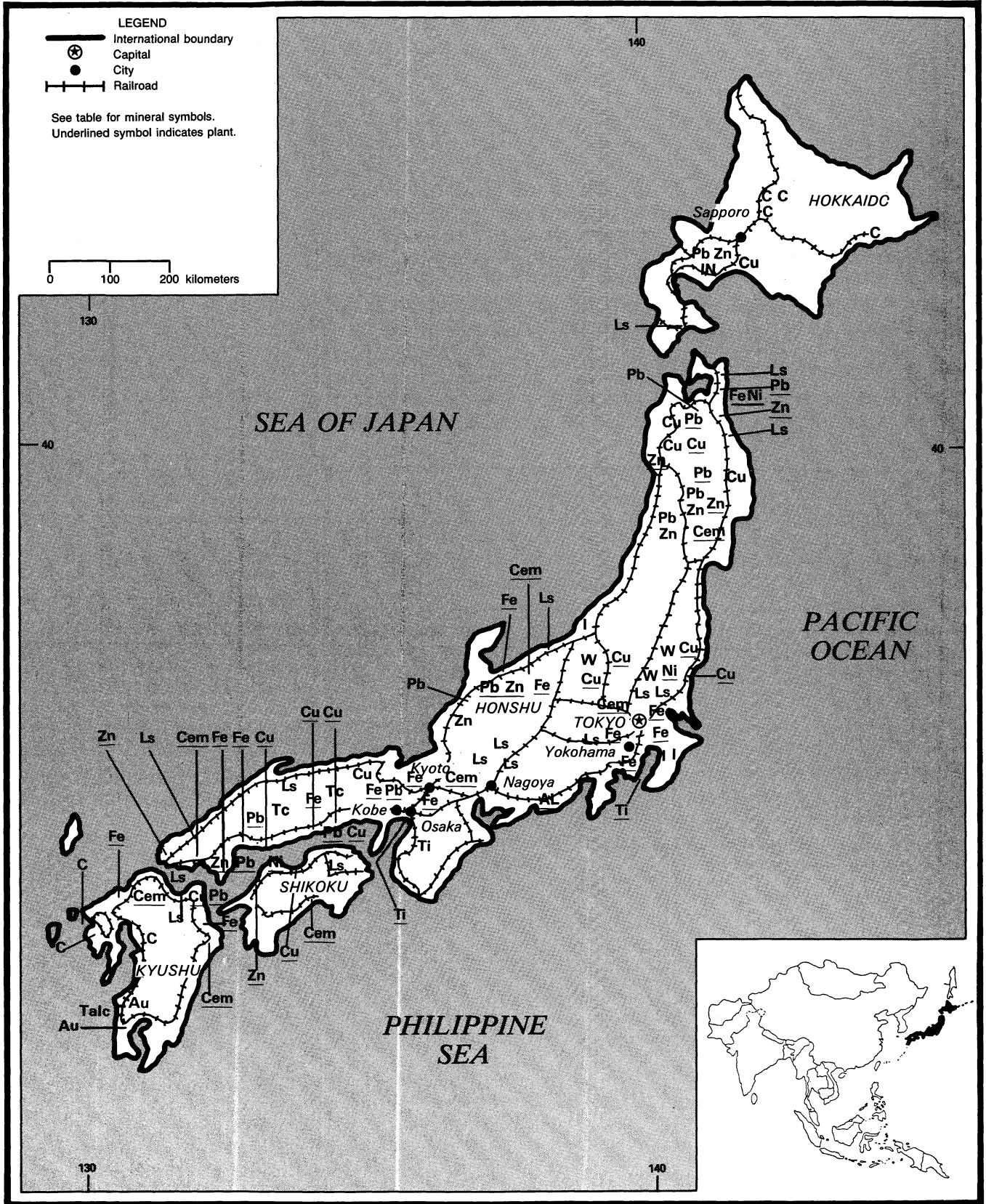
⁵Official proven reserves.

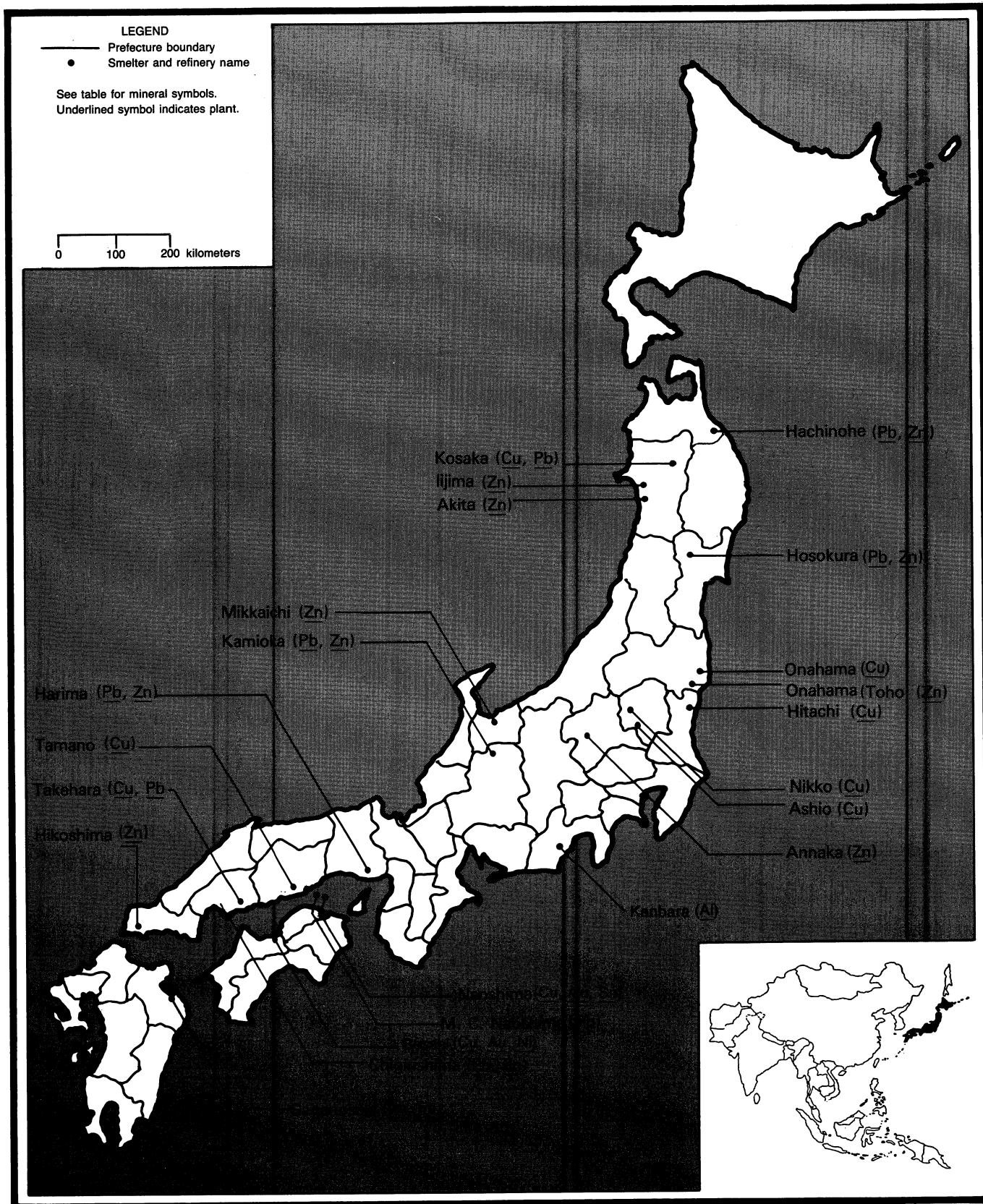
Sources: The Indonesian Department of Mines and Energy, the Indonesian Mining Association, P.T. Freeport Indonesia Co., P.T. Inco., and Oil and Gas Journal.

JAPAN

AREA 377,835 km²

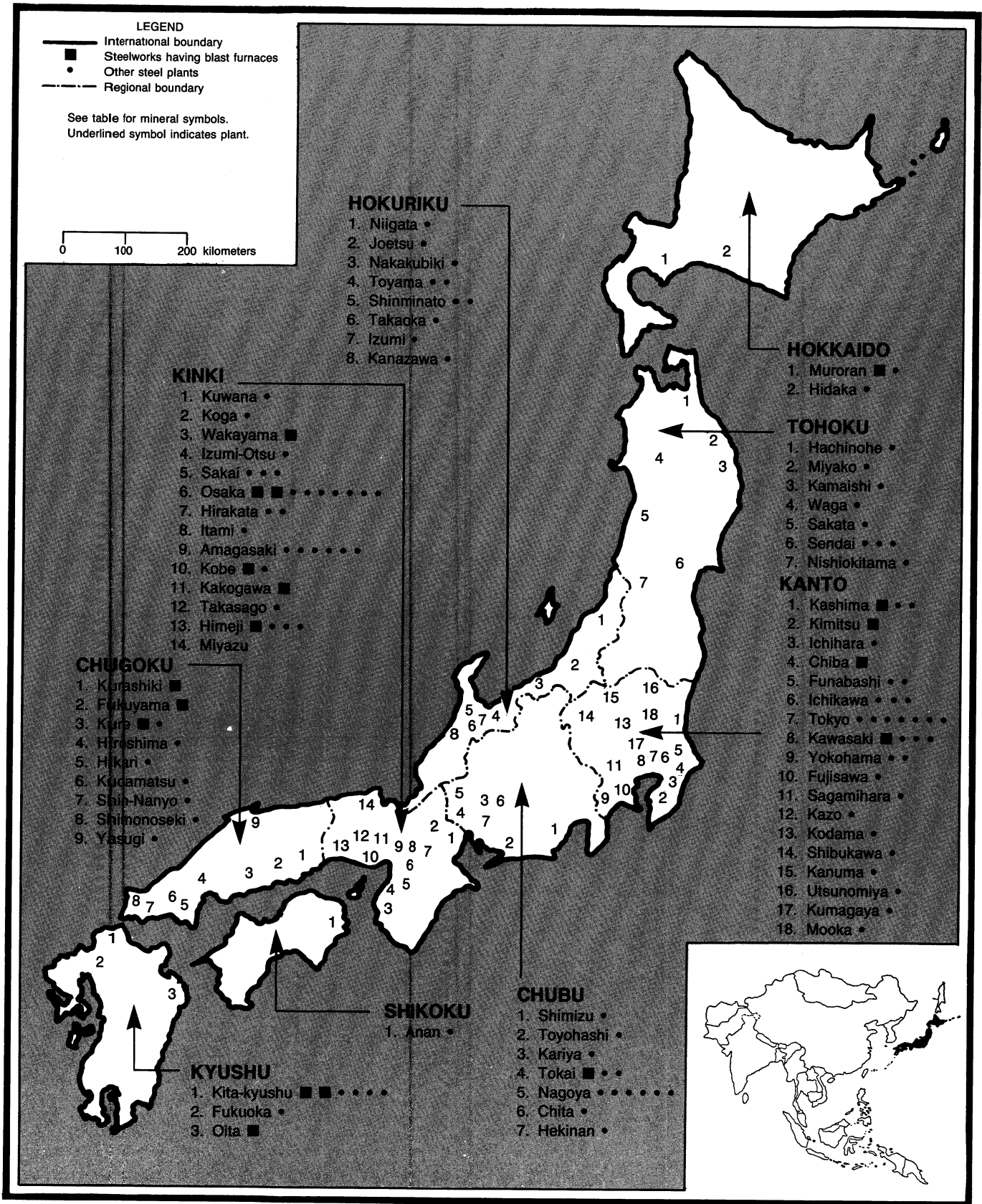
POPULATION 124.0 million





Metal Mining Agency of Japan (Tokyo) publication adapted from *Mining Activities of Japan, 1990*.

JAPAN: LOCATION OF MAJOR NONFERROUS SMELTING AND REFINING PLANTS



The Japan Iron and Steel Federation (Tokyo) publication adapted from *The Steel Industry of Japan*, 1991.

JAPAN: LOCATION OF MAJOR STEELWORKS

THE MINERAL INDUSTRY OF

JAPAN

By John C. Wu

In 1991, Japan was the world's largest producer of cadmium metal, indium metal, iodine, electrolytic manganese dioxide, pyrophyllite, selenium metal, and tellurium metal. It was the world's second largest producer of high-purity gallium metal, pig iron, steel, titanium sponge, and zinc metal and the third largest producer of cement, copper metal, limestone, and nickel metal. Japan remained one of the world's top six producers of bismuth metal, bromine, lime, primary magnesium, and silica sand. Ore reserves of crude petroleum, natural gas, and most nonfuel minerals in Japan are very small. However, Japan's reserves of iodine, limestone, silica stone and sand, and pyrophyllite are large and of world significance.

Japan is a major world market for metals and minerals. It is a large consumer of primary aluminum, cadmium metal, chromite, coal, cobalt metal, copper concentrate and metal, diamond, ferrochromium, iron ore, ilmenite and rutile, industrial salt, LNG, manganese ore, nickel ore and matte, crude petroleum, potash, phosphate rock, precious metals, rare earths, and zircon. On the other hand, Japan is a major exporter of cement, manufactured fertilizer materials, iodine, electrolytic manganese dioxide, high-purity rare metal products, iron and steel products, and titanium sponge and mill products.

The mining sector of Japan's mineral industry remained small. According to the latest statistics published by Japan's Economic Planning Agency, the value of output by the mining sector was estimated at \$8.4 billion,¹ accounting for 0.27% of Japan's GDP in 1991. Japan's GDP, in 1985 constant dollars, was \$3.1 trillion in 1991. The mineral processing sector, which expanded its nonferrous metal smelting and refining capacities in 1991,

continued to play an important role in providing the basic materials for the large manufacturing sector, thereby sustaining a steady growth of Japanese economy in 1991.

Japan remained an important market for U.S. exports of primary aluminum, beryllium metal, boron oxides and acids, coal, copper concentrate and metal, ferrous and nonferrous scrap metals, lithium products, dust and powder of precious stones, primary magnesium, molybdenum concentrate and metal, phosphate rock, rare-earth compounds, soda ash, tantalum metal and powder products, and refined petroleum products, especially petroleum coke. On the other hand, Japan continued to be an important supplier of fabricated aluminum mill and copper mill products, cement, iodine, iron oxide, high-purity rare metals, high-quality steel products, and titanium sponge and mill products to the United States.

Japan remained a large net importer of mineral commodities in 1991. According to the Ministry of Finance, mineral commodity imports, including metallic ore and scrap, coal, crude and refined petroleum, LNG, iron and steel products, and nonferrous metals, increased slightly to \$80.5 billion in 1991. Japan's mineral commodity exports, including metallic and industrial mineral products, rose 8% to \$24.6 billion in 1991. As a result, Japan's mineral trade deficit declined from \$57.5 billion in 1990 to \$55.9 billion in 1991 mainly because of a lower import bill for mineral fuels and higher export earnings from iron and steel products.

In 1991, imports of mineral fuels were \$54.8 billion, of which \$30.2 billion was for crude and partially refined petroleum, \$7.6 billion for refined petroleum products, \$7.7 billion for LNG, \$6.4

billion for anthracite and bituminous coal, and \$2.9 billion for other fuels. Imports of metallic ore and scrap totaled \$8.8 billion, of which \$3.6 billion was for iron ore and \$5.2 billion for nonferrous ore and ferrous and nonferrous scrap. Japan's imports of iron and steel products and nonferrous metals totaled \$16.9 billion, while exports of iron and steel, nonferrous metal, and other metal products totaled \$21.1 billion. Additionally, Japan exported \$3.5 billion worth of industrial mineral products in 1991.

GOVERNMENT POLICIES AND PROGRAMS

In June, the Coal Mining Council, an advisory body to the Ministry of International Trade and Industry (MITI) submitted its recommendations to the Government for implementing Japan's Ninth National Coal Policy beginning on April 1, 1992. In its recommendations, the council called on domestic coal companies to continue reducing their domestic production. However, no specific production target was given by the council.

The council also recommended that the Government provide subsidies to domestic coal companies for streamlining their management, diversifying their business, and developing their overseas coal resources. Government subsidies under the Ninth National Coal Policy reportedly would be funded by revenue from either general account of the Government budget, a new coal tariff, coal consumption tax, or existing petroleum tariff. The council also called on Japan to transfer its coal mining and environmental control technologies to such coal-producing countries as China,

the former U.S.S.R., and eastern European nations.²

To raise revenues for financing part of Japan's monetary contribution (\$9 billion) to the coalition forces in the Persian Gulf War, the Government imposed a temporary 1-year increase in crude petroleum and refined petroleum product taxes by 50% in 1991. The temporary excise tax rate for domestic and imported crude petroleum was raised to \$22.72 per kiloliter and domestic natural gas and imported LNG to \$8.02 per ton. The import surcharge tax rate for refined petroleum products was also raised to \$22.72 per kiloliter and imported LPG to \$7.46 per ton. The temporary tax increase was expected to raise \$1.8 billion in 1991.

According to the Metal Mining Agency of Japan (MMAJ), because of the Government's budgetary constraints, the 60-day supply goal of Japan's rare-metals stockpile of chromium, cobalt, manganese, molybdenum, nickel, tungsten, and vanadium under a two-scheme plan probably would not be attained until fiscal year 1995. The stockpile of the seven metals by the Government program increased only by 2.8 days to 38.1 days of supply by the end of fiscal year 1991, and the private program increased by 1.2 days to 16.3 days of supply.

To increase its mineral information gathering capability, MMAJ is to open a new branch office in Johannesburg, the Republic of South Africa, in 1992. As of 1991, MMAJ has a representative in each of the 12 branch offices in Bangkok, Thailand; Beijing, China; Canberra, Australia; Lima, Peru; London, United Kingdom; Manila, Philippines; Mexico City, Mexico; Nairobi, Kenya; New York, United States; Paris, France; Rio de Janeiro, Brazil; and Vancouver, Canada. Two representatives are stationed in each of the branches of New York and Vancouver. These representatives are under the supervision of MMAJ's Mineral Resources Information Center. MMAJ is an affiliated agency under the supervision of the Mining Division of MITI's Agency of Natural Resources and Energy.

In February, the Governments of Japan and Brazil reached an agreement calling for Japan to help Brazil fight serious mercury pollution caused by gold mining in the Amazon Basin. Under the agreement, the National Research Institute for Pollution and Resources of MITI was to send a factfinding team to conduct a survey on the mercury-contaminated areas in the spring of 1991. The agreement also called for MITI and the Brazilian Ministry of Mines and Industry to jointly develop a low-cost and mercury-free gold refining technology for extracting gold in Brazil.

In April, the Governments of Japan and Mongolia signed a 3-year cooperation agreement for Japan to assist in the development of nonferrous metals resources in Mongolia. Under the agreement, MMAJ was to undertake a preliminary survey on a 500,000-km² area in eastern Mongolia for the first 2 years beginning in June 1991. According to MMAJ, a team of five of MMAJ's geologists and staff of Mongolian State Geological Center were to conduct geological, geochemical, and geophysical surveys in the Uudam Tal area during the summer months of 1991-92. The Japan International Cooperation Agency was to provide about \$2.2 million for the first 2 years of joint geological surveys.

PRODUCTION

Mine production of all nonferrous minerals, except gold, silver, and zinc, declined from that of 1991 because of lower metal prices and continuing production cutback at several major nonferrous mines operated in the Prefectures of Akita, Gifu, and Iwate. Increased gold production was mainly due to increased ore output at the Hishikari Mine, Kagoshima Prefecture in southern Kyushu. Mine production of most construction-related materials, such as limestone, continued the upward trend of 1990 because of strong demand by the cement and construction industries, while production of other industrial minerals declined slightly from that of 1990.

In the mineral fuels sector, coal output dropped to a record low in 1991 because

of further production cut back to comply with the Government's Eighth National Coal Policy. Production of natural gas and crude petroleum increased in 1991 because the newly developed Iwafune Oilfield, offshore Niigata Prefecture in the Japan Sea, was brought on-stream in 1991.

In the mineral processing sector, production of most metals and industrial minerals, such as cement, pyrophyllite, sulfur, and talc, was higher than that of 1990 because of a stronger demand reflecting a continued growth in the Japanese economy in 1991. The decline in production of lead, magnesium, steel, tin, and several minor metals, specifically germanium, and some elements of rare-earth metals was due to weaker demand and unfavorable market conditions in 1991. (See table 1).

TRADE

Japan remained a major world importer of energy, nonfuel minerals, and nonferrous metals and a major world exporter of processed minerals in 1991. As a result of decreased import bills of mineral fuels and increased export earnings of processed minerals, such as nonferrous metals and steel products, Japan had a smaller mineral trade deficit in 1991. The lower import bill of mineral fuels was due to a decrease in the world's coal and oil prices, while increased export earnings were due to increased export volume and the higher world price of steel products in 1991.

Despite increased imports of mineral fuels, including coal, crude and partially refined petroleum, LNG, and refined petroleum products, the total import bill of mineral fuels declined from \$56.7 billion in 1990 to \$54.7 billion, accounting for 23.1% of total imports in 1991. Because of increased imports of minerals ores, iron and steel products, nonferrous metals, and metal scrap, total import bills of nonfuel minerals rose from \$23.6 billion in 1990 to \$25.7 billion, accounting for 10.9% of total imports in 1991.

Total exports of mineral commodities, including iron and steel, nonferrous

metals, and industrial minerals, increased from \$22.8 billion in 1990 to \$24.6 billion, accounting for 7.8% of total exports in 1991. Exports of iron and steel rose from \$12.5 billion in 1990 to \$13.6 billion because of increased exports to China, the Republic of Korea, Taiwan, Thailand, and to other countries in Southeast Asia. Exports of nonferrous metals and industrial minerals rose from \$10.3 billion in 1990 to \$11.1 billion.

The United States remained the most important trade partner of Japan because of its significant role in supplying Japan with a wide variety of raw materials, foodstuffs, and manufactured products. In overall merchandise trade, Japan's exports to the United States rose from \$90.3 billion in 1990 to \$91.5 billion, accounting for 29% of Japan's total exports in 1991. Imports from the United States also rose from \$52.4 billion in 1990 to \$53.3 billion, accounting for 23% of Japan's total imports in 1991. Despite an increase in imports from the United States, Japan had a merchandise trade surplus of more than \$38 billion with the United States because of the continued increase in exports of machinery and equipment in 1991. (See tables 2 and 3).

STRUCTURE OF THE MINERAL INDUSTRY

In terms of the number of establishments, employment, and gross values of production, Japan's mineral industry consisted of a small nonferrous metal mining sector, a small-size coal mining sector, a large industrial mineral mining sector, and a world-class ferrous and nonferrous minerals processing sector. Mining and mineral processing businesses are owned and operated by private companies incorporated in Japan. The Government extends financial and technical assistance to the mineral industry, which follows Government policy guidelines during depressed market conditions.

Because of the restructuring program resulting from the depressed market conditions domestically and

internationally in the 1980's, industry output capacity and employment had been reduced considerably. Contraction in coal, nonferrous metal mining, iron and steel, fertilizer materials, and cement was more drastic than other sectors because of the appreciation of the yen, higher domestic production costs, and lower import mineral prices.

According to MITI, coal was produced from 6 large-scale major mines and 13 small-scale mines mainly in the Hokkaido and Kyushu areas with total capacity of 9.4 Mmt/a and a work force of 4,600 in 1991. The number of operating nonferrous metal mines remained unchanged at 26, but employment declined from 2,465 in 1990 to 2,404 in 1991. The number of operating industrial minerals mines and employment both declined from 595 and 13,370, respectively, in 1990 to 592 and 13,247, respectively, in 1991.

In line with the overall industrial restructuring program, the steel industry continued implementing reduction in employment, but maintain its production capacity of about 137 Mmt/a in 1991. The steel industry reduced its work force by 811 workers to 293,327 in 1991. Because of the continued increase in domestic demand for copper, lead, and zinc, the nonferrous metal smelting and refining industry had expanded its capacity of copper and lead in 1991 and was expected to boost its capacity of zinc in the next 2 years. According to MITI, Japan's copper smelting and refining capacity had been raised from 1,316,400 mt/a and 1,124,400 mt/a, respectively, in 1990 to 1,352,400 mt/a and 1,180,800 mt/a, respectively, in 1991. Japan's lead refining capacity was also being expanded from 316,200 mt/a in 1990 to 327,000 mt/a in 1991.

According to the Statistics Bureau of Japan's Management and Coordination Agency, the number of persons employed by the mining industry in 1991 was about 70,000, accounting for 0.1% of the Japanese labor force of 63.7 million compared with 95,000 persons, accounting for 0.2% of 58.1 million in 1985. (See table 4).

COMMODITY REVIEW

Metals

Aluminum.—Production of primary aluminum by Nippon Light Metal Co. Ltd. at its Kanbara plant in Shizuoka Prefecture declined to a record low and remained insignificant when compared with Japan's requirement for primary aluminum. Since the mid-1980's, Japan had been virtually dependent on primary aluminum imports to meet all of its domestic demand. In 1991, Japan was the world's second largest consumer of primary aluminum following the United States, but was the largest importer of primary aluminum in the world. Its imports of primary aluminum reached a record high at 2.5 Mmt (in metal content of primary aluminum and alloyed ingots) and accounted for 34% of the primary aluminum traded in the world in 1991.

According to the Ministry of Finance, imports of primary aluminum totaled 2,831,018 tons in 1991, of which 124,204 tons was high-grade ingots; 1,932,940 tons, regular-grade ingots; and 773,874 tons, alloyed ingots. Because of its heavy reliance on imports, Japan widely diversified its overseas sources of primary aluminum into more than 50 countries. However, about 88% of Japan's primary aluminum imports in 1991 was from nine major producing countries, where most of Japan's overseas aluminum smelting operations are located. In 1991, the United States was the top supplier, accounting for 25% of Japan's total primary aluminum imports, followed by Australia, 16%; Brazil, 13%; Venezuela and New Zealand, 7% each; Canada, 6%; the United Arab Emirates and the former U.S.S.R., 5% each; and Indonesia, 4%.

Consumption of primary aluminum declined by 8.3% to 2.4 Mmt in 1991 because of a 53.7% decline in demand for secondary smelting. According to the Japan Aluminium Federation, consumption of primary aluminum, by sector, in 1990-91 is shown in table 5. (See table 5).

Cadmium.—Japan was the largest cadmium producer and second largest consumer in the world. Production of cadmium reached a 17-year high in 1991. Imports of cadmium also reached a record high in 1991 partially because of lower market prices but largely because of speculations about possible rapid growth of applications of cadmium-nickel batteries for the electric car.³

Cadmium was recovered as a byproduct of zinc refineries. Japan's raw material requirements for production of cadmium was 78% dependent on imported zinc ore from Australia, Canada, Peru, and the United States. According to the Japan Mining Industry Association, production of cadmium, by company, in 1990 was: Dowa Mining Co. Ltd., 344 tons; Mitsubishi Materials Corp., 366 tons; Mitsui Mining and Smelting Co. Ltd., 434 tons; Nippon Mining Co. Ltd., 440 tons; Sumitomo Metal Mining Co. Ltd., 236 tons; Toho Zinc Co. Ltd., 617 tons; and Nisso Metals and Chemicals, 2 tons.

In 1991, imports of cadmium surged by 76% to 3,426 tons, of which 680 tons was from Belgium, 665 tons from Australia, 514 tons from China, 511 tons from the Republic of Korea, 340 tons from Canada, 205 tons from Peru, and the remaining 511 tons from other countries. The average import c.i.f. price of unwrought cadmium was \$1.78 per pound, compared with \$3.80 per pound in 1990. Exports of cadmium dropped sharply from 255 tons in 1990 to 13 tons in 1991, of which 11 tons went to the Republic of Korea.

Domestic demand for cadmium reached a record high at 2,805 tons in 1991. Of the total demand, 84% was consumed for cadmium-nickel batteries, 5% for pigment, 3% for nonferrous alloys, 1% for stabilizer of plastic, and the remaining 7% for other uses. Consumption of cadmium for the manufacture of nickel-cadmium batteries had increased from 1,511 tons in 1985 to 2,346 tons in 1991. According to the Japan Storage Batteries Industry Association, production of nickel-cadmium batteries also had increased from 235 million units in 1985 to 624 million units in 1991.

In past years, most of the nickel-cadmium batteries in Japan were used for railroad crossing signals, toys, video cassette recorders, cordless telephones, and more recently for portable personal computer and cellular car telephones. The batteries industry was expecting an upsurge application of nickel-cadmium batteries for electric cars in the next few years.

Chromium.—Chromium ore produced by Nippon Chrome Industries Ltd. from the Wakamatsu Mine in Tottori Prefecture was estimated to remain at the same level as that of 1990. Japan relied on imports to meet practically all of its chromium ore requirements and 68% of its ferrochromium requirements in 1991.

Imports of metallurgical- and refractory-grade chromite declined by 4% to 755,059 tons in 1991 because of increased imports of ferrochromium. The Republic of South Africa remained the dominant supplier of chromite, providing 455,798 tons in 1991. Other important suppliers of chromite were Brazil, 67,995 tons; Madagascar, 66,227 tons; the former U.S.S.R., 49,685 tons; the Philippines, 30,000 tons; India, 28,632 tons; Albania, 27,330 tons; and Iran, 24,664 tons.

According to MITI, consumption of chromite by the ferroalloy industry dropped from 605,087 tons in 1990 to 580,734 tons in 1991. Ferrochromium was produced by five companies in 1991. Japan Metal and Chemical Co. Ltd. operated a 62,800-mt/a-capacity plant at Kita Kyushu in Fukuoka Prefecture and a 46,600-mt/a-capacity plant at Oguni in Yamagata Prefecture. NKK Corp. operated a 96,100-mt/a-capacity plant at Toyama in Toyama Prefecture. Nippon Denko K.K. operated a 77,990-mt/a-capacity plant at Hokuriku in Toyama Prefecture. Pacific Metals Co. Ltd. operated a 49,000-mt/a-capacity plant at Hachinohe in Aomori Prefecture. Showa Denko K.K. operated a 20,700-mt/a-capacity plant at Chichibu in Saitama Prefecture and a 55,000-mt/a-capacity plant at Shunan in Yamaguchi Prefecture. Lower production of ferrochromium in 1991 was caused by electrode

malfunctioning in one of the furnaces at NKK's Toyama plant and a temporary shut down for the planned repair at Showa Denko's Chichibu plant.

Japan ferrochromium imports rose from 441,672 tons in 1990 to 578,073 tons in 1991 owing to higher demand by the stainless steel industry and tight domestic supply of ferrochromium. The Republic of South Africa remained the dominant supplier of ferrochromium, providing 363,529 tons or 62% of total ferrochromium imports in 1991. Other important suppliers were India, 60,653 tons; Zimbabwe, 43,746 tons; Turkey, 20,897 tons; the Philippines, 17,688 tons; Brazil, 15,719 tons; and China, 15,140 tons. The average c.i.f. import prices of high-carbon and low-carbon ferrochromium were \$555.23 per ton and \$1,248.02 per ton, respectively, in 1991, compared with \$612.76 per ton and \$1,299.95 per ton, respectively, in 1990.

Japan was the world's leading producer of chromium metal in 1991. Production of chromium metal with 99.95% purity was by two companies. Nippon Denko K.K. operated a 700-mt/a plant using the aluminothermic process at Tokushima in Tokushima Prefecture. Tosoh Corp. operated a 3,600-mt/a plant using the electrolytic process at Yamagata in Yamagata Prefecture.

According to a Japanese industry source, domestic demand for chromium metal was about 2,000 tons, of which 59% was for super alloy, 20% for nonferrous alloys, 16% for welding rod, and 5% for other uses. In 1991, Japan exported 794 tons of chromium metal mainly to the United Kingdom, 250 tons; France, 178 tons; the United States, 167 tons; and China, 140 tons.

Cobalt.—Japan relied on imports to meet virtually all of its cobalt requirements. Cobalt metal production declined slightly in 1991. Sumitomo Metal Mining Co. Ltd., the sole cobalt producer, recovered cobalt from the precipitate of its nickel refinery in Niihama, Ehime Prefecture, on Shikoku Island. Nippon Mining Co. Ltd.'s Nikko cobalt-nickel refinery in Ibaraki

Prefecture remained shut down owing to the lack of raw materials.

Despite high cobalt prices, imports of cobalt metal rose sharply to a record high in 1991. According to a Japanese industry source, increased imports in 1991 were largely due to inventory buildup by the Japanese end users. Great concern about stability of cobalt supply from Zaire reportedly was the main cause of the Japanese inventory buildup. In 1991, imports of cobalt metal, including powders, flakes, and waste and scrap, were 6,716 tons, compared with 4,536 tons in 1990. Zaire and Zambia were the two dominant suppliers, providing 3,442 tons and 1,133 tons, respectively. Other important sources of imported cobalt in 1991 were Belgium, 823 tons (mostly in cobalt powder); Norway, 428 tons; and the former U.S.S.R., 217 tons.

According to MITI, consumption of cobalt by end use is shown in table 6. However, the cobalt consumption estimated by the industry was about 1,400 tons more than that of MITI. (See table 6).

Copper, Lead, and Zinc.—Japan's import reliance of copper, lead, and zinc continued to rise in 1991, when domestic demand for these metals moved higher, while domestic mine production remained low. Because of the strong Japanese yen, domestic high-cost producers of nonferrous minerals continued to scale down their mining operations. In 1991, according to MITI, there were only four major nonferrous metal mining companies that operated with more than 100 workers each and two small-scale nonferrous metal mining companies that operated with less than 100 workers.

The Hanaoka Mining Co. Ltd., a lead and zinc producer, operated three underground mines at Ezuri, Fukasawa, and Matsumine in Akita Prefecture with 371 workers. The Kamaishi Mining Co. Ltd., a copper and iron ore producer, operated the Kamaishi Mine in Iwate Prefecture with 106 workers. The Kamioka Mining Co. Ltd., a lead and zinc producer, operated two underground mines at Kamioka-Mozumi and Kamioka-Tochibora in Gifu Prefecture with 865

workers. The Toyoha Mining Co. Ltd., a lead and zinc producer, operated an underground mine at Toyoha in Hokkaido Prefecture with 367 workers. The Toyoha Mine, owned by Nippon Mining Co. Ltd. and operated by Toyoha Mining, has had 30 million tons of reserves, of which 15 Mmt had been mined out. The remaining 15 Mmt of ore reserves has an average ore grade of 9.8% zinc, 2% lead, and 0.3% copper plus 200 g/mt of silver and some amounts of indium. The Shin-Uchinotai Mining Co. Ltd., a lead and zinc producer, operated an underground mine at Nurukawa in Aomori Prefecture with 49 workers. Kosaka Smelting and Refining Co. Ltd. resumed lead mining at Kosaka in Akita Prefecture with 45 workers in 1991.

In domestic exploration, MMAJ conducted further exploration at the Jozankei area near the Toyoha Mine in Hokkaido Prefecture in 1991. The results indicated that the hydrothermal polymetallic vein at the Jozankei area contains between 1.4 % and 8.9% lead, between 2.3% and 35.9% zinc, plus between 55 g/mt and 404 g/mt of silver and between 50 g/mt and 260 g/mt of indium.

In overseas exploration and development, Western Zinc Corp., a joint venture of Mitsui Mining and Smelting Co. Ltd., Mitsui & Co. of Japan, and Cyprus Minerals Co. of the United States, began joint exploration for zinc in two unspecified areas in the Midwestern United States. The joint exploration project had completed its geophysical survey and was conducting exploratory drilling in the areas.⁴

In 1991, Mitsui Mining and Smelting Co. Ltd. reportedly paid \$1.4 million to Total Ener-Gold Co. for acquiring a 19.4% interest in the MacMillan and Clear Lake lead and zinc deposit in Yukon Territory, Canada. Mitsui Mining and Smelting, through its subsidiary Mitsui Metal Resources Development Corp. of Canada, entered into joint venture with Total. Under the joint-venture agreement, Mitsui Mining and Smelting will be allowed to raise its

equity holding on the property to 70% by paying an additional \$2.1 million.

Sumitomo Metal Mining Co. Ltd. reached an agreement with Phelps Dodge Corp. of the United States in June for Sumitomo Metal Mining to participate in Phelps Dodge's La Candelaria copper-gold project near Copiapo in northern Chile. According to the agreement, Sumitomo will take 20% interest or invest \$25 million in the project and will also share total equity capital needed to develop the mine. The development project was scheduled to begin in June 1992 and to be completed in early 1995 with a total project cost of about \$530 million. The La Candelaria deposit, which was discovered by Cia Minera Ojos del Salado SA, a wholly owned subsidiary of Phelps Dodge, has 354 Mmt of reserves, averaging 1.14% copper and 0.26 g/mt of gold.⁵

Japan remained the world's largest importer of copper in 1991. Imports of copper ore and concentrate, refined copper, and copper scrap all reached record-high levels in 1991. (See table 7 and figure 1).

In 1991, imports of lead ore and concentrate rose by 8.8% to 304,054 tons, of which 88,804 tons came from Australia, 78,180 tons from Canada, 50,231 tons from Peru, 29,422 tons from the United States, 23,669 tons from the Republic of South Africa, 19,333 tons from Thailand, and 14,415 tons from other countries. Imports of zinc ore and concentrate decreased 2.5% to 1,156,089 tons, of which 677,392 tons came from Australia, 173,098 tons from Peru, 111,083 tons from the United States, 90,321 tons from Canada, 45,998 tons from China, and 58,197 tons from other countries. The United States displaced Canada as Japan's third largest supplier when the Red Dog zinc mine in Alaska began its shipments of zinc concentrate to Japan in 1991.

Imports of refined lead decreased slightly to 68,805 tons, and imports of slab zinc increased slightly to 142,194 tons in 1991. The suppliers of refined lead in 1991 were Peru, 16,736 tons; Mexico, 16,077 tons; Australia, 14,179 tons; the former U.S.S.R., 5,942 tons;

the United States, 5,620 tons; Canada, 4,712 tons; and other countries, 5,539 tons. The major suppliers of slab zinc were North Korea, 32%; Canada, 15%; Australia, 14%; the Republic of Korea, 13%; Mexico, 9%; China, 5%; and Peru 4%. (See table 8).

In February, Marubeni Corp., a major Japanese trading company, reportedly reached a 5-year trade agreement with Primorsky-Vostok Mining Corp. of the former U.S.S.R. to import 8,000 mt/a of copper concentrate from the Vostok nonferrous metal mine on the far eastern coast of the former U.S.S.R. In return, Marubeni is to ship about 450 used Nissan vehicles to the Soviet far east and Siberia over the next 5 years.

According to a local press report, the Japanese Electric Wire and Cable Makers' Association and the Japan Brass Makers' Association will call on the Government to lower the tariff on refined copper to ensure stable supplies of copper and foster the continuing economic expansion. The officials of these two copper end-use industry associations were expected to meet with the Minister of International Trade and Industry in early 1992 to ask the Government to reduce the tariff on refined copper to the level comparable with other Western countries. In 1991, Japan imposed a tariff of 15 yen per kg or about 5 cents per pound on refined copper pricing at 485 yen per kg or about 99.7 cents per pound. By late 1991, the MITI reportedly was considering lowering the tariff on refined copper to 10 yen per kg following GATT meetings with the United States and European Community countries.

Metal production of copper and zinc increased as a result of capacity expansion sustained by strong domestic demand and increased exports to the Far East market, while metal production of lead remained steady. According to MITI, as of December 1991, the nonferrous mineral processing sector had 1,353,400 mt/a of copper smelting capacity, 1,238,400 mt/a of copper refining capacity, 327,000 mt/a of lead refining capacity, and 896,400 mt/a of zinc refining capacity.

Mitsubishi Materials Corp. brought on-stream a new continuous copper smelter at Naoshima complex in Kagawa Prefecture in May. The \$148 million new smelter with design capacity of 183 mt/h requires 600,000 mt/a of copper concentrate and 50,000 mt/a of scrap and other secondary materials. The smelter reportedly was the first in Japan to receive copper concentrate produced from the Escondida Mine in Chile. The sources of copper concentrate for the smelter came from Australia, Canada, Chile, Indonesia, Malaysia, Papua New Guinea, and the Philippines. To have an adequate capacity for refining at Naoshima, Mitsubishi Materials was expanding its copper refinery capacity to 179,500 mt/a by May 1992 from 163,200 mt/a in 1991. The rated capacity of the new smelter at Naoshima, according to MITI, remained at 193,200 mt/a in 1991.⁶

In 1991, Nippon Mining completed the expansion programs. Capacity of the smelter at its Saganoseki plant was being raised from 300,000 mt/a to 330,000 mt/a. Capacity of the refinery at its Hitachi plant in Ibaraki Prefecture and at its Saganoseki plant in Oita Prefecture was being raised from 120,000 mt/a to 132,000 mt/a and from 180,000 mt/a to 198,000 mt/a, respectively. The company also completed installation of new equipment to treat sulfuric acid gas for additional recovery of copper.

Hibi Kyodo Smelting Co. Ltd., a joint venture of Mitsui Mining and Smelting, Nittetsu Mining Co. Ltd., and Furukawa Co. Ltd., also completed an expansion program of the copper smelting and refining capacities at its Tamano plant in Okayama Prefecture in 1991. Capacity at the smelter and refinery was being raised from 210,000 mt/a to 252,000 mt/a and from 136,000 mt/a to 163,200 mt/a, respectively.

Construction of a new 150,000-mt/a copper smelter at Texas City near Galveston on the Gulf of Mexico in Texas by Texas Copper Corp., a subsidiary of Mitsubishi Materials, reportedly was still awaiting for an environmental permit after a joint environmental assessment from the U.S.

Army Corps of Engineers and the U.S. Environmental Protection Agency as well as an air permit from the Texas Air Control Board after a public hearing. Because of the delay in permitting procedure, construction work was postponed again until 1992.

Toho Zinc Co. Ltd., Japan's largest refined lead producer, completed capacity expansion of its lead smelting and refining facilities at Chigirishima in Hiroshima Prefecture. Capacity at the Chigirishima plant was being raised from 84,000 mt/a to 94,800 mt/a in 1991. The expansion program reportedly would allow Toho Zinc to feed the smelter with more low-grade ore. Sumitomo Metal Mining Co. Ltd. also raised the lead smelting and refining capacity at its Harima plant in Hyogo Prefecture from 26,400 mt/a to 30,000 mt/a in 1991.

To meet the growing domestic demand for slab zinc, several major slab zinc producers were expanding their zinc refining capacity through remodeling of existing facilities. The under taken expansion programs were at the Harima plant in Hyogo Prefecture by Sumitomo Metal Mining to raise its capacity from 79,200 mt/a to 90,000 mt/a, at the Akita plant in Akita Prefecture by Mitsubishi Material from 105,600 mt/a to 130,000 mt/a, and at the Iijima plant in Akita Prefecture by Akita Smelting Co. Ltd. from 156,000 mt/a to 234,000 mt/a.

Domestic consumption for refined copper continued the 1990 upward trend and reached a new high at 1,710,325 tons, of which 68% was for wire and cable, 31% for brass mill products, and 1% for other. Exports of refined copper rose 27% to 64,356 tons in 1991. The major overseas buyers were Taiwan, accounting for 47% of the total exports; the Republic of Korea, 24%; and Thailand, 13%. Overall stocks of refined copper increased by 22.1% to 130,763 tons at the end of 1991.

Domestic demand for refined lead increased 3.8% to 318,251 tons in 1991, of which 64% was for storage batteries, 22% for inorganic chemicals, 4% for solders, 3% for lead pipe and sheet, and 7% for other. Exports of primary lead dropped to only 8 tons from 25 tons in

1990. Overall stocks of primary lead rose by 17.2% to 30,761 tons at the end of 1991.

Domestic demand for zinc slab rose by 4% to 817,754 tons, of which 48% was for sheet galvanizing; 15% for tube, wire, and general galvanizing; 13% each for zinc diecastings and for brass mill products; and 11% for other. Exports of zinc metal dropped by 14.6% to 18,147 tons in 1991. Overall stocks of zinc slab rose by 10.6% to 97,378 tons at the end of 1991.

Gold and Silver.—Mine production of gold reached the highest level in 4 years and that of silver rebounded to a 3-year high in 1991, when Sumitomo Metal Mining began its mining operation at the Yamada ore body near the Hishikari Mine in Kagoshima Prefecture of southern Kyushu. The Hishikari Mine, the largest and richest gold mine, contributed about 80% of Japan's total gold mine output, while the Toyoha Mine, a major lead-zinc-silver mine in Hokkaido, contributed 45% of Japan's total silver mine output in 1991.

Following the discovery of new ore bodies at Yamada and Sanjin in the vicinity of the Hishikari Mine, Sumitomo Metal Mining began its mine expansion program in June and planned to raise ore output from the mine by 50% to 150,000 mt/a in the next 2 years. In 1991, ore output reportedly reached 130,000 tons averaging 54 g/mt of ore or 7 tons of gold. According to MITI, gold and silver produced from the Hishikari Mine by Sumitomo Metal Mining was 6,038 kg and 3,159 kg, respectively, in 1990.

In 1991, two high-grade gold deposits were discovered in Japan. MMAJ announced that it had discovered high-grade gold veins in the Hikiji area of central Kyushu District on the northeastern side of Mount Aso in Kyushu. According to the preliminary surveys and drilling conducted in 1990, quartz-adularia gold veins were founded at a depth of 50 m to 100 m below the surface. Samples assayed between 14.9 g/mt and 171.5 g/mt of gold and between 103 g/mt and 811 g/mt of silver with a width of 5 to 55 cm. MMAJ planned to

conduct further survey and drilling to ascertain the extent of the deposit.

Nissho Iwai Corp. announced that it has discovered a high-grade gold deposit at the old Heisei Buho Mine near the town of Niki in Yoichi-gun, about 50 km northwest of Sapporo in Hokkaido, as a result of its joint gold exploration with two Australian mining companies, Austpac Gold and MIM Holdings. According to Nissho Iwai, the gold vein assayed 26 g/mt of gold and 50 g/mt of silver over 3.5 m at a depth of between 130.1 and 133.6 m. Further drilling was planned for 1992 to ascertain the extent of the deposit for commercial development.⁷

Japan's production of gold metal decreased, while that of silver metal reached a record high in 1991. There were five metal producers of gold and silver in 1991. Dowa Mining was at its Kosaka precious-metals refinery in Akita Prefecture. Mitsubishi Materials was at its Naoshima precious-metals refinery in Kagawa Prefecture. Mitsui Mining and Smelting was at its Takehara precious-metals refinery in Hiroshima Prefecture. Nippon Mining was at its Saganoseki precious-metals refinery in Oita Prefecture. Sumitomo Metal Mining was at its Toyo smelting and refining facilities in Ehime Prefecture. Sludge from domestic copper refineries and foreign sources was used as raw materials for gold and silver recovery.

In 1991, Japan relied on imports to meet 57% of its gold metal demand and 25% of its silver metal demand. Because of a weaker demand, imports of gold metal dropped 15.5% to 255,863 kg. Of the total gold imported in 1991, 30% was from Switzerland, 29% from Australia, 13% from the United Kingdom, 8% from Canada, 7% from the U.S.S.R., 4% from the United States, 2% from New Zealand, and 7% from other countries. Imports of silver metal declined by 8.3% to 855 tons because of excessive imports and overstock in 1990. The principal suppliers in 1991 were Mexico, providing 361 tons; the United States, 271 tons; Australia, 92 tons; and Peru, 65 tons. (See table 9).

Iron and Steel.—Mine production of iron sand and roasted pyrite dropped to a record low in 1991. Japan's iron and steel industry relied on imports to meet virtually all of its iron ore requirements. Despite decreased consumption by the iron and steel industry, imports of iron ore, including iron sand, pellet, and sinter, increased slightly to 127.2 Mmt in 1991. Australia, Brazil, and India remained the three dominant sources of iron ore, providing 46%, 22%, and 16%, respectively. Because of the continued slide in the price of pig iron in 1991, imports of pig iron rose by 2.8% to 3.4 Mmt following a 43.5% jump in imports of pig iron in 1990. The former U.S.S.R., Brazil, and China were the three major suppliers of pig iron, accounting for 51%, 21%, and 17%, respectively, in 1991. Japan also imported about 821,000 tons of iron and steel scrap principally from the United States, 39%, and from Australia and the former U.S.S.R., 9% each, in 1991.

According to the Ministry of Finance, Japan's import c.i.f. price per ton of iron ore rose from \$26.93 in 1990 to \$28.62 in 1991, and its import c.i.f. price per ton of pig iron dropped from \$166.56 in 1990 to \$159.57 per ton in 1991. However, import c.i.f. price per ton of iron and steel scrap rose sharply from \$313.13 in 1990 to \$354.56 in 1991.

In October, six major steel producers had entered into long-term contracts with the Sishen Mine of ISCOR Ltd., the South African Iron and Steel Industrial Corp., to import 4 Mmt/a of iron ore for the next 5 years beginning in fiscal year 1992. According to the Japan Economic Journal, the quantity-basis contracts were signed separately by each steel producer with ISCOR in October. The iron ore price is subject to negotiation annually according to the international market quotations. The iron ore imports by company were as follows: Nippon Steel Corp., 1,808,000 mt/a; NKK Corp., 648,000 mt/a; Kawasaki Steel Corp., 568,000 mt/a; Sumitomo Metal Industries Ltd., 552,000 mt/a; Kobe Steel Ltd., 384,000 mt/a; and Nisshin Steel Co. Ltd., 128,000 mt/a.⁸

The economic sanctions imposed by the Japanese Government against the Republic of South Africa ended in October. However, iron ore was not included in the Government's list of import-banned products for sanctions against the Republic of South Africa. Between 1989 and 1991, Japan imported about 4.9 Mmt/a of iron ore from the Republic of South Africa under 1-year contracts.

Consumption of iron ore, including iron sand, pellet, and sinter by blast furnaces, decreased slightly from 132.16 Mmt in 1990 to 131.99 Mmt in 1991. Of total pig iron produced in 1991, 98.5% was for steelmaking and 1.5% was for foundry uses. Production of crude steel declined slightly in 1991, when the economy began to slow down in the second half of 1991. By the end of 1991, the total number of furnaces, including blast furnaces, electric furnaces, and other furnaces for pig iron production, remained at 47 with a pig iron production capacity of 98.5 Mmt/a.

Japan remained the world's second largest pig iron and crude steel producer, accounting for 15.7% and 14.9%, respectively, of the world production in 1991. Nippon Steel Corp., the largest steelmaker in the Western World, along with four other major steelmakers, continued to maintain its leading position in the Western World in 1991. (*See table 10 and figure 2*).

Because of the economic slowdown in the second half of 1991, domestic demand for steel by the automobile, construction, and industrial machinery industries declined for the first time since 1985. As a result, crude steel output decreased slightly from that of 1990. Of the crude steel produced in 1991, 68.6% was processed by the basic oxygen furnaces and 31.4% by the electric furnaces. The steelmaking sector, according to MITI, maintained its 72 basic oxygen furnaces and 477 electric furnaces. By the end of 1991, the overall crude steel production capacity was 137.4 Mmt/a. However, the industry's labor force was reduced by 811 to 293,327 workers at the end of 1991.

In April 1988, the steel industry, with strong Government support, launched a \$95 million project to develop a new steelmaking process, called direct iron ore smelting reduction (DIOS), to replace the conventional blast furnace process for the next generation. The research and development project, with two-thirds of the cost born by the MITI, was participated by eight integrated steelmakers, Japan Iron and Steel Federation (JISF), and Coal Mining Research Center. In May 1991, after 3 years of research, the project began construction of a \$54 million pilot plant with 500 mt/d at NKK's Keihin Steel Works on Ogishima, an artificial island, off Kawasaki in Kanagawa Prefecture. The DIOS pilot plant, which was scheduled for completion in mid-1993 and to be tested between 1994 and 1995, will have a smelting reduction furnace, a prereduction furnace, and a gas reforming furnace, which mixes coal powder into the gas from the smelting reduction furnace.⁹

According to JISF, the new process uses fine ore and pulverized coal to make iron without going through the sintering and coking process. Powdered ore and coal are prerduced and carbonized in a fluidized bed with hot gas from the smelting reduction furnace, then moved to the smelting reduction furnace, where molten pig iron is produced. The DIOS process reportedly would cut pig iron production cost by about 10% and would reduce carbon dioxide (CO₂) emission by 5% to 10% compared with that of the conventional blast furnace.¹⁰ In November 1991, a joint meeting, sponsored by JISF and the American Iron and Steel Institute (AISI), was held in Pittsburgh, Pennsylvania, to discuss, report, and exchange valuable information on the results of the research on Japan's DIOS and AISI's direct steelmaking program.

Because of the economic slowdown and a drop in new housing starts as well as a slower growth in plant and equipment investment, especially in the second half of 1991, steel demand by the construction and automobile industries declined, while demand by the shipbuilding, electric

appliances, and machinery industries continued to increase. According to JISF, Japan's apparent steel consumption, in crude steel equivalent, broke the previous year's record and reached 99.1 Mmt in 1991. Exports of steel, in crude steel equivalent, rebounded to 20 Mmt in 1991.

Overall domestic demand for steel declined in 1991 owing to a slowdown in construction activity, lagging automobile sales, and a slower private investment in plant and equipment (*See table 11*).

For the first time in 6 years, exports of iron and steel products reversed the downward trend and rose by 5.9% to 18 Mmt in 1991. Increased exports were a direct result of increased exports of cold-rolled coil, coated sheet, pipe and tube, and specialty steel to China, the Republic of Korea, Taiwan, and Southeast Asian countries. Exports to the United States dropped to below the 3 Mmt level, reflecting a slowdown in U.S. economy in 1991. Of the total exports in 1991, 14.3 Mmt was ordinary steel products, 3.1 Mmt, specialty steel products; and 0.6 Mmt, other. Export earnings from iron and steel products increased by 8.8% to \$13.6 billion in 1991. The average export price in 1991 was \$800 per ton compared with \$783 per ton in 1990.

Imports of iron and steel products rose by 18.5% to a record high at 13.8 Mmt in 1991. Of the total imports, 7.5 Mmt was ordinary steel products, 3.4 Mmt was pig iron, 1.4 Mmt was ferroalloy, and 1.5 Mmt was steel slab, semimanufactured, wire, and specialty steel products. Hot-rolled wide strips and plate continued to be the two major import steel products accounting for 67% of ordinary steel products imports in 1991. The major suppliers of ordinary steel products to Japan in 1991 were the Republic of Korea, 3.4 Mmt; Brazil, 1.8 Mmt; China, 1.4 Mmt; the United States, 870,000 tons; and Taiwan 730,000 tons. Japan's imports of iron and steel products from these countries accounted for 59% of total imports in 1991.

Magnesium.—Production of primary magnesium decreased because of increased imports in 1991. Overall

supply of primary magnesium rose from 29,359 tons in 1990 to 32,821 tons in 1991, of which 21,262 tons was imports. Ube Industries Ltd. operated a 9,000-mt/a plant at Ube in Yamaguchi Prefecture, while Japan Metals and Chemicals Ltd. operated a 5,000-mt/a plant at Takaoka in Toyama Prefecture. The United States and Norway remained the two most important sources of primary magnesium to Japan, providing 62% and 19%, respectively, of total imports in 1991.

Domestic demand for primary magnesium rose only slightly to 27,099 tons in 1991 from 27,064 tons in 1990. In 1991, demand by the manufacturers of aluminum mill and alloy products remained steady at 20,231 tons. However, demand by the manufacturers of nodular cast iron and others, such as casting and diecasting, totaled 2,644 tons in 1991, about 7% less than that of 1990. Exports also declined to 18 tons in 1991 from 20 tons in 1990. As a result, overall stocks of primary magnesium at the end of the year increased to 5,119 tons in 1991 from 3,935 tons in 1990.

In an effort to cope with the growing demand for primary magnesium and to reduce production cost, Ube Industries planned to launch a joint research project with CSIRO, an Australian Government research institute, and two Australian mining concerns, MIM Holdings Ltd. and Queensland Metals Corp. NL (QMC) on a new electrolysis process for magnesium metal in the spring of 1992. The \$50 million research project, to be conducted between 1992 and 1995, will be funded 50% by the Australian Government with an interest-free loan and the remainder by the three private companies. The research project will be carried out in Brisbane, Australia, and QMC is to supply the raw material magnesite.¹¹

Manganese.—Japan's only manganese mine, the Nodata Magawa Mine in Iwate Prefecture, was estimated to have an insignificant amount of production in 1991 when compared with its manganese ore requirements. Japan relied on imports for virtually all of its manganese ore requirements in 1991.

Imports of manganese ore totaled 1,483,045 tons in 1991, of which 8,653 tons was manganese dioxide ore and 1,474,392 tons, metallurgical-grade manganese ore. Australia and China were the two suppliers of manganese dioxide ore, providing 68% and 27%, respectively, in 1991. The Republic of South Africa and Australia remained the two dominant suppliers of metallurgical-grade manganese ore, providing 47% and 40%, respectively, in 1991. Japan also imported 180,544 tons of ferruginous manganese ore for production of pig iron in 1991, 73% from the Republic of South Africa and 27% from India.

The overall consumption of metallurgical-grade manganese ore and ferruginous manganese totaled 1,473,046 tons in 1990. (See table 12).

Manganese metal was produced by Tosoh Corp. at its Hyuga plant in Miyazaki Prefecture and by Chuo Denki Kogyo Co. at its Taguchi plant in Niigata Prefecture. Production of manganese metal was estimated to be at the same level as that of 1990. In 1990, Japan imported 13,687 tons of manganese metal mainly from the Republic of South Africa, 8,789 tons; China, 3,912 tons; and the United States, 944 tons. Consumption of manganese metal, according to the TEX Report Ltd. of Japan, was 9,957 tons in 1990, of which 50% was for production of nonferrous metal alloys, 36% for production of specialty steel, 8% for production of welding rod, and 6% for chemical and other uses.

Nickel.—Japan remained the world's third largest producer of nickel metal in 1991, but all of its raw material requirements for production of nickel products were met by imports. In 1991, imports of nickel ore increased by 20% to 4 Mmt. New Caledonia, Indonesia, and the Philippines remained the three suppliers, providing 2,113,388 tons, 1,040,978 tons, and 847,532 tons, respectively, in 1991.

Consumption of nickel ore by the iron and steel industry, mainly for the production of ferronickel, increased 21.8% to 2.9 Mmt in 1991. Imports of

ferronickel rose by 9.5% to 45,925 tons in 1991. The major suppliers of ferronickel in 1991 were New Caledonia, 22,475 tons; Indonesia, 11,717 tons; the Dominican Republic, 6,241 tons; and Colombia, 3,168 tons. Consumption of ferronickel increased from 296,330 tons in 1990 to 319,975 tons in 1991 because of increased production of stainless steel and other specialty steel.

Imports of nickel matte for the production of refined nickel and nickel oxide rose by 7.1% to 64,077 tons in 1991, of which 42,181 tons was from Indonesia and 21,896 tons was from Australia. Imports of nickel oxide and oxide sinters totaled 3,190 tons in 1991, compared with 2,456 tons in 1990. Australia was the dominant supplier of nickel oxide, providing 2,699 tons or 85% of the total imports in 1991.

Production of nickel oxide by Tokyo Nickel Co. Ltd. at its Matsusake plant in Mie Prefecture rose sharply to a record high in 1991 because of increased demand by the specialty steel industry. Production of refined nickel by Sumitomo Metal Mining at its Niihama plant in Ehime Prefecture increased in 1991. Sumitomo Metal Mining completed conversion of its Niihama cobalt refinery for nickel refining and was successfully producing nickel metal using its newly developed Matte Chorine Leaching Electrowinning (MCLE) process in 1991.

To meet the growing domestic demand for refined nickel, Japan's imports of refined nickel, including powder and flake, reached a record high at 57,625 tons in 1991. The major suppliers of refined nickel, including powder and flake, in 1991 were the former U.S.S.R., 23,306 tons; Canada, 7,594 tons; Zimbabwe, 7,501 tons; Norway, 6,652 tons; the United Kingdom, 5,654 tons; and Australia, 3,133 tons. (See table 13).

Platinum.—Japan was the world's largest consumer; however, Japan relied on imports to meet most of its platinum metal requirements. Platinum metal was produced by the five major nonferrous metals producers from the precious-metals refinery inside their nonferrous smelting and refining complex. Scrap

and sludge originated from domestic and foreign sources were used as raw materials for recovery of platinum metal. The five platinum metal producers were Dowa Mining at its Kosaka plant in Akita Prefecture, Nippon Mining at its Saganoseki plant in Oita Prefecture, Mitsubishi Materials at its Naoshima plant in Kagawa Prefecture, Mitsui Mining and Smelting at its Takehara plant in Hiroshima Prefecture, and Sumitomo Metal Mining at its Toyo plant in Ehime Prefecture.

In 1991, Japan imported 70.1 tons of platinum metal to meet its requirements. The former U.S.S.R., the United Kingdom, and the Republic of South Africa were the three principal sources, providing 41%, 22%, and 14%, respectively, in 1991. According to an industry source, consumption of platinum in 1991 was estimated at 62.5 tons, of which 37.0 tons was for jewelry, 12.0 tons for automobile catalytic converters, 8.0 tons for private investment, 2.0 tons each for electronic and glass, and the remaining 1.5 tons for the manufacturing of chemicals, petroleum, and others.

Dowa Mining and Tanaka Metal Industries, a major bullion wholesaler, will jointly bring on-stream Japan's first large-scale platinum-group metals recovery plant using spent automobile catalytic converters in Akita Prefecture in 1992. Construction of the \$20 million plant was scheduled for completion in April 1992. The platinum recovery plant, the world's largest, will have a processing capacity of 5,000 mt/a and is capable of recovering 4.5 tons of platinum, 1.8 tons of palladium, and 0.5 ton of rhodium.¹²

Rare Earths.—Japan remained a major world consumer of rare earths. All of Japan's rare-earth requirements were met by imports. Japan imported rare-earth chlorides and compounds for further processing into rare-earth products. Japan also imported a wide variety of rare-earth products to meet its domestic demand. Imports of both crude rare-earths and seven rare-earth products rose sharply in 1991 because of lower import prices, especially the prices of rare-earth

chlorides, rare-earth metals, and cerium oxide. (See table 14).

In 1991, imports of rare-earth chlorides were mainly from China, 1,252 tons; Malaysia, 1,104 tons; the United States, 385 tons; India, 199 tons; Brazil, 136 tons; and France, 8 tons. Imports of cerium oxide rose 183.3% in 1991 with the United States providing 989.4 tons or 44% of total imports and the former U.S.S.R., 925 tons or 41%. According to the Ministry of Finance, the quantity and value of crude rare earths and rare-earth product imports were 11,406 tons and \$95.9 million, respectively, in 1991, compared with 9,456 tons and \$91.2 million, respectively, in 1990. The major suppliers of crude rare earths and rare-earth products were China, 2,095.7 tons, the United States, 1,767.3 tons; Malaysia, 1,103.8 tons; the former U.S.S.R., 945.5 tons; and France, 670.8 tons in 1991.

Domestic production of rare-earth products declined slightly in 1991. In 1991, there were nine producers of rare-earth products. Santoku Metal Industry Co. Ltd. was in Hyogo. Nippon Yttrium Co. Lt. was in Tokyo. Nissan Rare Earth Chemicals Co. Ltd. was in Saitama. Seimi Chemical Co. Ltd. was in Kanagawa. Shin-Etsu Chemical Industry Ltd. was in Fukui. Tokoku Metals & Chemicals Co. Ltd. was in Fukushima. Mitsui Metal & Mining Co. Ltd. was in Fukuoka. Dowa Mining Co. was in Akita. Nippon Rare Earths Co. Ltd. was in Ehime.

Applications of rare earths in the 1950's and the 1960's were limited to the use of rare-earth fluorides for arc carbon, misch metal for pyrophoric alloys, and cerium and lanthanum oxides for use as a glass polishing agent, an additive to optical lens, and phosphors in television (TV) manufacturing. Application of rare earths in magnetic materials began in the 1970's and greatly expanded in the 1980's.

According to MMAJ, cerium oxide was used mainly as a polishing agent for TV tube glass, plate glass, and optical glass; decoloring of TV tube glass; and as a catalyst for automobile exhaust control, when used with lanthanum. Lanthanum oxide was used as an additive to optical

lens and ceramic condensers. Samarium and neodymium oxides were used for the manufacture of magnetic materials for computer printers and monitors. Europium oxide and yttrium oxide were used as a red phosphor in the manufacture of color TV tubes and tricolor fluorescent lamps. Misch metal was used for the manufacture of auto parts and pyrophoric alloys for cigarette lighters. (See table 15).

Tin.—Japan imported tin ore as well as refined tin to meet all of its requirements. Japan ceased tin mining, when its last tin mine, the Akenobe Mine in Hyogo Prefecture, was closed in 1987. Mitsubishi Material, Japan's only primary tin producer, produced crude tin from its Ikuno smelter then transported it to its Naoshima complex for electrolytic refining. Mitsui Mining and Smelting reportedly also recovered a small quantity of tin by using secondary materials at its Takehara complex. In 1991, production of refined tin declined because of increased imports of low priced tin from Southeast Asian countries.

Imports of refined tin rose by 4.8% to 34,349 tons, of which 12,932 tons was from Malaysia, 9,718 tons from Indonesia, 5,775 tons from Thailand, 4,874 tons from China, and the remaining 1,050 tons from Singapore and other countries. Domestic consumption of refined tin remained steady at 34,915 tons in 1991. The solder and tinplate manufacturers remained the two dominant end users, accounting for 45.5% and 23.5%, respectively, in 1991. Other uses of tin included stabilizer for plastic, 7.1%; brass mill products, 6.1%; cable and tinning, 4.7% each; and 5.4% other.

Titanium.—Japan remained the second largest producer of titanium sponge and one of the major producers of titanium dioxide pigment in the world. However, all of Japan's raw material requirements were met by imports. In 1991, Japan imported 33,787 tons of rutile mainly from Australia, 28,898 tons; India, 3,120 tons; and the Republic of South Africa, 860 tons. Imports of ilmenite totaled

542,216 tons. The principal suppliers were Australia, 204,990 tons; Malaysia, 132,486 tons; India, 96,597 tons; and Canada, 44,964 tons. Japan also imported about 120,000 tons of titanium slag from Canada, 70%, and the Republic of South Africa, 30%. All the rutile was consumed by the producers of titanium sponge. Ilmenite and titanium slag were consumed principally by the titanium dioxide producers for the production of pigment and synthetic rutile. A small amount of ilmenite was consumed as a blast furnace additive in the steel industry.

In 1991, Japan began importing about 17,300 tons of ilmenite from Vietnam under a 10-year contract. The \$49 million sales contract was signed in May between Nissho Iwai Corp., a major trading firm, and Vietnam's Nghe Tinh Province. According to the Vietnam News Agency in Hanoi, under the contract, in the first 2 years, Japan was to purchase 20,000 mt/a of ilmenite, then increase it to 50,000 mt/a. According to the Ministry of Finance, the average c.i.f. import price of ilmenite from Vietnam was \$92.32 per ton, compared with \$117.62 per ton from Malaysia and \$137.84 per ton from all countries in 1991.

Production of titanium sponge decreased considerably in 1991. A slowdown in titanium demand from the aerospace, chemical processing, and utility industries in both domestic and overseas markets was cited by the industry as the main cause of the 1991 decline. In 1991, domestic demand decreased 25% while exports dropped 47%. According to the Japan Titanium Society, total shipments of titanium sponge dropped by 31.1% to 17,291 tons in 1991, of which 13,916 tons was for the domestic market and 3,375 tons for exports. In 1991, titanium sponge was exported to the United Kingdom, 2,088 tons; France, 398 tons; the United States, 383 tons; the Federal Republic of Germany, 242 tons; the Republic of Korea, 240 tons; and 24 tons, other countries. Japan also exported 1,164 tons of titanium scrap and powder, principally to the United States, 540 tons; the United Kingdom, 434 tons;

and the Federal Republic of Germany, 112 tons in 1991.

In September, Toho Titanium, the second largest titanium sponge producer, announced that it will spend \$34.9 million to renovate the sponge production facilities of its Chigasaki plant in Kanagawa Prefecture. The renovation work, which was scheduled to start in early 1992, will involve replacement of the existing 1.6-ton reduction-separation furnaces with 7.4-ton furnaces, equipped with an up-to-date process control system, and installation of a new sponge pulverizing system to increase efficiency. According to the company, after completion of the renovation work in February 1993, Toho Titanium's sponge production capacity, with one production line of 7.4-ton furnaces and another line of 4.2-ton furnaces, will remain unchanged at 10,560 mt/a. However, the renovated facilities would allow Toho to become a more efficient and competitive producer.¹³

Production of titanium dioxide pigment decreased in 1991 owing mainly to a decline in domestic demand by the paint and printing ink industries. According to MITI, of the total production of titanium dioxide in 1991, 218,865 tons was the rutile type and 60,189 tons the anatase type. According to Japan Titanium Dioxide Industry Association, demand for titanium dioxide decreased to 278,579 tons in 1991 from 282,188 tons in 1990. The overall decline in titanium dioxide demand was caused by a 4% drop in demand from the paint industry, which consumed 105,000 tons, accounting for 38% of total demand. However, demand from the paper manufacturing industry sustained a small increase to 19,720 tons in 1991 from 19,330 tons in 1990. Exports of titanium dioxide remained at the 64,000-ton level in 1991, about the same level as that of 1990. Producers' stock at the end of 1991 rose to 28,000 tons from 19,950 tons in 1990.

To encourage the titanium dioxide industry to reduce the radiation level in ilmenite, rutile, and waste generated by the plant, the Government established and began implementing regulations to control the level of radioactive material in ores

and waste in June 1991. The controlling regulations include: (1) the annual effective dose equivalent limit of residents surrounding the plant or dumping site should not exceed 1 mSv/a for whole body exposure, (2) air absorbed dose rate should be surveyed and recorded periodically, (3) measures should be taken to prevent titanium ore and waste from dispersing flowing out or inhaling, (4) a maximum dose rate of 0.14 uGy/a in ore should be monitored continuously, and (5) soil cover at old dumping sites should be 50 cm.¹⁴

Industrial Minerals

Cement.—Japan remained the world's third largest cement producer after China and the former U.S.S.R. in 1991. Cement production reached a record high in 1991 because of the continued strong domestic demand and increased exports. According to MITI, in 1991, Japan's total cement clinker capacity was 90.1 Mmt/a and capacity utilization rate averaged 89% in 1991. The industry's work force at the end of 1991 was 6,846 persons, compared with 6,993 persons in 1990. In 1991, the industry consumed 95.7 Mmt of limestone, 19.4 Mmt of clay, 4.9 Mmt of silica stone, 4.6 Mmt of ore slag, and 3.5 Mmt of gypsum. Total energy consumption by the industry included 9.3 Mmt of coal, 709,000 tons of petroleum coke, 310,700 kL of heavy fuel oil, 12,200 tons of coking coal, and 9,584.9 MkW·h of electricity in 1991.

Domestic consumption of cement rose to 84.8 Mmt in 1991 from 81.6 Mmt in 1990. Exports of cement, including clinker, also increased to 7.3 Mmt in 1991 from 6.3 Mmt in 1990. Of the total domestic demand for cement in 1991, 70% was for ready-mixed concrete, 15% for cement products, 4% for civil engineering works, 2% for public and private buildings, 2% for construction of roads and ports, and 7% for other uses.

In an effort to ensure a full compliance with Japan's Anti-Monopoly Act, most of the leading cement producers reportedly had established a special executive committee and watchdog group in 1991 to monitor their marketing activities and any

potential violations of the law. In 1990, 12 cement producers had been accused for violating the laws in the Hokkaido cement market and were fined a combined total of \$77.4 million by the Fair Trade Commission.

In 1991, Mitsubishi Material acquired Tohoku Kaihatsu KK, which had a capacity of 2.3 Mmt/a, and became Japan's leading cement producer. Ube Industries Ltd., the third largest producer, reopened one of its 1.5-Mmt/a idle plant in Kitakyushu, Fukuoka Prefecture. In the second half of 1991, demand for cement was weakened and competition intensified by the slowdown in the economy. According to an industry observer, more mergers and acquisition activities will take place in Japan's cement industry when the long-term trend of cement demand begins to turn downward in the coming years.

In 1991, exports of clinker rose to 3.0 Mmt from 2.5 Mmt and were valued at \$102.0 million. Exports of portland cement increased to 4.4 Mmt in 1991 from 3.7 Mmt and were valued at \$164.5 million. The major buyers of clinker in 1991 were Singapore, accounting for 36%; Thailand, 18%; and Hong Kong, 17%.

The major buyers of portland cement were Hong Kong, accounting for 29%; Thailand, 23%; Singapore and the Republic of Korea, 13% each; and Taiwan, 8%. Exports of portland cement to the United States totaled 290,220 tons and were valued at \$9.1 million in 1991.

Imports of portland cement decreased to \$1.8 Mmt in 1991 from 2.5 Mmt in 1990 and were valued at \$90.4 million. The major suppliers of portland cement in 1991 were the Republic of Korea, accounting for 66%, and Taiwan, 24%. Japan also imported 855,000 tons of cement clinker, valued at \$311,780 in 1991. Average export f.o.b. price per ton of portland cement increased to \$37.78 in 1991 from \$31.64 in 1990, while average import c.i.f. price per ton of portland cement rose to \$49.31 in 1991 from \$45.74 in 1990.

To expand its overseas production capacity, Onoda Cement Co. Ltd., Japan's second largest cement producer,

reportedly was planning to build a second joint-venture cement plant in Nanjing, Jiangsu Province in China. The company was undertaking construction of a \$154 million joint-venture project with China's Huaneng Raw Material Corp. for building a 1.4-Mmt/a cement plant in Darien (Dalian), Liaoning Province. Mitsubishi Material, Japan's largest cement producer, also planned to construct a 900,000-mt/a joint-venture cement plant with Yantai Building Material Corp. in Yantai, Shandong Province, by 1994.

Limestone.—Japan is self-sufficient in limestone. Its annual output ranks the third largest in the world. Because of the continued growth in demand by the cement and construction industries, production of limestone broke the previous year's record level of 198.2 Mmt in 1990 and reached a new record of 206.8 Mmt in 1991. According to the Limestone Association of Japan, the industry consists of about 250 limestone mining companies with most of the major quarries being controlled by cement and steel companies. In 1991, the leading seven limestone mining companies and their output were, in decreasing order, Nittetsu Mining Co. Ltd., 27.7 Mmt; Todaka Mining Co. Ltd., 13.1 Mmt; Onoda Cement Co. Ltd., 10.9 Mmt; Ube Industries Ltd., 9.5 Mmt; Mitsubishi Materials Corp., 9.2 Mmt; Sumitomo Cement Co. Ltd., 7.0 Mmt; and Sumimetal Mining Co. Ltd., 5.5 Mmt.

According to MITI, consumption of limestone rose by 4.4% to 213 Mmt in 1991 following a 4.7% increase in 1990. Of the total demand for limestone in 1991, 47% was for cement production, 29% for construction materials and aggregate, 10% for ironmaking and steelmaking, 6% for production of lime, 3% for fillers, and 5% for other.

Mineral Fuels

Coal.—Japan's coal production continued to shrink and reached its lowest level since 1902. There were six major coal mines still operating in 1991. According to a report submitted by the Coal Mining Council to MITI in June,

four more coal mines are expected to be closed during the final stage of the restructuring program by the year 2000. However, according to an official of Japan Coal Industry Association, under the Ninth National Coal Policy (1992-96), four of the six remaining major coal mines planned to reduce their production.

Sumitomo Coal Mining Co. Ltd., which operated the Akabira Mine in Hokkaido, and Hokutan Sorachi Coal Mining Co. Ltd., which operated the Sorachi Mine in Hokkaido, planned to cut back production over the 5-year period beginning in April 1992. Mitsui Coal Mining Co. Ltd. planned to focus on production of its overseas coal projects and gradually reduce its coal production at its Ashibetse Mine in Hokkaido and the Miike Mine in Kyushu. Matsushima Coal Mining Co. Ltd., which operated the Ikeshima Mine in Kyushu, and Taiheiyo Coal Mining Co. Ltd., which operated the Kushiro Mine in Hokkaido, planned to maintain their coal production at optimum levels.¹⁵ According to the Japan Economic Journal, the four major coal mining companies, which were cutting back in their production and employment, must deal with the problem of uprooted coal miners and must diversify their operation into other businesses than coal to survive.

Japan had stopped production of metallurgical-grade bituminous coal (coking coal) since April of 1990. In 1991, the industry produced about 8 Mmt of steam coal and about 7,000 tons of anthracite. Of the total coal produced in 1991, 58% was from the Hokkaido area and 42% from the Kyushu and Honshu areas. The average heating value rose slightly to 5,810 kcal/kg in 1991 from 5,760 kcal/kg in 1990. The industry's employment declined by 296 to 4,455 at the end of 1991, and its labor productivity, as measured by metric tons per month per miner, rose to 146.0 in 1991 from 137.9 in 1990.

Japan was the world's largest coal importer. Coal imports rose by 5% to a new record at 109.4 Mmt in 1991, when the total steam coal demand by the cement and utility industries rose by 8% to 47.1 Mmt, while the domestic production of steam coal remained at the

8-Mmt level. Because of increased demand for steam coal by two new coal-fired powerplants at Hekinan in Aichi Prefecture and at Tsuruga in Fukui Prefecture, which became operational in the latter half of 1991, MITI raised its steam coal import quotas by 16% to 43 Mmt in 1991 from 37.1 Mmt in 1990. Coal imports in 1991 included 69.4 Mmt of coking coal, 37.6 Mmt of steam coal, and 2.4 Mmt of anthracite. Japan relied on imports to meet 92.2% of its coal requirement in 1991, compared with 85.5% in 1986, the year before the industry began implementing the Eighth National Coal Policy. (See table 16).

Overall consumption of coal increased 3.7% to 118.5 Mmt in 1991 owing to increased demand for coking coal by the iron and steel industry and stronger demand for steam coal by the cement and utility industries in 1991. The upward trend in steam coal demand by the utility industry is expected to continue until the year 2000. According to a forecast by the Central Electric Power Council in 1991, Japan's steam coal requirements for the utility industry are expected to increase to 38.7 Mmt in 1995 and 58.8 Mmt in the year 2000, as new coal-fired powerplants come on-stream in the next 8 years. (See table 17).

To meet the growing coal requirements and the declining domestic coal industry, Japan had been actively seeking additional sources of coal in overseas. In past years, Japanese major trading firms as well as energy-producing companies used a variety of financing methods, including direct investment, equity participation, and long-term contracts, to secure long-term coal supply from Australia, China, Colombia, New Zealand, the Republic of South Africa, and the United States.¹⁶

Petroleum and Natural Gas.—Japan remained the world's largest importer of natural gas and crude petroleum in 1991. Its domestic production of natural gas and crude petroleum was negligible when compared to its huge requirements for crude petroleum, refined petroleum products, and LNG. Production of crude petroleum and natural gas both increased considerably in 1991 because of the

stepped up production of oil and gas from a new offshore oilfield, called Off-Iwafune Oilfield, off Niigata Prefecture in the Sea of Japan. Peak oil and gas production of this new oilfield was expected to reach 6,920 bbl/d and 300,158 m³/d, respectively.

Consumption of crude petroleum and natural gas rose by 6% to 1,342.3 Mmbl and by 7% to 59.3 billion m³, respectively, in 1991. To meet a stronger demand in 1991, according to MITI, imports of crude petroleum rose by 6% to 1,526.5 Mmbl, the highest since 1979. Imports of natural gas, in the form of LNG, broke the previous year's record and reached 57 billion m³ in 1991. Imports of refined petroleum products, which included diesel, gasoline, heavy fuel oil, jet fuel, kerosene, and naphtha, dropped 23% to 212.8 Mmbl and continued the 1990 downward trend because of increased domestic production and a slower growth in demand for these refined petroleum products in 1991. Imports of residual (heavy) fuel oil, especially the type-C heavy oil, dropped significantly because of reduced consumption by the manufacturing and utility industries in 1991.

Crude petroleum imports in 1991 came mainly from the Middle East region, accounting for 72.8%, compared with 71.5% in 1990; and Asia, accounting for 22.3%, compared with 23.5% in 1990. In 1991, the main supplying countries of crude petroleum were the United Arab Emirates, 25%; Saudi Arabia, 22%; Indonesia, 12%; Iran, 9%; Oman, 7%; and China and Qatar, 6% each. Iraq and Kuwait, which provided 6% and 3%, respectively, of Japan's crude petroleum imports in 1990, supplied none and 0.3%, respectively, in 1991 because of the Persian Gulf War and continued sanctions against Iraq after the war.

Imports of LNG totaled 38 Mmt in 1991, of which 47.7% was from Indonesia, 18.7% from Malaysia, 13.8% from Brunei, 10.3% from Australia, 6.8% from the United Arab Emirates, and 2.6% from the United States. Australia, which began delivery of LNG from its Northwest Shelf LNG production facility in August 1989, raised its share

of Japan's LNG imports to 10.3% from 8.2% in 1990. Because of a major expansion in Malaysia's LNG production capacity at the Bintulu plant of Sarawak, Malaysia's share of Japan's LNG imports is expected to increase in the next 2 to 3 years.

Demand for overall refined petroleum products increased only 1.4% to 1,385 Mmbl because of a slowdown in the Japanese economy in the second half of 1991. According to MITI, the demand for gasoline rose by 3% to 288.1 Mmbl, naphtha declined by 7.5% to 125.5 Mmbl, jet fuel rose 4.4% to 23.9 Mmbl, kerosene increased by 2.8% to 170.3 Mmbl, diesel rose by 5.8% to 247.4 Mmbl, heavy fuel oil declined by 3.8% to 450.6 Mmbl, and lubricants decreased by 0.9% to 15.1 Mmbl in 1991.

Consumption of domestically produced natural gas totaled 2.6 billion m³ in 1991, of which 36% was consumed by the gas industry, 24% by the utility industry, 20% by the chemical industry, 14% by the oil and gas industries, and 6% by other manufacturing and service industries. Additionally, Japan consumed 38.1 Mmt or 57 billion m³ of imported natural gas in the form of LNG in 1991, of which 74.8% was consumed by the utility industry for power generation, 23.5% by the city gas industry for household use, and 1.7% by the iron and steel industry for steelmaking.

In domestic oil and gas exploration, Japan Petroleum Exploration Corp. (Japex) discovered oil and gas deposits in southern Hokkaido Island and in Akita Prefecture in the northeastern part of the main island in 1991. The oil and gas well, about 2 km east of Tomakomai in southern Hokkaido, flowed 900 bbl/d of oil and 178,400 m³ of gas. The oil and gas well at Yurimachi in the southwestern part of Akita Prefecture flowed 524 bbl/d of oil and about 3,500 m³ of gas.

In May, Mitsubishi Oil Co. Ltd. announced that it plans to develop three oilfields of the Kutubu project in the Southern Highlands, about 500 km northwest of Port Moresby, the capital city of Papua New Guinea. Mitsubishi Oil is expected to spend more than \$740

million for developing the oilfields. A 25-year production agreement had been authorized by the Papua New Guinea Government in early 1991. The oilfields reportedly have 200 Mbbbl to 250 Mbbbl of recoverable reserves and are expected to produce between 120,000 bbl/d and 140,000 bbl/d of oil beginning in June 1992. Most oil production will be exported to Japan for refining.

In an effort to secure a stable supply of oil for Japan and to secure a larger share of downstream oil business in the world market for Saudi Arabia, three Japanese oil companies agreed in principle with Saudi Arabia to form an oil refinery joint venture in both countries in May. According to local press reports, Nippon Oil Ltd., Arabian Oil Co., and Nippon Mining Co. of Japan are to build a refinery with a capacity of 150,000 bbl/d in Japan and another refinery with a capacity of 300,000 bbl/d in Saudi Arabia in partnership with Arabian American Oil Co. (Aramco) of Saudi Arabia and Caltex of the United States. The joint-venture projects are expected to be completed in the next 3 years with an estimated cost of \$4.5 billion. Feasibility studies for construction of the refining facilities are expected to start in early 1992.

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 negligible. (See table 18).

INFRASTRUCTURE

Japan has one of the world's most modern and complete infrastructures for its mining and mineral processing industry. Despite its small land area, Japan has a highway system of 1.1 Mkm, of which 65% is paved, and a railroad network of 27,327 km, of which 93% is 1.067-m narrow gauge. Both highway and railroad networks link not only all major seaports and coastal cities on four

major islands, but also connect Honshu (main island) to the islands of Shikoku and Kyushu in the south and Hokkaido in the north via bridges or tunnels.

Japan's domestic and international telecommunication services are among the best in the world with four satellite earth stations as well as submarine cables to China, the Philippines, the U.S.S.R., and the United States. For electric power transmission and distribution, Japan has a route length of 84,400 km and a circuit length of 144,000 km concentrating in the major industrial areas of Fukuoka, Hiroshima, Nagoya, Osaka, Takamatsu, Toyama, and Tokyo. Japan also has an extensive pipeline system composed of 1,800 km for natural gas, 84 km for crude petroleum, and 322 km for refined petroleum products.

Japan has 18 major ports and more than 2,000 minor ports for receiving raw materials from overseas and exporting manufactured products. The major port facilities, including the terminals and warehouses, are among the most indispensable 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 major seaports of major mineral processing centers are Chiba, Hachinohe, Hiroshima, Kawasaki, Kobe, Osaka, Nagoya, Niigata, Shimizu, Shimonoseki, Tokyo, Toyama, and Yokohama in Honshu; Fukuoka, Kita Kyushu, and Oita in Kyushu; and Muroran and Tomakomai in Hokkaido.

OUTLOOK

The nonferrous metal mining and coal mining sectors are expected to continue the 1991 downward trend because of the ongoing restructuring programs proposed by the Government. Mining activities of industrial minerals, especially limestone, are also expected to be slower than those of 1991, when the Japanese economy and construction activity became weaker in 1992. Mine production of copper, lead, and zinc is expected to decrease because

of the continuing streamlining of operations at the remaining five major nonferrous mines in the Prefectures of Akita, Aomori, Gifu, Hokkaido, and Iwate. Coal output is expected to drop to below 8 Mmt in 1992, when two of the remaining six major coal mines in Hokkaido begin implementing their capacity reduction program in 1992.

Outlook for the mineral processing sector is equally depressed as that of the mining sector. Because of a weaker Japanese economy, most ferrous and nonferrous mineral processing plants are expected to operate at a lower rate in 1992 than that of 1991. According to Japan Iron and Steel Federation, production of crude steel is expected to drop to the 98-Mmt level in 1992 because of the weakening automobiles manufacturing and construction sectors. Production of most nonferrous metals, such as cadmium, copper, gold, nickel, rare-earth oxide, and zinc, as well as industrial minerals, such as cement, are expected to remain steady or increase only slightly in an anticipated much slower economic growth in 1992.

Because of decreasing domestic mine production of nonfuel minerals and mineral fuels, imports of nonferrous minerals and metals as well as coal are expected to increase in 1992. In line with its mineral policy to secure and diversify its long-term supply of raw materials for a steady economic growth, Japan is expected to continue actively to participate in joint exploration and development of minerals in both developed and developing countries. The targeted countries are Australia, Brazil, Canada, Chile, China, Peru, Mexico, Mongolia, and the United States. The targeted minerals included coal, crude petroleum, base metals, antimony, columbium, lithium, molybdenum, nickel, rare earths, strontium, tantalum, titanium, tungsten, and vanadium.

¹Where appropriate, values have been converted from Japanese yen (Y) to U.S. dollars (\$) at the rate of Y144.79=US\$1.00 in 1990 and Y134.71=US\$1.00 in 1991.

²U.S. Embassy, Tokyo, Japan. State Dep. Telegram 10772, June 18, 1991, p. 1.

³Metal Bulletin (London). No. 7629, Nov. 4, 1991, p. 10.

⁶U.S. Embassy, Tokyo, Japan. State Dep. Telegram 03707, Mar. 5, 1991, p. 1.

⁵American Metal Market. V. 99, No. 109, June 7, 1991, p. 2.

⁶Metal Bulletin (London). No. 7594, July 1, 1991, p. 5.

⁷Mining Journal (London). V. 317, No. 8151, Dec. 5, 1991, p. 416.

⁸U.S. Embassy, Tokyo, Japan. State Dep. Telegram 19314, Oct. 24, 1991, p. 1.

⁹The Nikkei Weekly (Tokyo). V. 29, No. 1469, June 8, 1991, p. 8.

¹⁰American Metal Market. V. 99, No. 218, Nov. 12, 1991, p. 4.

¹¹Japan Chemical Week (Tokyo). V. 32, No. 1650, Nov. 28, 1991, p. 1.

¹²U.S. Embassy, Tokyo, Japan. State Dep. Telegram 19793, Nov. 1, 1991, p. 1.

¹³American Metal Market. V. 99, No. 180, Sept. 19, 1991, p. 12.

¹⁴Industrial Minerals (London). No. 295, Apr. 1992, p. 27.

¹⁵Work cited in footnote 12.

¹⁶U.S. Embassy, Tokyo, Japan. State Dep. Telegram 14247, Aug. 8, 1991, p. 1.

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TABLE 1
JAPAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990 ^P	1991 ^P
METALS					
Aluminum:					
Alumina, gross weight	359	415	466	481	438
	thousand tons				
Metal:					
Primary:					
Regular grades	41	35	35	34	32
	do.				
High-purity	12	14	16	16	20
	do.				
Secondary ²	1,032	1,309	1,353	1,458	1,461
	do.				
Antimony:					
Oxide	9,805	10,661	10,327	10,994	11,908
	thousand tons				
Metal	196	185	173	216	262
	thousand tons				
Arsenic, white (equivalent of arsenic acid) ⁶	500	500	500	500	500
	metric tons				
Bismuth	546	524	502	442	461
	metric tons				
Cadmium, refined	2,450	2,614	2,694	2,451	2,889
	metric tons				
Chromium:					
Chromite, gross weight	11,815	9,508	11,674	8,075	*8,000
	thousand tons				
Metal	2,864	3,045	3,620	*4,082	*3,500
	thousand tons				
Cobalt metal	124	109	99	199	185
	metric tons				
Columbium and tantalum: Tantalum metal	87	123	*90	*90	*85
	metric tons				
Copper:					
Mine output, Cu content	23,817	16,666	14,650	*12,927	12,413
	thousand tons				
Metal:					
Blister and anode:					
Primary	871,000	854,600	882,300	893,200	967,700
	kilograms				
Secondary	109,200	139,400	123,200	147,400	114,500
	kilograms				
Total	980,200	994,000	1,005,500	1,040,600	1,082,200
	kilograms				
Refined:					
Primary	870,994	854,608	882,263	893,133	967,721
	kilograms				
Secondary	109,355	100,500	107,303	114,843	108,562
	kilograms				
Total	980,349	955,108	989,566	1,007,976	1,076,283
	kilograms				
Gallium metal:					
Primary	10	6	6	6	*6
	metric tons				
Secondary	16	28	32	37	*40
	metric tons				
Germanium:					
Oxide	13	14	13	12	11
	metric tons				
Metal	5	4	4	3	3
	metric tons				
Gold:					
Mine output, Au content	8,590	7,308	6,097	7,303	8,300
	kilograms				
Metal:					
Primary	56,058	92,029	110,330	108,152	103,017
	kilograms				
Secondary ³	133,856	166,121	190,586	*213,000	*190,000
	kilograms				
Total	189,914	258,150	300,916	*321,152	*293,017
	kilograms				
Indium metal	27,207	48,388	49,465	48,077	51,646
	kilograms				
Iron and steel:					
Iron ore and iron sand concentrate:					
Gross weight	266	97	41	34	31
	thousand tons				
Fe content	167	61	25	*21	19
	thousand tons				

See footnotes at end of table.

TABLE 1—Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990 ^a	1991 ^a	
METALS—Continued						
Iron and steel—Continued:						
Roasted pyrite concentrate (50% or more Fe):						
Gross weight	thousand tons	210	214	211	210	224
Fe content	do.	135	136	132	131	140
Metal:						
Pig iron and blast furnace ferroalloys	do.	73,418	79,295	80,197	80,229	79,985
Electric-furnace ferroalloys:						
Ferrochrome		263,988	295,406	324,371	293,345	270,786
Ferromanganese		332,286	378,351	394,055	452,434	463,722
Ferronickel		203,143	242,276	275,341	234,311	295,422
Ferrosilicon		73,706	73,767	74,936	62,599	62,362
Silicomanganese		91,896	106,970	122,192	77,465	87,229
Other:						
Calcium silicon		1,419	1,360	808	514	410
Ferrocolumbium		714	649	737	984	710
Ferromolybdenum		2,032	2,656	2,784	3,366	3,729
Ferrotungsten		96	91	77	46	61
Ferrovandium		2,639	3,776	3,127	3,706	3,847
Unspecified		1,384	1,761	3,578	3,462	3,560
Total		973,303	1,107,063	1,202,006	1,132,232	1,191,838
Steel, crude	thousand tons	98,513	105,681	107,909	110,339	109,649
Semimanufactures, hot-rolled:						
Of ordinary steels	do.	78,825	84,100	86,687	88,911	87,982
Of special steels	do.	14,871	16,396	15,875	16,311	16,808
Lead:						
Mine output, Pb content		27,870	22,899	18,595	18,727	18,329
Metal, refined:						
Primary		218,770	217,711	207,735	204,881	220,121
Secondary		119,730	122,246	125,624	124,106	107,975
Total		338,500	339,957	333,359	328,987	328,096
Magnesium metal:						
Primary		8,180	9,012	8,381	12,843	11,559
Secondary		10,124	15,099	20,270	23,308	17,158
Manganese:						
Ore and concentrate:						
Gross weight		—	80	100	100	100
Mn content		—	17	21	21	21
Oxide		66,731	67,460	55,628	51,473	58,526
Metal		3,678	3,933	4,498	4,571	4,500
Molybdenum metal		624	652	707	686	661
Nickel metal:						
Refined		21,397	19,961	21,938	22,274	23,658
Ni content of nickel oxide sinter		22,475	24,744	21,444	21,500	25,000
Ni content of ferronickel		49,405	57,556	62,834	56,474	68,045
Total		93,277	102,261	106,216	100,248	116,703
Platinum-group metals:						
Palladium metal	kilograms	1,417	1,170	821	1,047	1,053

See footnotes at end of table.

TABLE 1—Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990 ^P	1991 ^P	
METALS—Continued						
Platinum-group metals—Continued:						
Platinum metal	kilograms	753	647	1,031	1,425	988
Rare-earth oxide:						
Cerium	do.	2,299,212	2,677,462	2,933,170	*3,100,000	*3,100,000
Europium	do.	2,485	6,234	7,673	*8,000	*7,000
Gadolinium	do.	31,571	48,835	49,887	*50,000	*50,000
Lanthanum	do.	280,680	362,694	308,804	*310,000	*300,000
Neodymium	do.	188,459	207,009	247,337	*250,000	*240,000
Praseodymium	do.	17,803	18,815	28,073	*30,000	*30,000
Samarium	do.	52,526	115,330	114,490	*115,000	*116,000
Terbium	do.	4,220	7,644	8,483	*8,000	*7,000
Yttrium	do.	176,425	316,586	353,842	*350,000	*350,000
Total	do.	3,053,381	3,760,609	4,051,759	*4,221,000	*4,200,000
Selenium, elemental		481	471	470	495	537
Silicon, high-purity		1,671	1,545	1,759	2,155	2,834
Silver:						
Mine output, Ag content	kilograms	281,020	251,971	155,792	149,920	170
Metal:						
Primary	do.	1,845,318	1,837,277	1,986,928	2,089,033	2,148,708
Secondary ³	do.	142,186	161,991	166,564	229,319	126,000
Total	do.	1,987,504	1,999,268	2,153,492	2,318,352	2,274,708
Tellurium, elemental		53	55	51	50	57
Tin:						
Mine output, Sn content		86	—	—	—	—
Metal, smelter		895	846	808	816	692
Titanium:						
Metal		10,083	16,408	21,341	25,630	18,940
Oxide		*239,401	259,875	283,184	285,851	279,054
Tungsten:						
Mine output, W content		259	266	296	260	279
Metal		2,713	3,481	3,758	4,176	4,147
Vanadium metal ⁴		728	*728	868	*700	889
Zinc:						
Mine output, Zn content		165,675	147,217	131,794	127,273	133,004
Oxide		73,434	83,312	84,034	83,174	84,990
Metal:						
Primary		591,516	601,082	591,142	605,718	640,649
Secondary		116,865	124,702	123,536	125,884	138,087
Total		708,381	725,784	714,678	731,602	778,736
Zirconium:						
Metal ⁵		45	45	45	45	50
Oxide		7,430	7,345	7,100	*6,800	*7,000
INDUSTRIAL MINERALS						
Asbestos		*5,207	*5,000	*5,000	*5,000	*5,000
Barite		31,625	—	—	—	—
Bromine, elemental ⁶		15,000	15,000	15,000	15,000	15,000
Cement, hydraulic	thousand tons	71,551	77,554	79,717	84,445	89,564

See footnotes at end of table.

TABLE 1—Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990 ^a	1991 ^a	
INDUSTRIAL MINERALS—Continued						
Clays:						
Bentonite	468,705	455,137	526,131	549,414	554,145	
Fire clay	907,342	961,354	942,199	922,755	845,867	
Kaolin	172,781	157,771	165,696	165,532	129,942	
Feldspar and related materials:						
Feldspar	33,754	29,465	43,137	57,877	92,201	
Aplite	466,429	^a 526,285	562,823	536,205	500,327	
Gypsum	thousand tons	5,438	^a 6,300	^a 6,300	^a 6,400	5,400
Iodine, elemental	7,014	7,451	7,592	7,581	7,502	
Lime: Quicklime	thousand tons	6,745	7,726	8,486	8,983	9,045
Nitrogen: N content of ammonia	do.	1,556	1,524	1,539	1,531	1,553
Perlite ^a	^a 200,000	^a 200,000	^a 202,000	^a 203,000	203,000	
Salt, all types	thousand tons	1,397	1,363	1,367	1,377	1,380
Silica sand	3,892,322	4,200,410	4,377,941	4,430,641	4,330,708	
Silica stone	thousand tons	14,291	16,215	17,230	17,896	18,472
Sodium compounds, n.e.s.:						
Soda ash	1,098,465	1,083,121	1,105,308	1,134,825	1,103,455	
Sulfate	255,313	246,541	256,393	253,131	249,817	
Stone, crushed and broken:						
Dolomite	thousand tons	3,834	5,423	5,465	5,371	5,318
Limestone	do.	165,957	182,468	190,854	198,224	206,780
Sulfur:						
S content of pyrite	do.	79	^a 71	62	53	30
Byproduct:						
Of metallurgy	do.	^a 1,250	^a 1,268	1,320	1,336	^a 1,350
Of petroleum	do.	^a 1,020	^a 1,093	1,176	1,268	^a 1,300
Talc and related materials:						
Talc	55,899	49,797	55,665	61,550	65,625	
Pyrophyllite	1,241,069	1,244,491	1,233,600	^a 1,213,036	1,229,287	
Vermiculite ^a	15,000	15,000	15,000	15,000	15,000	
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	thousand tons	629	720	779	783	793
Coal:						
Anthracite	do.	10	9	8	7	7
Bituminous ^a	do.	13,039	11,214	10,179	8,256	8,046
Total	do.	13,049	11,223	10,187	8,263	8,053
Coke including breeze:						
Metallurgical	do.	43,717	47,727	46,899	46,067	45,458
Gashouse including breeze	do.	2,716	2,907	2,896	1,414	1,243
Fuel briquets, all grades	do.	200	185	159	128	115
Gas, natural:						
Gross ^a	million cubic meters	2,168	2,097	2,009	2,044	2,134
Marketed	do.	2,350	2,294	2,155	2,189	2,273
Natural gas liquids:						
Natural gasoline	thousand 42-gallon barrels	57	56	55	^a 55	^a 55

See footnotes at end of table.

TABLE 1—Continued
JAPAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990 ^a	1991 ^b	
MINERAL FUELS AND RELATED MATERIALS—Continued						
Natural gas liquids—Continued						
Liquefied petroleum gas from natural gas (field plants only) ^c	thousand 42-gallon barrels	300	300	250	250	300
Peat ^d		60	60	60	60	60
Petroleum:						
Crude	thousand 42-gallon barrels	4,453	4,353	4,032	3,975	5,523
Refinery products:						
Gasoline:						
Aviation	do.	57	57	80	78	*80
Other	do.	216,136	222,904	241,723	265,137	279,575
Asphalt and bitumen	do.	34,436	35,758	36,085	38,902	37,670
Distillate fuel oil	do.	158,685	160,730	174,705	201,150	236,912
Jet fuel	do.	25,348	24,272	26,335	27,933	32,625
Kerosene	do.	126,003	132,300	128,488	145,415	153,999
Liquefied petroleum gas	do.	45,029	46,784	46,809	51,233	*52,000
Lubricants	do.	12,271	12,743	12,561	15,762	15,618
Naphtha	do.	55,250	55,061	56,287	68,310	88,724
Paraffin ^e	do.	900	1,000	1,000	1,200	1,200
Petroleum coke	do.	824	937	792	*900	*950
Refinery fuel and losses ^f	do.	140,464	133,961	*140,000	*150,000	*150,000
Residual fuel oil	do.	378,659	399,899	422,159	451,118	456,023
Unfinished oils	do.	43,161	47,677	53,218	*57,000	*57,000
Total	do.	*1,237,223	*1,274,083	*1,340,242	*1,474,138	*1,562,376

^aEstimated. ^bPreliminary. ^cRevised.

^dTable includes data available through Sept. 21, 1992.

^eIncludes unalloyed ingot, alloyed ingot, billet, and mother alloys.

^fRecovered from scrap, waste, and returned by end users.

^gRepresents metal content of vanadium pentoxide recovered from petroleum residues, ashes, and spent catalysts.

^hIncludes coking coal and steam coal.

ⁱIncludes output from gas wells and coal mines.

^jMay include some additional unfinished oils.

TABLE 2
JAPAN: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	373	200	(^o)	India 70; Republic of Korea 65.
Aluminum:				
Ore and concentrate	1,192	843	—	Mainly to Republic of Korea.
Oxides and hydroxides	249,465	278,641	6,385	Canada 92,856; Republic of Korea 72,457.
Metal including alloys:				
Scrap	9,893	7,751	48	Taiwan 2,822; Philippines 2,387.
Unwrought	2,947	4,814	523	Thailand 2,598; Republic of Korea 418.
Semimanufactures	136,748	193,603	80,492	Taiwan 23,513; Republic of Korea 20,624.
Antimony:				
Oxides and hydroxides	713	958	7	Taiwan 237; Republic of Korea 170.
Metal including alloys, all forms	16	22	11	Singapore 3; West Germany 3.
Arsenic: Elemental	14	13	2	Netherlands 6; Indonesia 2.
Beryllium: Metal including alloys, all forms kilograms	1,447	388	1	China 215; Singapore 88.
Bismuth: Metal including alloys, all forms	16	35	—	China 10; Netherlands 10; Belgium-Luxembourg.
Cadmium: Metal including alloys, all forms	141	202	(^o)	Netherlands 167; Hong Kong 17.
Chromium:				
Ore and concentrate	2,429	495	—	Singapore 265; Republic of Korea 111; China 80.
Oxides and hydroxides	3,761	5,236	1,186	Republic of Korea 1,839; Taiwan 1,428.
Metal including alloys, all forms	2,322	2,822	1,780	West Germany 239; Netherlands 185.
Cobalt:				
Oxides and hydroxides	21	99	—	Netherlands 41; United Kingdom 20.
Metal including alloys, all forms	356	287	63	West Germany 103; Netherlands 78.
Columbium and tantalum: Tantalum metal including alloys, all forms	22	26	1	West Germany 14; United Kingdom 6.
Copper:				
Oxides and hydroxides	879	1,137	40	Singapore 309; Taiwan 215; Republic of Korea 123.
Sulfate	797	872	67	Taiwan 625; Thailand 49.
Metal including alloys:				
Scrap	18,816	12,003	210	Republic of Korea 4,350; Taiwan 1,990; China 1,771.
Unwrought	68,625	81,710	28,982	Taiwan 23,588; Republic of Korea 12,493.
Semimanufactures	191,487	189,419	23,587	Taiwan 34,760; Singapore 32,286; Hong Kong 31,923.
Germanium: Metal including alloys, all forms kilograms	482	106	27	Singapore 70; Portugal 7.
Gold:				
Waste and sweepings grams	28,161	316,147	—	All to Hong Kong.
Metal including alloys, unwrought and partly wrought kilograms	18,135	30,994	2,154	Singapore 13,368; Taiwan 4,929; United Kingdom 1,655.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	45			Republic of Korea 35; Philippines 10.
Metal:				
Scrap	586,786	396,403	102	Republic of Korea 265,543; Taiwan 108,859.
Pig iron, cast iron, related materials	25,115	24,745	7,494	Taiwan 6,152; Republic of Korea 3,967.
Ferroalloys:				
Ferrochromium	1,123	2,811	1,045	Republic of Korea 869; Pakistan 357.

See footnotes at end of table.

TABLE 2—Continued
JAPAN: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
METALS—Continued					
Iron and steel—Continued:					
Metal—Continued:					
Ferrous—Continued:					
Ferromanganese	12,055	5,631	3,151	Taiwan 1,109; Thailand 626.	
Ferronickel	62	—			
Ferrosilicon	2,764	3,780	1	Republic of Korea 2,035; Thailand 361.	
Silicon metal	281	224	15	Republic of Korea 166; Hong Kong 22.	
Unspecified	8,239	5,819	1,082	Republic 166; Hong Kong 22.	
Steel, primary forms	thousand tons	149	43	9	Republic of Korea 1,929; Taiwan 805.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated ²	do.	7,880	5,735	578	Thailand 963; China 690; Republic of Korea 640.
Clad, plated, coated	do.	3,367	3,166	1,056	Taiwan 367; China 217; Thailand 172.
Of alloy steel ⁴	do.	1,094	937	237	Republic of Korea 254; Taiwan 155.
Bars, rods, angles, shapes, sections	do.	2,758	2,175	383	Taiwan 346; Thailand 310; Republic of Korea 284.
Rails and accessories	do.	140	173	81	Canada 43; Brazil 26.
Wire ⁵	do.	6151	131	39	Libya 29; Taiwan 8; Thailand 7.
Tubes, pipes, fittings	do.	3,249	3,258	533	China 429; U.S.S.R. 337; Singapore 219.
Lead:					
Oxides		292	70	4	Indonesia 14; Taiwan 11; North Korea 10.
Metal including alloys:					
Scrap		23,971	25,528	7,494	Taiwan 9,568; Indonesia 8,832; Republic of Korea 2,464.
Unwrought		1,407	1,425	—	Taiwan 1,247; Republic of Korea 76.
Semimanufactures		302	454	29	Republic of Korea 158; Taiwan 85.
Lithium: Oxides and hydroxides		3	14	—	Republic of Korea 9; Indonesia 2.
Magnesium: Metal including alloys, all forms		120	19	—	Thailand 15; Republic of Korea 4.
Manganese:					
Ore and concentrate, metallurgical-grade		55	80	—	All to Taiwan.
Oxides		32,987	30,606	98	U.S.S.R. 5,600; Indonesia 5,399.
Metal including alloys, all forms		982	64	—	U.S.S.R. 18; Taiwan 15; Thailand 11.
Mercury		205	104	—	Netherlands 52; Indonesia 12.
Molybdenum:					
Oxides and hydroxides		29	8	—	All to India.
Metal including alloys, all forms		94	17	9	Taiwan 4; Republic of Korea 3.
Nickel:					
Matte and speiss		18	167	—	All to Australia.
Oxides and hydroxides		186	245	26	Indonesia 52; Republic of Korea 49.
Metal including alloys:					
Scrap		129	222	81	Republic of Korea 84; Netherlands 48.
Unwrought		128	147	(⁶)	Republic of Korea 55; Indonesia 54.
Semimanufactures		1,989	3,301	404	India 729; United Arab Emirates 419.

See footnotes at end of table.

TABLE 2—Continued
JAPAN: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
METALS—Continued					
Platinum-group metals:					
Waste and sweepings	value, thousands	\$805	\$390	—	West Germany \$381; Belgium-Luxembourg \$8.
Metals including alloys, unwrought and partly wrought	kilograms	4,504	7,201	1,794	United Kingdom 1,640; Canada 1,257.
Rare-earths:					
Compounds		1,069	801	157	Singapore 239; Taiwan 113; Republic of Korea 96.
Metals		2	11	9	Republic of Korea 1.
Selenium, elemental		374	368	43	China 84; United Kingdom 84; Philippines 59.
Silicon, high-purity		368	492	104	Malaysia 165; Republic of Korea 50.
Silver:					
Waste and sweepings	value, thousands	\$1,944	\$2,710	\$2	United Kingdom \$2,350; Hong Kong \$73.
Metal including alloys, unwrought and partly wrought	kilograms	582,431	153,659	2,193	Singapore 56,695; Taiwan 23,296; Malaysia 22,007.
Tin: Metal including alloys:					
Scrap		108	42	—	China 33; Philippines 8.
Unwrought		484	311	2	Republic of Korea 258; United Kingdom 38.
Semimanufactures		346	570	17	Taiwan 232; Hong Kong 82; Republic of Korea 62.
Titanium:					
Ore and concentrate		53	67	—	All to Taiwan.
Oxides		39,801	47,335	189	Taiwan 16,090; Singapore 15,649.
Metal including alloys, all forms		13,585	8,177	1,836	United Kingdom 4,003; France 1,210.
Tungsten: Metal including alloys, all forms					
		590	586	290	West Germany 184; Canada 36.
Uranium and thorium: Oxides and other compounds					
		23	35	—	Mainly to United Kingdom.
Vanadium:					
Oxides and hydroxides		163	46	—	Republic of Korea 18; Taiwan 10; Indonesia 8.
Metal including alloys, all forms		3	6	—	United Kingdom 5.
Zinc:					
Oxides		925	1,290	233	Republic of Korea 248; Indonesia 216.
Metal including alloys:					
Scrap		5,973	8,519	13	Taiwan 6,196; Republic of Korea 1,230.
Unwrought		21,927	25,654	14	Philippines 10,029; Taiwan 9,484.
Semimanufactures		1,998	2,261	220	Taiwan 829; North Korea 180.
Zirconium:					
Ore and concentrate		376	265	—	Pakistan 100; Republic of Korea 98; Singapore 30.
Metal including alloys, all forms		74	37	4	France 28; United Kingdom 3.
Other:					
Ores and concentrates		—	2	—	All to Indonesia.
Oxides and hydroxides		548			
Ashes and residues		8,204	8,156	48	Republic of Korea 1,626; United Kingdom 1,274.
Base metals including alloys, all forms		15	11	(^c)	Republic of Korea 5; France 2.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		12,569	13,946	1	Republic of Korea 9,299; Taiwan 1,933.
Artificial:					
Corundum		30,165	31,774	2,733	Republic of Korea 17,933; Australia 3,548.
Silicon carbide		6,402	7,413	247	Republic of Korea 5,783; Taiwan 971.

See footnotes at end of table.

TABLE 2—Continued
JAPAN: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Artificial:				
Dust and power of precious and semiprecious stone including diamond kilograms	4,479	3,925	611	Taiwan 2,002; Republic of Korea 533.
Grinding and polishing wheels and stones	8,336	8,753	1,590	Republic of Korea 1,039; Hong Kong 712.
Asbestos, crude	50	142	—	Indonesia 53; Taiwan 37; Tunisia 24.
Barite and witherite	306	74	74	
Boron materials:				
Crude natural borates	2,464	2,016	—	Taiwan 1,428; Hong Kong 588.
Elemental ⁷	8	10	2	Canada 3; United Kingdom 3.
Oxides and acids	179	178	(?)	Republic of Korea 134; Thailand 24.
Bromine ⁸	8	6	—	Mainly to Guam.
Cement thousand tons	6,576	6,369	1,772	Hong Kong 2,389; Singapore 954; Thailand 600.
Chalk	751	156	—	All to Republic of Korea.
Clays, crude:				
Bentonite	1,510	1,277	3	Iraq 625; Indonesia 190.
Chamotte or dinas earth	558	364	—	Thailand 152; Republic of Korea 121.
Fire clay	5,064	4,945	24	Republic of Korea 2,948; Taiwan 657; Nigeria 351.
Kaolin	7,145	7,377	(?)	Taiwan 5,200; Indonesia 970; Sri Lanka 474.
Unspecified	41,556	43,084	(?)	Taiwan 23,561; Republic of Korea 6,305.
Cryolite and chiolite	5	15	—	Republic of Korea 10; Taiwan 4.
Diamond: Natural:				
Gem, not set or strung carats	2,411	2,973	149	Hong Kong 1,021; Singapore 1,000.
Industrial stones do.	109,076	120,509	13,514	Bulgaria 97,500; Malaysia 2,750.
Diatomite and other infusorial earth	2,541	1,863	(?)	Taiwan 361; Thailand 313; Iraq 234.
Feldspar, fluorspar, related materials:				
Feldspar	34,369	31,331	—	Taiwan 281; Indonesia 18; Philippines 17.
Fluorspar	506	338	—	Taiwan 281; Indonesia 18; Philippines 17.
Fertilizer materials:				
Crude, n.e.s.				
	302	653	10	Taiwan 592; China 47.
Manufactured:				
Ammonia	146	270	18	Republic of Korea 185; Malaysia 36.
Nitrogenous	705,268	755,577	2,114	Philippines 243,499; Thailand 218,048; Malaysia 125,355.
Phosphatic	37,771	2,337	—	Republic of Korea 2,000; Taiwan 157; Yemen 150.
Potassic	1,350	1,074	101	Philippines 733; Republic of Korea 120.
Unspecified and mixed	137,538	107,601	4,663	Thailand 23,140; Kenya 13,103; Sri Lanka 13,000.
Graphite, natural	2,059	1,314	125	Republic of Korea 341; Taiwan 233.
Gypsum and plaster	5,946	5,806	10	Indonesia 2,009; Taiwan 1,401.
Iodine	6,136	5,192	1,691	United Kingdom 880; India 501.
Kyanite and related materials	4,925	5,159	435	Republic of Korea 3,549; Taiwan 464.
Lime	9,736	4,694	5	Indonesia 2,280; Republic of South Africa 900.
Magnesium compounds:				
Magnesite, crude	307	791	—	India 500; Taiwan 284.
Oxides and hydroxides	121,575	94,665	10,509	Republic of Korea 21,209; India 16,051; Thailand 9,822.

See footnotes at end of table.

TABLE 2—Continued
JAPAN: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Mica:				
Crude including splittings and waste	577	683	28	Republic of Korea 314; Taiwan 132.
Worked including agglomerated splittings	173	1,095	60	Hong Kong 571; Taiwan 160; Republic of Korea 113.
Phosphates, crude	33	—		
Phosphorus, elemental	213	152	(^o)	United Kingdom 32; Republic of Korea 23; North Korea 20.
Pigments, mineral:				
Natural, crude	74	280	1	Republic of Korea 10,852; Taiwan 10,344.
Iron oxides and hydroxides, processed	32,736	32,653	3,921	Republic of Korea 10,852; Taiwan 10,344.
Precious and semiprecious stones other than diamond:				
Natural kilograms	24,389	18,462	221	Republic of Korea 3,727; Philippines 3,542.
Synthetic do.	145,942	88,311	9,284	Indonesia 33,534; Republic of Korea 23,185.
Pyrite, unroasted	8,200	200	—	Mainly to Australia.
Quartz crystal, piezoelectric	58	62	9	Philippines 10; Taiwan 10; Republic of Korea 8.
Salt and brine	1,036	1,320	167	Republic of Korea 625; U.S.S.R. 236.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	60,435	40,357	—	Indonesia 20,050; Philippines 11,042; China 4,207.
Sulfate, manufactured	17,355	8,306	54	Republic of Korea 5,275; Indonesia 1,907; Thailand 610.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	1,323	1,073	302	Republic of Korea 735; Guan 17.
Worked	2,270	2,162	124	Hong Kong 1,207; Republic of Korea 443.
Dolomite, chiefly refractory-grade	2,460	2,111	—	Indonesia 1,530; Taiwan 330; Malaysia 104.
Gravel and crushed rock	50,229	62,785	38	Australia 60,350; Republic of Korea 1,095.
Limestone other than dimension	1,476,665	1,945,099	894	Taiwan 477,672; Hong Kong 404,786.
Quartz and quartzite	15,877	1,358	9	Republic of Korea 414; United Kingdom 324.
Sand other than metal-bearing	3,780	5	67	Taiwan 1,934; Republic of Korea 841; Guam 539.
Sulfur:				
Elemental:				
Crude including native and byproduct	262,621	385,385	368	Republic of Korea 334,500; Taiwan 35,728.
Colloidal, precipitated, sublimed	1,656	1,532	1	Republic of Korea 342; India 333; Taiwan 287.
Sulfuric acid	800,441	731,543	31,023	Taiwan 203,784; Philippines 158,334.
Talc, steatite, soapstone, pyrophyllite	2,476	3,160	417	Republic of Korea 708; Singapore 551.
Vermiculite ⁹	21,323	24,611	—	Republic of Korea 21,662; Singapore 2,558.
Other:				
Crude	8,009	8,360	41	Taiwan 2,382; Indonesia 1,791; Republic of Korea 1,410.
Slag and dross, not metal-bearing	914,674	1,241,701	—	Republic of Korea 385,632; Singapore 313,574; Philippines 298,501.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	19	10	—	Dominican Republic 8; Philippines 2.
Carbon black	8,528	8,943	862	Republic of Korea 2,672; Taiwan 1,659.
Coal, all grades including briquets	1,153	2,183	—	Thailand 1,474; Iran 248; Taiwan 162.
Coke and semicoke thousand tons	2,506	1,731	773	Romania 248; 248; Philippines 135.
Peat including briquets and litter	28	102	—	China 74; Taiwan 28.

See footnotes at end of table.

TABLE 2—Continued
JAPAN: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	285	27	(²)	Philippines 11; China 9.
Gasoline	do.	3,170	3,462	(²)	Republic of Korea 1,972; Taiwan 706.
Mineral jelly and wax	do.	396	392	37	Republic of Korea 1,972; Taiwan 706.
Kerosene and jet fuel	do.	3,041	3,899	(²)	Republic of Korea 3,552; Hong Kong 125.
Distillate fuel oil	do.	4,992	7,661	—	Republic of Korea 1,765; China 1,700; Hong Kong 1,395.
Lubricants	do.	1,654	1,951	185	Republic of Korea 864; Singapore 288; Thailand 248.
Nonlubricating oils	do.	113	112	1	Taiwan 62; Thailand 11.
Residual fuel oil	do.	4,631	12,300	10	Republic of Korea 5,500; Taiwan 4,000.
Bitumen and other residues	do.	24	86	—	Thailand 43; Hong Kong 35.
Bituminous mixtures	do.	2	2	(²)	Indonesia 1.
Petroleum coke	do.	489	471	84	U.S.S.R. 173; Italy 85.

¹Revised.

¹Excludes exports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.

²Less than 1/2 unit.

³Excludes unreported quantity valued at \$112,935,000 in 1990 and \$135,711,000 in 1989.

⁴Excludes unreported quantity valued at \$451,172,000 in 1990 and \$570,637,000 in 1989.

⁵Excludes unreported quantity valued at \$631,127,000 in 1990 and \$62,845,000 in 1989.

⁶Includes tellurium.

⁷Includes fluorine.

⁸Includes perlite and chlorites.

TABLE 3
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	93	46	31	West Germany 12; China 3.
Aluminum:				
Ore and concentrate	thousand tons	2,269	2,302	(²) Australia 1,420; Indonesia 637; Malaysia 158.
Oxides and hydroxides		76,961	73,456	12,275 Australia 55,374; West Germany 3,854.
Metal including alloys:				
Scrap		400,226	352,699	205,016 Australia 37,644; Hong Kong 19,708.
Unwrought	thousand tons	2,363	2,724	583 Australia 519,355; Brazil 292,533.
Semimanufactures		80,321	70,866	18,894 France 9,704; Hungary 5,765; Bahrain 5,485.
Antimony:				
Ore and concentrate		4,978	5,997	— China 2,847; Bolivia 2,108; Australia 988.
Oxides		7,268	6,299	186 China 3,955; United Kingdom 1,128.
Metal including alloys, all forms		6,225	6,316	(²) China 6,127; Thailand 91; Hong Kong 90.
Arsenic:				
Elemental		30	95	(²) Mainly from China.
Oxides and acids		315	362	— France 215; Republic of Korea 148.
Beryllium:				
Oxides and hydroxides		73	60	60
Metal including alloys, all forms	kilograms	2,144	1,172	1,146 China 18; United Kingdom 8.
Bismuth: Metal including alloys, all forms		408	180	— Republic of Korea 116; Belgium-Luxembourg 20.
Cadmium: Metal including alloys, all forms		2,908	2,199	20 Republic of Korea 888; Belgium-Luxembourg 380.
Chromium:				
Ore and concentrate		1,043,468	789,225	— Republic of South Africa 537,110; Madagascar 53,265.
Oxides and hydroxides		2,217	2,659	971 West Germany 997; China 236.
Metal including alloys, all forms		830	571	— United Kingdom 193; France 150; China 108.
Cobalt:				
Oxides and hydroxides		449	224	78 Finland 80; Belgium-Luxembourg 64.
Metal including alloys, all forms		3,376	4,807	106 Zaire 2,100; Zambia 1,022.
Columbium and tantalum:				
Ore and concentrate ³		1,110	1,503	— Canada 948; Malaysia 211; Brazil 132.
Tantalum metal including alloys, all forms		64	56	43 West Germany 5; Taiwan 4.
Copper:				
Ore and concentrate	thousand tons	3,376	3,523	455 Canada 970; Philippines 430; Chile 335.
Matte and speiss including cement copper		179	3,110	— Republic of Korea 2,338; Portugal 567.
Oxides and hydroxides		646	970	704 Norway 145; Singapore 100.
Sulfate		139	136	— Thailand 85; France 45.
Metal including alloys:				
Scrap		82,247	126,662	45,047 Hong Kong 24,306; Singapore 13,372.
Unwrought		515,214	653,051	103,130 Chile 194,701; Zambia 155,969.
Semimanufactures		39,358	37,703	2,656 Taiwan 22,205; Republic of Korea 7,922.
Germanium:				
Oxides		875	1,010	83 United Kingdom 877; France 26.
Metal including alloys, all forms	kilograms	1,099	1,713	221 China 1,245; France 150.
Gold:				
Waste and sweepings	do.	2,260	1,926	— Singapore 1,304; Thailand 580; China 23.
Metal including alloys, unwrought and partly wrought	do.	284,273	302,938	6,603 Switzerland 91,090; Australia 69,686; Canada 50,262.

See footnotes at end of table.

TABLE 3—Continued
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Indium: Metal including alloys, all forms	32	36	2	France 13; China 11.
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite	thousand tons	127,709	125,290	(^c) Australia 53,853; Brazil 30,198; India 20,753.
Metal:				
Scrap	do.	1,157	1,048	471 U.S.S.R. 152; Vietnam 143.
Pig iron, cast iron, related materials	do.	2,274	3,283	7 U.S.S.R. 1,349; Brazil 1,047.
Ferroalloys:				
Ferrochromium		477,080	441,672	— Republic of South Africa 274,194; Philippines 46,588.
Ferromanganese		21,786	43,268	— France 12,242; Republic of South Africa 11,932; Brazil 6,544.
Ferromolybdenum		1,322	1,600	16 Chile 869; Austria 469.
Ferronickel		52,073	41,941	408 New Caledonia 20,839; Indonesia 12,273.
Ferrosilicochromium		14,018	6,690	— Zimbabwe 4,464; China 1,710; U.S.S.R. 498.
Ferrosilicomanganese		274,282	195,282	— China 84,447; U.S.S.R. 41,761; Republic of Africa 41,516.
Ferrosilicon		406,901	476,482	1,203 China 154,800; Brazil 119,333; Norway 96,360.
Silicon metal		133,700	129,763	1,054 China 64,225; Brazil 27,378; Republic of South Africa 10,543.
Unspecified		27,501	25,763	1,105 Brazil 8,747; China 8,079; France 2,174.
Steel, primary forms		727,686	1,082,972	76,913 Brazil 277,752; Turkey 172,561; Republic of Korea 153,111.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		4,978,194	4,477,679	386,006 Republic of Korea 1,859,002; Taiwan 570,136.
Clad, plated, coated		258,551	292,436	3,134 Republic of Korea 255,462; Taiwan 19,939.
Of alloy steel ²		20,208	19,936	744 Republic of Korea 9,684; West Germany 3,460.
Bars, rods, angles, shapes, sections		743,228	884,270	23,910 Republic of Korea 319,017; Belgium-Luxembourg 110,610.
Rails and accessories		6,540	9,848	2 Republic of Korea 4,563; North Korea 3,181.
Wire		69,575	61,388	58 Republic of Korea 43,633; Taiwan 8,523.
Tubes, pipes, fittings		454,974	360,077	2,080 Republic of Korea 270,185; Taiwan 28,602.
Lead:				
Ore and concentrate		298,964	279,535	5,408 Canada 79,604; Australia 74,539; Peru 66,689.
Oxides		37,388	31,090	8 Taiwan 11,420; Mexico 9,971; France 3,999.
Metal including alloys:				
Scrap		—	1,126	449 Australia 424; Kuwait 91.
Unwrought		83,093	99,041	1,499 Peru 18,232; Mexico 17,545; Australia 14,595.
Semimanufactures		93	1,675	41 China 1,072; United Kingdom 468.
Lithium: Oxides and hydroxides		1,020	1,036	774 U.S.S.R. 170; China 82.
Magnesium: Metal including alloys:				
Scrap		643	888	85 Taiwan 559; Republic of Korea 91.
Unwrought		13,847	16,517	10,698 Norway 4,498; Canada 431.
Semimanufactures		457	621	464 Republic of Korea 107; Netherlands 17.

See footnotes at end of table.

TABLE 3—Continued
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade				
thousand tons	1,939	1,647	(²)	Republic of South Africa 844; Australia 505.
Oxides	4,494	4,323	16	Belgium-Luxembourg 2,810; China 575; Hong Kong 425.
Metal including alloys, all forms	10,739	13,689	944	Republic of South Africa 8,789; China 3,912.
Mercury	62	34	(²)	China 23; Spain 4.
Molybdenum:				
Ore and concentrate	23,106	24,408	6,065	Canada 8,021; Chile 7,453; Netherlands 2,141.
Oxides and hydroxides	352	335	335	
Metal including alloys, all forms	606	348	124	West Germany 151; Austria 22.
Nickel:				
Ore and concentrate	thousand tons	3,828	3,338	—
thousand tons				New Caledonia 1,580; Indonesia 1,044;
Matte and speiss	59,923	62,291	—	Indonesia 37,970; Australia 23,859.
Oxides and hydroxides	283	270	21	Canada 219; Finland 18.
Metal including alloys:				
Scrap	2,241	3,843	2,049	Taiwan 968; United Kingdom 195.
Unwrought	38,255	44,383	130	U.S.S.R. 16,803; Norway 6,819; Zimbabwe 6,792.
Semimanufactures	6,891	6,698	1,016	United Kingdom 2,736; West Germany 353.
Platinum-group metals:				
Ores and concentrate ³	27,742	38,804	35,220	Canada 2,573.
Waste and sweepings	kilograms	5,294	5,295	—
kilograms				Taiwan 4,909; Thailand 250.
Metals including alloys, unwrought and partly wrought	do.	63,083	125,885	7,072
do.				U.S.S.R. 58,795; United Kingdom 17,551.
Rare-earths:				
Compounds	11,712	8,894	2,086	China 2,084; Malaysia 2,055; France 1,364.
Metals including alloys, all forms	337	180	20	China 129; Brazil 14.
Selenium, elemental	58	44	(²)	Philippines 27; Republic of Korea 15.
Silicon, high-purity	1,722	1,547	785	West Germany 674; Denmark 25.
Silver:				
Ore and concentrate	9,142	6,390	—	All from Peru.
Waste and sweepings	38	112	65	Singapore 43; Thailand 3.
Metal including alloys, unwrought and partly wrought	1,265	1,548	369	Mexico 659; Peru 276.
Tin:				
Oxides	7	7	—	Mainly from United Kingdom.
Metal including alloys:				
Scrap	21	65	(²)	Republic of Korea 33; Taiwan 16.
Unwrought	35,683	36,297	588	Malaysia 12,692; Indonesia 8,604; Thailand 7,283.
Semimanufactures	60	54	5	Hong Kong 18; Singapore 17.
Titanium:				
Ore and concentrate	616,090	757,595	5,370	Australia 243,145; Malaysia 151,220; India 130,715.
Oxides	17,200	17,196	51	Australia 9,468; Republic of Korea 2,709.
Metal including alloys, all forms	1,062	577	157	U.S.S.R. 358; United Kingdom 31.
Tungsten:				
Ore and concentrate	2,316	2,589	—	Portugal 1,258; Australia 571; China 371.
Metal including alloys, all forms	378	292	29	Republic of Korea 186; West Germany 40.

See footnotes at end of table.

TABLE 3—Continued
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Uranium and thorium:				
Ore and concentrate	60	(²)	—	All from Canada.
Oxides and other compounds kilograms	4,434	1,149	242	India 700; West Germany 202.
Vanadium:				
Oxides and hydroxides	4,313	4,796	331	Republic of South Africa 3,768; China 662.
Metal including alloys, all forms	154	104	40	West Germany 64.
Zinc:				
Ore and concentrate thousand tons	1,029	1,186	85	Australia 610; Peru 224; Canada 135.
Oxides	14,171	13,267	36	Republic of Korea 6,252; Taiwan 2,396.
Metal including alloys:				
Scrap	759	409	56	Singapore 152; Taiwan 60; China 59.
Unwrought	150,714	154,803	151	North Korea 44,482; Republic of Korea 25,795.
Semimanufactures	2,136	5,390	41	China 3,924; France 945; Singapore 179.
Zirconium:				
Ore and concentrate	172,848	119,008	2,365	Australia 87,127; Republic of South Africa 28,428.
Metal including alloys, all forms	641	683	398	France 258; U.S.S.R. 18.
Other:				
Ores and concentrates	5,151	94	(²)	Australia 40; Mexico 30; Bolivia 16.
Ashes and residues	69,616	76,754	10,163	Australia 12,749; Republic of Korea 10,904.
Base metals including alloys, all forms	111	106	10	Belgium-Luxembourg 30; West Germany 20.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Artificial:				
Corundum	87,529	75,290	168	China 47,657; Hungary 12,698; U.S.S.R. 5,128.
Silicon carbide	65,868	51,003	347	China 26,305; U.S.S.R. 5,475; Norway 4,962.
Dust and powder of precious and semiprecious stones excluding diamond kilograms	824,600	685,364	667,364	Australia 18,000.
Grinding and polishing wheels and stones	1,582	1,972	302	Taiwan 351; Thailand 265; Italy 239.
Asbestos, crude	295,168	287,659	13,864	Canada 90,448; Republic of South Africa 86,964.
Barite and witherite	129,383	115,684	82	China 112,307; India 3,040.
Natural: Corundum, emery, pumice, etc.	9,171	9,386	2,135	India 6,589; China 411.
Boron materials:				
Crude natural borates	65,854	66,096	18	Turkey 65,570; U.S.S.R. 451.
Elemental ⁶	4	6	1	Belgium-Luxembourg 2; West Germany 1.
Oxides and acids	28,075	26,581	17,916	Italy 4,053; Chile 718.
Bromine ⁷	5,926	5,490	841	Israel 4,541; United Kingdom 108.
Cement	3,724,428	2,543,903	277	Republic of Korea 1,441,532; Taiwan 681,505.
Chalk	—	1	1	
Clays, crude thousand tons	1,470	1,627	995	China 219; Australia 115.
Cryolite and chiolite	375	391	—	Denmark 323; Greenland 68.
Diamond:				
Natural:				
Gem, not set or strung thousand carats	3,353	3,304	112	India 1,672; Israel 665; Belgium-Luxembourg 566.
Industrial stones do.	655	691	264	Belgium-Luxembourg 119; Zaire 98; Ireland 68.
Dust and powder do.	2,072	1,884	363	Ireland 745; Zaire 369; United Kingdom 262.

See footnotes at end of table.

TABLE 3—Continued
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Diamond—Continued:					
Synthetic: Dust and powder	do.	53,842	59,447	25,047	Ireland 33,122; Switzerland 353.
Diatomite and other infusorial earth		5,327	4,501	4,433	Ireland 64.
Feldspar, fluorspar, related materials:					
Feldspar		4,298	22,471	(²)	Norway 8,236; China 5,746; Australia 5,562.
Fluorspar		708,957	567,023	(²)	China 452,892; Thailand 47,499.
Unspecified		10,250	9,835	—	Norway 8,200; Canada 1,635.
Fertilizer materials:					
Crude, n.e.s.		19,630	28,652	—	Republic of Korea 13,252; China 6,679; Philippines 2,672.
Manufactured:					
Ammonia	kilograms	418	1,960	—	All from West Germany.
Nitrogenous		285,614	262,077	29,168	Qatar 131,893; Indonesia 43,609.
Phosphatic		167,581	158,580	57,525	China 84,519; Republic of Korea 15,057.
Potassic		1,253,565	1,199,402	137,293	Canada 592,337; U.S.S.R. 182,838.
Unspecified and mixed		657,324	688,728	557,816	Republic of Korea 86,758; Norway 9,296.
Graphite, natural		119,251	126,527	453	Taiwan 122,539; China 71,996.
Gypsum and plaster		3,259,030	3,637,273	683	Thailand 3,145,257; Mexico 406,014.
Iodine		291	289	187	Chile 102.
Kyanite and related materials		37,583	34,825	6,195	Republic of South Africa 27,129; India 1,395.
Lime		—	18	—	All from Philippines.
Magnesium compounds:					
Magnesite, crude		735	1,381	4	China 1,377.
Oxides and hydroxides		429,395	372,014	26	China 335,118; North Korea 15,673.
Other		3,530	4,139	—	West Germany 3,763; Belgium-Luxembourg 216.
Mica:					
Crude including splittings and waste		24,253	27,393	463	China 12,226; India 6,457; Finland 2,571.
Worked including agglomerated splittings		239	730	1	Republic of Korea 270; Belgium-Luxembourg 246.
Nitrates, crude		28,899	19,309	—	Chile 17,641; West Germany 1,548.
Phosphates, crude	thousand tons	1,590	1,543	750	Republic of South America 249; Jordan 238.
Phosphorus, elemental		24,372	20,427	9,608	China 2,750; Republic of South Africa 2,434.
Pigments, mineral:					
Natural, crude		673	675	9	China 612; Austria 25; India 17.
Iron oxides and hydroxides, processed		15,745	15,506	5,722	West Germany 6,886; China 995.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	785,915	1,085,156	65,465	Brazil 381,659; Indonesia 206,000; Canada 126,514.
Synthetic	do.	46,891	65,710	52,591	France 10,625; Switzerland 1,349.
Pyrite, unroasted		327,863	317,550	—	China 202,918; Australia 74,666; Philippines 16,446.
Quartz crystal, piezoelectric		128	110	68	Brazil 18; West Germany 13.
Salt and brine	thousand tons	7,703	7,920	—	Australia 4,190; Mexico 3,583.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		305,972	294,893	294,729	Netherlands 90.
Sulfate, manufactured		1,983	18,812	4,400	China 13,404; Taiwan 990.

See footnotes at end of table.

TABLE 3—Continued
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	1,461,256	1,436,167	37,006	China 355,176; Republic of Korea 283,921.	
Worked	635,214	618,842	2,602	China 230,152; Republic of Korea 177,259.	
Dolomite, chiefly refractory-grade	1,214,976	1,386,481	3,536	Republic of Korea 342,607; Thailand 330,004.	
Gravel and crushed rock	419,961	480,440	298	Taiwan 358,900; China 76,016.	
Limestone other than dimension	5,860	900	2	France 799; Austria 51.	
Quartz and quartzite	121,399	119,623	1,750	India 71,339; Thailand 16,800.	
Sand other than metal-bearing	2,304,139	2,627,688	2,507	Australia 1,769,042; Taiwan 405,080.	
Sulfur:					
Elemental:					
Crude including native and byproduct	287	939	344	Republic of Korea 595.	
Colloidal, precipitated, sublimed	160	61	—	France 38; China 17.	
Sulfuric acid	17	—	—	—	
Talc, steatite, soapstone, pyrophyllite	763,535	666,040	25,363	China 529,611; Australia 107,216.	
Vermiculite ^a	33,325	36,974	260	China 16,727; India 300.	
Other:					
Crude	383,404	445,880	65,385	Republic of Korea 207,783; China 49,930.	
Slag and dross, not metal-bearing	359,950	490,428	837	Republic of South Africa 105,612; Republic of Korea 92,644.	
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural	3,791	3,964	2,967	Trinidad and Tobago 988.	
Carbon black	33,412	22,282	9,740	Republic of Korea 7,006; West Germany 1,627.	
Coal:					
Anthracite and bituminous	thousand tons	78,291	107,517	11,546	Australia 55,736; Canada 19,267.
Lignite including briquets		26,737	14,326	815	U.S.S.R. 9,423; Australia 3,548.
Coke and semicoke		383,070	326,751	—	China 146,201; Australia 123,920.
Gas, natural: Liquefied	thousand tons	32,358	35,465	1,010	Indonesia 17,401; Malaysia 6,380.
Peat including briquets and litter		60,347	79,289	505	Canada 67,867; West Germany 6,973.
Petroleum:					
Crude	thousand 42-gallon barrels	1,263,598	1,404,214	—	United Arab Emirates 309,109; Saudi Arabia 280,554; Indonesia 169,555.
Refinery products:					
Liquefied petroleum gas	do.	162,450	168,618	(^c)	Saudi Arabia 74,877; United Arab Emirates 40,373.
Gasoline	do.	178,812	169,892	1,887	Saudi Arabia 68,105; United Arab Emirates 21,119.
Mineral jelly and wax	do.	92	91	46	Republic of South Africa 33.
Kerosene and jet fuel	do.	78,140	64,309	4,982	Singapore 21,190; Saudi Arabia 12,479.
Distillate fuel oil	do.	46,925	42,013	2,588	Saudi Arabia 15,994; Kuwait 5,789.
Lubricants	do.	2,216	1,772	226	Singapore 1,167; Republic of Korea 281.
Nonlubricants	do.	334	420	253	France 129; Singapore 11.
Residual fuel oil	do.	97,103	101,308	4,844	Indonesia 36,030; Singapore 12,721.
Bitumen and other residues	do.	1,279	1,106	895	China 198; Taiwan 13.

See footnotes at end of table.

TABLE 3—Continued
JAPAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS—Continued					
Refinery products—Continued:					
Bituminous mixtures	do.	12	12	4	United Kingdom 4.
Petroleum coke	do.	24,271	22,424	17,912	Kuwait 1,812; China 802.

¹Revised.

²Excludes imports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.

³Less than 1/2 unit.

⁴Includes vanadium ore and concentrate.

⁵Excludes unreported quantity valued at \$3,194,000 in 1990 and \$3,611,000 in 1989.

⁶May include other precious metal ores and concentrates.

⁷Includes tellurium.

⁸Includes fluorine.

⁹Includes perlite and chlorites.

TABLE 4
JAPAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Coal	Hokutan Sorachi Coal Mining Co. Ltd.	Sorachi, Hokkaido Prefecture	800
Do.	Mitsui Coal Mining Co. Ltd.	Ashibetsu, Hokkaido Prefecture, and	
Do.	Matsushima Coal Mining Co. Ltd.	Miike, Kyushu Ikeshima, Kyushu	4,600 1,300
Do.	Sumitomo Akabira Coal Co. Ltd.	Akabira, Hokkaido Prefecture	670
Do.	Taiheiyo Coal Mining Co. Ltd.	Kushiro, Hokkaido Prefecture	2,000
Copper:			
In concentrate	Hanaoka Mining Co. Ltd. (Subsidiary of Dowa Mining Co. Ltd.)	Hanaoka, Akita Prefecture	7
Do.	Shin Kamaishi Mining Co. Ltd. (subsidiary of Nittetsu Mining Co. Ltd.)	Kamaishi, Iwate Prefecture	4
Refined	Hibi Kyodo Smelting Co. Ltd. (Mitsui Mining and Smelting Co. Ltd. 63.5%; Nittetsu Mining Co. Ltd. 20.3%; Furukawa Co. Ltd., 16.2%)	Tamano, Okayama Prefecture	163.2
Do.	Mitsubishi Materials Corp.	Naoshima, Kagawa Prefecture	163.2
Do.	Nippon Mining Co. Ltd.	Hitachi, Ibaraki Prefecture, and Saganoseki, Oita Prefecture	330
Do.	Onahama Smelting and Refining Co. Ltd. (49.3% Mitsui Metal Corp.; 29.8% Down Mining Co. Ltd.; 7.7% Furukawa Co. Ltd.; 13.2% other)	Onahama, Fukushima Prefecture	234
Do.	Sumitoma Metal Mining Co. Ltd.	Besshi, Ehime Prefecture	192
Gold:			
In concentrate	kilograms	Mitsui Kushikino Mining Co. Ltd.	200
Do.		Sumitomo Metal Mining Co. Ltd.	7,000
Refined	do.	Mitsubishi Materials Corp.	60,000
Do.		Nippon Mining Co. Ltd.	15,000
Do.		Sumitomo Metal Mining Co. Ltd.	30,000
Limestone		Mitsubishi Materials Corp.	10,000
Do.		Nittetsu Mining Co. Ltd.	28,000
Do.		Sumitomo Cement Co. Ltd.	8,000
Do.		Todaka Mining Co. Ltd.	14,000
Do.		Ube Industries Ltd.	11,000
Iodine, crude		Ise Chemical Industries Co. Ltd.	4.3
Do.		Nippon Natural Gas Industry Co. Ltd.	1.3
Do.		United Resources Industry Co. Ltd.	1.8
Lead:			
In concentrate		Hanaoka Mining Co. Ltd.	8
Do.		Kamioka Mining and Smelting Co. Ltd. (subsidiary of Mitsui Mining and Smelting Co. Ltd.)	2
Do.		Toyoha Mining Co. Ltd. (subsidiary of Nippon Mining Co. Ltd.)	10

TABLE 4—Continued
JAPAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Lead—Continued:			
Refined	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	33.6
Do.	Mitsubishi Cominco Smelting Co. Ltd. (subsidiary of Mitsubishi Materials Corp.)	Naoshima, Kagawa Prefecture	46
Do.	Mitsui Mining and Smelting Co. Ltd.	Takehara, Hiroshima Prefecture	43.8
Do.	Nippon Mining Co. Ltd.	Saganoseki, Oita Prefecture	36
Do.	Toho Zinc Co. Ltd.	Chigirishima, Hiroshima Prefecture	94.8
Manganese:			
In electrolytic dioxide	Mitsui Mining and Smelting Co. Ltd.	Takehara, Toyama Prefecture	25
Do.	Tosoh Corp.	Hyuga, Miyazaki Prefecture	24
Do.	Japan Metals and Chemical Co. Ltd.	Takaoka, Yoyama Prefecture	18
Nickel:			
In ferronickel	Hyuga Smelting Co. Ltd. (subsidiary of Sumitomo Metal Mining Co. Ltd.)	Hyuga, Miyazaki Prefecture	18
Do.	Nippon Yakin Kogyo Co. Ltd.	Oheyama, Kyoto Prefecture	14.4
Do.	Pacific Metals Co. Ltd.	Hachinohe, Aomori Prefecture	42
In oxide	Tokyo Nickel Co. Ltd. (Inco Ltd. 45%; Shimura Kako Co. Ltd. 30%; Mitsui Co. Ltd. 10%; other 15%.)	Matsuzaka, Mie Prefecture	36
Refined	Sumitomo Metal Mining Co.	Niihama, Ehime Prefecture	27.9
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; Yawata, Fukuoka Prefecture; Kimitsu, Chiba Prefecture; and Nagoya, Aichi Prefecture	48,800
Do.	Sumitomo Metal Industries	Kashima, Ibaraki Prefecture, and Kokura, Fukuoka Prefecture	22,140
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
Titanium, sponge metal	Osaka Titanium Co. Ltd.	Amagasaki, Hyogo Prefecture	13.2
Do.	Showa Titanium Co. Ltd.	Toyama, Toyama Prefecture	3
Do.	Toho Titanium Co. Ltd.	Chigasaki, Kanagawa Prefecture	10.8
Zinc:			
In concentrate	Hanaoka Mining Co. Ltd.	Hanaoka, Akita Prefecture	40
Do.	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	60
Do.	Toyoha Mining Co. Ltd.	Toyoha, Hokkaido Prefecture	50
Refined	Akita Smelting Co. Ltd.	Iijima, Akita Prefecture	156
Do.	Mitsubishi Materials Corp.	Akita, Akita Prefecture	105.6
Do.	Nikko Zinc Co. Ltd.	Mikkaichi, Toyama Prefecture	120
Do.	Toho Zinc Co. Ltd.	Annaka, Gunma Prefecture	139.2
Do.	Hachinohe Smelting Co. Ltd.	Hachonohe, Aomori Prefecture	108

TABLE 5
JAPAN: DEMEAND FOR PRIMARY ALUMINUM, BY SECTOR

(Thousand metric tons)

Sector	1989	1990	1991
Aluminum rolling	1,749	1,875	1,916
Aluminum casting	121	126	126
Aluminum diecasting	38	38	37
Other casting and diecasting	5	5	6
Wire and cable	71	72	85
Steel deoxidization	39	39	40
Tubes	10	11	11
Secondary smelting	318	370	128
Other	61	53	24
Total	2,412	2,589	2,373

Source: Japan Aluminium Federation (Tokyo).

TABLE 6
JAPAN: CONSUMPTION OF COBALT, BY END USE

(Metric tons)

End use	1989	1990	1991
Catalysts	373	416	416
Cemented carbides	302	345	365
Magnetic materials	555	647	631
Specialty steels	787	890	896
Other	568	696	707
Total	2,585	2,994	3,015

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1991, p. 175.

TABLE 7
JAPAN: IMPORTS OF COPPER IN 1991, BY FORM AND ORIGIN

(Metric tons)

Source	Copper concentrate (gross weight)	Copper scrap	Unwrought	
			Unrefined	Refined
Australia	212,376	3,906	—	50,384
Canada	983,430	647	—	2,977
Chile	537,315	—	2,406	198,815
Indonesia	428,271	—	—	—
Malaysia	108,902	4,490	—	—
Mexico	161,579	—	—	134
Papua New Guinea	317,317	—	—	—
Peru	83,104	—	25,062	28,122
Philippines	407,540	3,891	—	43,626
Portugal	85,135	—	—	—
South Africa, Republic of	21,907	39	1,189	19,550
U.S.S.R., former	38,219	902	1,002	7,580
United States	310,224	48,933	—	132,311
Zambia	—	—	—	126,387
Other	91,554	32,822	3,949	11,072
Total	3,786,873	95,630	33,608	620,958

Source: Ministry of Finance (Tokyo). Japan Imports and Exports, Commodity by Country, Dec. 1991.

TABLE 8
**JAPAN: SOURCE OF MATERIALS USED IN THE PRODUCTION OF
COPPER, LEAD, AND ZINC**

(Metric tons)

Commodity and/or source	1989	1990	1991
Copper, refined:			
Domestic ore	6,547	5,881	6,412
Imported ore ¹	875,716	887,252	961,309
Scrap	58,496	60,289	70,873
Other	48,807	54,554	37,689
Total	989,566	1,007,976	1,076,283
Lead, refined:			
Domestic ore	38,052	39,041	33,967
Imported ore	169,683	165,840	186,154
Scrap	9,495	7,877	9,334
Other	42,748	48,258	43,137
Secondary recovery	73,381	67,971	55,504
Total	333,359	328,987	328,096
Zinc, slab:			
Domestic ore	135,407	129,294	138,684
Imported ore	455,735	476,424	501,965
Scrap	24,425	23,283	28,077
Other	48,940	58,460	62,103
Secondary recovery	50,171	44,141	47,907
Total	714,678	731,602	778,736

¹Includes blister.

Source: Ministry of International Trade Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1989-91, annual.

TABLE 9
JAPAN: SUPPLY AND DEMAND FOR GOLD AND SILVER

Item ¹	1990	1991
Gold:		
Supply		
Domestic production	108,152	103,017
Imports	302,902	255,863
Secondary recovery	148,411	99,200
Total supply	559,465	458,080
Demand		
Demand for industrial use:		
Dental and medical	15,046	*15,000
Electrical, electronic, and communications apparatus	51,704	*55,000
Gold plating	17,896	*18,000
Gliding	563	*600
Jewelry	107,970	*100,000
Decorations and badges	635	*700
Pottery and porcelain	3,882	*4,000
Fountain pens	613	*700
Watches	2,620	*3,000
Subtotal	200,929	*197,000
Demand for industrial arts and crafts	4,031	*4,200
Demand for investment and other		
Private investment	149,292	*130,000
Other	124,448	*120,000
Total domestic demand	478,700	*447,000
Exports	30,994	*38,000
Total demand	509,694	*485,000
Silver:		
Supply		
Beginning stock	1,159	1,395
Primary metal production	2,089	2,149
Metal imports	932	855
Secondary recovery	229	126
Total supply	4,409	4,525
Demand		
Silver nitrate for photography	1,757	1,796
Silver nitrate for other uses	279	260
Electrical contacts	302	303
Brazing alloy	140	148
Electroplating	127	138
Rolled products	236	234
Jewelry and silverware	118	109
Other	363	394
Total domestic demand	3,321	3,382
Exports	(9)	40
Total demand	3,321	3,422
Ending stock	1,396	1,396

¹Estimated. ²Revised.

¹Gold is in kilograms and silver is in metric tons.

²Less than 1/2 unit.

Source: Aruzumi Publishing Co. Ltd. (Tokyo). Industrial Rare Metals, Annual Review, No. 103, 1991, p. 184.

TABLE 10
JAPAN: CRUDE STEEL PRODUCTION AND RANKING OF THE TOP SEVEN COMPANIES

	Output (million metric tons)		Company ranking in market economy countries	
	1990	1991	1990	1991
Nippon Steel Corp.	28.76	28.63	1	1
NKK Corp.	12.11	12.45	6	5
Kawasaki Steel Corp.	11.12	10.91	10	7
Sumitomo Metal Industries Ltd.	11.14	10.90	8	8
Kobe Steel Ltd.	6.56	6.50	15	16
Tokyo Steel Manufacturing Co. Ltd.	3.48	3.66	36	33
Nisshin Steel Co. Ltd.	3.60	3.47	31	37
Total	76.77	76.52	XX	XX

XX Not applicable.

Source: Metal Bulletin (London). No. 7637, Feb. 17, 1992, p. 17.

TABLE 11
JAPAN: DOMESTIC ORDERS FOR ORDINARY STEEL AND SPECIALTY STEEL PRODUCTS, BY END USE

(Thousand metric tons)

End use	Ordinary		Specialty	
	1990	1991	1990	1991
Automobiles	12,239	11,889	2,811	62,861
Construction	18,464	17,964	700	714
Conversion and processing	3,668	3,720	4,044	3,888
Electric machinery	3,128	3,254	124	124
Home and office equipment	952	906	249	244
Industrial machinery	2,427	2,321	1,401	1,296
Rolling stock	50	51	30	26
Shipbuilding	2,586	2,614	148	132
Steel dealers	24,247	23,070	1,333	1,342
Tanks and containers	2,360	2,371	26	35
Other	346	319	79	75
Total	70,467	68,470	10,945	10,737

Source: Ministry of International Trade and Industry (Tokyo). Iron and Steel Statistics, monthly, Apr. 1992, pp. 68-69.

TABLE 12
JAPAN: CONSUMPTION OF MANGANESE ORES, BY END USE

(Metric tons)

End use	1989	1990	1991
Metallurgical-grade manganese:			
Iron and steel sector			
Ferrous alloys	753,109	804,547	799,486
Pig iron	32,698	20,916	27,897
Sinter	40,193	22,273	18,146
Steel	335,083	258,711	194,864
Subtotal	1,161,083	1,106,507	1,040,393
Other uses	36,764	45,194	80,764
Total	1,197,847	1,151,701	1,121,157
Ferruginous manganese:			
Iron and steel sector			
Ferrous alloys	138,408	138,635	135,065
Pig iron	120,554	80,085	61,921
Sinter	54,810	47,430	49,093
Steel	121,332	126,796	105,866
Total	479,417	392,946	351,945

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Iron and Steel Statistics, 1991, pp. 76 and 81.

TABLE 13
JAPAN: SUPPLY AND DEMAND FOR REFINED NICKEL

(Metric tons)

Item	1989	1990	1991
Supply:			
Beginning stock	11,934	12,315	12,123
Production	21,939	22,275	23,659
Imports ¹	42,934	49,125	57,625
Total supply	76,807	83,715	93,407
Demand:			
Batteries	2,924	2,919	3,367
Catalyst	521	499	497
Coinage	733	172	371
Exports	114	68	73
Galvanized sheet	5,906	6,085	5,878
Magnetic material	2,821	3,252	3,226
Nonferrous alloy	4,000	4,912	3,634
Other	2,503	3,695	4,001
Rolled sheet	801	958	1,030
Specialty steel	42,270	43,022	45,494
Total demand	62,593	65,582	67,571
Ending stock	12,315	12,123	17,882

¹Included refined nickel ingots, powder, and flakes.

Source: The Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals of Minerals and Nonferrous Metals Statistics, 1991, p. 173.

TABLE 14
JAPAN: IMPORTS OF RARE-EARTH METALS AND COMPOUNDS

(Metric tons)

Item	1989	1990	1991
Rare-earth chlorides	2,294	2,003	3,084
Rare-earth products:			
Cerium oxide	704	790	2,239
Lanthanum oxide	258	249	313
Rare-earth metals	337	180	436
Rare-earth compounds	4,863	3,774	3,812
Pyrophoric alloys	498	383	501
Cerium compounds	2,816	1,559	593
Yttrium oxide	776	518	428

Source: Ministry of Finance (Tokyo). Japan Exports and Imports Commodity by Country, Dec. 1991.

TABLE 15
JAPAN: CONSUMPTION OF RARE-EARTH PRODUCTS AND YTTRIUM OXIDE

(Metric tons)

Products	1989	1990	1991
Cerium oxide	3,300	3,350	3,500
Europium oxide	11	12	12
Lanthanum oxide	420	440	500
Misch metal	230	230	230
Neodymium oxide	550	650	770
Samarium oxide ¹	365	340	340
Other rare earths ²	120	120	120
Yttrium oxide	280	290	300
Total	5,276	5,432	5,772

¹Includes recycled scrap.

²Includes gadolinium oxide, neodymium oxide, praseodymium oxide, and terbium oxide.

Source: Japan Society of Newer Metals (Tokyo). Newer Metal Industry Quarterly, No. 348, July 15, 1992, p. 30.

TABLE 16
JAPAN: COAL IMPORTS, BY SOURCE

(Thousand metric tons)

	Anthracite		Bituminous			
			Coking		Steam	
	1990	1991	1990	1991	1990	1991
Australia	263	381	29,643	33,087	24,231	25,170
Canada	—	—	17,600	16,962	1,320	1,325
China	603	1,094	1,301	1,595	2,655	2,808
Colombia	—	—	85	152	35	152
Indonesia	—	—	240	493	664	2,026
Korea, North	483	481	—	—	—	—
New Zealand	—	—	183	416	—	—
South Africa, Republic of	127	62	3,375	3,345	1,301	1,802
United States	—	—	9,649	9,767	1,345	2,079
U.S.S.R.	180	145	5,482	3,539	2,665	2,264
Vietnam	150	239	—	—	—	—
Other	—	—	—	—	5	—
Total	1,806	2,402	67,558	69,354	34,221	37,626

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Production, Supply and Demand of Petroleum, Coal, and Coke, 1991, pp. 152-155.

TABLE 17
JAPAN: COAL CONSUMPTION, BY SECTOR

(Thousand metric tons)

Sector	1989	1990	1991
Manufacturing:			
Cement, ceramics, other	17,599	18,196	18,846
Of which:			
Domestic	491	472	166
Imported	17,108	17,724	18,680
Coke	5,106	5,133	5,006
Of which:			
Domestic	187	127	100
Imported	4,919	5,006	4,906
Iron and steel	64,306	63,875	65,004
Of which:			
Domestic	658	292	135
Imported	63,648	63,582	64,869
Utilities:			
Electric power	24,527	25,472	28,239
Of which:			
Domestic	9,326	8,780	8,313
Imported	15,201	16,691	19,926
Gas	841	725	555
Of which:			
Domestic	214	163	3
Imported	627	562	552
Other	908	565	575
Of which:			
Domestic	884	520	481
Imported	24	45	94
Total consumption	113,287	113,966	118,225
Of which:			
Domestic	11,760	10,354	9,198
Imported	101,527	103,611	109,027

Source: Ministry of International Trade and Industry (Tokyo). Energy Production and Demand Monthly Monthly Statistics, Jan. 1992, pp. 12-13.

TABLE 18
JAPAN: RESERVES OF MAJOR
MINERAL COMMODITIES FOR
1991

(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Coal	7,000,000
Copper ore, content	211
Dolomite ¹	1,197,662
Gold ore, content kilograms	558,000
Iodine	*1,800
Lead ore, content	649
Limestone ²	57,814,046
Pyrophyllite	143,611
Silica stone ³	1,065,661
Silica sand ⁴	361,337
Zinc ore, content	3,351

*Estimated.

¹Average ore grade is 17.9% MgO.

²Average ore grade is 54.2% CaO.

³Average ore grade is 90.0% SiO₂.

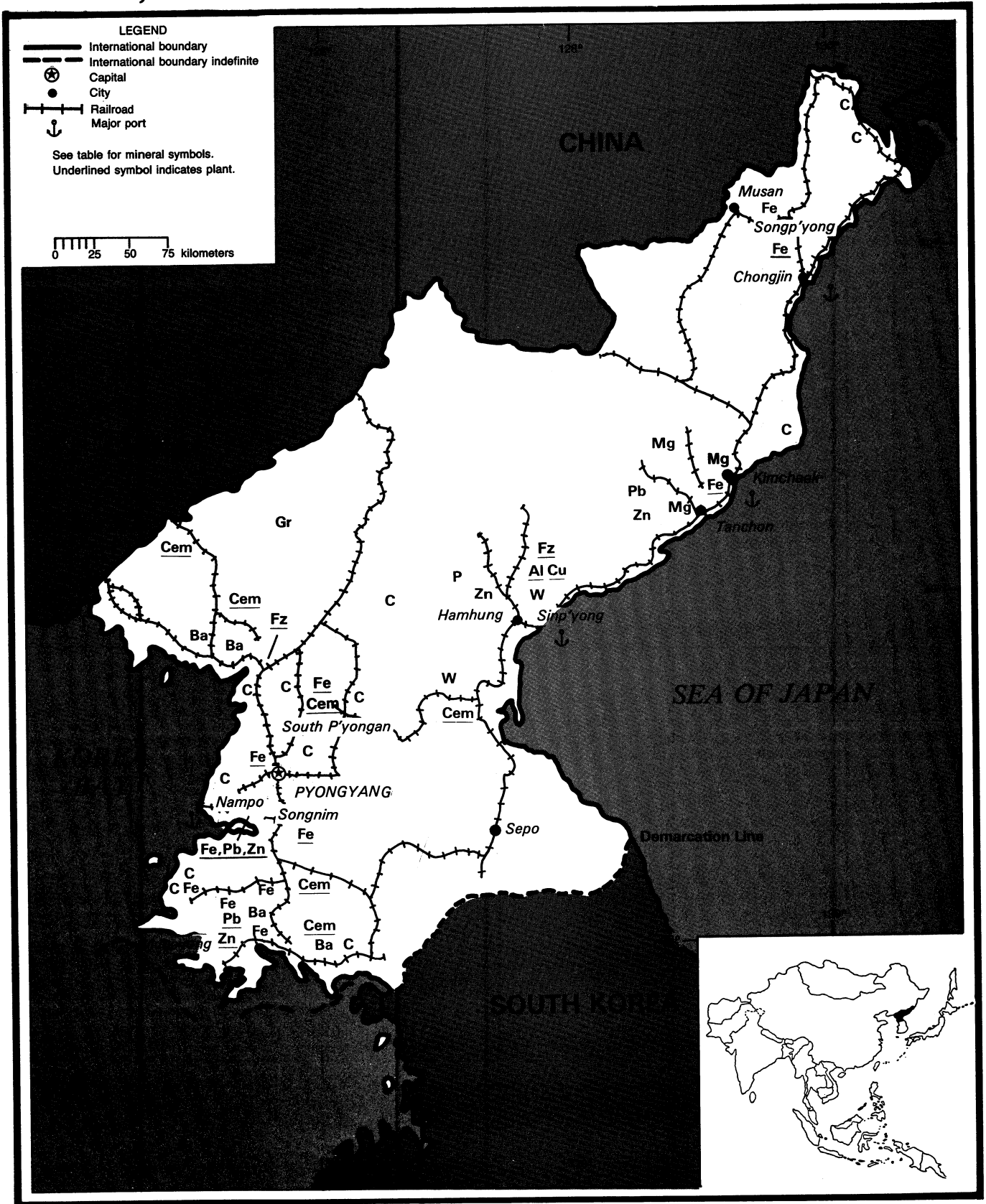
⁴Average ore grade is 72.4% SiO₂.

Sources: Ministry of International Trade and Industry; Agency of Natural Resources and Energy. Natural Resources and Energy.

NORTH KOREA

AREA 120,540 km²

POPULATION 21.8 million



THE MINERAL INDUSTRY OF NORTH KOREA

By Chin S. Kuo

The country's economy was staggering from the effects of the collapse of the former U.S.S.R., which used to supply oil and accounted for almost one-half of North Korea's trade. In 1991, the trade between the two countries was put on a cash basis instead of barter, and the volume had plummeted. Imports of oil from the former U.S.S.R. fell sharply. North Korea began to move closer to China for oil and other assistance. The country also sought oil purchases from Iran and Libya. Because of the shortage of energy and raw materials, plants were either shut down or operated only at 40% capacity. The Government planned to overcome the difficulties by launching a massive campaign to save energy, looking for alternative sources of oil, and using coal more widely.

Korean nationals living in Japan participated in the setup of 70% of the joint ventures in North Korea. Ten joint ventures related to Chinese enterprises were set up in Pyongyang and other places. The former U.S.S.R., Bulgaria, and other countries also set up joint ventures with North Korea.

North Korea planned to create two free trade zones in Rajin and Sonbong on the northeast coast, including the Port of Chongjin, offering foreign investors tax incentives and capital protection to help speed its economic development and boost trade relations with other countries. The foreign incentives included income tax and customs reductions or exemptions.

In the last year of the third 7-year plan (1987-93), mineral production was targeted at 10 Mmt of steel, 1.7 Mmt of nonferrous metals, 22 Mmt of cement, 7.2 Mmt of chemical fertilizers, and 180 Mmt of coal. Electricity generation was planned for 10,000 MW. (See table 1).

Mineral trade between North Korea and the Republic of Korea has been increasing. In 1991, the country exported coal, gold, steel, and zinc to the south and imported light oil, high-density polyethylene, soap, and textiles. The trading arm of Samsung Group in the south purchased indirectly from North Korea 3,000 tons each of steel plate in May and October and 3,800 tons of zinc lumps. The Lucky-Goldstar, Kolon, and Ssangyong groups were seeking a limited form of barter with North Korea for its timber, iron, and zinc products.

Iron ore production was increased by 700,000 tons in the Musan mining complex compared with that of 1990. Moderate increase in production for pig iron, steel, and rolled steel was experienced in the Hwanghae iron and steel complex. A new 2-Mmt/a steel plant was being constructed at the Chollima steel complex, and the output of the plant was to facilitate the economic development of the country. The Kimchaek iron and steel complex lowered raw material consumption in the production of pig iron and steel.

Nonferrous metal ores and alunite deposits were found in Kapsan, Unhung, Pochon, and Paekam counties, Yanggang Province. A nonferrous metal mine was open at Taebong in Yanggang Province in April with a dressing plant that was capable of processing 100,000 mt/a of ore. The No. 3 shaft at the Chonma Mine, North Pyongan Province, was also commissioned in April. The Sangnong Mine in the Hochon area of South Hamgyong Province increased production of nonferrous metal ores. A second sulfuric acid plant was built at the copper smelter in Pyongbuk, North Pyongan Province. The Komdok mining complex remained the largest producer of lead and zinc ore in the country. North Korean

zinc ingots amounting to 30,000 tons were shipped to the south for use by galvanized steel producers.

Korea Ryongaksan General Trading Co. in Pyongyang and International Trading Corp. in Tokyo set up a joint venture, International Chemical Joint Venture Corp., to refine rare-earth products from monazite in 1988. This is the largest foreign-funded project in North Korea to date. Monazite was mined at Chelsan and transported to Hamhung after being partly processed. Mine reserves were estimated at 500,000 tons. The \$12 million¹ plant at Hamhung was capable of processing 1,500 mt/a of monazite. The first shipment of refined rare-earth metals was made to Japan in May for part of an initial 400 mt/a in 14 kinds of rare-earth products.

Kyowa Shiji Co. of Japan, a trading company, agreed to set up a joint-venture firm called Jisong Graphite Co. with the country to produce graphite from the latter's largest Fungsan graphite mine. Mine operations were to start in August with a production target of 50,000 mt/a. About 10,000 tons of graphite was to be used by North Korean steelmakers and utility companies for electrodes and the remainder was exported to European countries, including the Federal Republic of Germany, to help ease the country's foreign exchange shortage. The Fungsan Mine has reserves estimated at 90 Mmt.

Magnesite deposits are scattered in the Taehung area near Tanchon, South Hamgyong Province, and reserves were estimated at 6 billion tons. The open pit Yongyang Mine is the leading producer. An ore crushing plant was being constructed. A large-scale, open pit mine is in operation at Pukdu, which accounts for 50% of the area's magnesite output, and an ore chute extending more than 460 m links it with the Muhak Mine. The ore

processing capacity of the complex was rated at 2 Mmt/a. There is also a magnesia plant in Tanchon. Magnesite deposits also occur in Kimchaek, Paekam, and other areas of the country.

The construction of a caustic soda plant with a capacity of 10,000 mt/a in Sinuiju, North Pyongan Province, was begun. Most of the caustic soda was currently produced at the Sunchon vinalon complex from indigenous raw materials. A salt plant was under construction at Hamhung to produce salt from seawater.

The first-stage expansion project at the Sariwon potassic fertilizer complex progressed at a faster pace than expected. A large kiln, 70 structures, and 20 pieces of equipment had been installed. The newly developed Chonggye and Chongdan Mines began production of limestone and potash feldspar as main raw materials for the Sariwon potassic fertilizer complex. The Hungnam fertilizer complex at Hamhung is the country's largest chemical fertilizer production center, mostly of nitrogen fertilizer. Another fertilizer complex was under construction in the Manpo area of Chagang Province to produce nitrogenous and phosphatic fertilizers.

A cement plant with a capacity of 12,000 mt/a was being constructed in Yanggang Province. The Sunchon cement complex increased production during the year.

A large anthracite production center is at the Kaechon district coal mining complex where there are eight mines. The combined production capacity was planned for 5 Mmt/a after expansion. Coal deposits in the area were estimated to be more than 700 Mmt. The Sunchon mining complex produced 25% of South Pyongan Province's coal output. In turn, coal production capacity of South Pyongan Province accounted for 60% of the country's output. Anthracite was mainly supplied to industrial plants, and some anthracite was also exported.

Considerable development of coal-cutting faces and districts had been accomplished in the Anju district mining complex and the Tokchon district mining complex. These mechanized coal-cutting faces were developed in the Sosa pit of

the Scho Mine, the Youth pit of the Taeyang Mine, and the Changdong pit of the Yonpung Youth Mine, with a combined production capacity of 500,000 mt/a. The Anju district mining complex has the largest coalfields in the country.

Coal deposits of 20 brown coal seams were discovered in an area between Sukchon and Mundok counties in South Pyongan Province. Preparations to build an open pit mine were under way. Brown coal deposits were also found in Saebjol county, North Hamgyong Province, and Paekam county, Yanggang Province.

Construction of hydroelectric power stations was under way on many rivers, including the Namdae in North Hamgyong Province and the Changja in Chagang Province. The Pukchang thermal power complex in South Pyongan Province increased power generation with the installation of the coal conveyance system.

¹Where necessary, values have been converted from Korean Won (W) to U.S. dollars at the rate of W2.00=US\$1.00 for 1991.

TABLE 1
NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991
METALS					
Aluminum metal ingot, primary	10,000	10,000	10,000	—	—
Cadmium metal, smelter	100	100	100	100	100
Copper:					
Mine output, Cu content	<u>12,000</u>	<u>12,000</u>	<u>12,000</u>	<u>15,000</u>	<u>15,000</u>
Metal:					
Smelter:					
Primary	25,000	24,000	25,000	25,000	20,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	<u>30,000</u>	<u>29,000</u>	<u>30,000</u>	<u>30,000</u>	<u>25,000</u>
Refined:					
Primary	25,000	24,000	25,000	25,000	19,000
Secondary	10,000	10,000	10,000	10,000	5,000
Total	<u>35,000</u>	<u>34,000</u>	<u>35,000</u>	<u>35,000</u>	<u>24,000</u>
Gold, mine output, Au content kilograms	5,000	5,000	5,000	5,000	5,000
Iron and steel:					
Iron ore and concentrate, marketable:					
Gross weight thousand tons	8,500	9,000	9,500	10,000	10,000
Fe content do.	4,000	4,200	4,400	4,700	4,700
Metal:					
Pig iron do.	6,500	6,500	6,500	6,500	6,500
Ferroalloys, furnace type unspecified do.	120	120	120	120	120
Steel, crude do.	6,700	6,800	7,300	8,000	8,000
Lead:					
Mine output, Pb content	90,000	90,000	80,000	80,000	80,000
Metal:					
Smelter, primary only	<u>64,000</u>	<u>64,000</u>	<u>65,000</u>	<u>65,000</u>	<u>70,000</u>
Refined:					
Primary	64,000	64,000	70,000	70,000	75,000
Secondary	6,000	6,000	5,000	6,000	5,000
Total	<u>70,000</u>	<u>70,000</u>	<u>75,000</u>	<u>76,000</u>	<u>80,000</u>
Silver, mine output, Ag content kilograms	50	50	50	50	50
Tungsten, mine output, W content	500	500	500	1,000	1,000
Zinc:					
Mine output, Zn content	220,000	225,000	230,000	230,000	200,000
Metal, primary	210,000	210,000	210,000	200,000	175,000
INDUSTRIAL MINERALS					
Barite	100,000	100,000	100,000	100,000	100,000
Cement, hydraulic thousand tons	9,000	12,000	16,000	16,000	16,000
Fluorspar	40,000	40,000	40,000	40,000	41,000
Graphite	25,000	25,000	35,000	35,000	35,000
Magnesite, crude thousand tons	1,500	1,500	1,500	1,500	1,600
Nitrogen, N content of ammonia do.	450	500	500	500	550
Phosphate rock	500,000	500,000	500,000	500,000	500,000
Salt, all types	570,000	570,000	570,000	580,000	580,000

See footnotes at end of table.

TABLE 1-Continued
NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991
INDUSTRIAL MINERALS—Continued					
Sulfur thousand tons	230	230	230	230	240
Talc, soapstone, pyrophyllite	<u>100,000</u>	<u>100,000</u>	<u>100,000</u>	<u>170,000</u>	<u>170,000</u>
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite thousand tons	55,000	62,000	65,000	68,000	70,000
Lignite do.	<u>15,000</u>	<u>18,000</u>	<u>20,000</u>	<u>22,000</u>	<u>20,000</u>
Total do.	<u>70,000</u>	<u>80,000</u>	<u>85,000</u>	<u>90,000</u>	<u>90,000</u>
Coke do.	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>
Petroleum refinery products:					
Gasoline thousand 42-gallon barrels	7,700	8,000	8,300	8,500	8,400
Jet fuel and kerosene do.	1,600	1,700	1,800	1,800	1,700
Distillate fuel oil do.	7,100	7,400	7,700	7,800	7,600
Residual fuel oil do.	4,000	4,100	4,200	4,200	4,100
Refinery fuel and other products do.	<u>2,000</u>	<u>2,100</u>	<u>2,200</u>	<u>2,200</u>	<u>2,200</u>
Total do.	<u>22,400</u>	<u>23,300</u>	<u>24,200</u>	<u>24,500</u>	<u>24,000</u>

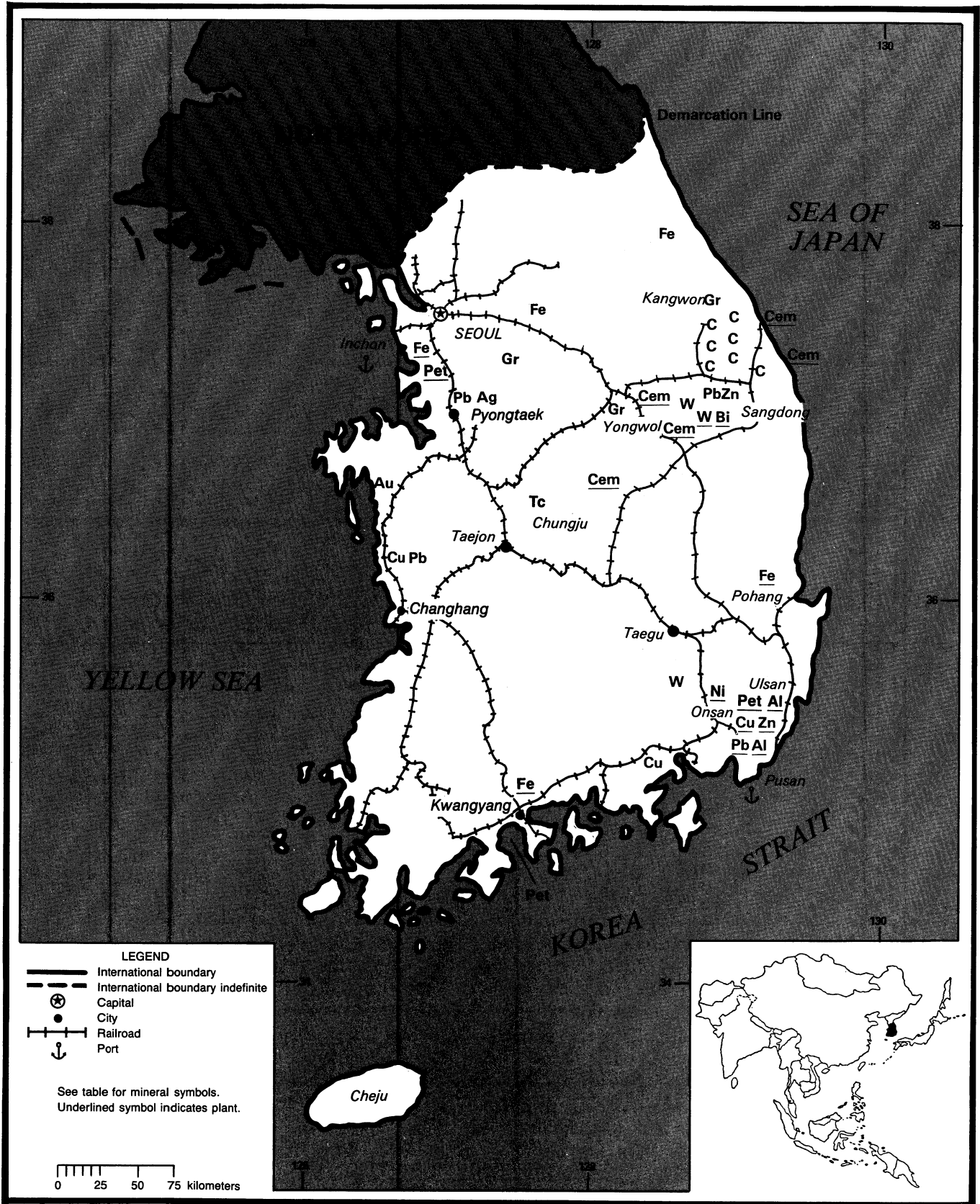
¹Table includes data available through June 24, 1992.

²In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

REPUBLIC OF KOREA

AREA 98,480 km²

POPULATION 43.1 million



THE MINERAL INDUSTRY OF THE REPUBLIC OF KOREA

By Chin S. Kuo

The country's economy fared moderately compared with 1990 due to rising industrial production, a weakened currency that made exports more competitive, and return of business confidence at the end of the Gulf War. The real GNP growth rate in 1991 was expected to be 8.6%.¹ Per capita GNP rose to \$6,253,² placing the country among the World Bank's high-income economies. However, a bulging trade deficit of \$9.7 billion, an unemployment rate of 2.3%, and a runaway inflation of 9.5% accompanied the strong economic performance.

Coal and metal ore mining was the primary activity of the mining sector, which contributed only 2.52% to the country's industrial production. When compared with the level of production in 1990, the iron and steel industry registered an increase of 13.3% in output; nonferrous metals, 4.9%; and industrial mineral products, 15.6%.

Foreign investment in the Republic of Korea totaled a record \$1.4 billion in 1991. Excluding Saudi Aramco's purchase of 35% stake in the Ssangyang Oil Refinery Co., foreign investment rose only modestly to \$1 billion from \$803 million in 1990. The service sector attracted \$325 million in 178 projects while manufacturing investments were \$1.07 billion in 109 projects. The largest group of foreign investors included the United States, Japan, and countries of the European Community.

The country's investment abroad in the first half of 1991 plunged 30% from a year ago to \$623 million because of the Gulf War that depressed overseas investment. Manufacturing was the most favored sector for foreign investment, largely metals, machinery, and textiles, and by region, Southeast Asia topped the list.

Lucky-Goldstar International was considering participation in a new primary aluminum smelting project in Venezuela with 20% stake. Venezuela's Alcasa planned to build a 215,000-mt/a smelter near its existing Matanzas plant at a cost of \$16 million. In return, Lucky-Goldstar could expect to receive about 43,000 mt/a of primary ingot; the plant was to begin operation in late 1991. In 1991, the Republic of Korea imported more than 350,000 tons of primary aluminum.

Daewood Corp. won a \$40 million contract to supply equipment to 40 Soviet state-run steel mills, including 3,000 cabin coolers, over a period of 5 years. Daewood was to ship 600 coolers annually in a barter trade for steel products.

Sammi Group was to invest \$573 million to expand and modernize its Atlas Stainless Steel Division in Tracey, Quebec. The investment was to allow Atlas to increase its output of sheet, strip, and plate from 80,000 to 300,000 mt/a in 1995, making it one of the largest stainless steel producers in North America. Sammi also planned to establish a research center and an affiliated company to increase secondary processing of stainless steel in Quebec.

Samsung Corp. (40%), Yongchang Steel (30%), and P.T. Super Tataraya Steel (30%) formed a joint-venture company, Starnesia Steel, to produce hot-rolled and bright bars at a new plant near Jakarta, Indonesia. The plant was to produce initially 20,000 mt/a from startup in 1992 and reach full capacity of 54,000 mt/a by 1993. Consequently, 25% of Starnesia Steel's total output was to be exported from Indonesia to the Republic of Korea.

Pohang Iron and Steel Co., Ltd. (Posco) began discussions with a

subsidiary fabricator of Southern Steel Union, the largest Vietnamese state-run steel manufacturer, to form a joint venture to produce galvanized sheets for roofing applications. Posco planned to construct a plant near Ho Chi Minh City to receive Posco CR sheet for hot-dip galvanizing.

Pyoung San Mining was reported to be interested in a stake of the closed Basay Mining Corp.'s copper mine on the island of Negros in the central Philippines. Basay had a capacity of 25,000 mt/d and ore reserves of 10.78 Mmt at 0.65% Cu for open pit mining and 38.98 Mmt at 0.57% Cu for underground mining. Pyoung San was believed to be considering a joint venture with Cosmo Magneta of the Philippines, which owns 13% of Basay.

Poongsang Metal Corp. intends to construct a new nonferrous metals plant in Laen Chabang, Chon Buri Province, with local Thai zinc producer, Padaeng Industry Corp., which is owned by the Thai Government. The joint venture, Padaeng Poongsang Metals Co. (Padaeng 51% and Poongsang 49%), was to fund the \$48 million facility that would produce copper alloys, including cupronickel, and brass. Combined annual production capacity was to be 15,000 tons when the plant comes on-stream in late 1992.

Hyundai Corp. decided to join in the exploitation of the coal mines of the Yakut Autonomous Republic's Chita Region and the Khabarovsk Territory. In addition to assistance in working a major coalfield, Hyundai was to build a 319-km railroad line at its own cost. Hyundai Resources Development was to begin drilling under a 50-50 joint venture with the Kalmyk Government in the Autonomous Republic of Kalmyk in 1992. The company estimated an oil

resource at 3.6 billion bbl near Elista between the Black Sea and the Caspian Sea.

Samsung Co. participated in the project to build a 130,000-bbl/d high-sulfur crude refinery at Malacca in Malaysia with 15% stake worth \$1.2 billion. The other partners were the Malaysian national oil company, Petronas, Caltex of the United States, and Taiwan's Chinese Petroleum Corp. However, Caltex withdrew from the project in June.

GOVERNMENT POLICIES AND PROGRAMS

The Government planned new legislation to control industrial waste that would result in increased recycling of a variety of products containing ferrous and nonferrous metals. Companies that produce or import 29 items in 13 categories, including automobiles, electric appliances, and aluminum cans, will be required to pay a fixed deposit in advance to cover the collection and disposal cost of their products. The deposits will be refunded whenever the waste is collected and recycled. The recycling of aluminum cans was implemented in September and is expected to raise the domestic aluminum scrap supply from the present 70,000 mt/a to 200,000 mt/a by 1995. Aluminum scrap recycling will save the country \$2.2 million annually in foreign exchange spent on importing aluminum ingots.

PRODUCTION

Production of iron ore and major nonferrous metal ore was in general on the decline because of depleting mineral reserves. Output of iron ore, lead ore, zinc ore, and tungsten ore decreased by 13%, 15%, 3%, and 17%, respectively, from the 1990 level. The country's most abundant industrial mineral, graphite, also showed a modest reduction of 8% in production. Anthracite output, which was used mainly for home heating, fell 14% to 13.7 Mmt. (See table 1.)

TRADE

Imports shot up as domestic consumption jumped to overheated levels and the quality of domestic products declined. While imports increased 17% to \$81.6 billion, exports expanded 10.6% to \$71.9 billion, resulting in a trade deficit of \$9.7 billion.

Direct barter trade was approved by the National Unification Board for Chonji Trade Co. to ship 5,000 tons of rice to Nampo, North Korea, in return for 30,000 tons of coal and 11,000 tons of cement. Lucky-Goldstar International Corp. contracted with a Chinese trading firm to export 30,000 bbl of diesel oil, worth \$1.4 million, produced by Honan Oil Refining Co., to North Korea. The Republic of Korea imported gold, zinc, tin, steel, iron ore, electrolytic copper, and fishery products from the North while North Korea bought petrochemicals, textiles, and consumer products from the South. The trade was conducted through Hong Kong and other third-country ports. Gold imports from North Korea were more than 10% of the total imports and were duty-free because they were treated as internal trade.

The country's trade with China grew quickly in the first half of 1991: exports to China were valued at \$1.06 billion and imports from China valued at \$1.48 billion. Textiles, cathode-ray tubes, and plastic products were among the major items shipped to China. The Republic of Korea posted a deficit of \$98 million on exports of \$214 million with the former U.S.S.R. and imports of \$310 million. Jindo Industries signed a contract to buy 5 Mbbl of crude oil from the former U.S.S.R. beginning in the fall, marking the first contract involving direct former Soviet crude oil deliveries to the Republic of Korea.

Posco negotiated with Mercedes-Benz and General Motors for large quantity export of CR sheet following shipments of samples in 1990 of 30 tons and 50 tons, respectively. (See tables 2 and 3.)

STRUCTURE OF THE MINERAL INDUSTRY

Most of the country's large, mineral-related companies are state-owned and under the control of either the Ministry of Trade and Industry or the Ministry of Energy and Resources. In recent years, some state-owned enterprises have gradually gone public, and part of the Government has been transferred to private investors' hands.

The country's number of persons employed in the mining sector decreased to 68,000 compared with 81,000 the year before. The mineral industry labor is skilled and highly productive, in particular metal ore miners. Miners are dominated by male workers at 91% of the work force. (See table 4.)

COMMODITY REVIEW

Metals

Aluminum.—Sam Sun Industrial Co. Ltd., the country's leading aluminum extruder, and Alcoa of the United States agreed to set up a 40-60 joint venture to produce aluminum extrusions and tube products principally for the domestic aerospace market. Operations were expected to begin in mid-1992. Sam Sun was to contribute the assets of its Changwon extrusions operation, which had four extrusion presses and an ingot casting unit. The joint venture was expected to participate in the automotive, business equipment, marine, and other markets in the country and Pacific Rim nations.

Copper.—Poongsan Corp.'s wholly owned subsidiary, PMX Industries Inc. in Cedar Rapids, Iowa, was nearing the completion of its copper and brass melt shop. Construction of the stainless melt shop was to begin in the spring of 1992, and production of metal was expected to start at the beginning of 1993. The mill's rolling, slitting, and packaging capacity was to be 5,000 mt/month, and the total cost of the project was \$200 million. Poongsan's exclusive sales agent in

Japan, JPS Ltd., imported 10,000 mt/a of copper and copper alloy products while supplying rolling and other processing equipment to Poongsan.

Iron and Steel.—The country's finished steel production was estimated to be 26.9 Mmt, 9.9% over 1990's output, and of this Posco accounted for 18.5 Mmt. While imports declined by 14% to 1.9 Mmt, total demand, including steel for export, increased 7.9% to 28.8 Mmt. Strong demand came from major consuming sectors, including shipbuilding, construction, and automobile manufacturing. Shipbuilders enjoyed a recovery after the Gulf War, and auto output and sales also reached high records.

Posco signed a 5-year contract with Australia's BHP Iron Ore Co. for shipment of 8 Mmt/a of ore beginning in 1992 from Mount Newman, Goldworthy, and Yandi ores. Posco was to commission its 3-Mmt/a expansion at Kwangyang in October 1992, bringing capacity to 20 Mmt/a.

On January 30, Posco formally opened a new 1.28-Mmt/a cold strip mill (No. 4) at its Kwangyang works after an investment of \$704 million and 24 months of work. With two cold-rolling mills at Pohang and two at Kwangyang, Posco's cold-rolled capacity was 5.47 Mmt/a. The construction on the third at Kwangyang was started in September 1990 with the commissioning scheduled for September 1992. The company expected to produce about 4.6 Mmt of cold rolled in 1991, a 25% increase over 1990. Together with other cold-rolled makers such as Union Steel and Dongbu, the country's total cold-rolled production was expected to grow by 19% to 6.19 Mmt. However, total demand was expected to gain 17% to 6.44 Mmt.

Posco signed a contract worth about \$1.1 million to supply 2,000 tons of cold-rolled sheet to Vietnam's state-run import company through the Daewood Corp. Posco also started trial export of quality cold-rolled coils to the Brazilian car industry. The company expected to import about 7.25 Mmt of iron ore from Brazil. Posco reached an agreement in

September with China's Guangzhou-Peugeot, a 50-50 joint venture auto manufacturer between the Chinese Government and the French car maker, to ship 3,800 tons of CR coil and sheet. Deliveries of 10,000 tons per quarter were planned, and shipment would be increased to 15,000 or 20,000 tons quarterly from 1992.

Posco shut down its No. 1 wire rod mill at Pohang for scheduled renovation on June 1. The mill currently has a capacity of 440,000 mt/a. When the work was completed in September, its capacity was to rise slightly to 450,000 mt/a. This gave Posco a combined capacity of its three Pohang mills of 1.54 Mmt/a. The closure was to take about 100,000 tons out of the market. Meanwhile, the Government relaxed import duties on rods and tightened export restrictions. Posco imported 30,000 tons of rods directly from Brazil and elsewhere during the third quarter. The country's wire rod demand reached 1.7 Mmt and domestic production decreased by 15% to 1.5 Mmt.

USS-Posco Industries, Posco's joint venture with U.S. Steel, was refused permission to ship about 700,000 mt/a of raw steel from the Republic of Korea to its Pittsburg, California, steel-finishing facility. Objections were raised about the added air pollution that would result from vessels calling at the port. The company's steel shipments had to be routed through the Port of Stockton and brought back by railroad to the steel mill with an additional cost of \$10 million per year. The \$450 million modernization program supposedly was to reach full capacity of 1.3 Mmt/a, but the target date was not met. Total output in 1991 was expected to be about 1.2 Mmt. USS-Posco also continued to be plagued with startup problems on sheet-finishing equipment in the sheet and tinplate plant. The company planned to reduce its 1,100-person work force by 10% during the next 2 to 3 months from May due to market conditions.

Four thousand workers went on strike for 6 days at Sammi Steel's Changwon plant, which produced stainless steel sheet, long bars, billets, and tubes. The

final agreement reached with management was a package including a pay increase of 17%, better working conditions, and a family allowance scheme. The company established a joint-venture company called Cosmos Steel in Yashio, Japan, with Osaka's Hanwa Kozai to handle sales of 500 mt/month of special steel products from Sammi and its North American operations. Dai Yang Metal planned to construct a stainless sheet processing plant near Los Angeles, California, and incorporate it into a local affiliate called Ocean Metal Corp., which was to construct the \$4.97 million plant. The plant was to be ready for commissioning by February 1992.

Kangwon Industries planned to diversify into specialty steels with new melting and rolling facilities at its Pohang works. With the purchase of a 100-ton electric furnace and rolling facilities that were set for commissioning in 1992, the company was to produce 500,000 mt/a of special steel rods. Meanwhile, Kangwon Industries was also building a 600,000-mt/a H-beam mill at Pohang that was to be commissioned in late 1993. Incheon Iron & Steel hoped to complete construction on a 500,000-mt/a expansion of its H-beam facilities by the end of the year to raise the company's capacity to 1.1 Mmt/a. The company also began a refurbishing project for its existing H-beam mill to increase efficiency. Domestic demand for beams was put at 1 Mmt in 1991 and expected to grow at 10% annually.

Dongkuk Steel Mills, an electric steel producer, planned to install two direct current electric furnaces with continuous casters, a 100-ton unit at its own works in Incheon, and a 120-ton unit at that of its subsidiary, Hankuk Steel, in Changwon near Pusan. Both were expected to be completed by November 1992. The work was to increase Incheon's capacity by 600,000 mt/a to 1.1 Mmt/a and Changwon's by 650,000 mt/a to 800,000 mt/a. Dongkuk Steel owns 63% interest in Hankuk Steel. Dongkuk Steel commissioned a new 700,000-mt/a plate mill at Pohang that lifted the country's total capacity to 3.2 Mmt/a. Domestic demand for plate was about 3 Mmt.

Construction of the new plant started in late 1988 and the first hot runs on the rolling mill began in 1990. The plant was to rely on Posco for the supply of slabs and imports from Brazil and Romania. The company also operated a 300,000-mt/a mill at Pusan and a 100,000-mt/a mill at Changwon. An 11-day strike at Dongkuk Steel's Pusan, Inchon, and Pohang works put an added strain on the domestic bar market. Dongkuk Steel produced 1.3 Mmt/a of bars for a local market share of 25%. Production of 50,000 tons was lost as a result of the strike. The country's total demand of bars was put at 5.7 Mmt.

Korea Steel Pipe Co. planned to move its plant from Inchon to Mokpo in the southwest and double its present capacity. Construction was to begin on the new plant and was expected to be completed during the second half of 1992. Commercial production was to start in 1993. The new plant would have a capacity of 200,000 mt/a of ERW pipes and tubes. The company planned to build new lines to produce larger diameter pipes in addition to the relatively modern lines that produced small diameter pipes. Its Inchon facilities will be closed in 1995.

Hyundai Pipe proceeded with the construction of a new plant in Ulsan that was to produce pipe for the former Soviet market. The plant, costing \$41 million, included a 50,000-mt/a oil pipe mill and a 40,000-mt/a spiral weld pipe mill, which was expected to be completed in August 1991. The company planned to add a second line to its oil pipe mill to boost another 50,000 mt/a in capacity in 1992 because it signed a contract worth \$300 million with the former Soviet Government to export 150,000 tons of pipe over the next few years.

Other small pipe producers were Pusan Steel Pipe, whose new large-diameter facility at Pohang was commissioned in July, and Dongyang Steel Pipe, whose 50,000-mt/a Inchon plant supplied the limited domestic requirements for large-diameter pipes. The country's demand was put at 100,000 mt/a with the balance met by imports.

Korea Iron & Steel Wire (KISW) planned to add more drawing equipment at its Malaysian subsidiary in Johore to lift the works' capacity to 5,000 mt/month by early 1992. The subsidiary imported all its wire rods from various sources, including its parent, and exported its production to Europe and the United States (50% to 60%) and Singapore (30%). KISW operated five plants in and around Pusan with a total capacity of 13,000 mt/month.

Due to the lower price of domestic steel scrap and increased availability, the country's minimills became increasingly reliant on domestic sources for feedstock. Imports of steel scrap dropped to 37% of the total requirements. The larger suppliers were the United States, Japan, Australia, Canada, Saudi Arabia, and New Zealand, in diminishing order. The country's electric steelmakers such as Inchon and Dongkuk rely on the Inchon port for scrap deliveries, and port congestion and traffic jams were delaying deliveries that caused a shortage of raw materials feed for their furnaces.

Tin.—The rising cost of raw materials and falling market prices had forced Korea Zinc to cease tin smelting in July. The company's 1,800-mt/a Ulsan smelter produced 500 tons of tin from imported concentrates from Malaysia and China in 1991. Lucky Metals considered a 30% to 40% cutback in production at its Changhang smelter. Annual demand was 7,500 tons, but domestic production amounted to only one-third of the demand. The rest was covered by imports. The Government planned to reduce tin import tariffs from a current 10% to 7% in 1992 and 5% in 1993. Dongyang Tinplate Industry and Dongbu Steel Co. were negotiating with the large Korean trading houses to secure long-term supply sources abroad. Due to a shortage of domestically produced tinplate, these companies requested additional supplies of 6,000 tons of tinplate from Nippon Steel Corp. and two other mills in Japan in the first quarter of 1991. Pohang Special Tin Plate Co. opened a plant at Pohang with a

production capacity of 120,000 mt/a of special tin products.

Zinc.—Strong domestic demand led the country's two primary zinc smelters to increase total production by 7.3% to 267,000 tons. Korea Zinc expected output to climb by 4.2% to 177,000 tons whereas Young Poong's production jumped by 16.7% to 90,000 tons. Korea Zinc's QSL plant with a capacity of 60,000 mt/a was due to start up in late 1991. Exports fell as more zinc was diverted into the local market.

Industrial Minerals

Cement.—Keo Yang Co., affiliated with Posco, planned to construct a 600,000-mt/a plant near Kwangyang to process slag into powder for domestic cement production. The first-stage construction of the plant, at a cost of \$31 million, was scheduled for dedication in late 1991. The company also planned to quadruple plant capacity to 2.4 Mmt/a by 1993 with an additional investment of \$98 million. Tong Yang Cement planned expansion of its facilities at Samchok to raise output from 5 Mmt/a to 8 Mmt/a by the end of 1991. A sixth kiln line was commissioned in a record time of 12 months with an investment of \$150 million. The new line increased total capacity to 2.5 Mmt/a of cement clinker. The expansion ensured Tong Yang's rank as the second largest cement producer in the country. Hyundai Cement also expanded its cement output from two quarries. Dan Yang quarry currently maintained 3 Mmt/a, and Yongweol quarry produced 2 Mmt/a. Both production facilities were to be expanded to provide more than 4 Mmt/a each by the end of 1993.

A surge in private housing construction combined with Government-supported capital projects pushed up demand for cement. Strong import volume (including clinker) and increased output resulted in an oversupply of cement of as much as 4 Mmt. The Government extended its duty-free import period to June 30.

Potassium Sulfate.—Kyunggi Chemical Co.'s plant started production of potassium sulfate in 1982 and had a capacity of 20,000 mt/a. In 1991, the capacity had expanded to 80,000 mt/a and was likely to continue expansion in the future to service the expanding markets of the Far East.

Mineral Fuels

Liquefied Natural Gas.—The country was to buy 2 Mmt/a of Malaysian LNG, worth \$310 million per year, for 20 years starting in 1995, but abandoned the plan due to high prices. The Republic of Korea's other LNG supplier was Indonesia, which supplied also 2 Mmt/a under a 20-year contract that began in 1986. Another 20-year contract that was to double purchases from Indonesia was signed in May. The Ministry of Energy and Resources was considering another source in northwest Australia that was to supply 1 to 2 Mmt of LNG annually from the mid-1990's.

The country consumed 2.5 Mmt of LNG per year, 75% of which was for power generation, and was expected to consume 7 Mmt/a in 1996 and 12 Mmt/a by the year 2001. LNG was expected to supply 7% and petroleum 45%, respectively, of total energy consumption in the year 2000.

Hyundai Engineering Co. Ltd. let a contract to M. W. Kellogg Ltd. of the United Kingdom for process design and technical service for a receiving terminal for an LNG plant being built at Incheon. Completion of the terminal and three storage tanks was expected in 1995 and that of a fourth tank in 1996.

Petroleum.—The growth rate in energy consumption in terms of oil equivalent tonnage by the household, commercial, and industrial sectors slowed in 1991, although it continued to rise for transportation. Energy consumption by source was estimated at 53% from petroleum, 24% from coal, 15% from nuclear power, and 7% from LNG. Crude oil imports for 1991 were estimated to be 400 Mbbbl.

A joint oil-refining venture formed by Ssangyong Oil Refining Co. and Saudi-Arabian American Oil Co. was approved by the Ministry of Energy and Resources. The Saudi firm was expected to acquire 35%, worth \$400 million of Ssangyong's existing refinery in Onsan. Ssangyong is the third largest refiner in the country. The company was to complete construction of a 30,000-bbl/d fluid-catalytic cracker, a 30,000-bbl/d hydrocracker, and a 25,000-bbl/d desulfurizing facility by the end of 1994.

The Government planned to free overseas trade of kerosene and gasoline and ease regulations on establishing gas stations in August. However, prices of Bunker-C oil and diesel were to remain regulated. The five refiners face severe competition in the domestic oil market. Honam Oil Refinery Co. had a capacity of 380,000 bbl/d; Yukong Ltd., 375,000 bbl/d; Ssangyang Oil Refinery Co., 160,000 bbl/d; Kyung In Energy Co., 60,000 bbl/d; and Kukdong Oil Co., 60,000 bbl/d.

Korea Petroleum Development Corp. planned to more than double its crude oil reserves to 84 Mbbbl by 1996 from 39 Mbbbl to cope with rising demand. Completion of new oil stock facilities was to provide the country with enough reserves for 60 days of consumption. It was estimated that the country would consume 1.5 Mbbbl/d of oil by 1996.

In the petrochemical sector, Lucky, Ltd.'s naphtha cracker was commissioned in September. Two similar plants had come on-stream, another was under construction, and another plant was planned. Hyundai Petrochemical Co. dedicated a 350,000-mt/a ethylene unit at its \$1.7 billion petrochemical complex in Daisan. The Government planned to eliminate soft loans and make it more difficult for new entrants to find building sites in a bid to limit the expected damage from excess capacity.

Reserves

The country is poor in mineral resources; anthracite coal is the most abundant and is the important mineral commodity. Indigenous metallic ores

include those of lead, zinc, and tungsten, the latter being significant in terms of world production but not in reserve base. Industrial minerals with a large share of world output are diatomaceous earth, feldspar, graphite, mica, pyrophyllite, and talc. (See table 5.)

INFRASTRUCTURE

Westinghouse Electric Corp. won a major contract worth \$355 million from Korea Electric Power Co. (Kepco) to build two gas-fueled powerplants near Seoul, which were to include seven combustion turbines and electrical generators. Because of the country's booming economy, Kepco plans to add generators capable of producing 37 MkW of power at a cost of \$63.5 billion between 1991 and 2006, reaching 46.9 MkW in 2001 and 58.7 MkW in 2006. Electricity use has been growing at 1.5 times the rate of economic growth. Home and office use accounted for one-third of electricity consumption, whereas that for industry was the remaining 67%. Kepco reopened five oil-burning facilities that had not been used since 1980 to supply electricity.

Kepco planned to increase its purchase of uranium oxide from Australia as its needs were expected to double over the next 15 years with the construction of nine nuclear stations. Current uranium needs were supplied by Western Mining's Roxby Downs and North Broken Hill Peko's Ranger mines (40%), French and Canadian contracts (10%), and purchases on the spot market (50%).

OUTLOOK

Raw steel consumption is expected to increase 7.5% to 27.2 Mmt in 1992, compared with a 17.5% increase in 1991. The construction industry, which accounts for half of steel consumption, is expected to show slow growth as a result of Government restrictions. The auto industry, representing 10% of the steel consumption, plans to increase productivity 13% over that of 1991. The appliances industry, highly dependent on exports, is expected to grow at a slower

rate than 1991. The shipbuilding industry, however, will remain at the same high level of operation as 1991 because of booming world shipbuilding demand. With the completion of the fourth stage of the Kwangyang works in October 1992, Posco's production capacity will increase to 21 Mmt/a and domestic steel production will reach 27.1 Mmt.

¹Korea Economic Update, Washington, DC. V. 3, No. 1, 1992, p. 3.

²Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W725=US\$1.00 for 1991.

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TABLE 1
REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²
METALS					
Aluminum, primary	21,654	17,500	17,500	2,000	*2,000
Bismuth metal	145	132	96	79	42
Cadmium, smelter	—	490	*500	*500	*450
Copper:					
Mine output, Cu content	178	36	4	53	5
Metal:					
Smelter	157,923	169,000	179,890	185,563	*202,000
Refined, primary	154,591	168,334	178,665	*183,000	201,911
Gold metal kilograms	7,600	11,121	14,270	20,760	20,809
Iron and steel:					
Iron ore and concentrate:					
Gross weight thousand tons	470	390	334	298	222
Fe content do.	263	218	187	180	134
Metal:					
Pig iron do.	11,057	12,577	14,846	15,339	18,510
Ferrous alloys:					
Ferromanganese	58,044	75,924	85,329	84,000	94,893
Ferrosilicon	12,646	8,909	4,582	2,000	18,912
Other	90,382	89,966	101,818	99,000	74,173
Total	161,072	174,799	191,729	185,000	187,978
Steel, crude thousand tons	16,782	19,117	21,873	23,125	26,001
Lead:					
Mine output, Pb content	13,998	14,457	16,535	14,857	12,633
Metal, smelter	62,593	60,799	*60,000	*61,000	40,554
Manganese ore and concentrate:					
Gross weight	91	—	—	—	—
Mn content	36	—	—	—	—
Molybdenum, mine output, Mo content	325	144	132	103	144
Silver metal kilograms	209,058	226,687	239,214	238,236	264,746
Tin, mine output, Sn content	3	—	—	—	—
Tungsten, mine output, W content	2,375	2,029	1,701	1,361	780
Zinc:					
Mine output, Zn content	23,530	21,820	23,202	22,792	22,039
Metal, primary	186,078	223,000	240,184	248,244	254,050
INDUSTRIAL MINERALS					
Asbestos	2,518	2,428	2,361	1,534	*1,500
Barite	2,942	2,573	3,735	*2,923	1,014
Cement, hydraulic thousand tons	25,662	28,995	30,474	33,600	34,999
Clays: Kaolin	630,945	832,110	1,219,174	1,446,598	1,755,225
Diatomaceous earth	64,783	71,952	75,019	55,445	91,126
Feldspar	180,269	241,511	232,607	237,447	247,969
Fluorspar, metallurgical-grade	63	261	856	560	290
Graphite:					
Crystalline	838	678	1,186	*703	1,552
Amorphous	106,507	107,767	100,282	98,987	75,239
Total	107,345	108,445	101,468	*100,690	76,791

See footnotes at end of table.

TABLE 1—Continued
REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²
INDUSTRIAL MINERALS—Continued					
Kyanite and related materials: Andalusite	85	112	19	—	14
Mica: All grades	31,938	18,848	7,888	*4,765	5,127
Nitrogen: N content of ammonia	474,891	506,471	480,310	411,287	407,297
Salt	664,000	1,020,000	830,000	616,681	695,804
Soda ash, manufactured*	*288,500	*280,000	*280,000	*280,000	*300,000
Stone, sand and gravel:					
Limestone	41,675	46,377	48,011	48,851	59,221
Quartzite	1,235	1,379	1,554	1,452	1,627
Sand including glass sand	1,350	1,488	1,358	1,408	1,354
Talc and related materials:					
Pyrophyllite	690,819	673,776	770,298	657,611	573,208
Talc	161,052	146,478	162,098	181,600	170,563
MINERAL FUELS AND RELATED MATERIALS					
Carbon black	146,758	183,346	193,358	215,300	231,000
Coal: Anthracite	24,273	24,295	20,785	17,217	14,850
Coke*	5,100	5,200	5,500	*5,500	*5,600
Fuel briquets: Anthracite briquets	23,587	22,926	18,700	18,779	14,996
Petroleum refinery products:					
Gasoline	10,936	13,618	18,309	23,984	28,917
Jet fuel*	*9,500	*9,500	*9,600	*9,600	*9,700
Kerosene	7,966	10,619	13,161	13,873	14,523
Distillate fuel oil	60,296	73,504	88,577	94,814	128,379
Residual fuel oil	*73,400	*75,000	100,320	98,634	142,443
Lubricants*	*7,100	*7,300	*7,400	*7,400	*7,500
Other*	*15,000	*15,000	*16,000	*17,000	*18,000
Refinery fuel and losses*	4,000	4,000	4,000	4,000	4,000
Total*	188,198	208,541	257,367	269,305	353,462

*Estimated. *Preliminary. *Revised.

¹Includes data available through June 15, 1992.

TABLE 2
REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	182	287	—	Bangladesh 101; Pakistan 35; Taiwan 34.
Metal including alloys:				
Scrap	456	137	24	Japan 97; Taiwan 15.
Unwrought	3,819	6,308	14	Japan 2,634; Taiwan 2,547.
Semimanufactures	24,875	25,392	474	Hong Kong 10,948; Philippines 3,333; Japan 3,259.
Antimony: Oxides	116	170	—	All to Japan.
Arsenic: Oxides and acids	125	188	—	Japan 165; West Germany 17.
Bismuth: Metal including alloys, all forms	161	129	—	Japan 114; United Kingdom 12.
Cadmium: Metal including alloys, all forms	828	874	—	Japan 834; Netherlands 40.
Chromium:				
Oxides and hydroxides	(^o)	3	—	All to Indonesia.
Metal including alloys, all forms	kilograms	1,198	—	
Cobalt:				
Oxides and hydroxides	47	—	—	
Metal including alloys, all forms	—	46	—	Mainly to Japan.
Columbium and tantalum: Tantalum metal including alloys, all forms	kilograms	5,494	69	4 Japan 65.
Copper:				
Matte and speiss including cement copper	—	11,325	—	Japan 9,371; unspecified 1,642.
Sulfate	198	566	—	New Zealand 296; Canada 80; Philippines 54.
Metal including alloys:				
Scrap	2,080	1,919	35	Japan 1,684; Hong Kong 85.
Unwrought	35,225	1,129	(^o)	Taiwan 452; France 200; Hong Kong 171.
Semimanufactures	37,971	45,063	618	Hong Kong 16,665; Japan 7,966; Taiwan 7,966.
Germanium: Metal including alloys, all forms	kilograms	1	—	
Gold:				
Waste and sweepings	value, thousands	\$623	\$172	\$17 United Kingdom \$377; Japan \$85.
Metal including alloys, unwrought and partly wrought	kilograms	11,282	14,374	51 Japan 6,619; Singapore 3,700.
Iron and steel:				
Metal:				
Scrap	19,272	39,576	2,101	Hong Kong 23,071; Japan 9,761.
Pig iron, cast iron, related materials	2,408	2,981	—	Japan 2,594; Hong Kong 198.
Ferroalloys:				
Ferromanganese	2,209	1,429	89	Taiwan 780; Bangladesh 500.
Ferrosilicomanganese	1,622	940	—	Taiwan 900; Thailand 40.
Ferrochromium	—	250	—	NA.
Silicon metal	32	—	—	
Unspecified	300	502	—	Philippines 300; Japan 201.
Steel, primary forms	thousand tons	804	331	2 Japan 138; Indonesia 132.

See footnotes at end of table.

TABLE 2—Continued
REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
METALS—Continued					
Iron and steel—Continued:					
Metal—Continued:					
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated	thousand tons	3,876	3,964	827	Japan 1,887; Malaysia 168.
Clad, plated, coated	do.	507	1,009	137	Japan 262; Thailand 66; unspecified 204.
Of alloy steel	do.	51	132	11	Hong Kong 17, Italy 16; India 11.
Bars, rods, angles, shapes, sections	do.	1,277	779	43	Japan 369; Thailand 70; Saudi Arabia 42.
Rails and accessories	do.	34	311	2	Japan 287; China 6.
Wire	do.	156	164	4	Japan 52; Philippines 15; Indonesia 13.
Tubes, pipes, fittings	do.	865	890	390	Japan 209; Saudi Arabia 34.
Lead:					
Ore and concentrate		4,560	12,350	—	Australia 8,750; Japan 3,600.
Oxides		8,626	2,678	—	Japan 2,446; Indonesia 144.
Metal including alloys:					
Scrap		1,234	2,433	—	Japan 1,010; United Kingdom 980.
Unwrought		5,493	4,635	3	Japan 2,123; Singapore 1,798.
Semimanufactures		103	149	1	Saudi Arabia 78; Pakistan 15.
Magnesium: Metal including alloys:					
Scrap		45	81	—	All to Japan.
Unwrought		67	11	—	Japan 10; Sri Lanka 1.
Semimanufactures		114	175	16	Japan 158; Australia 1.
Manganese:					
Oxides		46	60	(?)	Sri Lanka 57; Indonesia 3.
Metal including alloys, all forms		—	2	—	Mainly to Japan.
Mercury	kilograms	69	—		
Molybdenum:					
Metal including alloys:					
Scrap		1	1	—	All to Japan.
Semimanufactures		1	1	(?)	NA.
Nickel: Metal including alloys:					
Scrap		1,392	2,221	—	Japan 2,219.
Unwrought		1,152	1,330	202	Belgium-Luxembourg 1,042; Singapore 42.
Semimanufactures		11	5	1	Japan 2; Hong Kong 1.
Platinum-group metals:					
Waste and sweepings	value, thousands	\$4,062	\$5,721	—	Japan \$2,184; Hong Kong \$1,590.
Metals including alloys, unwrought and partly wrought	kilograms	2,019	77	13	United Kingdom 63.
Selenium, elemental		55	—		
Silicon, high-purity		12	37	26	Hong Kong 10; Japan 2.
Silver:					
Ore and concentrate		81	—		
Waste and sweepings	value, thousands	\$92	\$687	\$1	Japan \$545; Singapore \$140.
Metal including alloys, unwrought and partly wrought	kilograms	87,257	100,411	—	Japan 68,560; Australia 11,870; China 11,677.

See footnotes at end of table.

TABLE 2—Continued
REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Tin: Metal including alloys:				
Scrap	747	483	—	Japan 465; Philippines 18.
Unwrought	332	170	1	Japan 167.
Semimanufactures	70	116	(?)	Hong Kong 29; Japan 28; Pakistan 15.
Titanium:				
Ore and concentrate	146,708	136,440	—	All to Japan.
Oxides	5,263	5,563	1	Japan 2,835; Indonesia 1,324.
Metal including alloys, all forms	11	25	—	Japan 21; Netherlands 3.
Tungsten:				
Ore and concentrate	48	—	—	—
Oxides and hydroxides	17	18	—	West Germany 17.
Metal including alloys:				
Scrap	237	93	27	Japan 55; West Germany 10.
Unwrought	285	166	—	Japan 150; West Germany 13.
Semimanufactures	4	6	(?)	Mainly to Japan.
Vanadium: Metal including alloys, all forms	2	166	—	All to Japan.
Zinc:				
Ore and concentrate	—	1,456	1,456	—
Oxides	7,908	8,903	—	Japan 6,762; Indonesia 782; India 317.
Blue powder	964	1,179	—	Hong Kong 450; Singapore 437.
Ash and residue containing zinc	55	280	—	All to Malaysia.
Metal including alloys:				
Unwrought	73,583	56,310	705	Japan 26,111; Singapore 11,740.
Semimanufactures	136	234	16	Solomon Islands 39; Japan 25.
Zirconium: Ore and concentrate	225	—	—	—
Other:				
Oxides and hydroxides	184	85	—	China 58; Japan 15.
Ashes and residues	13,134	12,119	—	Australia 10,887; Japan 879.
Base metals including alloys, all forms	kilograms	—	281	97 Japan 184.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	226	42	7	Indonesia 28; Hong Kong 8.
Artificial: Corundum	—	10	—	NA.
Dust and powder of precious and semiprecious stones including diamond	kilograms	12,005	352	344 Hong Kong 6.
Grinding and polishing wheels and stones	2,292	2,601	322	Canada 326; Japan 290.
Boron: Oxides and acids	4	28	—	Nigeria 26.
Bromine	—	2	—	All to India.
Cement	thousand tons	3,701	1,740	5 Japan 1,278; Hong Kong 225.
Chalk	—	29	—	Bangladesh 20; Mexico 2.
Clays, crude:				
Bentonite	3,727	6,119	—	Thailand 5,520; Japan 380.
Chamotte earth	16,095	15,104	—	Japan 15,084; China 20.
Fire clay	4	—	—	—
Kaolin	46,854	37,776	—	Japan 35,126; Taiwan 2,496.

See footnotes at end of table.

TABLE 2—Continued
REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Clays, crudes—Continued:				
Unspecified	1,266	1,491	—	China 1,060; Sri Lanka 372.
Cryolite and chiolite	3	6	—	All to Nigeria.
Diamond:				
Natural: Gem, not set or strung	carats	2,185	2,400	35 Belgium-Luxembourg 1,775; Hong Kong 525.
Synthetic	do.	—	5	— All to Japan.
Diatomite and other infusorial earth		228	673	— Taiwan 443; Indonesia 180.
Feldspar		6,611	24,571	— Taiwan 24,556.
Fertilizer materials:				
Crude, n.e.s.		499	514	— All to Japan.
Manufactured:				
Ammonia		9	16	— Netherlands 8; United Arab Emirates 5.
Nitrogenous		228,420	239,351	15,350 Thailand 80,302; Philippines 55,297.
Phosphatic		27,228	11,717	— Japan 10,815; Philippines 795.
Potassic		48,280	89,283	— Japan 17,835; Pakistan 11,550; unspecified 56,318.
Unspecified and mixed	thousand tons	799	856	— Thailand 499; Japan 90; unspecified 169.
Fluorspar		34	93	— Indonesia 48; Nigeria 45.
Graphite, natural		52,629	48,697	— Japan 32,828; unspecified 10,224.
Gypsum and plaster		16,565	11,497	(^o) Japan 5,511; Philippines 5,500.
Lime		53	14	— Mainly to Indonesia.
Magnesium compounds:				
Magnesite, crude		2	—	
Oxides and hydroxides		3,241	133	— Singapore 72; Philippines 60.
Mica:				
Crude including splittings and waste		—	5	— Indonesia 3.
Worked including agglomerated splittings		312	309	31 Japan 245; China 29.
Nitrates, crude		—	5	— All to Nigeria.
Pigments, mineral: Iron oxides and hydroxides, processed		40	80	(^o) Japan 56; unspecified 24.
Precious and semiprecious stones other than diamond:				
Natural	kilograms	34,092	64,442	10,629 China 22,174; Hong Kong 17,767.
Synthetic	do.	23,326	65,512	3,791 Thailand 33,434; Japan 18,234.
Quartz crystal, piezoelectric	grams	—	51,492	14,392 Ireland 33,300; Japan 3,800.
Salt and brine		24,157	40,568	474 Japan 39,434; unspecified 537.
Sodium compounds, n.e.s.:				
Soda ash, manufactured		2	247	— Hong Kong 235; Nigeria 12.
Sulfate, manufactured		—	4	— Mainly to Libya.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		398,825	296,950	— Japan 282,300; Taiwan 14,180.
Worked		217,888	184,030	185 Japan 180,914.
Dolomite, chiefly refractory-grade		305,531	348,947	— Japan 338,033; Taiwan 10,900.
Gravel and crushed rock		585	347	— Japan 301; Taiwan 36.
Limestone other than dimension		698	1,203	— Indonesia 918; France 250.
Quartz and quartzite		5,506	3,019	— Japan 2,973; Singapore 36.

See footnotes at end of table.

TABLE 2—Continued
REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued:				
Sand other than metal-bearing	27	1,431	—	Japan 1,400; Pacific Islands 14.
Sulfur:				
Elemental:				
Crude including native and byproduct	5,605	6,402	3	Indonesia 3,077; Malaysia 1,152.
Colloidal, precipitated, sublimed	184	605	—	Japan 496; Indonesia 107.
Sulfuric acid	64,382	90,793	—	Taiwan 82,535; Philippines 8,194.
Talc, steatite, soapstone, pyrophyllite	293,762	289,113	479	Japan 164,882; China 89,566.
Other:				
Crude	90,168	79,118	—	Japan 52,589; China 25,904.
Slag and dross, not metal-bearing	81,920	87,154	—	All to Japan.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	150	—	—	—
Carbon black	37,055	43,848	—	Indonesia 16,281; Japan 6,957; Taiwan 3,387.
Coal:				
Anthracite	—	50	—	All to Indonesia.
Bituminous	210	258	—	Thailand 130; Taiwan 112.
Coke and semicoke	3,629	7,252	—	Japan 4,300; Taiwan 1,018; Thailand 1,000.
Petroleum:				
Refinery products:				
Liquefied petroleum gas	thousand 42 gallon barrels	370	1,094	— Japan 884; Hong Kong 192.
Gasoline	do.	4,436	733	— Mainly to Japan.
Naphtha	do.	6,704	2,466	— Japan 2,427; Australia 39.
Mineral jelly and wax	do.	10	9	— Turkey 4; Japan 2.
Kerosene and jet fuel	do.	1,582	233	18 Japan 96; Thailand 62.
Distillate fuel oil	do.	8,382	10,687	119 Japan 8,973; China 495.
Lubricants	do.	467	531	— Indonesia 40; Thailand 30.
Residual fuel oil	do.	13,714	12,379	1 Japan 10,202; Singapore 1,512.
Bitumen and other residues	do.	27	28	— Hong Kong 16; Malaysia 3.
Bituminous mixtures	do.	4	4	— Thailand 2; Japan 1.
Petroleum coke	do.	—	919	— Japan 628; Spain 212.

NA Not available.

¹Table prepared by Audrey D. Wilkes.

²Less than 1/2 unit.

TABLE 3
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	74	101	3	Japan 65; France 21.
Alkaline-earth metals	77	66	(²)	Ireland 40; France 25.
Aluminum:				
Ore and concentrate	31,320	34,538	20	Hong Kong 12,900; Guyana 8,519; unspecified 12,134.
Oxides and hydroxides	138,176	115,093	566	Japan 72,422; Australia 38,961.
Ash and residue containing aluminum	213	142	—	Japan 116; West Germany 26.
Metal including alloys:				
Scrap	55,601	39,577	28,296	Saudi Arabia 4,097; United Arab Emirates 1,545.
Unwrought	485,558	361,926	34,763	Australia 160,495; Canada 43,892.
Semimanufactures	74,149	72,084	12,955	Japan 21,132; Bahrain 10,361.
Antimony:				
Ore and concentrate	2,568	2,326	—	Hong Kong 405; China 121; unspecified 1,696.
Oxides	527	505	1	United Kingdom 207; Japan 156.
Metal including alloys, all forms	645	2,178	(²)	Thailand 889; China 136; unspecified 1,536.
Arsenic:				
Ore and concentrate	52	217	—	Australia 168; Japan 36.
Elemental	37	24	(²)	Mainly unspecified.
Oxides and acids	18	40	—	NA.
Beryllium: Metal including alloys, all forms				
	kilograms	489	149	149
Bismuth: Metal including alloys, all forms				
	do.	2,119	20,755	743 Belgium-Luxembourg 4,980; unspecified 10,830.
Cadmium: Metal including alloys, all forms				
		258	60	33 Japan 8; unspecified 19.
Chromium:				
Ore and concentrate	3,250	528	—	Philippines 18; unspecified 510.
Oxides and hydroxides	2,725	2,799	485	Japan 1,831; West Germany 218.
Metal including alloys, all forms	83	108	(²)	Japan 88; United Kingdom 14.
Cobalt:				
Oxides and hydroxides	73	147	35	Belgium-Luxembourg 55; Finland 23.
Metal including alloys, all forms	437	355	22	Belgium-Luxembourg 261; Netherlands 18.
Columbium and tantalum:				
Metal including alloys, all forms:				
Columbium	kilograms	43	112	8 Japan 104.
Tantalum		3	2	(²) Mainly from Japan.
Copper:				
Ore and concentrate	463,175	368,402	68,645	Canada 85,370; Chile 68,798; Papua New Guinea 63,535.
Matte and speiss including cement copper	13,086	8,487	—	Chile 6,967; Norway 931; Portugal 481.
Oxides and hydroxides	1,411	1,379	1,096	Australia 160; Japan 87.
Sulfate	1,081	413	(²)	China 220; Japan 46; unspecified 128.

See footnotes at end of table.

TABLE 3—Continued
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued:				
Metal—Continued:				
Semimanufactures—Continued:				
Flat-rolled products—Continued:				
Of iron or nonalloy steel—Continued:				
Clad, plated, coated	339,063	324,580	1,295	Japan 319,806; West Germany 1,545.
Of alloy steel	557,104	460,666	13,495	Japan 386,615; France 19,400.
Bars, rods, angles, shapes, sections	443,130	1,414,872	32,441	Turkey 341,203; Japan 285,342.
Rails and accessories	10,359	3,291	128	Japan 2,894; West Germany 62.
Wire	3,317	21,689	2,042	Japan 14,725; Taiwan 863.
Tubes, pipes, fittings	149,876	231,935	29,330	Japan 176,343; West Germany 8,043.
Lead:				
Oxides	260	83	14	Mexico 60; West Germany 5.
Ash and residue containing lead	123	624	—	Australia 346; Japan 178.
Metal including alloys:				
Scrap	41,971	47,711	13,204	Saudi Arabia 15,056; Australia 6,426.
Unwrought	96,988	107,380	18,217	Australia 44,123; Mexico 22,029.
Semimanufactures	62	44	26	Japan 9; West Germany 7.
Lithium:				
Oxides and hydroxides	129	149	143	Japan 6.
Metal including alloys, all forms kilograms	170	285	276	Japan 9.
Magnesium: Metal including alloys: Scrap				
Unwrought	1,101	1,544	877	Norway 254; Canada 173.
Semimanufactures	1,296	362	258	Canada 70; West Germany 25.
Manganese:				
Ore and concentrate:				
Battery-grade	5,071	5,294	—	Singapore 3,444; Japan 195.
Metallurgical-grade	503,252	387,824	136	Australia 220,363; India 78,298.
Oxides	4,314	4,101	16	Japan 1,913; Belgium-Luxembourg 700.
Metal including alloys, all forms	823	891	87	China 134; unspecified 551.
Mercury	31	27	6	Japan 10; unspecified 5.
Molybdenum:				
Ore and concentrate				
Oxides and hydroxides	(²)	460	2	Belgium-Luxembourg 285; Netherlands 173.
Metal including alloys:				
Unwrought	13	5	(²)	Japan 3; West Germany 1.
Semimanufactures	170	354	319	Japan 26; Austria 2.
Nickel:				
Matte and speiss				
Oxides and hydroxides	98	105	11	Japan 51; Canada 36.
Metal including alloys:				
Scrap	1,781	2,439	564	Japan 1,071; United Kingdom 486.
Unwrought	8,164	6,571	24	Belgium-Luxembourg 1,973; Australia 1,783.
Semimanufactures	1,054	1,547	147	Japan 580; Sweden 268.

See footnotes at end of table.

TABLE 3—Continued
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Platinum-group metals:				
Waste and sweepings	value, thousands	\$47	—	
Metals including alloys, unwrought and partly wrought:				
Platinum	kilograms	482	395	234 West Germany 131; Japan 30.
Unspecified	do.	649	1,353	670 West Germany 309; Japan 229.
Rare-earth metals including alloys, all forms				
		4	122	100 Belgium-Luxembourg 10; Brazil 7.
Selenium, elemental				
		7	7	(^o) Japan 6.
Silicon, high-purity				
		72	92	34 Japan 58.
Silver:				
Waste and sweepings	value, thousands	\$13	\$2	\$2
Metal including alloys, unwrought and partly wrought	kilograms	146,668	122,949	14,136 Switzerland 37,817; Australia 29,621.
Tellurium, elemental				
	do.	736	712	2 Japan 510; Belgium-Luxembourg 100.
Tin:				
Ore and concentrate		3,691	4,228	32 Bolivia 1,121; West Germany 599.
Oxides		2	3	— Japan 2.
Metal including alloys:				
Scrap		16	4	4
Unwrought		10,380	6,050	— Malaysia 4,212; Indonesia 1,050.
Semimanufactures		690	608	9 Japan 527; Malaysia 44.
Titanium:				
Ore and concentrate		68,908	39,872	3 Malaysia 20,581; Thailand 9,500.
Oxides		6,969	5,160	137 Japan 3,260; West Germany 1,288.
Metal including alloys:				
Waste and scrap		—	34	34
Unwrought		12	730	180 Netherlands 174; United Kingdom 91.
Semimanufactures		745	869	77 Japan 736; Belgium-Luxembourg 40.
Tungsten:				
Ore and concentrate		2,115	3,007	— Australia 605; unspecified 2,206.
Oxides and hydroxides		—	15	— Mainly from Italy.
Metal including alloys:				
Unwrought		3	2	1 Japan 1.
Semimanufactures		75	63	11 Japan 41.
Uranium and thorium:				
Oxides and other compounds		(^o)	—	
Uranium metal including alloys, all forms value	thousands	—	\$2	— All from West Germany.
Vanadium:				
Oxides and hydroxides		37	113	21 Japan 59; unspecified 33.
Metal including alloys, all forms	kilograms	84	911	— All from Japan.
Zinc:				
Ore and concentrate		449,999	485,327	17,968 Australia 273,176; Canada 124,082.
Oxides		1,038	2,110	95 Taiwan 424; unspecified 1,279.

See footnotes at end of table.

TABLE 3—Continued
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Zinc—Continued				
Blue powder	83	(^o)	—	All from Japan.
Matte	19,173	13,003	2,048	Japan 6,097; Australia 1,741.
Ash and residue containing zinc	3,490	3,683	513	Malaysia 801; Saudi Arabia 595; Canada 564.
Metal including alloys: Scrap	2,890	543	349	New Zealand 102; Philippines 20.
Unwrought	20,345	25,283	18	Mexico 3,702; Taiwan 1,979; unspecified 14,351.
Semimanufactures	1,330	951	3	Peru 828; Japan 94.
Zirconium:				
Ore and concentrate	21,813	24,515	135	Australia 23,068; Malaysia 774.
Zirconium—Continued:				
Oxides	66	117	7	Japan 61; United Kingdom 50.
Metal including alloys:				
Scrap	kilograms	50	—	
Unwrought	do.	161	220	20 West Germany 200.
Semimanufactures		76	68	44 Canada 18.
Other:				
Ores and concentrates	330	—		
Oxides and hydroxides	16	57	(^o)	Japan 32; United Kingdom 25.
Ashes and residues	301	127	109	Canada 18.
Base metals including alloys, all forms	50	2	(^o)	Japan 1.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	19,773	21,132	106	Japan 8,922; India 8,664.
Artificial:				
Corundum	36,178	43,578	978	Japan 16,450; Hong Kong 4,362.
Silicon carbide	14,237	14,900	109	Japan 5,559; Italy 2,271.
Dust and powder of precious and semiprecious stones including diamond	kilograms	4,513	202,576	1,990 Japan 197,851; Ireland 2,601.
Grinding and polishing wheels and stones		1,715	1,885	80 Japan 1,086; Austria 100.
Asbestos, crude	77,475	74,549	—	Canada 37,257; Zimbabwe 9,198.
Barite and witherite	4,148	47,839	2	India 21,706; Thailand 4,024; unspecified 21,072.
Boron materials:				
Crude natural borates	2,603	2,675	1,630	Chile 1,000; West Germany 45.
Elemental	kilograms	138	293	174 Japan 104; West Germany 10.
Oxides and acids		3,315	3,345	1,528 Chile 823; Italy 756.
Bromine	192	196	—	Italy 89; unspecified 105.
Cement	404,610	3,777,766	192	Saudi Arabia 283,808; Indonesia 205,701; unspecified 1,806,104.
Chalk	23,641	23,493	160	France 23,108; Belgium-Luxembourg 204.
Clays, crude:				
Bentonite	6,892	11,549	7,253	Australia 746; India 360.
Chamotte earth	11,544	14,008	827	Hong Kong 10,750; unspecified 2,026.
Fire clay	311	315	73	Japan 22; unspecified 200.
Kaolin	145,944	171,320	96,230	Hong Kong 15,892; Japan 9,572.
Unspecified	6,219	5,343	2,105	Japan 1,054; Hong Kong 875.

See footnotes at end of table.

TABLE 3—Continued
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamond:				
Natural:				
Cryolite and chiolite	46	28	2	Japan 21; Denmark 5.
Gem, not set or strung	carats 14,600	36,005	805	Belgium-Luxembourg 6,420; Hong Kong 3,440; unspecified 20,910.
Industrial stones	do. 215,720	63,640	46,075	Ireland 6,860; Japan 6,105.
Synthetic: Gem, not set or strung	do. 109,185	26,065	5,415	West Germany 15,500; Ireland 5,150.
Diatomite and other infusorial earth	417	414	19	Thailand 149; Taiwan 100.
Feldspar, fluorspar, related materials:				
Feldspar	2,339	8,863	28	Australia 5,208; Japan 1,492.
Fluorspar	74,503	52,939	—	Thailand 19,145; Hong Kong 2,158.
Fertilizer materials: Manufactured:				
Ammonia	618,064	508,091	251,745	Qatar 63,778; Saudi Arabia 59,663.
Nitrogenous	123,023	190,974	(²)	Indonesia 54,754; Mexico 23,240.
Phosphatic	3,500	2,000	—	All from Japan.
Potassic	680,151	570,901	27,909	Canada 394,756; Jordan 66,147.
Unspecified and mixed	17,172	5,911	3,860	Japan 137; unspecified 1,840.
Graphite, natural	6,341	23,692	29	Hong Kong 476; Japan 277; unspecified 22,625.
Gypsum and plaster	203,261	234,445	809	Thailand 222,310; Morocco 11,000.
Iodine	13	14	—	Japan 10; Chile 4.
Kyanite and related materials:				
Andalusite	9,609	10,877	—	Japan 199; unspecified 10,660.
Kyanite	2,104	2,036	1,716	Sweden 320.
Sillimanite	—	81	—	United Kingdom 41; Japan 40.
Mullite	5,157	4,919	1,798	Japan 3,121.
Lime	26	35	—	Japan 34.
Magnesium compounds:				
Magnesite, crude	489	2,384	—	Japan 290; unspecified 2,040.
Oxides and hydroxides	91,494	80,495	742	Japan 19,789; unspecified 58,603.
Other	810	580	—	West Germany 400; Philippines 180.
Mica:				
Crude including splittings and waste	2,123	2,508	406	Malaysia 1,124; India 657.
Worked including agglomerated splittings	1,374	190	(²)	Japan 109; Belgium-Luxembourg 42.
Nitrates, crude	15,162	13,030	374	Chile 7,950; West Germany 3,409.
Phosphates, crude	thousand tons 1,544	1,560	1,220	Jordan 117; Nauru 74.
Phosphorus, elemental	3,310	3,090	896	Belgium-Luxembourg 420; Netherlands 420; Thailand 210.
Pigments, mineral:				
Natural, crude	141	312	1	Austria 177; United Kingdom 39.
Iron oxides and hydroxides, processed	24,081	19,126	2,813	Japan 10,470; Belgium-Luxembourg 1,948.
Precious and semiprecious stones other than diamond:				
Natural	kilograms 443,163	307,010	35,687	Brazil 86,900; Japan 46,369.
Synthetic	do. 428,994	303,616	174,081	Japan 104,769; China 6,850.
Quartz crystal, piezoelectric	do. 1,903	5,806	59	Belgium-Luxembourg 4,600; Japan 1,147.
Salt and brine	thousand tons 1,039	1,081	(²)	Australia 803; Mexico 149.

See footnotes at end of table.

TABLE 3—Continued
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Sodium compounds, n.e.s.:				
Soda ash, manufactured	146,929	219,845	217,540	West Germany 1,038; unspecified 1,226.
Sulfate, manufactured	96,735	110,622	5,552	Taiwan 16,237; Japan 5,044.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	133,403	100,255	5,963	India 21,673; Italy 17,418.
Worked	26,592	46,836	1,000	Italy 31,932; Spain 3,145; Brazil 2,520.
Dolomite, chiefly refractory-grade	974	1,398	—	United Kingdom 999; Norway 329.
Gravel and crushed rock	5,618	8,036	42	France 4,464; Philippines 1,102.
Limestone other than dimension	2,489	5,897	—	All from Japan.
Quartz and quartzite	2,544	3,594	613	Japan 629; Sweden 515.
Sand other than metal-bearing	468,432	520,130	405	Australia 414,785; Malaysia 85,500.
Sulfur:				
Elemental:				
Crude including native and byproduct	554,925	517,345	6	Japan 335,650; Canada 181,689.
Colloidal, precipitated, sublimed	2,830	1,766	1,479	Japan 255; West Germany 22.
Dioxide	1	(^o)	—	West Germany (^o).
Sulfuric acid	98,175	171,497	1,850	Japan 169,646.
Talc, steatite, soapstone, pyrophyllite	123,409	1,721,630	6,652	Taiwan 1,066; unspecified 1,712,817.
Vermiculite ³	27,864	46,706	17,967	Japan 21,717; Philippines 1,793.
Other:				
Crude	41,110	100,666	443	Japan 35,925; Turkey 20,500; Philippines 7,326.
Slag and dross, not metal-bearing	444,959	387,209	—	Japan 384,395; Thailand 1,468.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	207	302	302	
Carbon black	7,138	8,396	2,975	Japan 2,566; West Germany 1,069
Coal:				
Anthracite	thousand tons	1,517	1,072	36 Unspecified 1,036.
Bituminous	do.	23,500	22,846	3,343 Australia 8,413; Canada 4,478.
Briquets of anthracite and bituminous coal		34	—	
Lignite including briquets		31,053	34,717	— All from Australia.
Coke and semicoke		402,862	144,819	1,198 Japan 99,883; Australia 2,220.
Gas, natural: Liquefied	thousand tons	2,015	2,237	(^o) Mainly from Indonesia.
Peat including briquets and litter		298	20,751	2 West Germany 18,290; Canada 1,002.
Petroleum:				
Crude	thousand 42-gallon barrels	289,583	289,550	— Oman 62,899; United Arab Emirates 48,331; Saudi Arabia 45,607.
Refinery products:				
Liquefied petroleum gas	do.	19,459	26,075	12 Saudi Arabia 13,902; United Arab Emirates 4,143.
Gasoline	do.	3,534	4,030	118 Singapore 1,170; Japan 946.
Naphtha	do.	6,553	13,906	261 Saudi Arabia 3,186; Singapore 2,765.
Mineral jelly and wax	do.	146	153	11 Japan 55; unspecified 73.

See footnotes at end of table.

TABLE 3—Continued
REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Petroleum—Continued:					
Refinery products—Continued:					
Kerosene and jet fuel	do.	5,782	17,843	3,139	Japan 3,592; Saudi Arabia 3,162.
Distillate fuel oil	do.	7,915	13,762	2,553	Japan 2,816; Saudi Arabia 1,842.
Lubricants	do.	201	191	37	Japan 102.
Residual fuel oil	do.	16,453	29,566	15,923	Japan 6,597; Singapore 2,309.
Bitumen and other residues	do.	15	(²)	(²)	
Bituminous mixtures	do.	6	—		
Petroleum coke	do.	880	682	642	West Germany 24.

¹Revised. NA Not available.

²Table prepared by Audrey D. Wilkes.

³Less than 1/2 unit.

⁴May include some perlite and chlorite.

TABLE 4
REPUBLIC OF KOREA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum, primary	Aluminum of Korea Ltd.	Ulsan	17.5
Bismuth, metal	Korea Tungsten Mining Co. Ltd.	Sangdong	0.135
Cement	Ssangyong Cement Industrial Co. Ltd.	Yongwol	11,500
Copper, metal	Lucky Metals Co. Ltd.	Changhang	50
Do.	do.	Onsan	150
Graphite	Kaerion Graphite Ltd.	Kangwon	25
Do.	Wolmyong Mining Co.	do.	26
Lead, metal	Lucky Metals Co. Ltd.	Changhang	15
Do.	Korea Zinc Co. Ltd.	Onsan	80
Nickel, metal	Korea Nickel Corp.	do.	12
Steel	Pohang Iron and Steel Co. Ltd. (Mostly government owned)	Kwangyang	5,400
Do.	do.	Pohang	9,100
Talc	Dongyang Talc Mining Co.	Chungju	NA
Tungsten, in ore	Korea Tungsten Mining Co. Ltd.	Sangdong	3
Zinc, metal	Korea Zinc Co. Ltd.	Onsan	165
Do.	Young Poong Corp.	Sukpo	75

NA Not available.

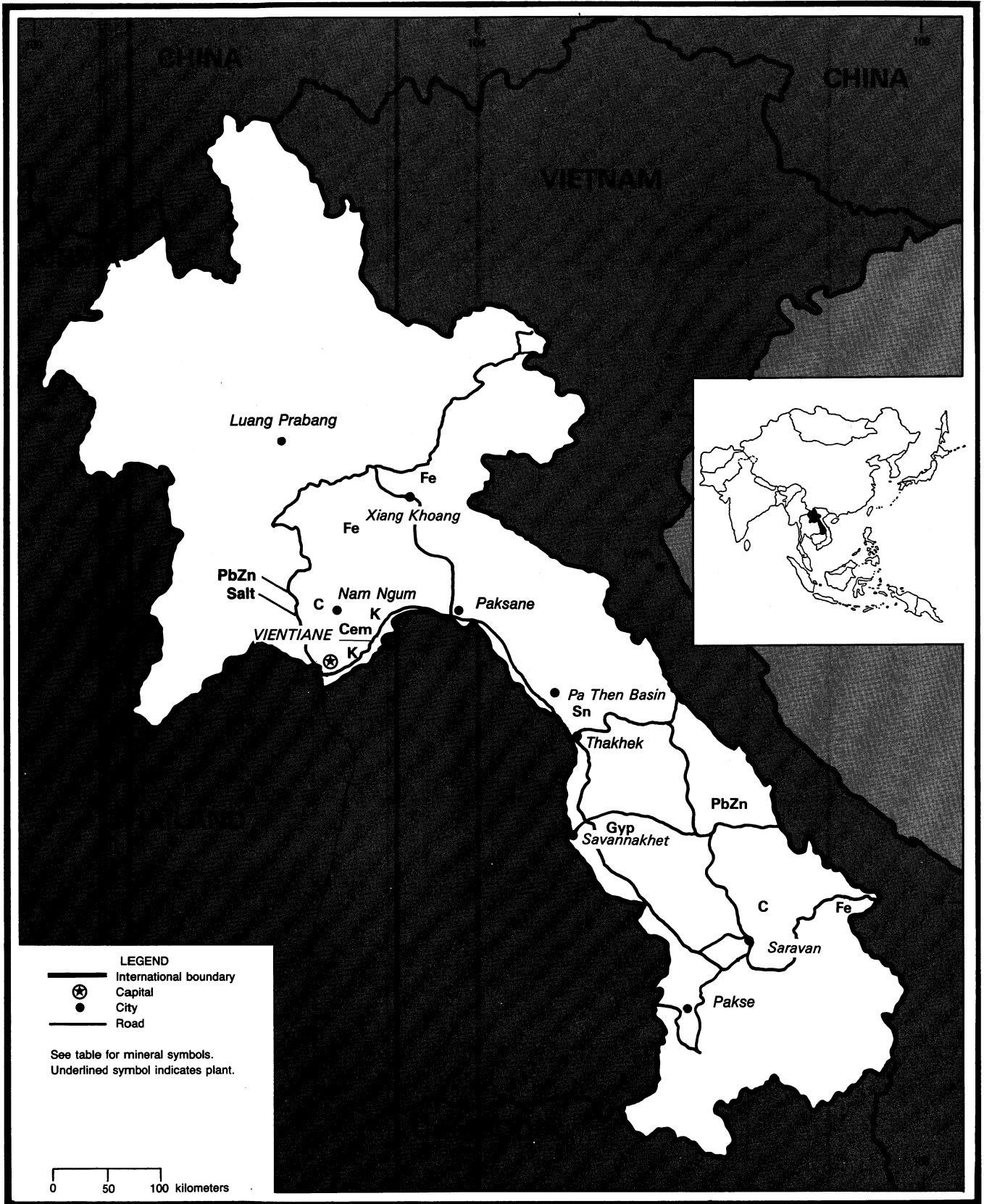
TABLE 5
REPUBLIC OF KOREA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1991

Commodity	Reserves (thousand tons)
Bismuth	4
Coal, anthracite	1,450,600
Graphite	39,500
Pyrophyllite and talc	15,000
Tungsten	60
Zinc, in ore	10,800

LAOS

AREA 236,800 km²

POPULATION 4.1 million



THE MINERAL INDUSTRY OF

LAOS

By Travis Q. Lyday

Laos is a small country with a minuscule mineral industry. Its agrarian economy, much of it slash-and-burn cropping, supports the majority of the Lao people. The Government's recognition of the need for mineral exploration and development led to the adoption of legal measures designed to encourage both domestic and foreign participation. With an estimated per capita GDP of only \$150 and a high inflation rate, the country could benefit from tapping its mineral resources. The development of a mining sector would lead to new sources of revenues and the creation of employment that would be independent of the agricultural sector.

The mineral industry of Laos is essentially unstructured. Private-sector activity in the mineral industry was excluded until 1987, and reforms of old laws have led to some foreign interest in mineral development. Private-sector interest was initially attracted to exploration for petroleum and gold. However, other commodities such as coal and gemstones are beginning to receive attention from potential foreign capital sources.

Owing to the difficulty of access, general lack of infrastructure, high capital cost of development, and questionable potential utilization, Laos' iron ore deposits near Xiang Khoang remain essentially undisturbed. Future customers

for this ore may include either Thailand or Vietnam, pending growth of their respective steel industries. Exploration for gold was centered particularly in the region about 60 km northwest of Vientiane. Tin continued to be mined by cottage industry methods in the area of Pa Then Basin north of Thakhek and only on a scale approximating 500 mt/a.

There is a small output of gypsum, of which a good part is believed to be shipped across the border to Vietnam. Gemstones were "mined" sporadically, or at least collected in streambeds throughout the southern part of the country.

Coal was mined near Bo Chan (location unknown) in Vientiane Province at the rate of about 1,500 mt/a.

Any information on mineral reserves would be estimates and premature in view of the present efforts to organize mineral exploration and development in the country. Copper, gold, iron ore, lead and zinc, tin, gemstones, gypsum, potash, coal, and probably petroleum, appear to have production potential in Laos.

Laos has a total of almost 27,530 km of roads, of which there was 1,856 km having a bituminous surface. Another 7,450 km consisted of gravel, crushed stone, or other type of improved surface. The remaining 18,224 km was unimproved, loose surface, and often impassable during the rainy season from May to September or October.

Laos has a total of 65 airports. However, there are only nine with paved runways; none have runways more than 3,659 m in length. There are two airports with runways 2,440 m to 3,659 m long.

The country had one pipeline 136 km long for refinery products. It is believed to be in the process of being extended from Vientiane to Vinh, Vietnam.

Power was generated by the 150-MW Nam Mgum hydroelectric plant. Other than what was consumed locally in the Vientiane area, most of the output was exported to Thailand. An additional 3 MW of capacity was distributed among several small hydroelectric plants, and about 14 MW of capacity was provided by a number of diesel units in various parts of the country.

Laos is only on the verge of social, political, and industrial development and consolidation. The country seemingly has possibilities for mineral development with consequent benefit to its economy—increasing the national income and enhancing the well-being of the people. The major problem is a lack of capital to develop infrastructure and industry. Foreign venture legislation has been passed that may help in removing obstacles and problems to modernize the country. Foreign petroleum concessions may bring in sufficient capital to begin the process of capital formation as a necessary precursor to development.

TABLE 1
LAOS: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
Cement (from imported clinker)	4,500	4,500	³ 6,875	6,500	7,000
Gemstones (sapphires) carats	8,000	15,000	¹ ³ 37,925	30,000	35,000
Gypsum	70,000	³ 80,000	³ 104,000	90,000	100,000
Salt, rock	13,000	30,000	³ 7,950	8,000	8,000
Tin, mine output, Sn content	450	³ 300	³ 127	³ 500	300

¹Preliminary. ²Revised.

¹Table includes data available through Dec. 22, 1992.

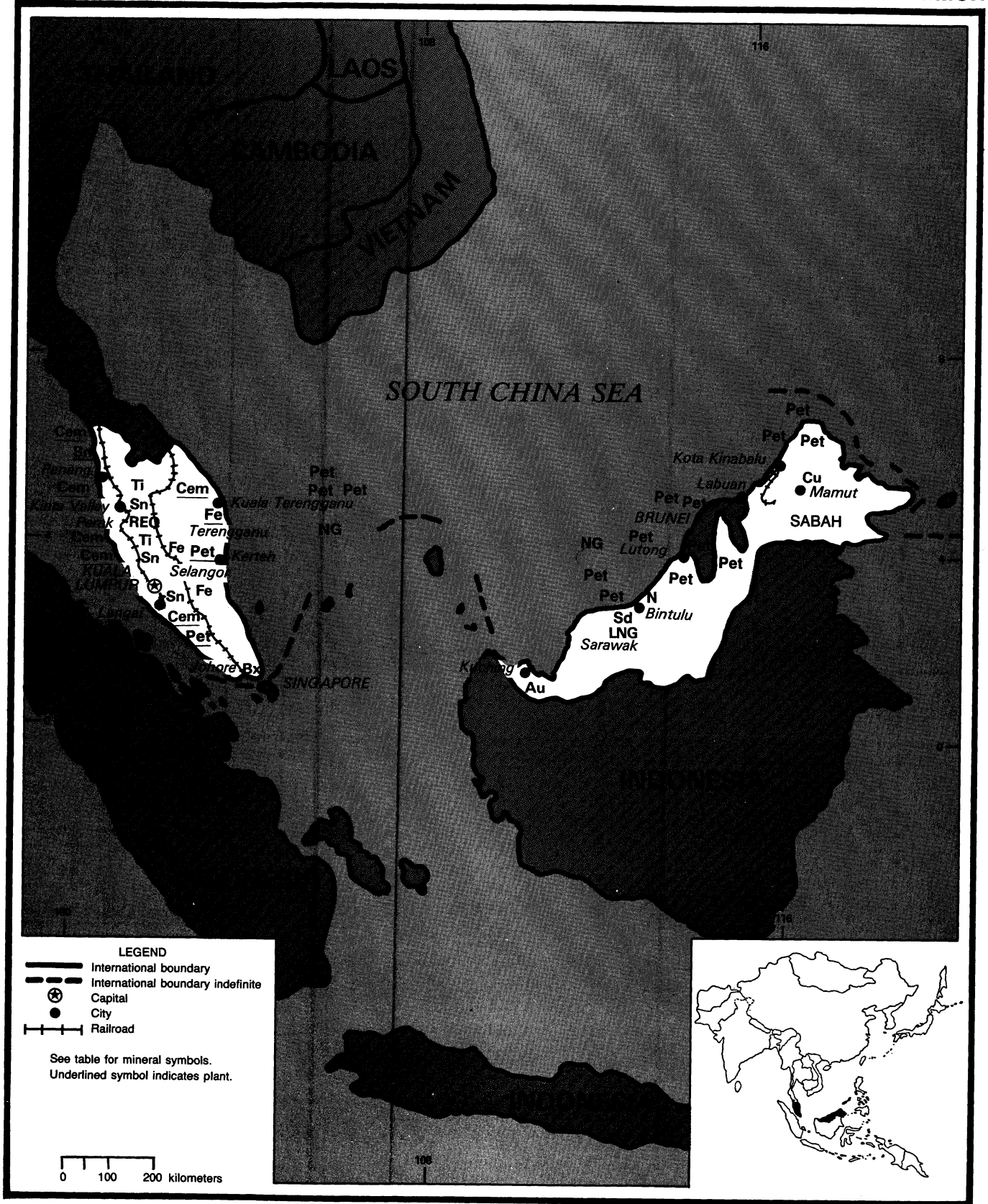
²In addition to the commodity listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

³Reported figure.

MALAYSIA

AREA 329,750 km²

POPULATION 18.0 million



LEGEND

- International boundary
- International boundary indefinite
- Capital
- City
- Railroad

See table for mineral symbols.
Underlined symbol indicates plant.

0 100 200 kilometers

THE MINERAL INDUSTRY OF

MALAYSIA

By John C. Wu

Malaysia's important mineral resources include bauxite, clay, copper, petroleum, ilmenite, natural gas, iron ore, rare earths, and tin. Of these minerals, only its tin reserves are large and are ranked the world's third largest after China and Brazil. In past years, deposits of copper, lead, and zinc as well as gold and silver had been discovered in the central belt of Peninsular Malaysia extending from Kelantan to Johore. A large polymetallic sulfide deposit of copper-gold-lead-zinc and deposits of gold and silver also had been identified in the Mengapur area of Pahang. According to Malaysia's Department of Mines, two more gold deposits had been discovered in 1991 in the States of Pahang and Terengganu and are slated for subsequent development.

In 1991, Malaysia was the world's fourth largest tin producer and an important producer in Southeast Asia of bauxite, copper, crude petroleum, ilmenite, kaolin, monazite, natural gas, and zircon. The mining industry, which contributed 9.6% to Malaysia's GDP in 1991, remained an important sector of the economy. Despite a further decline in the tin industry, Malaysia's mining industry expand slightly, mainly due to the increase in output of crude petroleum and natural gas.

According to Malaysia's Department of Statistics, the output of the mining industry grew an estimated 5.1% in 1991 compared with 5.2% in 1990, while Malaysia's GDP grew 8.8% in 1991 compared with 9.8% in 1990. Malaysia's GDP in 1978 constant dollars was estimated at \$31.5 billion,¹ of which about \$3 billion was contributed by the mining industry in 1991. Malaysia exported most of its mineral products to Japan and neighboring Southeast Asian countries. Malaysia became a less important supplier of crude petroleum and

refined tin to the United States when U.S. imports of these two commodities from Malaysia were reduced considerably in 1991.

Malaysia remained a net exporter of mineral products in 1991. Malaysia exported all of its coal, copper concentrate, ilmenite, rare earths, and zircon concentrate and exported about 85% of its smelted tin. Malaysia also exported about 80% to 85% of its bauxite, natural gas, and silica sand and exported about 74% of its crude petroleum production. Export earnings from crude petroleum and natural gas accounted for 14.4% of Malaysia's export earnings, which was estimated at \$34.4 billion in 1991. Malaysia's imports of nonfuel minerals, such as iron ore and tin concentrate, were mostly reexported after smelting. However, a considerable quantity of coal, heavy crude petroleum, and industrial minerals, including gypsum, phosphate rock, potash, and salt, were imported annually for domestic consumption.

In 1991, the focus of Malaysia's mineral industry's major investment remained on the mineral fuels sector. To increase natural gas production capacity for the growing demand by the liquefied natural gas (LNG) plants in Bintulu, the Royal Dutch/Shell Group companies invested \$555 million in 1991 and planned to invest \$629 million in 1992. PETRONAS, the State-owned oil and gas company, awarded a \$692 million contract to build the company's first 100,000-bbl/d sweet crude oil refinery in Malacca and a \$1.6 billion contract to construct five 130,000-m³ LNG carriers using French's Gaz Transport Technology.

During the 1991-95 Sixth Malaysia Plan, PETRONAS is expected to invest about \$4 billion, of which \$1.6 billion is

for the Malacca oil refinery, \$600 million for the Bintulu LNG plant, and \$550 million for petrochemical projects. In December, Malaysia brought on-stream its 730-km natural gas pipeline with a total project cost of \$833 million.

In the nonfuel minerals sector, Malaysia invested a total of \$200 million in 1991 for construction of a new 2,000-mt/d cement plant in Ipoh, Perak, and for expanding cement capacity at Rawang in Selangor and at Kanthan in Perak by 0.5 Mmt/a to 2.6 Mmt/a. Mamut Copper Mining Sdn. Bhd. (MCM) was to invest an additional \$35 million to redevelop and extend the mining life of the Mamut Mine in Sabah. The development project of copper-gold at Mengapur in Pahang, however, was still in the final stage of evaluation in 1991.

GOVERNMENT POLICIES AND PROGRAMS

After 2 1/2 years of study, the Ministry of Primary Industries with assistance from United Nations Development Program completed the final drafting of National Mineral Development Policy and Planning in June and produced eight important documents. These documents included National Mineral Policy, Mineral Tax and Investment, Mineral Title Management, Mineral Sector Development Plan, Model State Mineral Enactment, Model State Standard Mineral Agreement, Model Federal Mineral Development Act, and an integrated report. The final draft of these documents needs the consent of the Federal Government and the respective State Governments as well as final approval of the Parliament before implementation.

According to the Ministry of Primary Industries, the primary goal of the

National Mineral Development Policy is to provide Malaysia with a modern and internationally competitive regulatory system, which will allow the mineral sector to expand, diversify, and contribute to Malaysia's economic development. Under this new policy, local and foreign investors will be encouraged to explore for bauxite, clay, coal, copper, gold, rare metals, and silica in Malaysia; miners will be ensured of security of tenure, paying lower royalty, and enjoying tax incentives, such as income tax allowances on exploration expenditures and lower import duties on mining equipment. Under this new policy, foreign investors also will be allowed to raise their ownership in a Malaysian venture to 100% from 30% in the past years.²

In June, Malaysia unveiled its Second Outline Perspective Plan-OPP2 (1991-2000) based on a new socioeconomic policy, called New Development Policy (NDP), to replace the First Outline Perspective Plan-OPP1 (1971-90) based on the New Economic Policy. The primary goal of NDP is to attain a balanced development for establishing a more united and just society. To achieve this goal, the Government strategies are: (1) to focus on eradication of hardcore poverty, while reducing relative poverty; (2) to focus on employment and step up development of a viable Bumiputra (native Malay) commercial and industrial community; (3) to focus more on human resource development; and (4) to rely heavily on the private sector to stimulate economic growth.

The OPP2 embodying the NDP also sets out major macroeconomic and sectoral targets between 1991 and 2000. During the OPP2 period, Malaysia's real GDP is projected to grow at an average annual rate of 7%. Among the major sectors of GDP, manufacturing is expected to be the leading growth sector, which is projected to grow at an average annual rate of 10.5%. The mining and quarrying, however, is expected to be the slowest growing sector, which is projected to grow at an average annual rate of only 1.5%. As a result, the sector's contribution to Malaysia's GDP

by manufacturing is projected to increase from 27.0% in 1990 to 37.2% in the year 2000, while that of mining and quarrying is projected to decline from 9.7% in 1990 to 5.7% in the year 2000.³

PRODUCTION

The oil and gas industry continued to dominate the mineral industry of Malaysia in 1991. The output of both crude petroleum and natural gas reached a record high in 1991. The country's tin industry continued to suffer from low tin prices on the Kuala Lumpur Tin Market, and the industry's employment reached a record low in 1991. As a result of reduced tin production, the output of byproducts such as ilmenite and monazite also decreased considerably. Output of copper ore at the Mamut Mine in Sabah and washed bauxite in the Pengerang area of Johore declined in 1991. However, copper and gold recovery was higher than that of 1990 because of installation of a new flotation cell in the spring of 1991. Production of silica sand in the Bintulu area of Sarawak decreased slightly, while production of cement and kaoline reached a record high in 1991 because of stronger demand in the domestic market. Production of barite decreased sharply due to weaker domestic demand in 1991. (See table 1.)

TRADE

Malaysia remained a minerals net exporting country. In 1991, Malaysia's export earnings of crude petroleum and natural gas in the form of LNG were \$4,957 million, accounting for more than 97% of the total mineral export earnings and 14.4% of the country's total merchandise exports. Despite a higher export volume, export earnings from crude petroleum and LNG in 1991 were lower than that of 1990 because of lower oil and gas prices in the world market. Exports of refined tin were lower than those of 1991 mainly because of lower tin prices and reduced exports to the Netherlands and the United States. Malaysia had not exceeded its export

ceiling imposed by the Association of Tin Producing Countries (ATPC) in 1991.

Malaysia continued to import about 22,000 bbl/d of heavy crude petroleum from the Middle East to meet the requirement for the domestic refineries. Other important minerals imports in 1991 were iron ore and tin concentrate for reexport after smelting and cement, gypsum, phosphate rock, potash, sodium carbonate, and sulfur for domestic consumption.

STRUCTURE OF THE MINERAL INDUSTRY

The structure of Malaysia's mineral industry remained unchanged in 1991. However, the output capacity of the oil and gas industry continued to expand, while capacity of the tin industry contracted further in 1991. The cement industry was expanding its capacity in 1991. Associated Pan Malaysia Cement Sdn. Bhd. was upgrading its plants and will raise its capacity by 500,000 mt/a by 1992.

According to an estimate by the Malaysian Ministry of Human Resources, the total number of persons employed by the mining and quarrying industry rose to 39,400 from 39,100 in 1990, despite a sharp drop in the tin industry's employment. According to the Malaysian Department of Mines, the number of worker employed by the major nonfuel minerals at the end of 1991 was: 76 in barite, 211 in bauxite, 1,212 in copper, 524 in gold, 83 in iron ore, 453 in kaolin, 214 in silica sand, and 6,594 in tin. Additionally, there were about 1,000 involved in limestone quarrying and 100 coal miners in 1991. Malaysia's total labor force rose from 7.0 million to 7.3 million in 1991, while the unemployment rate decreased from 6.0% in 1990 to 5.6% in 1991 owing mainly to an employment gain in the manufacturing and service industries. (See table 2.)

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—Mine production of bauxite declined in 1991 due to a weaker domestic demand. Exports of bauxite totaled 301,975 tons and were valued at \$1.3 million in 1991. Johore Mining and Stevedoring Co. Sdn. Bhd., Malaysia's sole bauxite producer, operated a multiple-bench, open pit mine and a washing plant with a work force of about 210 at Bukit Raja around Pengerang Highway north of Sungai Rengit, east of Johore Bahru. The washing plant, capable of milling 1 Mmt/a of ore, produced a monthly average of about 31,300 tons of washed bauxite with 10% water content in 1991. The company produced three grades of bauxite—refractory-grade, metallurgical-grade, and cement-grade.

Copper.—Production of copper concentrate from the Mamut Mine in Sabah decreased slightly to 98,313 tons from 101,931 tons in 1990. Exports of copper concentrate, all to Japan, totaled 96,513 tons and were valued at \$58.7 million in 1991. Copper content of the concentrate had been upgraded to an average of 26% in 1991 from 24% in 1990. Upgrading of the copper concentrate was accomplished by installation of a Jameson flotation cell at the Mamut concentrator. The Jameson flotation cell technology was imported from MIM Holdings of Australia in early 1991. Employment at the Mamut Mine increased by 100 to 1,200 workers in 1991, and 99% of those employed are Malaysian.

The copper concentrate produced in 1991 contained 25,581 tons of copper, 1,615 kg of gold, and 13,270 kg of silver. According to MCM, the owner and operator of the Mamut Mine, the percentage contribution of copper, gold, and silver to overall revenues based on prevailing prices was 70%, 28%, and 2%, respectively, in 1991.

In 1991, MCM planned to spend about \$35 million during 1992-95 to redevelop

the Mamut Mine and to extend the mining life to 1997. The company reportedly was awarded a license by the State Government to explore for copper, gold, silver, and other metals in the Pinggan-Pinggan area near Kota Marudu and Pitas Districts in the State of Sabah. The company had applied for another license to prospect for other nonferrous metals and jadeite at the Magkadou and Merungin areas.⁴ MCM became a wholly owned subsidiary of Mega First Corp. Bhd., a Malaysian public-listed merchant banker. Mega First reportedly acquired MCM for about \$55 million in April 1991.

According to a Malaysian Government source, the final stage of feasibility study for the Mengapur project had been completed by Malaysia Mining Corp. (MMC) in 1991. However, MMC has not decided on whether to develop the polymetallic sulfide deposit of copper, gold, and silver. According to an early estimate by MMC, to develop an open pit mine and related infrastructure will cost about \$350 million. A 250-kg/h pilot plant was constructed at Mengapur for processing the skarn-type sulfide ore. Mine layout and detailed pit design for Zone A, a sulfide ore pit, as well as a flotation works were also undertaken by MMC in 1990.⁵

Gold.—Gold production increased slightly in 1991 due to a higher recovery of gold as a byproduct of copper mining at the Mamut Mine in Sabah. Of the total gold produced in 1991, 58.0% was from the Mamut copper mine in Sabah; 41.5% was from 22 to 30 small-scale mines in the States of Kelantan, Pahang, and Sarawak; and 0.5% or about 15 kg of gold was recovered as a byproduct of tin mining in Peninsular Malaysia.

Following completion of a \$1.5 million feasibility study by an unnamed Australian company, Malaysia's State Development Corp. reportedly planned to undertake an alluvial gold project in the Lubok Mandi area of Rusila, about 20 km south of Kuala Terengganu. Construction of a \$15 million processing plant will start in early 1992.⁶ In early 1991, a large number of illegal miners

were panning and prospecting gold in the Lubok Mandi area. About 80 illegal miners reportedly were arrested by the Terengganu State police.

Iron and Steel.—Iron ore production continued the 1990 upward trend and reached the highest level in 9 years. Increased consumption by a local major iron and steel producer, Malayawata Steel Bhd., was the major factor for the increased output of iron ore in 1991. A small amount of iron ore has been exported annually to China. In 1991, most iron ore was produced from small deposits located in the States of Perak, Kedah, Johore, and Penang. According to the Geological Survey of Malaysia, the known deposits with significant reserves in Peninsular Malaysia, using 60% Fe as a cutoff grade, are located at Bukit Ibam in Pahang, 1 Mmt; Bukit Besi in Terengganu, 8 Mmt; and Pelepah Kanan in Johore, 10 Mmt.

In April, Perwaja Terengganu Sbn. Bhd. (PTSB), the State-owned steel company, awarded a \$145 million contract to Danieli, an Italian plantmaker, for construction of a 450,000-mt/a rod and bar mill at Kemaman in Terengganu. In late 1990, PTSB had awarded a \$250 million contract to a German-Mexican consortium to renovate its direct-reduced-iron (DRI) plant with a Mexican DRI technology and to upgrade its steel billet plant to 1.2 Mmt/a in late 1990. According to the Managing Director of PTSB, the DRI plant renovation and upgrading of the steel billet plant were expected to be completed in early 1993.

To secure its long-term raw material supply, PTSB signed a \$900 million iron pellet purchase agreement with Compania Mineral del Pacifico SA (CMP) of Chile in June. The contract called for PTSB to purchase 1.5 Mmt/a of iron billets from CMP beginning in 1993 for 10 years. PTSB reportedly is CMP's single largest customer.

To help erase PTSB's debts and losses, the Government planned to sell between 40% and 45% of PTSB equity to the public or merge with another public company for future privatization.⁷ PTSB reported an \$8.7 million profit for its

fiscal year ending March 31, 1989. However, the company reportedly had accumulated debts of \$436 million and incurred accumulated losses of \$545 million in 1991.

As part of its billet capacity expansion project, Southern Iron and Steel Works Sdn. Bhd. commissioned a new 70-ton furnace equipped with a 70-MVA rectifier furnace transformer and 12-pulse rectifier group of 88 kADC having a melting power of 1 MVA per ton. The equipment, which is claimed as the world's most powerful DC furnace, was supplied by ABB Process Automation of Baden, Switzerland. To expand its billet capacity, Antara Steel Mills Sdn. Bhd. began construction of a \$36.4 million billet plant at Pasir Gudang in Johore in 1991. The 500,000-mt/a billet plant, utilizing Spanish and German equipment, was scheduled to come on-stream in mid-1993.

The \$3.2 billion joint-venture steel project between Malaysia and Taiwan to build a 2.5-Mmt/a integrated steel mill in Malaysia was placed on hold in late 1991. The Taiwanese Parliament reportedly was withholding the final approval of investment in the project unless the Malaysian Government signed an investment-guarantee pact with the Taiwanese Government.⁸

Tin.—Malaysia's tin industry contracted further in 1991 because of the continued low level of tin prices in the Kuala Lumpur Tin Market (KLTM), a weaker world demand for tin, and increased world surplus tin. By the end of 1991, the total number of operating mines declined to 92 from 141 in 1990, and the total number of tin miners dropped to 6,594 in 1991 from 8,508 in 1990. As a result, the 1991 mine output of tin dropped to the lowest level in Malaysia's post-World War II tin mining history. Of the tin produced in 1991, 46% was by dredging, 31% by gravel pumping, 9% by open pits, and 14% by others.

According to Malaysia's Department of Mines, the 1991 monthly output of tin decreased to 1,541 tons in December from 2,265 tons in January. The total

number of operating mines decreased to 92 in December from 131 in January. In 1991, the total number of tin miners declined to 6,594 in December from 8,115 in January. The gravel pumping sector was the major victim taking the hardest hit, closing 45 mines and losing 1,205 jobs. During 1991, the tin industry, as a whole, shut down 45 gravel pumping mines, 3 dredges, and 2 open pit mines and incurred the loss of 1,914 jobs.

According to All-Malaya Chinese Miners Association, most Malaysian tin miners suffered from huge losses in 1991. The average production costs in 1991, according to the Association, were about \$6.15 per kg, while the tin prices on KLTM averaged \$5.47 per kg. In March of 1991, the tin price had dropped to a record low of \$5.42 per kg. MMC, the largest tin producer in Malaysia, reported a 22% drop in sales from its tin operation to \$19.3 million for the fiscal year ending January 1991 because of lower tin prices. For the first time in its 15-year history, MMC reported a loss of \$7.7 million in 1991 compared with a profit of \$9.3 million in 1990.⁹

To reduce excessive world tin stocks and stabilize tin prices in the world market, the seven-member ATPC began implementing its fifth supply rationalization scheme in 1991. To halt further accumulation of the world tin surplus, ATPC's members agreed in the October meeting in Canberra, Australia, to cut the 1992 export quotas by 9.1% to 87,091 tons from 95,849 tons in 1991. The export quota allocated to Malaysia was reduced to 24,840 tons from 28,556 tons in 1991.

Production of tin metal by Datuk Keramat Smelter Bhd. and Malaysia Smelting Corp. Bhd. decreased slightly in 1991 because of reduced domestic supply of tin concentrate. To fully utilize its tin smelting capacity, Malaysia imported a record 30,536 tons of tin concentrate in 1991 mainly from Australia, Bolivia, and China to supplement domestic supply. In 1991, Malaysia Smelting Corp. (MSC) started production of casting in small ingots of 12.5 kg with a new tin grade with a minimum 99.99% purity. In

1991, MSC installed new electrolytic equipment in its Butterworth refinery to produce this high-grade tin for use in specialized solder and chemical use.¹⁰

Malaysia exported 42,425 tons of refined tin in 1991 compared with 52,703 tons in 1990. The major buyer of Malaysia's refined tin in 1991 was Japan, followed by the Netherlands, the Republic of Korea, and the United States. In 1991, export earnings from tin fell 24% to \$249 million. According to the Malaysian Department of Mines, domestic demand for refined tin rose 36% to 3,406 tons in 1991, about 400 tons more than the Government earlier projection. Of the total domestic tin consumption, 1,661 tons was consumed by the solder industry, 720 tons by the tinsplating industry, 361 tons by the pewter industry, and 664 tons by other.

Industrial Minerals

Barite.—Barite production dropped sharply to below the 1986 level because production ceased from the Kuala Trengganu area of Terengganu. Barite production in 1991 was from three small operations—the Tasik Chini, Bukit Iban, and Jenderak areas of Pahang and two small operations in the Sok and Bukit Pencuri areas of Kelantan. Most output was sold to the local oil well-drilling market in 1991.

Cement.—Because of a steady growth in demand for cement by the construction industry, Malaysia's cement production reached a record of 7.5 Mmt in 1991. Malaysia has nine cement plants, of which seven were in Peninsular Malaysia and two (grinding plants) in East Malaysia. The industry's total clinker capacity was 7.3 Mmt/a and grinding capacity was about 8.9 Mmt/a in 1991.

Because of the growing domestic demand, the top four cement producers announced expansion plans to be completed in the next 3 to 4 years. According to The Cement and Concrete Association of Malaysia, Associated Pan Malaysia Cement Sdn. Bhd. planned to expand its capacity to 2.8 Mmt/a; Cement Industries Malaysia Sdn. Bhd. to increase

its capacity to 1.4 Mmt/a; and Tasek Cement Bhd. to raise its capacity to 1.4 Mmt/a by 1993. Perak-Hanjong Cement Sdn. Bhd. was to expand its capacity to 2.4 Mmt/a by 1995. Kedah Cement Sdn. Bhd., Malaysia's second largest cement producers, also announced in 1990 that it planned to double its clinker capacity to 3 Mmt/a by 1992.

Kaolin.—Because of increased domestic demand in 1991, more small-scale mines were operating in the States of Johore and Perak. As a result, output of kaolin increased substantially. Of the total kaolin produced in 1991, 63% came from 14 mines operating in Perak, 34% from 4 mines in Johore, and the remainder from 2 mines in Selangor and 1 mine in Pulau Pinang. Exports of kaolin totaled 89,544 tons and were valued at \$4.5 million in 1991. Kaolin was consumed in the domestic market as fillers in production of rubber and plastic products, paint, and adhesive and as raw material for manufacture of tiles, whiteware, and white cement.

Mica.—Malaysia began production of mica in 1988 with one mine operated in Perak. The output of mica reached 3,500 tons with two mines operating in 1991. Most mica was exported to the Republic of Korea and Japan. Exports of mica totaled 1,992 tons and were valued at \$379,000 in 1991.

Titanium.—Most ilmenite concentrate was recovered as a byproduct from tin tailing treatment plants operating in the States of Perak and Selangor. Production of ilmenite concentrate dropped sharply in 1991 because of reduced exports to Japan. Exports of ilmenite concentrate were 202,833 tons compared with 203,504 tons in 1990. Export earnings of ilmenite concentrate were valued at \$17.2 million in 1991.

Malaysia Titanium Corp. Sdn. Bhd., commissioned a 50,000-mt/a titanium dioxide plant in Ipoh, Perak, in 1991. Malaysia Titanium is owned 70% by Hiltox Corp. of the United States. Texas-based Hiltox reportedly purchased

the company and the plant during receivership and invested an additional \$10 million to refurbish the idled synthetic rutile plant. The rehabilitated chloride-process titanium dioxide plant was scheduled to produce and deliver initially between 15,000 tons and 20,000 tons of titanium dioxide to Hiltox's milling facilities in Corpus Christi, Texas, in 1991. The output was expected to reach full capacity in 1992.¹¹

Mineral Fuels

Coal.—Coal production from the Beradai deposit in the Merit-Pila area near Kapit and the Selantek deposit in the Semantan area near Kuching declined sharply from that of 1990. According to Malaysia's Department of Mines, one of the two coal mines had been shut down temporarily since April 1991 because of operational difficulties. Most of the coal output from the area was exported to Japan, the Republic of Korea, and Taiwan. In 1990, Sarawak exported about 95,000 tons of coal and earned about \$2.3 million. Coal exports in 1991 were estimated at 65,000 tons and valued at about \$1.7 million.

In 1991, several high-quality coal deposits reportedly had been discovered by BHP Minerals in the Meliau and Melibau basins, about 150 km southeast of Kota Kinabalu in Sabah. According to the Geological Survey of Malaysia, BHP Minerals, a unit of Broken Hill Proprietary Co. of Australia, has been prospecting the two basins since 1987. The coal reserves in the areas were estimated to have 100 million tons of good quality bituminous coal with low sulfur contents and high heating values.

Natural Gas.—Overall natural gas production from offshore Sabah, Sarawak, and Terengganu averaged about 62.7 Mm³/d. In 1991, about 60% of the natural gas was produced by Sarawak Shell Bhd. (SSB) from the Central Luconia gasfields offshore Sarawak. The remaining natural gas was produced by Sabah Shell Petroleum Co. (SSP) from the Samarang Oilfield offshore Sabah and by Esso Production Malaysia Inc. (EPMI)

from the Duyong Gasfield, and the Gungtung, Kepong, and Bekok Oilfields offshore Terengganu.

The natural gas produced from three Central Luconia gasfields (E11, F6, and F23) at the rate of 38 Mm³/d was delivered as feedstock to the LNG and nitrogen fertilizer plants in Bintulu, Sarawak. The natural gas produced from the Samarang Oilfield at the rate of 2 Mm³/d was delivered as feedstock to a methanol plant and as power source for a 79-MW powerplant and a sponge iron plant on Labuan Island off Sabah. The natural gas produced from the Duyong Gasfield and Guntong, Kepong, and Bekok Oilfields at the rate of 22.7 Mm³/d was delivered as the power source for a 900-MW powerplant in Paka, the PTSB iron and steel complex in Telok Kalong, Terengganu, and as a feedstock to a gas-processing plant and a liquefied petroleum gas production plant in Kertih, Terengganu.

Production of LNG by Malaysia LNG Sdn. Bhd. (MLNG) rose to 7.6 Mmt from 6.7 Mmt in 1990 through implementation of several plant efficiency improvements. In 1991, throughput of the total LNG production capacity at the Bintulu plant had been raised to 7.5 Mmt/a from original design capacity of 6 Mmt/a.

To carry out further expansion of the LNG capacity in Bintulu, Sarawak, PETRONAS awarded a \$150 million contract to Nuovo Pignone of Italy in July to supply process turbo-compressors for three LNG trains. In October, PETRONAS hired Foster-Wheeler Corp. of the United States as project management consultant for evaluation of bids for engineering, procurement, and the three-stage construction of the Bintulu LNG plant project to double the capacity to 15 Mmt/a with six LNG trains by 1996.

Most of the LNG produced in 1991 was exported to three Japanese utility companies, Tokyo Electric Power Co., Tokyo Gas Co., and Saibu Gas Co. under two 20-year supply contracts signed separately in 1983 and in 1990. In May, MLNG signed an agreement with Korea Gas Corp. of the Republic of Korea to

supply 57,000 tons of LNG for delivery in September 1991, followed by a series of short-term sales in 1992-94. Malaysia also signed a memorandum with the Republic of Korea in May to supply 2 Mmt/a of LNG for 20 years beginning in 1995. The Republic of Korea reportedly canceled the plan with MLNG in August to import LNG from Malaysia because of failure in reaching a price agreement.

To meet the growing requirement for transporting LNG to the overseas markets, PETRONAS signed a \$1.4 billion contract with Gaz Transport of France in 1991 for construction of five LNG carriers, each with a capacity of 130,000 m³ using Gaz Transport Technology. The LNG transporting vessels are to be built by Les Chantiers de l'Atlantique, a subsidiary of GEC Alsthom, at the Saint Nazaire shipyard in France for delivery during 1994-97.

The 730-km network of gas pipelines, which links the Telok Kalong gas-processing plants near Kerteh along the east coast of Peninsular Malaysia to Johore Bahru in the south, and to Port Kelang and Port Dickson along the west coast via Segamat, was completed in mid-1991. In August, the pipeline began supplying processed gas to powerplants and industrial users in the south and along the west coast. The link to Singapore was expected to come on-stream, when the Senoko powerplant on Singapore Island begins firing in February 1992.¹²

In September, PETRONAS formed a joint-venture firm with MMC and Shapadu Corp of Malaysia and Tokyo Gas and Mitsui & Co. of Japan to undertake a \$291 million gas-reticulation project in Peninsular Malaysia. This gas distribution system will make natural gas available to small manufactures, such as ceramic and glassware makers, textile mills, small steel mills; commercial enterprises, such as a hospital; and later to household customers. The joint-venture firm is 55% owned by the two local companies, 25% by the two Japanese firms, and 20% by PETRONAS.

Petroleum.—Malaysia's crude oil production rose to an average of 652,100 bbl/d in 1991 from 626,400 bbl/d in 1990, after PETRONAS and EPMI jointly brought their offshore Dulang Oilfield on-stream in March. As a result, Malaysia's crude oil production capacity, including condensate, rose to an average of 690,000 bbl/d in 1991. Production of crude oil in 1991 was from 32 oilfields with 43 offshore platforms operated by PETRONAS Carigali Sdn. Bhd., the upstream arm of PETRONAS, and three foreign contractors, EPMI, SSB, and SSP.

The Dulang Oilfield was discovered in 1988 about 130 km offshore of the northeastern coast of Terengganu. The Dulang field has two production areas, the United Area and the Western Area. Production from the United Area is split 72% PETRONAS and 28% EPMI. The output from the Western Area is entirely PETRONAS.

The first of a three-stage development project of the Dulang field involving installation of the main processing and production facilities, a single point mooring system, and a flating storage and offloading vessel with a storage capacity of 850,000 bbl in the United Area was completed in March 1991. The field started production on March 15 with an initial rate of 10,000 bbl/d and gradually increased to 30,000 bbl/d by yearend. According to PETRONAS, the first shipment of 450,000 bbl of the new waxy grade of Dulang crude oil was sold to a Japanese buyer in May.

The second stage of the Dulang development project involving installation of the Dulang satellite was scheduled for completion in 1992. The third stage involving development of the Western Area will begin in 1993 and will be completed in 1994. Crude oil production is expected to reach 50,000 bbl/d in 1992 and gradually increase to between 67,000 bbl/d and 70,000 bbl/d in 1995. Total capital investment of the project, including \$360 million on development drilling and \$120 million on satellite platforms, was estimated at \$675 million. Direct field-operating costs are estimated at \$4.40/bbl in 1991. Recoverable

reserves of the Dulang field were estimated at 176 Mbbbl of crude oil and 2.83 billion m³ of natural gas.¹³

In 1991, Malaysia exported about 75% of its crude petroleum output or 489,100 bbl/d mainly to Singapore, the Republic of Korea, Japan, and the United States. Despite increased export volume of crude petroleum, export earnings dropped by 5.9% to \$3.7 billion because of lower oil prices in 1991. Malaysia imported about 22,000 bbl/d of heavy crude oil in 1991 to meet the requirement of the domestic oil refineries.

PETRONAS' plan to build a 100,000-bbl/d sour crude refinery in Malacca suffered a setback when Caltex Petroleum Corp. of the United States and Chinese Petroleum Corp. of Taiwan pulled out of the \$1.7 billion project in June, citing uncertainties over the final cost and fears of unprofitability. However, Idemitsu Co. Ltd. of Japan and Samsung Co. Ltd. of the Republic of Korea signed a letter of intent with PETRONAS in November to take 40% and 15% stakes, respectively, in the sour crude refinery project. Idemitsu Co. reportedly was cautious about making a final decision. Under the agreement, a feasibility study on building a 100,000-bbl/d refinery in Malacca will be conducted by Idemitsu in 1992.

Reserves

Malaysia is estimated to have more than 15% of known world tin reserves. The estimated ilmenite and monazite reserves associated with tin reserves are substantial. Ore reserves of bauxite, copper, natural gas, petroleum, and other industrial minerals are small but considered significant for the area. Reserves of major mineral commodities, according to the Malaysian Government and industry sources, are shown in table 3. (See table 3.)

INFRASTRUCTURE

Malaysia's existing highways, railroad system, and port facilities are adequate to transport most of the nonferrous mineral products to the domestic and overseas

markets. In July, construction work on Malaysia's 730-km natural gas pipeline system of the Peninsular Gas Utilization II (PGU II) project was completed. The pipeline's initial transmitting capacity would be 19.8 Mm³/d of gas to meet the requirements of powerplants. As part of PGU II, the network link to Singapore was expected to be completed by February 1992. Work on two new gas-processing plants and upgrading of export terminals at Kerteh also should be completed by 1992. A consortium was formed by PETRONAS, two local companies, and two Japanese firms in 1991 to build a gas-reticulation system covering the States of Selangor and Johore. The consortium planned to begin construction of the system in 1992 with an estimated cost of about \$300 million.

According to the Malaysian Highway Authority, the East-West Highway (Federal Route 2) crossing Peninsular Malaysia from the west to the east and the Klang Valley Expressway connecting Kuala Lumpur to Port Klang were completed. The 924-km North-South Highway along the west coast of Peninsular Malaysia connecting Thailand in the north and Singapore in the south was expected completion by early 1994. By early 1991, more than 50% of the \$1.7 billion highway from Bukit Kayu in the northern Kedah to Johore Bahru in the southern Johore had been completed.

Malaysia's installed electricity capacity was 5,400 MW, and total demand was about 4,200 MW in 1991. Demand for electricity had been increasing at an average annual rate of about 11% as a result of the growing manufacturing sector over the past 5 years. To cope with the increasing demand for electricity, Tenaga Nasional, the semiprivate national electrical power company, announced in early 1991 that it plans to invest \$365 million for purchasing seven gas-powered turbines to raise Malaysia's total electricity-generating capacity by 800 MW to 6,200 MW by 1995.

OUTLOOK

The oil and gas industry will continue to dominate the mineral industry of Malaysia because of its contribution to the Malaysian economy. The crude petroleum production capacity will be raised to 750,000 bbl/d when EPMI and PETRONAS completed their three-stage development of the Dulang Oilfield offshore Terengganu in 1994. Production of natural gas should also increase to more than 65 Mm³/d in the next 2 years because of the growing demand for natural gas by the manufacturers of LNG and nitrogen fertilizer materials in the Bintulu area of Sarawak as well as by the manufacturing and utility industries in western and southern Peninsular Malaysia.

The tin industry is expected to remain depressed in 1992, unless the market prices of tin recover substantially from the 1991 record low. Production of copper concentrate at the Mamut Mine in Sabah is expected to operate at the rate of 120,000 mt/a until 1997. Production capacity of the cement industry will expand by 2.2 Mmt/a to 9.5 Mmt/a in the next 3 years as the growing demand for cement by the construction industry continues. Malaysia should emerge as an important producer of LNG, nitrogen fertilizer materials, and petrochemical products in Southeast Asia when all of the announced investment plans are successfully implemented in the next 4 years.

Under the newly announced Sixth 5-year (1991-95) development plan, the Malaysia economy was projected to grow at an average annual rate of 7.5%. However, Malaysia's public foreign debt will continue to mount because of increased borrowing from abroad for upgrading the country's major ports, Federal highways in Peninsular Malaysia, and other economic development projects in various parts of the country.

¹Where appropriate, values have been converted from Malaysia ringgits (M\$) to U.S. dollars at the rate of M\$2.70=US\$1.00 in 1990 and M\$2.75=US\$1.00 in 1991.

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¹³Far Eastern Economic Review (Hong Kong). Japanese Clinch Role in M\$800 Million Gas Project. V. 154, No. 42, Oct. 17, 1991, pp. 108, 111.

¹⁴Petroleum Economist (London). Malaysia: A First for Petronas. V. 58, No. 6, June 1991, p. 21.

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Agencies

The Ministry of Primary Industry:
Department of Mines
11th Floor, West Block
Wisma Selangor Dredging
142 C, Jalan Ampang,
50656 Kuala Lumpur, Malaysia

Geological Survey of Malaysia
20th Floor, Tabung Haji Building
Jalan Tun Razak, P.O. Box 11110
50736 Kuala Lumpur, Malaysia

Tin Industry (Research and
Development) Board
8th Floor, West Block
Wisma Selangor Dredging
142 C, Jalan Ampang, P.O. Box 12560
50782 Kuala Lumpur, Malaysia

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Malaysia Industrial Digest, quarterly.

TABLE 1
MALAYSIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³	
METALS						
Aluminum: Bauxite, gross weight	thousand tons	482	361	355	398	376
Antimony, mine output, Sb content (Sarawak)		129	—	—	—	—
Columbium and tantalum concentrate, gross weight		228	—	—	4	—
Cb content of columbium ⁴		34	—	—	1	—
Ta content of tantalum ⁴		16	—	—	—	—
Copper, mine output, Cu content (Sabah)		29,861	² 22,097	² 23,805	² 24,327	² 25,581
Gold, mine output, Au content:						
Malaya	kilograms	484	717	678	869	872
Sabah	do.	2,713	1,773	¹ 1,951	1,586	1,615
Sarawak	do.	315	439	255	139	276
Total	do.	3,512	2,929	² 2,884	2,594	2,763
Iron and steel:						
Iron ore and concentrate	thousand tons	161	² 202	193	³ 344	375
Steel, crude ⁵	do.	750	550	⁸ 880	⁹ 900	900
Rare-earth metals: Monazite, gross weight		2,908	2,920	2,948	3,323	1,981
Silver, mine output, Ag content						
Sabah	kilograms	15,480	10,490	¹ 12,808	¹ 12,455	13,270
Sarawak ³	do.	317	285	199	¹ 103	170
Total	do.	15,797	10,775	¹ 13,007	¹ 12,558	13,440
Tin:						
Mine output, Sn content		30,388	28,866	32,034	28,468	20,710
Metal, smelter		44,363	49,945	⁵ 50,874	⁴ 49,002	50,400
Titanium: Ilmenite concentrate, gross weight		509,202	486,305	533,637	⁵ 530,237	336,347
Tungsten, mine output, W content		—	—	—	—	2
Zirconium: Zircon concentrate, gross weight		17,828	25,671	18,704	4,279	5,579
INDUSTRIAL MINERALS						
Barite		38,935	38,766	36,526	48,291	16,600
Cement, hydraulic	thousand tons	3,316	3,775	4,794	⁵ 5,881	7,451
Clays: Kaolin		96,882	116,869	108,347	152,972	186,699
Limestone ⁶	thousand tons	84,000	84,000	85,000	85,000	87,000
Mica		—	1,065	2,251	3,341	3,517
Nitrogen: N content of ammonia		321,300	300,600	278,900	228,800	286,200
Silica sand (Malaya and Sarawak)		360,070	418,818	452,025	686,604	668,244
MINERAL FUELS AND RELATED MATERIALS						
Coal	thousand tons	—	28	112	99	64
Gas, natural: ⁴						
Gross	million cubic meters	16,433	16,730	18,683	¹ 18,900	² 22,900
Net ⁵	do.	12,944	13,123	13,964	14,230	¹ 16,000
Petroleum: ⁴						
Crude	thousand 42-gallon barrels	181,724	198,343	214,938	² 227,288	² 238,293
Refinery products:						
Gasoline	do.	9,130	9,804	10,979	¹ 11,854	¹ 13,400
Jet fuel ⁶	do.	2,900	3,000	² 2,766	3,000	3,000
Kerosene	do.	3,943	4,041	4,580	⁶ 6,655	⁶ 6,900
Distillate fuel oil	do.	10,183	10,753	15,619	¹ 17,933	¹ 19,600

See footnotes at end of table.

TABLE 1—Continued
MALAYSIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ^P	
Petroleum⁴—Continued:						
Refinery products—Continued:						
Residual fuel oil	thousand 42-gallon barrels	8,350	9,107	10,802	¹ 14,307	¹ 14,000
Other ⁷	do.	12,000	12,500	⁶ 9,596	¹ 12,000	12,500
Total⁶	do.	46,506	49,205	54,342	¹65,749	69,400

¹Estimated. ²Preliminary. ³Revised.

⁴All production is from Peninsular Malaysia (Malaya) unless otherwise specified. Table includes data available through July 2, 1992.

⁵In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone), fertilizers and salt is produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

⁶Byproduct from gold mines in Sarawak.

⁷Includes production from Malaya, Sabah, and Sarawak.

⁸Gross less volume of reinjected and flared.

⁹Reported figure.

¹⁰Includes LPG, naphthas, and lubricants.

TABLE 2
MALAYSIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bauxite	Johore Mining and Stevedoring Co. Sdn. Bhd. (61% owned by Alcan Aluminium Ltd. of Canada, 30% by local investors, and 9% by other)	Bukit Raja-Pengerang, Johore	500
Cement	Associated Pan Malaysia Cement Sdn. Bhd.	Rawang, Selangor and Kantan, Perak	2,500
Do.	Cement Industries Malaysia Sdn. Bhd.	Kangar, Perlis	1,000
Do.	Kedah Cement Sdn. Bhd. (Government owned)	Langwai, Kedah	1,500
Do.	Perak-Hanjong Cement Sdn. Bhd. (60% owned by Hyundai Cement Co. Ltd. of Republic of Korea and 40% by Perak State Government)	Padang Rengas, Perak	1,200
Do.	Tasek Cement Bhd.	Ipoh, Perak	1,100
Copper, concentrate	Mamut Copper Mining Sdn. Bhd. (A wholly owned subsidiary of Mega First Corp. Bhd.)	Mamut, Sabah	120
Gas:			
Natural million cubic meters per day	Esso Production Malaysia Inc.	Offshore Terengganu	22.7
Do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	2.8
Do.	Sarawak Shell Bhd.	Offshore Sarawak	38.5
Liquefied	Malaysia LNG Sdn. Bhd. (60% owned by PETRONAS, 17.5% each by Shell Gas N.V. and Mitsubishi Corp., and 5% by Sarawak State Government)	Tanjung Kidurong, Bintulu, Sarawak	7,500
Petroleum, crude million 42-gallon barrels per day	Esso Production Malaysia, Inc.	Offshore Terengganu	390
Do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	100
Do.	Sarawak Shell Bhd.	Offshore Sarawak	184
Do.	PETRONAS Carigali Sdn. Bhd.	Offshore Terengganu	22
Tin:			
Concentrate	Malaysia Mining Corp. Bhd. (51.7% owned by Government, 9.5% by Hongkong & Shanghai Bank Nominees Pte. Ltd. of Singapore, and 38.8% by others)	Concentrate in the States of	12
Refined	Datuk Keramat Smelting Bhd. (50.5% owned by Amalgamated Metal Corp., 29% by Consolidated Tin Smelters Ltd., and 20.5% by Malaysia Mining Corp. Bhd.)	George Town, Penang	40
Do.	Malaysia Smelting Corp. Bhd. (58% owned by Straits Trading Co. and 42% by Malaysia Mining Corp. Bhd.)	Butterworth, Penang	60

TABLE 3
MALAYSIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR
1991

(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Bauxite	14,000
Clays ¹	25,600
Copper	*260
Gas, natural	1,611
billion cubic meters	
Petroleum, crude	2,940
million 42-gallon barrels	
Marble	68,000
Tin, in concentrate	1,100
Titanium	*900

*Estimated.

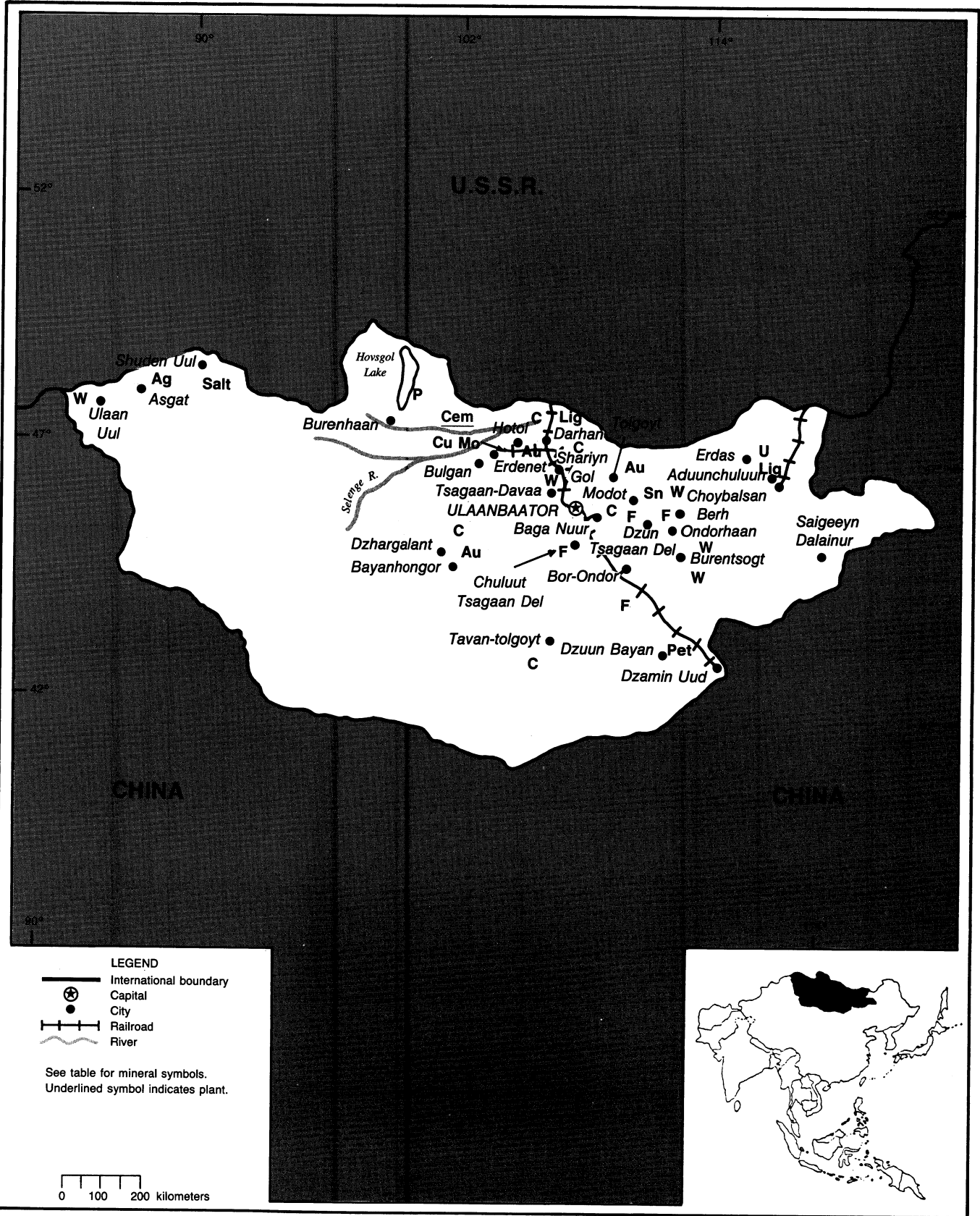
¹Includes kaolin and ball clay.

Sources: Geological Survey of Malaysia, Malaysia Mining Corp. Bhd. and PETRONAS.

MONGOLIA

AREA 1,565,000 km²

POPULATION 2.2 million



THE MINERAL INDUSTRY OF

MONGOLIA

By John C. Wu

Mongolia is a mineral-rich country. According to the Mongolian State Geological Center (SGC), more than 6,000 occurrences of about 80 different minerals had been found in Mongolia. Of these findings, about 500 deposits of 40 different minerals had been evaluated, and about 150 deposits were being worked. Currently, coal, copper, fluorspar, and molybdenum were mined by large-scale operations, while other deposits, such as clay, gold, gypsum, limestone, silver, precious stones, tin, and tungsten, were mined by medium- and small-scale operations.

Most mining operations were in the north-central and eastern parts of the country. The large-scale Erdes uranium mine reportedly had been operated in the 1980's by the former U.S.S.R. at Marday in the Dashbalbar district of northeastern Mongolia near the Russian border. Small quantities of industrial minerals, such as magnesite, silica sand, and zeolite, reportedly had been mined and exported in 1990.¹

According to the latest Mongolian Government statistics, minerals output accounted for 18% of Mongolia's gross industrial output, and minerals exports accounted for about 40% of Mongolia's export earnings in 1990. Mongolia's gross industrial output and export earnings were estimated at \$1.5 billion² and \$402 million, respectively, in 1990. The percentage share of mining in Mongolia's national income and industrial net product was 8.5% and 23.8%, respectively, in 1990.

In 1991, Mongolia continued to rely heavily on the former U.S.S.R. for capital goods and industrial raw materials to meet its domestic requirements. Because of the economic crisis in the former U.S.S.R. and the end of its aid to

Mongolia, shipments of most capital goods and industrial raw materials to Mongolia had been cut back, delayed, or even terminated. As a result, Mongolian industrial production decreased for the first time in modern Mongolian history.

Despite its economic and financial difficulties in 1991, Mongolia had established closer economic and trade relations with China, Japan, the United States, and other countries. In January, Mongolia's President made his first visit to the United States and had a meeting with the U.S. President and later signed a U.S.-Mongolian trade agreement. Mongolia also signed bilateral trade agreements during 1990-91 with Afghanistan, Albania, Austria, China, Egypt, Finland, India, Iran, Japan, North Korea, and the former U.S.S.R.

In February, Mongolia joined the International Monetary Fund and the World Bank Group, which includes the International Bank of Reconstruction and Development, the International Development Association, and the International Finance Corporation. Mongolia joined the Asian Development Bank in late 1990. In August, Mongolia signed an agreement with China to transport its goods through Chinese territory and ship goods from the Tianjin seaport in northern China.

To help Mongolia achieve democracy and implement economic reforms, the United States offered a \$10.6 million credit while Japan offered a \$7 million development aid and a \$15 million cash grant as emergency aid in September. In December, a group of donor nations led by Japan and the United States as well as international organizations decided in Tokyo to provide a \$77 million interest-free loan for technical assistance and to extend a \$155 million loan, on

preferential terms, as an emergency aid to help Mongolia overcome its economic crisis in 1991-92.

GOVERNMENT POLICIES AND PROGRAMS

The Mongolian Government announced that it would implement economic reforms beginning in 1991. The reforms would include balancing the Federal budget, restricting monetary growth, liberalizing the prices of most commodities, liberalizing internal and external trade, and privatizing ownership of most state enterprises and organizations.

To implement these reforms in 1991, the Small People's Hural (standing legislature) had adopted and enacted a Banking Law, Law of Business Entities, Law on Privatization, Tax Law, Bankruptcy Law, and Law on Protection of Consumer Rights. The Small People's Hural had also enacted a new edition of the Law on Customs, Education, Labor, Pension, Allowance, and of the Law on Royalty of the Social Insurance and Amendments to its Civil Code allowing private property ownership in 1991.

To attract foreign investors to participate in exploration and development of Mongolian mineral resources, the Government had appointed the Mongolian Bureau of Mines (MBOM) in 1991 to draft a new mining law to provide a fair structure for licenses, royalties, and repatriation of investment, as well as to give foreign investors incentives and greater flexibility in minerals exploration and exploitation.

To narrow the gap between the official exchange rate and the black-market rate and to raise the purchasing power of Mongolia's tugrik, the Bank of Mongolia,

the country's central bank, sharply devalued its national currency to 40 tugriks from 7 tugriks for each U.S. dollar in June. The devaluation was the largest since the tugrik was issued as the national currency in 1924.

On November 21, the Great People's Hural (national assembly) decided that the official name of the country be changed from the People's Republic of Mongolia to the Republic of Mongolia, when the new democratic constitution is adopted by the national assembly in January of 1992.

PRODUCTION

Mongolia remained the world's third largest fluor spar producer in 1991. Mongolia was an important producer of copper, molybdenum, tin, tungsten, and uranium in the region. The activity of the mining industry in 1991 was severely affected by the shortage of fuels and supplies, such as coal and diesel fuel for power generation, spare parts and tires for mining equipment and trucks, and explosives for blasting. The shortage was caused mainly by the withdrawal of financial aid from the former U.S.S.R. As a result, the overall output of the mining industry dropped considerably in 1991.

Mongolia's mineral production in 1991 was estimated to be about 20% lower than that of 1990. Production of copper concentrate at the Erdenet Mine in 1991 reportedly decreased by 27% from that of 1990. Production of fluor spar also dropped by more than 30%. The output of coal, limestone, and other metallic and industrial minerals was at a lower level than that of 1990. (See table 1).

TRADE

In 1991, Mongolia continued to conduct a significant portion of its merchandise trade with the former U.S.S.R. and other CMEA block countries under the old joint-venture agreements signed before 1989 and under new trade agreements signed after 1989. However, Mongolia's trade with the former U.S.S.R. and CMEA countries dropped sharply due to lack of trade

credits and hard currency among CMEA member countries, including Mongolia. According to a local press report, Mongolia's merchandise exports dropped to \$297.4 million in 1991 from \$660.8 million in 1990, while Mongolia's imports also decreased to \$559.3 in 1991 from \$924 million in 1990.³

Exports of mineral commodities were estimated at about \$200 million, accounting for 70% of Mongolia's export earnings in 1991. Copper concentrate, molybdenum concentrate, tungsten, tin, and fluor spar, in decreasing order, remained the top 5 of Mongolian export commodities out of 132. Exports of coal and silver, zeolite, magnesite, and silica sand ranked 10th, 11th, 62d, 63d, and 64th, respectively.

Due to a lack of mineral processing facilities, Mongolia continued to rely on the former U.S.S.R. for processed mineral products to meet its domestic demand. In 1991, refined petroleum products, ferrous and nonferrous metals, and fertilizer materials remained the major import components, accounting for 38% of Mongolia's imports in 1991.

COMMODITY REVIEW

Metals

Copper and Molybdenum.—Production of copper concentrate and molybdenum concentrate from the Erdenet Mine in Bulgan Aymag of northern Mongolia dropped to 258,000 tons and 2,846 tons, respectively, in 1991 from 354,000 tons and 4,208 tons, respectively, in 1990. The drastic decline in mine output was caused by the shortage of electricity, explosives, fuels, lubricants, and spare parts, which had been supplied by the former U.S.S.R. Blasting and stripping at the mine reportedly stopped for several months, and delivery of ore to the mill from the mine decreased sharply in the second half of 1991. To solve the problem of supply shortage and to continue operating the mine and mill, the operator of the Mongolian-Soviet joint-venture Erdenet mining and milling complex reportedly was seeking alternative supply sources of explosives,

fuels, and other raw materials from China, Japan, and other countries in 1991.

In 1991, exports of copper concentrate totaled 245,000 tons compared with 345,000 tons in 1990.⁴ Mongolia continued exporting more than 80% of copper concentrate and all of molybdenum concentrate to the former U.S.S.R. in 1991. Exports of copper concentrate to Japan, according to Japanese trade statistics, rose to 32,791 tons in 1991 from 8,423 tons in 1990. Small quantities of the copper concentrate were also exported to China, Czechoslovakia, and Finland.

In 1991, a new trade agreement for marketing the output of Erdenet's copper concentrate was signed between Mongolia and the former U.S.S.R. Under the new agreement, a third of the copper concentrate was to be shipped to the former U.S.S.R. in exchange for refined petroleum products. The second third was to be exported to the world market to generate hard currency. Marketing of the remaining third was to be determined by the joint-venture firm, either exporting the copper concentrate to the world market or selling it as refined copper after processed by smelters in the former U.S.S.R. The Erdenet Mine was to continue exporting all molybdenum concentrate to the former U.S.S.R.

As a result of further exploration in past years, ore reserves at Erdenet and the surrounding areas were estimated at 1,374 Mmt containing 7.6 Mmt of copper and 400,000 tons of molybdenum, according to SGC. Mining life of the Erdenet mine was expected to last 50 or more years.

Gold and Silver.—Official statistics on production and trade of gold and silver remained classified as a state secret. However, gold production during 1987-91 was believed to be between 800 kg/a and 1,200 kg/a, of which about 13% to 15% was recovered as a byproduct of the Erdenet copper operation. Silver recovered as a byproduct of copper was estimated to be between 15 mt/a and 21 mt/a. The state bank controlled all buying and trading of gold in Mongolia.

According to Mongolian and former Soviet sources, gold had been produced at Tolgoyt, Ikh Alt, Shariyn Gol, and Bugantai in Selenge Aymag; and at Dzhangalant (Zhargalant), Mukhar Ereg, Uvur Chuluut, and Duvunt in Bayanhongor Aymag. Gold mining at Tolgoyt and Ikh Alt was by a Mongolian-former Soviet joint venture, while gold mining at Shariyn Gol and at Duvunt was by Mongolian enterprises. The deposit at Shariyn Gol had been operated with a Bulgarian partner before 1991. New gold mines reportedly were expected to be brought on-stream by Mongolian enterprises at Haylast (Hailaast), Dazaamar (Zaamar), and Elstei in Tov Aymag.

In 1991, SGC opened three promising gold deposits for foreign investors to participate in joint exploration and development. These deposits included the Boroo and the Bumbat in Tov Aymag and the Erengiin in Bulgan Aymag. Amax Gold and Morrison Knudsen Corp. of the United States subsequently expressed interest in participating in joint exploration and development of the Boroo deposit.

The Boroo deposit, about 130 km northwest of Ulaanbaatar, covers an area 2.5 km long and 800 m wide. Ore reserves were estimated at between 30 tons and 40 tons of gold. Gold content of the deposit averaged 2.5 g/mt of ore. Two less significant gold deposits, Narantolgoi and Sujigtei, are within 40 km of Boroo. Ore reserves of the two nearby deposits are small, about 5 tons of gold each, but with a richer ore grade of between 10 g/mt and 22 g/mt.

Mongolia reportedly air transported all of the native gold recovered from its placer deposits to the United Kingdom for assay and refining. In 1991, Mongolia purchased a gold concentration plant from GEC Alstom Engineering Systems Ltd. of the United Kingdom. The total plant cost, which included design, engineering, manufacture, site construction, and commissioning, was estimated at \$885,000.⁵

Lead and Zinc.—According to MBOM and the Mineral Processing Technological Center, a zinc deposit of scarn magnetite

at Tumurtiin Ovoo, about 16 km north of Baruun-Urt, the capital of Suhbaatar Aymag, was under development in 1991. The ore reserves at the deposit were estimated at 7.8 Mmt averaging 11.5% zinc. Iron ore separated from zinc ore at Tumurtiin Ovoo will be used as the raw material for a new electric arc furnace steel mill, which was under construction in Darhan with Japanese financial and technical assistance.

In April, the Metal Mining Agency of Japan and Japan International Cooperation Agency had reached an agreement with SGC to assist in exploration and development of nonferrous metal resources in Mongolia. Under the agreement, Japan was to cooperate with Mongolia to carry out a 3-year geological survey on a 500,000-km² area known as Uudam Tal (flat plain) in southeastern Mongolia beginning in 1991. The Japanese Government would provide financial assistance amounting to \$2.2 million for the 3-year project.

Following the April 1991 Mongolia-Japan joint exploration agreement, Japan planned to participate actively in the joint exploration of a polymetallic (copper, lead, silver, and zinc) deposit for subsequent development at Tsav (Tsaviin) beginning in 1992. The Tsav deposit, located 130 km northeast of Choybalsan, the capital of Dornod Aymag, had been explored by the former U.S.S.R. in the 1980's. According to Mongolian and Japanese sources, the Tsav is a rich vein-like deposit having two types of ores, polymetallic quartz with silver and a carbonate polymetallic type with silver. Combined ore reserves of 10 ore bodies at Tsav were estimated at 7 Mmt averaging 10% lead and zinc, 0.15% copper, and with 200 kg/mt silver plus bismuth, cadmium, gold, and indium.

Rare Metals and Rare Earths.—According to SGC, rare metals and rare earths deposits had been discovered in the Altan Bom area of Hovsgol Aymag, the Mushgai Khudag area of Omnogovi Aymag, the Ludiin Gol area of Dornogovi Aymag, the Khalzan Burigtei and Tsakhirin areas of Hovd Aymag, the Shar Tolgoi and Ulaantolgoi areas of Uvs

Aymag, and other areas mostly in southern Govi and in northwestern Mongolia. For example, columbium, molybdenum, and tantalum were found to be associated with granite deposits in the Altan Bom area; columbium, tantalum, zirconium, and rare earths were found to be associated with carbonatite deposit in the Khalzan Burigtei area; and rare earths were found to be associated with carbonatite in the Mushgai Khudag and Ludiin Gol areas.

Tin and Tungsten.—Production of both tin and tungsten concentrate decreased considerably in 1991 due to the lack of fuel, spare parts, and explosives. The Tsagaan-Davaa tungsten mine in Tov Aymag remained shut down in 1991. According to MBOM, tin production in 1991 was mainly by a Mongolian-Czechoslovakian joint venture at the Modot deposit in Henity Aymag. Production of tin was between 150 tons and 200 tons. Tungsten production was mainly by a joint venture of Mongolia and the former East Germany at Burentsogt in Suhbaatar Aymag and by a state-owned enterprise at Ulaan Uul in Bayan Olgii Aymag and at Ongon Khalrkhan in Tov Aymag. A small quantity of tungsten was also produced at the Modot Mine as a byproduct. Tungsten ore reserves at Burentsogt reportedly will be depleted in 1 to 2 years.

According to SGC, promising placer tin deposits had been discovered at Janchivlan in Tov Aymag, at Narsyan Khundlen in Dornod Aymag, and at Ortsog in Dornogovi Aymag. Potential tungsten deposits were found at Ondor Tsagaan in Henity Aymag and at Eguzer in Suhbaatar Aymag. For example, the Ortsog cassiterite scarn deposit, about 90 km west of the Khar-Airage railroad station in Dornogovi Aymag, was estimated to have 40,000 tons of ore reserves, averaging 0.02% to 2.0% tin plus small quantities of lead, zinc, and silver. The Ondor Tsagaan tungsten deposit, about 70 km northwest of Ondorhaan in Henity Aymag, was estimated to have 175,000 tons of ore reserves, averaging 0.124% WO₃,

0.019% Mo, 0.08% Bi, and 0.011% BaO. The Eguzer deposit, about 200 km southeast of Baruun-Urt, the capital of Suhbaatar Aymag, was estimated to contain 42,500 tons of tungsten oxide and 12,000 tons of molybdenum. The ore reserves averaged 0.197% WO₃, 0.56% Mo, 0.08% BaO, and 0.132% Bi₂O₃.

Industrial Minerals

Fluorspar.—Mongolia remained the world's third largest fluorspar producer in 1991. According to a Mongolian source, Mongolia produced about 750,000 tons of rock-grade fluorspar in 1991, of which about 250,000 tons was exported as metallurgical-grade ranging from 45% to 95% CaF₂, and 450,000 tons was concentrated into about 120,000 tons of acid-grade calcium fluoride containing up to 94% CaF₂. During 1987-90, the output of rock-grade fluorspar was estimated at about 1 Mmt/a.

In 1991, fluorspar was produced mainly by Mongolsovtvetmet, a joint venture of Mongolia and the former U.S.S.R., and Mongol Czechoslovakmetal, a Mongolian-Czechoslovakian joint venture. Mongolsovtvetmet operated underground mines at Berh and Delgerkhaan, both in Henity Aymag, and at Bor Ondor in Dornogovi Aymag, and open pit mines at Bor Ondor, Khar-Airage, Khazhu Ulaan, and Orgon, all in Dornogovi Aymag and at Zuun Tsagaan Del in Henity Aymag. Mongol-Czechoslovakmetal operated an open pit mine with a capacity of 45,000 mt/a at Chuluut Tsagaan Del in Tov Aymag. Mongolsovtvetmet also operated a 120,000-mt/a calcium fluoride processing plant at the Bor Ondor complex in Dornogovi Aymag.

Other operating fluorspar mines, according to SGC, were at Khulyn Kholbo, at Anas, and at Mal in Henity Aymag. Additional fluorspar resources had been identified at Buruun Suzhin, Kholoi, and Muregtsoq in Dornod Aymag; at Maikhanta, Khavirga Ikh Bichigta, Bumbat, and Khufidel in Dundgovi Aymag; and at Dai Uul and Tsagaan Eligeni in Dornogovi Aymag.

Salt.—Mongolia produces between 16,000 tons and 18,000 tons of salt annually. However, Mongolia imports salt annually from the former U.S.S.R. to meet the requirements of its small soda industry. According to SGC, common salt was produced mainly from the Shuden Uul area near Uvs Lake in the northern part of Uvs Aymag and the Saigeeyn Dalainur deposit in the southeastern part of Dornod Aymag. Other small-scale salt mining operations were at Gurvantes in Omnogovi Aymag, at Buur and Beger in Govi Altay Aymag, and at Dalai and at Ikh San in Hovd Aymag.

Mineral Fuels

Coal.—Coal production decreased to the lowest level since 1986 because of the shortage of fuel, spare parts, and explosives. Most of the brown coal and lignite was produced from the Baga Nuur Mine in Tov Aymag with 4-Mmt/a capacity and from the Aduunchuluun Mine in Dornod Aymag. Other major operating coal mines in 1991 were the Shariyn Gol Mine in Selenge Aymag with 1.5-Mmt/a capacity and the Nalayha Mine near Ulaanbaatar in Tov Aymag with a 500,000-mt/a capacity.

The state-owned coal mining corporation, Mongol Nuurs, controls most of the mining and marketing of coal in Mongolia. However, about 10 small-scale coal mining operations with a capacity of less than 250,000 mt/a each were controlled and operated by the Aymag Government. According to the Mongolian Government, about 65% of the coal or 4.8 Mmt/a was for power generation, 13% was consumed by the construction and manufacturing industries, 10% was consumed by the heating services industry for residential and public buildings, and the remainder was consumed by other sectors and in exports to the former U.S.S.R.

Petroleum.—Mongolia continued to rely on imports from the former U.S.S.R. to meet the requirement for most of its refined petroleum products. Imports of

refinery products were between 800,000 mt/a and 850,000 mt/a in 1989-90. Because of economic chaos in the former U.S.S.R. in late 1991, exports of refined petroleum products to Mongolia were disrupted. As a result, Mongolia reportedly drew down its petroleum stocks in November. By mid-December shipments from the former U.S.S.R. reportedly resumed after signing of a Mongolian-Soviet trade protocol on December 14.

According to the protocol agreement, a revolving hard currency fund will be established, and the former U.S.S.R. was to contribute the first \$10 million. In 1992, Mongolia is to export \$250 million worth of mineral products, including concentrates of copper, molybdenum, and fluorite, and meat products to the former U.S.S.R., while the former U.S.S.R. will export \$250 million of gasoline (280,000 tons), heavy fuel oil (80,000 tons), and diesel fuel (290,000 tons). The quantity of refined petroleum products to be imported from the former U.S.S.R. in 1992 reportedly equals the country's 1991 consumption. However, the 1991 refined petroleum consumption was about 25% less than that of Mongolia's annual requirement.⁶

¹Mining Magazine (London). Mongolian Exports. V. 164, No. 3, Mar. 1991, p. 177.

²Where necessary, values have been converted from Mongolian tugriks (Tug) to U.S. dollars at the rate of Tug 40.00=US\$1.00 in 1991 and Tug 5.63=US\$1.00 in 1990.

³Asia Money & Finance (Hong Kong), Naidansurengiyn Zolzhargal: Mongolia, An Economist's Dream. Mar. 1992, p. 11.

⁴U.S. Embassy, Ulaanbaatar, Mongolia. State Dep. Telegram 001236, Apr. 15, 1992, p. 1.

⁵Mining Magazine (London). V. 164, No. 2, Feb. 1991, p. 117.

⁶U.S. Embassy, Ulaanbaatar, Mongolia. State Dep. Telegram 002905, Dec. 18, 1991, p. 1.

TABLE 1
MONGOLIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991
Cement, hydraulic ³ thousand tons	541	502	513	441	400
Coal: ³					
Anthracite and bituminous do.	655	692	645	600	550
Lignite and brown do.	7,110	7,914	7,400	6,557	6,450
Total do.	7,765	8,606	8,045	7,157	7,000
Copper, mine output, Cu content	120,750	121,800	123,550	123,900	90,300
Fluorspar: ³					
Acid grade thousand tons	73	115	115	119	120
Metallurgical grade do.	510	584	586	495	250
Total do.	583	699	701	614	370
Gold, mine output, Ag content kilograms	900	1,000	1,200	1,000	800
Gypsum thousand tons	30	30	30	30	29
Lime, hydrated and quicklime do.	114	122	95	103	100
Molybdenum, mine output, Mo content	1,400	1,400	1,450	1,670	1,130
Salt	16,000	16,000	16,000	17,000	17,000
Silver, mine output, Ag content kilograms	20,700	20,900	21,200	21,200	15,500
Tin, mine output, Sn content	1,200	1,200	1,200	320	250
Tungsten, mine output, W content	1,500	600	600	500	300

¹Revised.

²Table includes data available through July 1, 1992.

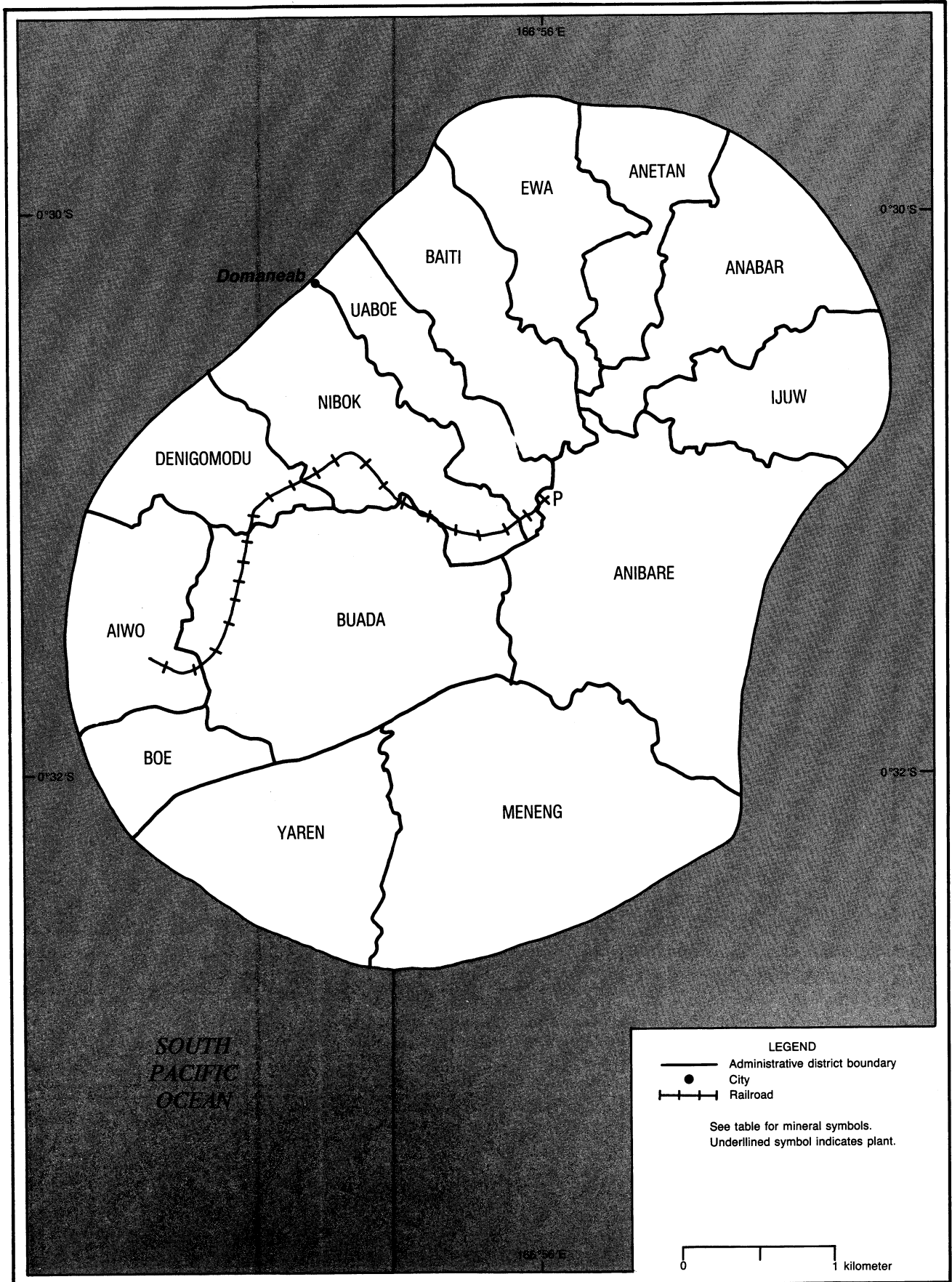
³In addition to the commodities listed, crude construction materials such as sand and gravel, varieties of stone such as limestone, silica sand, magnesium, zeolite, uranium, and zinc presumably are produced, but available information is inadequate to make reliable estimates of output levels.

⁴Reported.

NAURU

AREA 21 km²

POPULATION 9,300



THE MINERAL INDUSTRY OF

NAURU

By Travis Q. Lyday

The 21-km² island of Nauru is one of three historic phosphate-producing islands of the Pacific. The other two are Banaba (or Ocean Island) in the Gilbert Islands Group of Kiribati and Makatea, part of French Polynesia; however, Nauru is the only remaining producer.

Nauru is the world's smallest nation. It also has one of the highest per capita incomes in the world. The economy continued to be based on the mining of extensive high-grade phosphate rock deposits on the central plateau of the island by the Government-owned Nauru Phosphate Corp. (NPC). The deposits are among the richest in the world, having a consistent content of 84% bone phosphate of lime (BPL) or tricalcium phosphate, equivalent to 38.5% phosphorous pentoxide (P₂O₅). Rock treated in the calcination plant averaged about 89% BPL (40.7% P₂O₅) and may be as high as 91% BPL (41.7% P₂O₅).

Phosphate rock is mined from deposits interdigitated with evenly spaced dolomitized coral limestone pillars using mechanical extractors with clamshell buckets, leaving the coral as a "forest" of very hard-rock pinnacles. The associated coral is cobbled for domestic use as road aggregate. (See table 1.)

After overburden is removed by bulldozing, the alluvial phosphate rock is removed from around the coral pinnacles, trucked to a railhead for primary crushing, and reduced to minus 50 mm. A narrow-gauge railway using diesel locomotives transports the crushed material to a treatment plant where it is dried before further crushing to minus 12 mm and sold as run of mine product. A proportion of the fine material is upgraded by high-temperature calcination to remove organic carbon and marketed as Nauru Calcined Rock.¹

There is 3.9 km of NPC-owned railroad track, which is used to transport phosphate from the central plateau of the island to processing facilities in Aiwo District on the southwestern coast.

All phosphate rock mined on Nauru was exported by NPC. Phosphate remained Nauru's sole export. Exports of phosphate rock, by destination, for 1989-91 are given in table 2. (See table 2.)

Phosphate rock reserves on Nauru are expected to be sufficient for only a few more years of mining at current production levels, with estimated depletion by 1995.²

Australia delivered its counterclaim on January 16 against Nauru at the International Court of Justice (ICJ) at The Hague, Netherlands. The Nauruan Government began the process of seeking compensation from the former partners of the British Phosphate Commission (BPC), comprised of representatives of Australia, New Zealand, and the United Kingdom, by filing a claim in May 1989 against Australia at the ICJ. The claim was filed against Australia for compensation during the period from 1919 until 1968, when its phosphate was sold at below market prices, for the rehabilitation of the environmental damage caused by mining. Australia had been the administering authority in control of mining Nauru's phosphate, on behalf of the other partners of BPC during the period. The Government, through NPC, assumed control of the phosphate industry shortly after Nauru achieved independence in 1968. In 1987, the Government's independent Commission of Inquiry determined that Australia should bear responsibility for paying the costs of rehabilitating the land, about 80% of the island, previously worked by phosphate mining before independence.

¹Pacific Islands Yearbook (16th ed). Nauru, ed. by N. and N. Douglas. Angus and Robertson, 1989, p. 346.

²Bogdan, H. and Associates. Nauru 1990: An Environmental Challenge for Australia and the Pacific. Melbourne, Australia, 1990, p. 21.

OTHER SOURCES OF INFORMATION

Nauru Phosphate Corp.
Republic of Nauru
Central Pacific
Telephone: +674 4180 or
+674 4198

TABLE 1
NAURU: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ^P
Phosphate rock thousand metric tons	1,376	1,541	1,181	926	530

¹Table includes data available through Aug. 2, 1991.

²In addition to the commodity listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

TABLE 2
NAURU: EXPORTS OF PHOSPHATE ROCK, BY DESTINATION

(Thousand metric tons)

Destination	1989	1990	1991
Australia	822.8	593.9	186.6
Korea, Republic of	52.8	153.0	59.2
New Zealand	305.8	179.3	190.9
Philippines	—	—	93.4
Total	¹1,181.3	926.2	530.1

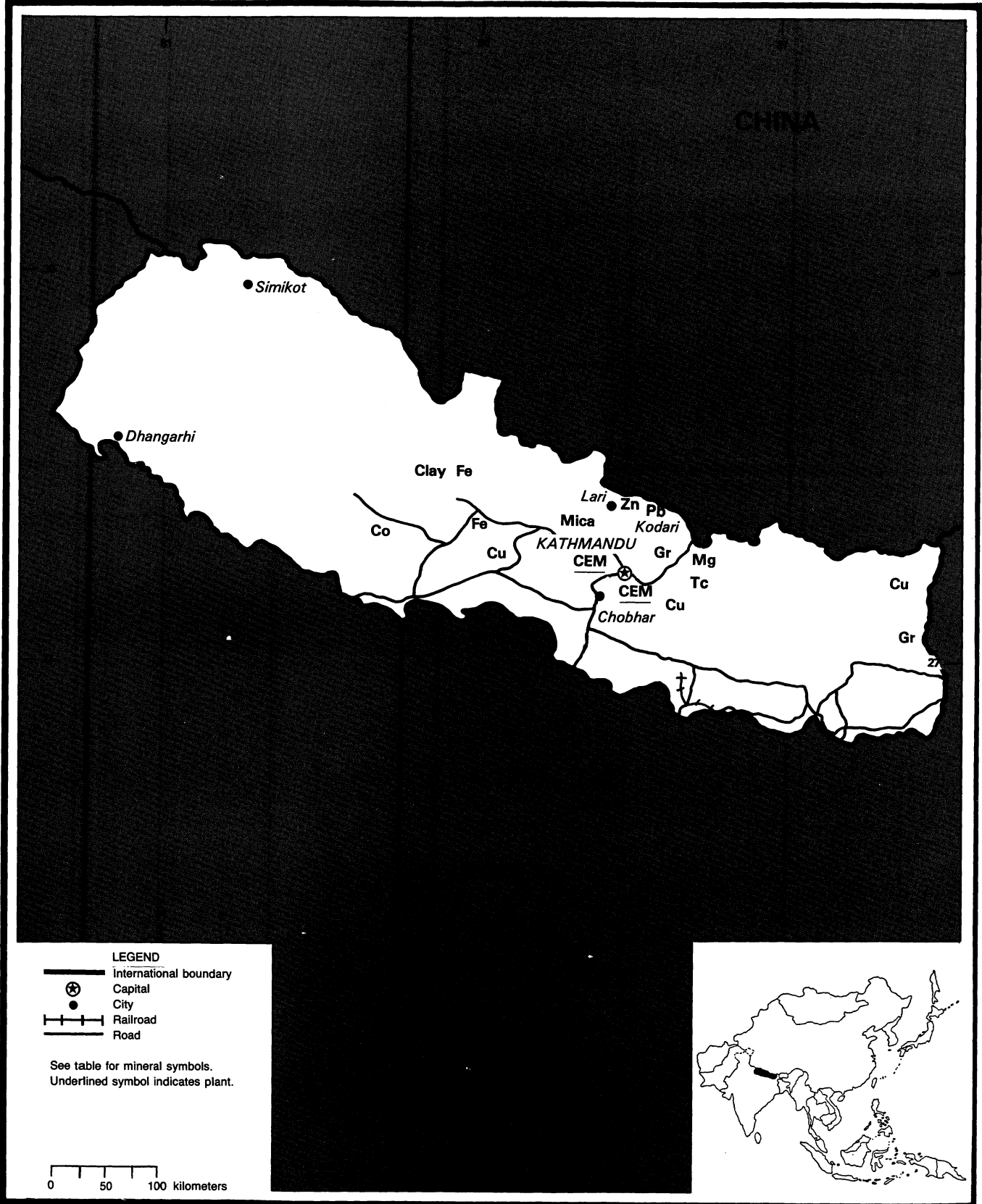
¹Data do not add to total shown because of independent rounding.

Source: Phosphate Rock Statistics 1991, International Fertilizer Association Ltd.

NEPAL

AREA 140,800 km²

POPULATION 19.6 million



THE MINERAL INDUSTRY OF

NEPAL

By John C. Wu

The Kingdom of Nepal is a landlocked country situated between China and India. It is among the poorest countries in the world with a per capita income of less than \$200. The agricultural sector dominates the economy, accounting for more than 90% of the work force and for 60% of the GDP. The industrial sector is largely limited to the processing of agricultural produce—grain, jute, sugarcane, and tobacco. A growing industrial activity is the production of textiles and carpets.

The mineral industry of Nepal is small. The mining operations are sparsely distributed throughout the country and are representative of early stages of development. Lack of electricity and an undeveloped road system hinder mining as well as exploration and development. The mines are privately owned and operated. The exception is Nepal Orind Magnesite Ltd., 50 km east of Kathmandu in the Dolkha District, which is 50% owned by the Government.

Definitive geological work for estimating mineral reserves has not been accomplished. The Government reported a deposit of lead and zinc near Lari with a reserve of about 2 million tons. However, the basis for the estimate was not defined. Large quantities of limestone are thought to be available, but no systematic delineation of reserves has been accomplished. Other mineral resources include clays, magnesite, quartz, talc, and small quantities of copper, iron ore, and lignite.

There is a 7,080-km road system that has only about 2,650 km of pavement, the remainder having a gravel or earth surface. The country has 52 km of narrow-gauge railroad, all of which is in the southeast close to the Indian border. The 20-km section between Raxaul and Birganj is Government owned. There are

TABLE 1
NEPAL: PRODUCTION OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity ³	1987	1988	1989	1990	1991 ⁴
Beryl kilograms	(*)	400	900	*1,000	(*)
Cement, hydraulic	151,631	215,010	217,666	107,179	135,897
Clays for cement manufacture	*10,000	8,033	7,206	824	8,850
Coal: Lignite	5,081	8,311	9,639	7,808	10,150
Copper ore:					
Gross weight	*6	9	20	18	22
Cu content	2	3	7	6	4
Gemstones: ⁵					
Garnet kilograms	25,000	25,000	25,000	20,000	*22,000
Tourmaline do.	50	*22	20	20	5
Lime, agricultural	*500	21,200	40,500	*45,000	24,500
Magnesite, crude	38,388	45,000	27,978	*25,000	*25,000
Salt	*7	6	7,200	6,900	7,300
Stone:					
Limestone	334,270	323,584	289,743	*295,000	221,920
Marble:					
Chips	11,644	1,164	57	945	778
Cut square meters	15,847	15,855	23,448	46,892	34,306
Craggy do.	6,168	6,171	68,954	5,318	*6,000
Talc	*3,359	4,430	6,728	1,798	3,500

*Estimated. †Preliminary.

¹Table includes data available through Dec. 22, 1992.

²Data are for the fiscal year ending mid-July of that stated.

³In addition to the commodities listed, construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

⁴Beryl may have been produced but quantities were not reported.

⁵Reported figure.

five airports with paved runways. The potential for hydroelectric power development is high but undeveloped. Electric generating capacity is 280,000 kW. Kathmandu and several of the larger cities have electricity, but there is no national electric power transmission and distribution system.

The outlook for the development of Nepal's economy is dependent on foreign aid, both technically and financially. Japan currently heads the list of aid donors, followed by the United States.

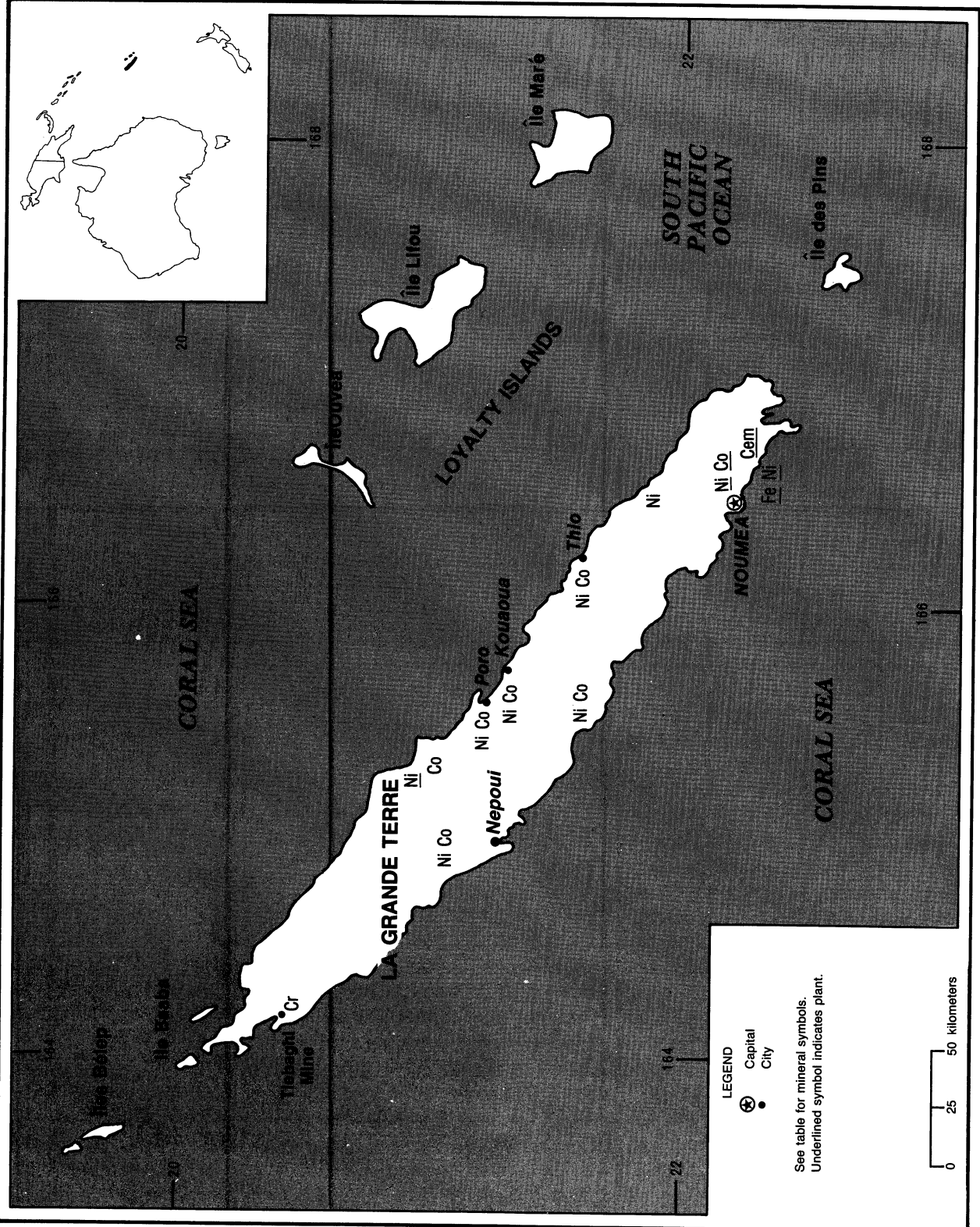
Other donors include countries of the EC and China and India in the Far East, as well as international organizations. Infrastructure projects in progress include a cement plant, small-scale hydroelectric power stations, bridge construction, installation of a high-power transmission line, and construction of a highway in western Nepal. The potential for mineral development remains largely untapped.

NEW CALEDONIA

(France)

AREA 19,060 km²

POPULATION 171,500



THE MINERAL INDUSTRY OF NEW CALEDONIA

By Travis Q. Lyday

The mineral industry in the French Territory of New Caledonia and Dependencies continued to be dominated by the mining of nickeliferous laterite-saprolite ore, which was used for the subsequent production of ferronickel of various grades and of nickel matte at the Doniambo smelter at Nouméa. Minor amounts of cobalt were recovered as a component of nickel matte exports from refining operations at Sandouville, near Le Havre, northern France. Minor amounts of pit and quarry construction materials also were produced.

New Caledonia remained the third largest producer of mined nickel in the world after Canada and the former U.S.S.R. and was the largest producer of ferronickel, with about 40% of the world's output.

Nickel was produced at mines owned by Société Métallurgique le Nickel-SLN (SLN), a 95%-owned subsidiary of Metropolitan France's Eramet-SLN, and from smaller, independent producers. SLN produced about 65% of the territory's nickel ore at the two mining centers of Kouaoua and Thio on the east coast and at contractor-operated mines on the west coast of La Grande Terre, the main island. The remaining 35% came from smaller, independent operators, including Nickel Mining Corp., Nouméa Nickel, Société des Mines de la Toutouta, and Société des Minière du Sud Pacifique.

Mine output from the independently operated mines was mainly for export to Australia's Yabulu nickel refinery near Townsville, Queensland, and Japan's nickel processors. SLN's nickel ore was used as feed for its Doniambo smelter at Nouméa for the production of ferronickel ingots and shot and nickel matte. Most of the ferronickel production was shipped to consumers in Australia, and all

production of nickel matte was shipped to Eramet-SLN's refinery at Sandouville-Le Havre for further processing into high-purity electrolytic nickel and nickel salts.¹

Nisshin Steel Co., the leading producer in Japan of cold-rolled stainless steels, signed in October the long-term cooperation agreement with Eramet-SLN that was first announced at the beginning of July. Under the terms of the agreement, Nisshin Steel acquired a 5% share of Eramet-SLN, the parent company of the Doniambo smelter operator SLN, with this increasing progressively to a 10% share in 1994, in exchange for a long-term ferronickel supply contract. Nisshin Steel will gradually increase its intake of Doniambo smelter production from 1,000 mt/a to 5,000 mt/a of contained nickel. The contract was to be for a 10-year period beginning January 1, 1992, and ending December 31, 2001. Reportedly, this is the first direct investment by a Japanese steel company in a foreign ferroalloys producer.²

Inco Ltd. of Canada, the world's largest nickel producer, and France's Bureau de Recherches Géologiques et Minières (BRGM) announced in November an agreement in principle on a project to evaluate the feasibility of developing lateritic nickel resources contained by their respective mining titles and rights in the southern part of Le Grande Terre. Inco was to purchase BRGM's subsidiary, Société de Promotion de Mines, and buy the patents and technical know-how owned or developed by BRGM related to the processing of nickel ores. The agreement also was to create a joint venture between Inco, with a majority interest, and BRGM, which would implement the project. The agreement, subject to approval by appropriate public

authorities, was expected to be finalized early in 1992.³

New Caledonia's nickel reserves, estimated to be 30% of world reserves, are second only to those of Cuba. Several small-scale chromite ore deposits have been identified in the vicinity of the Tiébaghi chromite mine, both to the east and to the west of the present site. Chromical S.A., the owner-operator of the now closed Tiébaghi Mine, appears optimistic that sufficient chromite reserves will be identified for the company to recommence operations at the mine site.

In addition to abundant reserves of nickel ores, the island territory is well endowed with other mineral resources. Significant prospects have been reported for antimony, copper, gold, iron ore, lead-zinc, manganese, and phosphate rock. However, none of these has been mined commercially.

The transportation infrastructure includes 6,340 km of roads, of which only about 10% is paved, with the remaining improved earth. There are 29 airports serving the country, 6 with permanent-surface runways. International shipping ports include the port at the capital city of Nouméa and the ports at Népoui, Poro, and Thio. Electricity generating capacity in 1990 was 400,000 kW.⁴ Generally, infrastructure for the mining of nickel ore is regarded as adequate.

¹Eramet-SLN. 1991 Annual Report. 23 pp.

²Metal Bulletin (London). No. 7596, July 8, 1991, p. 5.

³Mining Journal (London). V. 317, No. 8151, Dec. 6, 1991, p. 414.

⁴U.S. Central Intelligence Agency, Washington, DC. The World Factbook 1991, p. 224.

OTHER SOURCES OF INFORMATION

Agency

Le Service des Mines et L'Energie
Noumea, New Caledonia

Publications

Service de la Statistique (Paris).
Annuaire Statistique, annual.

Annales des Mines (Paris). Productions
et Exportations Minieres &
Metallurgiques de la Nouvelle
Caledonie, monthly.

TABLE 1
NEW CALEDONIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991*
Cement*	50,000	60,000	² 67,232	65,000	65,000
Chromite, gross weight	61,832	70,341	60,281	⁴ 6,223	—
Cobalt, mine output:					
Co content* ³	5,800	6,000	6,000	6,000	6,000
Recovered*	750	800	800	800	800
Nickel:					
Ore:					
Gross weight					
thousand tons	2,842	3,385	4,919	⁴ 4,486	4,600
Ni content	56,850	67,700	98,500	89,000	91,500
Metallurgical products:					
Ferronickel:					
Gross weight*	115,600	146,300	142,500	126,500	137,500
Metal content (nickel plus cobalt)	29,531	37,352	36,285	32,278	35,000
Nickel matte:					
Gross weight*	11,300	14,300	14,500	13,000	10,800
Metal content (nickel plus cobalt)	8,283	10,470	10,650	9,683	8,000
Stone, sand and gravel: ²					
Stone:					
Crude (unspecified)					
cubic meters	20,000	20,000	20,000	25,000	25,000
Crushed					
do.	100,000	100,000	100,000	125,000	125,000
Sand					
do.	75,000	75,000	75,000	100,000	100,000
Silica (for metallurgical use)					
do.	15,000	15,000	15,000	20,000	20,000

*Estimated. ²Revised.

¹Table includes data available through July 9, 1992.

²Reported figure.

³Series reflects cobalt recovery from ores and intermediate metallurgical products of nickel exported from New Caledonia to France and Japan.

TABLE 2
NEW CALEDONIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

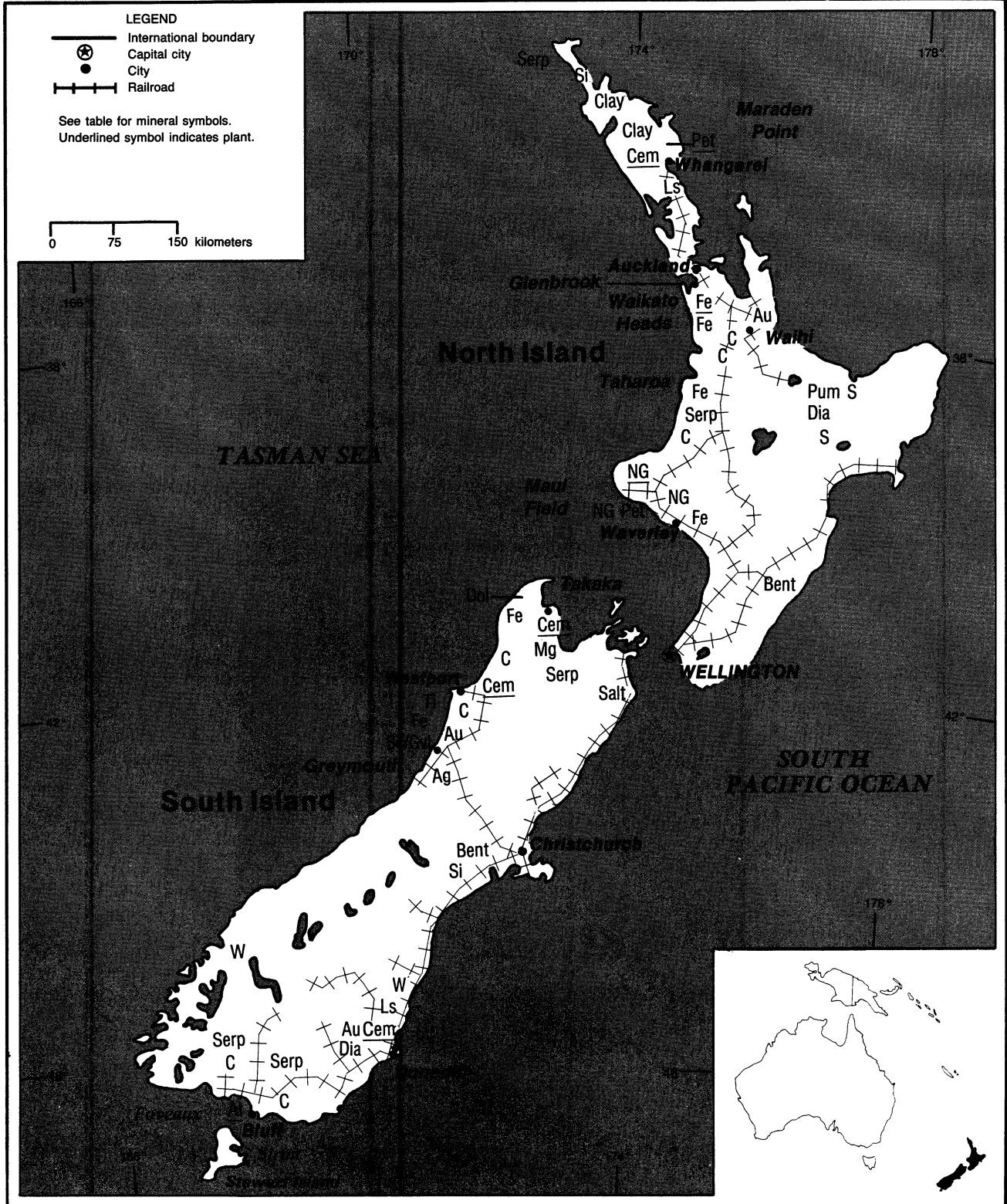
Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	S.A. Ciments de Numbo, operator and owner, 100%	Noumea, La Grande Terre	180
Nickel, ore	Societe Metallurgique le Nickel-SLN, operator and owner, 100%	Kouaoua mining center, east coast of La Grande Terre	1,000
Do.	do.	Thio mining center, east coast of La Grande Terre	700
Do.	do.	Several mines on west coast of La Grande Terre	1,100
Ferronickel, matte	Societe Metallurgique le Nickel-SLN, operator and owner, 100%	Doniambo smelter, Noumea, La Grande Terre	148

¹Contained nickel.

NEW ZEALAND

AREA 268,680 km²

POPULATION 3.3 million



THE MINERAL INDUSTRY OF NEW ZEALAND

By Travis Q. Lyday

The New Zealand mining industry is primarily centered on coal and gold, mineral commodities with long traditions in the country. The mineral industry in New Zealand began with the discovery of gold on the Coromandel Peninsula, North Island, in 1852. Coal mining also began in the 1850's, and early in this century, its production value exceeded that of gold for the first time. During the 1960's, building aggregates replaced coal as the country's most valuable mineral product. In the early 1980's, aggregates were, in turn, replaced by natural gas as New Zealand's most valuable mineral product.

The existence of extensive iron sand deposits on the west coast of North Island was known for more than a century, but not until the late 1960's was a steelmaking industry in New Zealand able to use successfully the iron sands and coal from an area near Waikato North Head. Construction of the Glenbrook steelworks was completed in 1970. Its capacity was expanded to 750,000 mt/a in 1988, but was operated far below this level throughout 1991.

Serious exploration for oil and gas began in the late 1950's, resulting in the discovery of several natural gas fields to date. The Kapuni Field was discovered in 1959 and began production in 1970, supplying gas to North Island Government distribution centers and industrial customers. The much larger Maui offshore gasfield, New Zealand's largest, was discovered in 1969. Production has been used primarily for electricity generation and as a premium fuel.

Today's extractive mineral industry in New Zealand constitutes only a small segment of the economy, contributing on the order of 1% to 2% to the GDP of the country. The mineral processing sector provided an estimated 4% to 5% to the

GDP, based on a significant extent on imported alumina, crude oil, and fertilizer, increasing the value of the mineral industry output to about 5% to 6% of GDP.

GOVERNMENT POLICIES AND PROGRAMS

New Zealand's Resource Management and Crown Minerals Act that reforms air, water, land, and mineral laws was passed in midyear, more than 18 months after it was introduced. Under the new act, landowners have the right to veto access to Crown-owned (Government) minerals at the stage of prospecting-exploration and at the stage of production in the case of petroleum. Previously, landowners could not deny access, but could object at the various licensing stages. The new act, however, allows the Minister of Energy to override the landowner, if it can be proved that a petroleum project were in the national interest.¹

The Government began to review in December the petroleum taxation legislation to encourage investment in both exploration and production.²

PRODUCTION

Because reliable statistical information on production is unavailable for most commodities, production levels were estimated.

Mining activities in New Zealand during the year continued to be composed of coal extraction, both by underground and open pit methods; quarrying of raw materials for use primarily in domestic construction (clays, sand and gravel, and stone) and agricultural industries (limestone and marble); and gold and titaniferous magnetite sand (iron sand) mining. Hard-rock gold mining continued

at the Martha Hill Mine at Waihi on North Island's Coromandel Peninsula and at Macraes on South Island; alluvial mining occurred at several sites, especially on South Island. Gold mining was scheduled to begin officially early in 1992 at the Golden Cross Mine, 13 km from the Martha Hill Mine near Waihi. Mineral production also included natural gas, natural gas liquids, and petroleum condensate. Production of these fossil fuels continued to increase.

The mineral processing sector consisted chiefly of the production of primary aluminum, manufactured fertilizers, petroleum refinery products, and crude steel produced mostly from imported raw materials. (See table 1.)

TRADE

Among mineral commodity imports, crude petroleum, partly refined petroleum, and petroleum refinery products dominated. Other mineral commodity imports were alumina, fertilizer materials, and steel semimanufactures. Aluminum ingots continued to be the dominant mineral commodity export, followed closely by gold, steel semimanufactures and other products, and iron ore (iron sand).

STRUCTURE OF THE MINERAL INDUSTRY

A significant part of the mineral industry was controlled by the Government until 1984, including a considerable share of coal production capacity; oil and gas production facilities; the Glenbrook Steelworks; and the nation's sole oil refinery at Marsden Point. Since 1984, the Government has been reducing its attachment and control of these enterprises in a privatization

program through deregulation and sale of its equity to the private sector. Major facilities in private hands during 1991 included the aluminum smelter at Bluff; the gold operations at Golden Cross, Macraes, and Martha Hill; the steel plants of New Zealand Steel Ltd. and Pacific Steel Ltd.; the two cement plants at Portland and Westport; and most of the mines and quarries for industrial minerals. (See table 2.)

COMMODITY REVIEW

Metals

Aluminum.—Comalco NZ Ltd. continued discussions to yearend with New Zealand Government authorities regarding privatization of the 700-MW Manapouri hydroelectric power station supplying the Tiwai Point aluminum smelter at Bluff on North Island. Privatization of the plant, operated by the state-owned Electricity Corp. of New Zealand Ltd., is a prerequisite for the planned expansion, from 259,000 mt/a to about 380,000 mt/a with the addition of a fourth potline, of the country's only aluminum smelter. The discussions involved Comalco taking a minority share of the power station, in association with other private parties and the Government, to assure access to a long-term economical power supply.³

Gold.—During 1991, more than one-half of New Zealand's gold production was recovered from the lode gold mining operations at the Macraes Mine in the Eastern Otago region of South Island and at the Martha Hill Mine at Waihi on the Coromandel Peninsula of North Island. Remaining production was obtained from about 150 alluvial operations mining placer deposits in the Otago-Southland and West Coast areas of South Island.

New Zealand's recorded gold production for 1991 increased more than 40% over that of 1990, reaching its highest level since 1920. The increase was due to the Macraes Mine producing for its first full year, as production from

the Martha Hill Mine and the South Island alluvial output remained constant.

Macraes Mining Co. Ltd. was planning to double, from 1.5 Mmt/a to 3 Mmt/a, throughput to its treatment plant. The upgrade will be done in two stages beginning in early 1992 with the installation of flash flotation circuits. Stage 2 will involve the installation of additional ball and regrind mills, leach tanks, and scavenger tanks.⁴

The Golden Cross Mine began the commissioning process near yearend, producing its first gold-silver bullion in December. The combined open pit-underground mine was scheduled to officially open early in 1992.

Iron and Steel.—New Zealand Steel Ltd. operated the country's only integrated steel plant at Glenbrook, 60 km south of Auckland, North Island. New Zealand Steel also operated titanomagnetite-bearing iron sand mining and concentration plants at Waikato North Head, about 18 km from Glenbrook, for its own steelworks, and at Taharoa, about 100 km farther south, for export to Japanese steel mills for lining blast furnaces.

Pacific Steel Ltd., utilizing the electric arc furnace method, was New Zealand's second largest steelmaker, producing exclusively long products (rod and bar).⁵

Mineral Fuels

Coal.—The scheduled sale of the Government-owned Coal Corp. of New Zealand, the country's largest producer, was delayed pending the conclusion of legal challenges arising from Maori land disputes against the Crown under the Treaty of Waitangi. Negotiations were in progress at yearend.

Natural Gas.—The installation of a second production platform in the Maui gasfield, 35 km off the coast of North Island, proceeded as scheduled. The second platform was being installed in order to maintain the current output levels of 10 Mm³/d of natural gas and 15,000 bbl/d of gas condensate, which have been

forecast to begin declining within the next few years. The more than \$500 million⁶ project, the largest in the area of resource development in New Zealand, was scheduled to commence production by March 1993.

Reserves

Coal in New Zealand has been mined only in certain well-defined areas, and no significant quantities of coal are known outside these areas. New Zealand mined bituminous, subbituminous, and lignite coals. New Zealand has 15.7 billion tons of in situ coal resources, of which 8.6 billion tons is considered recoverable by mining techniques presently employed in New Zealand.⁷ Most of the lignite resources, if mined, would require large-scale mining techniques not currently used in the country.

New Zealand's reserves of iron ore are contained in black sands of the western beaches from Westport southward in South Island and from Wanganui to Muriwai in North Island. These sands are estimated to contain a total of 850 Mmt of combined titaniferous magnetite and ilmenite.

Although New Zealand is rich in epithermal gold deposits, large-scale exploration, prospecting, and development projects face a high level of public opposition because of potential environmental degradation. The estimated gold reserves in the Buller, Grey, and Hokitika River valleys on the Coromandel Peninsula are 311 tons. Additional alluvial reserves contain an estimated 93 tons of gold. (See table 3.)

INFRASTRUCTURE

New Zealand's downstream mineral industry had two steel mills; an aluminum smelter; aluminum, copper, and brass extrusion plants; and an oil refinery. Most of these operations were established and prospered under a mantle of Government protection, subsidies, or incentives until privatization was introduced in 1984.

The communications and transportation infrastructure of New Zealand was well

developed. There are 4,716 km of Government-owned railroads, of which 113 km is electrified; 92,648 km of roads, including 49,547 km paved and 43,101 km gravel or crushed stone; and 1,000 km of pipeline for natural gas, 160 km for refined oil products, and 150 km for condensate. There are 33 principal airports with permanent-surface runways out of an aggregate of 157 serving the country. Inland waterways, of which there is 1,609 km, are of little importance to the transportation industry. International shipping ports include Auckland, Christchurch, Dunedin, Tauranga, and Wellington.⁸ Electric generating capacity in 1990 was reportedly 7.8 MW, of which about 75% was generated from hydroelectric power stations, 7% from geothermal stations, and 18% from fossil fuels (14% natural gas-fired and 4% coal-fired thermal plants).⁹

Generally, infrastructure for mineral industry operations are regarded as adequate.

OUTLOOK

Coal production in New Zealand is expected to decrease in as much as the Government has scaled back the operations of its wholly owned coal mining corporation, Coal Corp. of New Zealand Ltd. The commercial commitment for gold mining may be more encouraging as mining companies complete exploration in one of the last countries in the Pacific Rim with a potential for a modern-day gold rush. However, regulatory constraints and environmental concerns have thus far effectively limited any major expansion of the gold mining industry, as only the largest corporations with sound financial backing have the resources to sustain the long mining license application period. Mining companies, while encouraged by geological investigations, are increasingly unwilling to put up with a seemingly endless array of environmental studies, which can make the mining approval process last up to 10 years.

¹Australian Journal of Mining (Richmond North, Australia). V. 6, No. 59, Aug. 1991, p. 10.

²Barker, R. New Zealand. Ch. in Mining Annual Review 1992 (London). Mining J. (in press).

³Metal Bulletin (London). No. 7663, Mar. 9, 1991, p. 15.

⁴Mining Journal (London). V. 318, No. 8158, Jan. 31, 1991, p. 78.

⁵Metal Bulletin Monthly. July 1991, p. 85.

⁶Where necessary, the values have been converted from New Zealand dollars (NZ\$) to U.S. dollars at the rate of NZ\$1.80=US\$1.00.

⁷U.S. Embassy, Canberra, Australia. State Dep. Telegram 05213, June 6, 1989, 7 pp.

⁸U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1991, p. 226.

⁹Search (Carlton, Victoria). V. 22, No. 2, Mar. 1991, p. 65.

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Ministry of Commerce
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Mining and Exploration Association Inc.
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TABLE 1
NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991*	
METALS						
Aluminum metal, smelter:						
Primary	252,000	264,398	259,671	307,500	307,500	
Secondary*	4,000	3,100	3,100	3,500	4,000	
Total*	256,000	267,498	262,771	311,000	311,500	
Gold, mine output, Au content	kilograms	1,216	2,404	4,766	4,630	26,611
Iron and steel:						
Iron ore, gross weight* ³	2,000	290	—	—	2,060	
Iron sand (titaniferous magnetite):						
Gross weight	thousand tons	2,294	2,351	2,367	2,296	2,300
Fe content*	do.	1,300	1,300	1,300	1,300	1,300
Pig iron (sponge iron)	do.	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)
Direct-reduced iron	do.	—	418	493	549	2,594
Steel, crude	do.	409	460	608	765	700
Lead, refinery output, secondary*	2,400	3,600	25,000	5,000	5,000	
Silver, mine output, Ag content	kilograms	—	1,845	4,837	4,914	211,000
Tungsten, mine output (scheelite):*						
Gross weight	(⁴)	—	(⁴)	—	—	
W content	(⁴)	(⁴)	(⁴)	—	—	
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	880	812	729	750	750
Clays:						
Bentonite	—	1,255	1,342	1,393	1,500	
Kaolin (pottery)	25,548	24,020	26,324	25,235	25,000	
For brick and tile	63,671	87,892	60,438	65,267	65,000	
Lime*	160,000	150,000	100,000	100,000	90,000	
Nitrogen: N content of ammonia	73,000	73,000	70,000	70,000	70,000	
Perlite	—	2,938	2,500	1,972	2,000	
Pumice	10,000	25,003	40,974	98,063	100,000	
Salt	67,500	45,000	76,000	80,000	80,000	
Sand and gravel:*						
Silica sand (glass sand)	165,089	55,201	102,131	37,677	40,000	
Other industrial sand	489,000	330,042	316,930	476,000	475,000	
For roads and ballast	thousand tons	13,672	12,455	12,577	9,897	10,000
For building aggregate	do.	5,146	5,806	5,172	4,057	5,000
Stone:						
Dolomite	12,918	24,061	14,581	13,756	14,000	
Greenstone*	kilograms	1,000	1,000	1,000	1,000	1,000
Limestone and marl:						
For agriculture	thousand tons	909	708	967	1,039	1,000
For cement	do.	1,211	1,256	1,408	1,360	1,400
For other industrial uses	do.	208	281	314	353	350
For roads	do.	323	190	377	411	400
Serpentine	14,000	16,042	21,495	20,157	20,000	

See footnotes at end of table.

TABLE 1—Continued
NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991*	
INDUSTRIAL MINERALS—Continued:						
Stone—Continued:						
Unspecified:						
Dimension	² 29,376	17,543	² 20,297	² 26,963	25,000	
Rock for harbor work	thousand tons	¹ 1,194	1,359	1,543	² 2,145	2,000
Sulfur	¹ 1,533	4,323	1,206	² 2,689	2,500	
MINERAL FUELS AND RELATED MATERIALS						
Carbon dioxide, liquefied ³	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>	
Coal:⁴						
Anthracite	thousand tons	(⁵)	(⁵)	(⁵)	(⁵)	
Bituminous	do.	600	600	763	700	700
Subbituminous	do.	1,500	1,600	1,700	1,600	1,600
Lignite	do.	200	200	250	250	250
Total	do.	<u>2,300</u>	<u>2,400</u>	<u>2,713</u>	<u>2,550</u>	<u>2,550</u>
Coke:⁴						
Coke oven		2,000	2,000	2,000	2,000	2,000
Gashouse		6,000	6,000	6,000	7,000	7,000
Total		<u>8,000</u>	<u>8,000</u>	<u>8,000</u>	<u>9,000</u>	<u>9,000</u>
Fuel briquets ⁴		5,000	5,000	5,000	5,000	5,000
Gas:⁴						
Manufactured (from gasworks)	million cubic feet	350	350	400	400	400
Natural:						
Gross production	do.	² 189,700	190,000	² 209,150	200,000	200,000
Marketed production	do.	<u>165,000</u>	<u>165,000</u>	<u>²174,480</u>	<u>175,000</u>	<u>175,000</u>
Natural gas liquids:⁴						
Liquefied petroleum gas	thousand 42-gallon barrels	1,201	1,000	1,250	1,250	1,300
Natural gasoline	do.	157	200	² 250	250	300
Total	do.	<u>1,358</u>	<u>1,200</u>	<u>1,500</u>	<u>1,500</u>	<u>1,600</u>
Petroleum:						
Crude	do.	<u>10,220</u>	<u>10,629</u>	<u>10,220</u>	<u>¹10,000</u>	<u>10,000</u>
Refinery products:⁴						
Gasoline	do.	² 11,492	14,000	² 6,429	6,500	6,500
Distillate fuel oil	do.	² 7,467	5,000	² 8,892	9,000	9,000
Residual fuel oil	do.	² 2,131	2,000	² 1,863	2,000	2,000
Other	do.	² 938	1,000	² 1,058	1,500	1,500
Refinery fuel and losses	do.	² 1,799	1,000	1,000	1,500	1,500
Total	do.	<u>23,827</u>	<u>23,000</u>	<u>19,242</u>	<u>20,500</u>	<u>20,500</u>

*Estimate. ¹Revised.

¹Table includes data available through June 16, 1992.

²Reported figure.

³Not used for manufacture of iron; reportedly consumed for gas purification, preparation of stock icks, and manufacture of brick. Because of these uses, iron content is not reported.

⁴Revised to zero.

⁵Less than 1/2 unit.

TABLE 2
NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
METALS					
Alkali and alkaline-earth metals	value, thousands	\$52	\$278	—	Australia \$274.
Aluminum: Metal including alloys:					
Scrap		8,582	9,280	13	Japan 7,258; Australia 1,464.
Unwrought		230,271	235,837	53	Japan 199,904; Republic of Korea 28,154.
Semimanufactures		13,884	15,171	757	Australia 10,118; Singapore 1,117.
Chromium: Oxides and hydroxides		2	1	—	All to Fiji.
Cobalt: Oxides and hydroxides		1	12	12	
Copper:					
Matte and speiss including cement copper		22	—		
Metal including alloys:					
Scrap		1,987	4,278	20	Australia 1,969; Taiwan 766; India 536.
Unwrought		340	284	190	Australia 61; Malaysia 13.
Semimanufactures		9,332	8,713	1,354	Australia 3,988; Malaysia 821.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite	thousand tons	1,441	895	—	Mainly to Japan.
Metal:					
Scrap		34,254	61,097	18	Japan 36,427; Thailand 18,738.
Pig iron, cast iron, related materials		20	—		
Ferrous alloys, unspecified		20	—		
Steel, primary forms		21,518	12,140	—	Philippines 6,014; Singapore 5,607; Japan 491.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated		140,086	249,211	82,842	Japan 73,747; Australia 27,843; Hong Kong 21,535.
Clad, plated, coated		73,169	83,592	30,818	Australia 24,671; Malaysia 5,110.
Of alloy steel		200	110	(^o)	Australia 39; Tonga 24.
Bars, rods, angles, sections		9,244	11,824	79	Fiji 3,465; Guam 2,103; New Caledonia 1,677.
Rails and accessories		42	—		
Wire		4,378	6,677	89	Australia 4,730; Hong Kong 732.
Tubes, pipes, fittings		10,774	14,253	356	Australia 7,170; Papua New Guinea 2,206.
Lead: Metal including alloys:					
Scrap		1,213	1,272	—	Indonesia 503; Republic of Korea 402; Taiwan 257.
Unwrought and semimanufactures		58	1,224	—	Australia 1,216.
Mercury	value, thousands	\$5	—		
Molybdenum: Metal including alloys, all forms	do.		\$52	—	All to France.
Nickel: Metal including alloys:					
Scrap		160	—		
Unwrought		(^o)	18	—	All to Australia.
Semimanufactures		(^o)	1	—	Do.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	\$148	\$295	—	Australia \$222; West Germany \$52.
Silicon, high-purity		1	2	—	Fiji 1.

See footnotes at end of table.

TABLE 2—Continued
NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
METALS—Continued:					
Silver:					
Waste and sweepings ²	value, thousands	—	\$409	—	United Kingdom \$352; Australia \$52.
Metal including alloys, unwrought and partly wrought	do.	\$3,118	\$2,010	—	Hong Kong \$833; Japan \$504; Australia \$485.
Tin: Metal including alloys:					
Semimanufactures		53	85	1	Fiji 36; Singapore 36.
Titanium: Oxides		11	2	—	Mainly to Samoa.
Tungsten: Metal including alloys, all forms	value, thousands	—	\$265	—	France \$256; West Germany \$9.
Uranium: Oxides and other compounds	do.	\$6	—		
Zinc:					
Ore and concentrate		59	—		
Oxides		42	454	—	Australia 293; Japan 160.
Metal including alloys:					
Scrap		765	712	—	Taiwan 413; Australia 137; Republic of Korea 103.
Unwrought and semimanufactures		10	14	—	Australia 12; Fiji 2.
Zirconium: Ore and concentrate		—	500	—	All to China.
Other:					
Waste and scrap of precious metals, n.e.s.	value, thousands	\$161	—		
Ashes and residues		1,611	1,663	—	India 585; China 502; Republic of Korea 237.
Base metals including alloys, all forms	value, thousands	\$86	—		
Metalloids ⁴		39	—		
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		95	124		Fiji 62; Taiwan 34; Australia 28.
Artificial: Corundum		—	19	—	All to United Kingdom.
Grinding and polishing wheels and stones	value, thousands	\$242	\$322	\$214	Australia \$40; Fiji \$24; Papua New Guinea \$16.
Dust and powder of precious and semiprecious stones	do.	—	\$79	\$52	West Germany \$26.
Cement		40,454	158,921	105,596	
Chalk		—	5	—	Fiji 3.
Clays, crude		20,947	22,299	—	Japan 12,240; Taiwan 3,260; Republic of Korea 3,060.
Diamond: Gem, not set or strung	value, thousands	\$55	\$1,091	\$31	Australia \$878; Thailand \$52.
Diatomite and other infusorial earth		4	4	—	Fiji 2, Tonga 2.
Fertilizer materials:					
Crude, n.e.s.		7,998	237	17	Malaysia 122; Singapore 45.
Manufactured:					
Ammonia		1	1	—	Samoa 1.
Nitrogenous		65,605	90,446	—	Australia 73,293; Chile 12,000; Malawi 4,060.
Phosphatic		42	47	8	French Polynesia 21; Solomon Islands 5.
Potassic		39	82	—	Australia 23; Fiji 20; Malaysia 18.
Unspecified and mixed		475	309	5	Cook Islands 152; French Polynesia 62.

See footnotes at end of table.

TABLE 2—Continued
NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	3	3	—	Mainly to Fiji.
Lime	3	—	—	
Phosphates, crude	2	11	—	United Kingdom 10; Australia 1.
Pigments, mineral: Iron oxides and hydroxides, processed	4	155	146	Fiji 5.
Precious and semiprecious stones other than diamond:				
Natural	value, thousands	\$948	\$828	\$25 Australia \$647; Thailand \$86.
Synthetic	do.	—	\$2	— All to Australia.
Salt and brine	2,449	3,720	(²)	Australia 2,285; Fiji 492.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	—	7	—	All to Fiji.
Sulfate, manufactured	4	22	—	Fiji 18; Australia 3.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	value, thousands	\$15	\$49	— Fiji \$41; Cook Islands \$4.
Worked	do.	\$227	\$148	— Samoa \$70; Cook Islands \$42; Australia \$18.
Dolomite, chiefly refractory-grade	1	1,098	—	Japan 1,077; Australia 21.
Gravel and crushed rock	1,140	1,227	—	Malaysia 1,026; Indonesia 146.
Limestone other than dimension	2,124	16,338	—	Fiji 1,041; Papua New Guinea 489.
Sand other than metal-bearing	273	198	—	Australia 163; American Samoa 16.
Sulfur:				
Elemental: Colloidal, precipitated, sublimed	3	1	—	All to Australia.
Sulfuric acid	84	99	—	Fiji 53; Solomon Islands 18.
Talc, steatite, soaptone, pyrophyllite	2	7	—	All to Fiji.
Vermiculite including perlite	value, thousands	\$43	\$55	— Australia \$35; Taiwan \$9; Indonesia \$8.
Other:				
Crude	244	—	—	
Slag and dross, not metal-bearing	102	2,277	—	China 2,003; American Samoa 221.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	86	—	—	
Carbon black	21	1	—	Mainly to Fiji.
Coal, all grades including briquets	485,728	335,717	—	Japan 242,500; India 50,975; China 30,242.
Gas, natural: Liquefied	876	7,035	—	Australia 6,985; Samoa 50.
Peat including briquets and liter	2,767	3,399	—	Australia 3,140; French Polynesia 152.
Petroleum:				
Crude	thousand 42-gallon barrels	3,831	6,199	— All to Australia.
Refinery products:				
Liquefied petroleum gas	42-gallon barrels	107,776	96,987	— Australia 43,824; New Caledonia 30,450.
Mineral jelly and wax	do.	165	1,022	— Taiwan 990.
Bitumen and other residues	do.	6	72	— Solomon Islands 60; Fiji 12.
Bituminous mixtures	do.	8,739	116,812	— Australia 109,916; Fiji 1,884.

¹Table prepared by Audrey D. Wilkes.

²Less than 1/2 unit.

³May include other precious metals.

⁴Reported under SITC item number as "selenium, phosphorus, etc."

⁵Excludes unreported quantity valued at \$59,000.

TABLE 3
NEW ZEALAND: IMPORTS OF MINERAL COMMOITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
METALS					
Alkali, alkaline-earth metals	value, thousands	\$5	\$20	13	West Germany \$16; United Kingdom \$4.
Aluminum:					
Ore and concentrate		2,288	4,448	—	China 2,244; Guyana 2,100.
Oxides and hydroxides		517,817	490,395	6,534	Australia 482,816; West Germany 597.
Metal including alloys:					
Scrap		541	1,221	1	Australia 1,168; Fiji 27.
Unwrought		4,776	9,068	819	Australia 7,623; United Kingdom 167.
Semimanufactures		11,264	12,740	147	Australia 8,061; Japan 817; West Germany 783.
Antimony: Metal including alloys, all forms	value, thousands	\$86	\$37	—	Hong Kong \$19; Australia \$16.
Cadmium: Metal including alloys, all forms	do.	—	\$5	\$1	Australia \$3.
Chromium:					
Ore and concentrate		301	426	—	Republic of South Africa 294; Australia 132.
Oxides and hydroxides		147	219	21	China 84; West Germany 78.
Metal including alloys, all forms	value, thousands	\$6	\$18	\$2	Norway \$10; United Kingdom \$5.
Cobalt:					
Oxides		19	4	—	United Kingdom 3.
Metal including alloys, all forms	value, thousands	\$50	\$35	—	West Germany \$32; United Kingdom \$2.
Copper:					
Ore and concentrate		42	40	—	All from Netherlands.
Metals including alloys:					
Scrap		46	818	53	Australia 715; Taiwan 32.
Unwrought		5,310	5,231	7	Taiwan 3,095; Australia 1,162.
Semimanufactures		13,424	10,794	195	Australia 9,266; Japan 356.
Iron and steel:					
Iron ore and concentrate including roasted pyrite		36	60	—	All to Australia.
Metal:					
Scrap		21	203	79	Australia 104; Brazil 20.
Pig iron, cast iron, related materials		694	6,113	57	Australia 5,671; United Kingdom 183.
Ferroalloys:					
Ferrochromium		82	80	—	Australia 26; Republic of South Africa 18.
Ferromanganese		1,441	2,131	—	Australia 1,687; Japan 364.
Ferrosilicon		2,237	2,772	13	Australia 1,995; Philippines 558.
Ferrasilicomanganese		1,542	1,204	—	All from Australia.
Unspecified		97	73	—	Australia 48; United Kingdom 14.
Steel, primary forms		15,656	1,660	8	Australia 1,600; United Kingdom 41.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated		37,230	25,637	6	Australia 11,610; Japan 9,272.
Clad, plated, coated		68,939	61,121	1,014	Australia 30,104; Japan 19,764.
Of alloy steel		15,249	61,121	103	Japan 9,032; United Kingdom 1,254.
Bars, rods, angles, shapes, sections		60,619	61,509	1,449	Australia 39,329; Japan 8,606.
Rails and accessories		1,140	9,210	356	United Kingdom 8,559; Australia 257.

See footnotes at end of table.

TABLE 3—Continued
NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
METALS—Continued:					
Iron and Steel—Continued:					
Metal—Continued:					
Semimanufactures—Continued:					
Wire	15,826	15,992	99	Republic of Korea 5,638; Australia 3,576; United Kingdom 3,397.	
Tubes, pipes, fittings	21,616	22,838	1,084	Australia 12,366; Japan 5,438.	
Lead:					
Oxides	78	53	—	Australia 28; United Kingdom 19.	
Metal including alloys:					
Scrap	—	1,723	—	Australia 1,707; Fiji 16.	
Unwrought	2,999	2,143	—	Mainly from Australia.	
Semimanufactures	116	58	2	Australia 50.	
Magnesium: Metal including alloys, all forms	311	258	(²)	Norway 251.	
Manganese:					
Ore and concentrate: Metallurgical grade	152	75	—	Singapore 42; China 18.	
Oxides	568	488	(²)	Australia 271; Japan 141; China 76.	
Metal including alloys, all forms	value, thousands \$467	\$351	—	Australia \$227; West Germany \$106.	
Mercury	do.	\$7	\$5	—	Australia \$2; Japan \$2.
Molybdenum: Metal including alloys, all forms	do.	\$10	\$8	\$4	Japan \$4.
Nickel: Metal including alloys:					
Scrap	1	4	—	All from Australia.	
Unwrought	26	53	—	Norway 35; Canada 14.	
Semimanufactures	112	54	10	Australia 15; Japan 9.	
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands \$147	97	\$3	Hong Kong \$27; Australia \$25.	
Silicon, high-purity	824	1,484	1,079	Norway 400; Australia \$25.	
Silver: Metal including alloys, unwrought and partly wrought	value, thousands \$2,145	\$1,205	\$105	Australia \$955; Fiji \$34.	
Tin: Metal including alloys:					
Unwrought	94	86	—	Malaysia 60; Hong Kong 13.	
Semimanufactures	169	161	(¹)	Australia 2,950; Malaysia 5.	
Titanium:					
Ore and concentrate	2	11	—	All from Australia.	
Oxides	4,170	3,298	21	Australia 2,950; Finland 300.	
Metal including alloys, all forms	value, thousands \$6	\$31	\$1	United Kingdom \$29.	
Tungsten: Metal including alloys, all forms	do.	\$26	\$51	\$15	Canada \$34; West Germany \$2.
Uranium: Oxides and other compounds	do.	\$4	\$6	\$6	
Zinc:					
Ore and concentrate	(²)	7	—	Australia 6; Thailand 1.	
Oxides	513	620	(²)	Australia 250; Thailand 165; India 80.	
Metal including alloys:					
Unwrought	22,998	20,991	19	Australia 11,412; Canada 9,009.	
Semimanufactures	266	543	14	Australia 410; Republic of Korea 54.	
Zirconium:					
Ore and concentrate	135	131	58	Australia 73.	

See footnotes at end of table.

TABLE 3—Continued
NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
METALS—Continued:					
Metal including alloys, all forms	value, thousands	\$37	\$9	—	Japan \$7; Australia \$1.
Other:					
Ores and concentrates		181	211	—	Australia 208; China 3.
Waste and scrap of precious metals, n.e.s.	value, thousands	\$10	\$13	—	All from Australia.
Ashes and residues		18	—	—	
Base metals including alloys, all forms	value, thousands	\$27	\$4	\$1	United Kingdom \$3.
Metalloids ²		88	90	—	Hong Kong 47; Philippines 40.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		175	126	36	Australia 83; Brazil \$4.
Artificial: Corundum		116	85	42	Australia 23; Japan 9.
Grinding and polishing wheels and stones	value, thousands	\$2,937	\$3,417	\$366	Singapore \$667; Australia \$605; Japan \$397.
Dust and powder of precious and semiprecious stones including diamond	do.	\$230	\$322	\$175	Ireland \$74; Australia \$37.
Asbestos, crude		—	2	—	All from Canada.
Barite and witherite		1,681	1,448	—	Thailand 684; China 276.
Boron materials:					
Crude natural borates	value, thousands	\$203	\$247	\$2	Netherlands \$245.
Oxides and acids		1,817	1,454	816	Chile 332; Argentina 152.
Cement		6,527	4,376	223	Singapore 1,791; Malaysia 592.
Chalk		1,259	1,332	40	United Kingdom 612; Australia 300.
Clays, crude:					
Bentonite		894	878	318	Singapore 428; Australia 110.
Kaolin		11,000	8,539	1,956	Australia 6,279; United Kingdom 244.
Unspecified		4,043	5,951	4,688	Australia 999; United Kingdom 208.
Cryolite and chiolite		326	37	—	Mainly from United Kingdom.
Diamond:					
Gem, not set or strung	value, thousands	\$9,036	\$8,009	\$927	India \$2,208; Australia \$1,909.
Industrial stones	do.	\$126	\$14	\$6	Australia \$7; United Kingdom \$1.
Diatomite and other infusorial earth		2,622	1,023	1,420	Australia 509; United Kingdom 105.
Feldspar		1,322	274	—	Norway 168; Australia 75.
Fertilizer materials:					
Crude, n.e.s.		18	29	2	United Kingdom 17; Norway 9.
Manufactured:					
Ammonia		1	—	—	
Nitrogenous		70,848	57,569	28,934	Belgium-Luxembourg 11, 354; West Germany 9,577.
Phosphatic		187,976	37,304	37,294	United Kingdom 8.
Potassic		139,623	163,781	249	Canada 134,148; Israel 13,051.
Unspecified and mixed		30,330	20,998	880	Morocco 10,838; West Germany 4,991.
Fluorspar		301	115	—	China 70; Australia 45.
Graphite, natural		9	140	(?)	Republic of Korea 71; China 53.
Gypsum and plaster		79,000	145,533	—	Mexico 125,857; Thailand 15,518.
Iodine including fluorine and bromine		10	20	—	Belgium-Luxembourg 9, Japan 6.
Lime		7	26	—	West Germany 16; Australia 4.

See footnotes at end of table.

TABLE 3—Continued
NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Magnesium compounds:				
Magnesite, crude	3,689	1,160	—	China 1,040; Mexico 55.
Oxides and hydroxides	6,603	5,343	288	Australia 2,689; China 2,246.
Mica:				
Crude including splittings and waste value, thousands	\$255	\$213	\$3	Taiwan \$74; China \$65; Australia \$43.
Worked including agglomerated splittings value thousands	\$104	\$84	\$2	United Kingdom \$48; Australia \$12.
Nitrates, crude	59	42	—	Mainly from Belgium-Luxembourg.
Phosphates, crude	627,023	615,445	159,736	Morocco 117,621; Israel 114,023.
Pigments, mineral: Iron oxides and hydroxides, processed	1,572	1,426	19	Mexico 24,796; Australia 1,468.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	\$3,974	\$3,553	\$47	Australia \$1,729; Thailand \$1,123.
Synthetic do.	\$102	\$90	\$11	West Germany \$45; Thailand \$20.
Pyrite, unroasted	—	4	2	West Germany 2.
Quartz, piezoelectric units value, thousands	\$28	\$3	—	Brazil \$2; Japan \$1.
Salt and brine	65,226	26,933	19	Mexico 24,796; Australia 1,468.
Sodium compounds, n.e.s.:				
Soda ash	259	2,564	—	Australia 2,409; Japan 134.
Sulfate	14,305	8,580	8,019	China 206; Australia 160.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,222	2,550	—	Zimbabwe 1,283; China 444; India 249.
Worked	\$8,586	\$5,768	\$3	Italy \$3,815; Australia \$456.
Dolomite, chiefly refractory-grade	1,236	2,546	—	Australia 2,001; West Germany 545.
Gravel and crushed rock	170	131	—	Australia 118; Japan 6.
Quartz and quartzite	182	122	(²)	Australia 115; United Kingdom 4.
Sand other than metal-bearing	789	566	125	Australia 368; Japan 40.
Sulfur:				
Elemental:				
Crude including native and byproduct	107,209	139,878	714	Canada 138,242; Jordan 750.
Colloidal, precipitated, sublimed	114	116	1	Poland 66; Australia 40.
Sulfuric acid	69	70	2	Taiwan 41; Netherlands 12.
Talc steatite, soapstone, pyrophyllite	1,547	1,587	8	China 991; Australia 541.
Other:				
Crude value, thousands	\$565	\$586	\$5	West Germany \$321; China \$102.
Slag and dross, not metal-bearing	513	357	1	Australia 263; China 36.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	176	138	83	Trinidad and Tobago 36; United Kingdom 19.
Carbon, black	6,430	5,449	976	Australia 3,182; Malaysia 840.
Coal, all grades including briquets	629	625	116	United Kingdom 467; Australia 42.
Coke and semicoke	2,890	7,006	30	Australia 6,972.
Gas, natural: Gaseous value, thousands	\$21	\$3	\$2	United Kingdom \$1.
Petroleum:				
Crude thousand 42-gallon barrels	21,906	26,461	—	Saudi Arabia 14,285; Indonesia 4,392; United Arab Emirates 4,090.

See footnotes at end of table.

TABLE 3—Continued
NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued:					
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	800	475	—	Netherlands 301; Italy 174.
Mineral jelly and wax	do.	51,305	41,144	5,091	China 15,425; Japan 9,994.
Bitumen and other residues	42-gallon barrels	55	94,087	—	Mainly from Australia.
Bituminous mixtures	42-gallon barrels	1,757	1,254	399	Australia 581; Netherlands 460.
Petroleum coke	do.	612,524	576,774	576,598	Singapore 193.

NA Not available.

¹Table prepared by Audrey D. Wilkes.

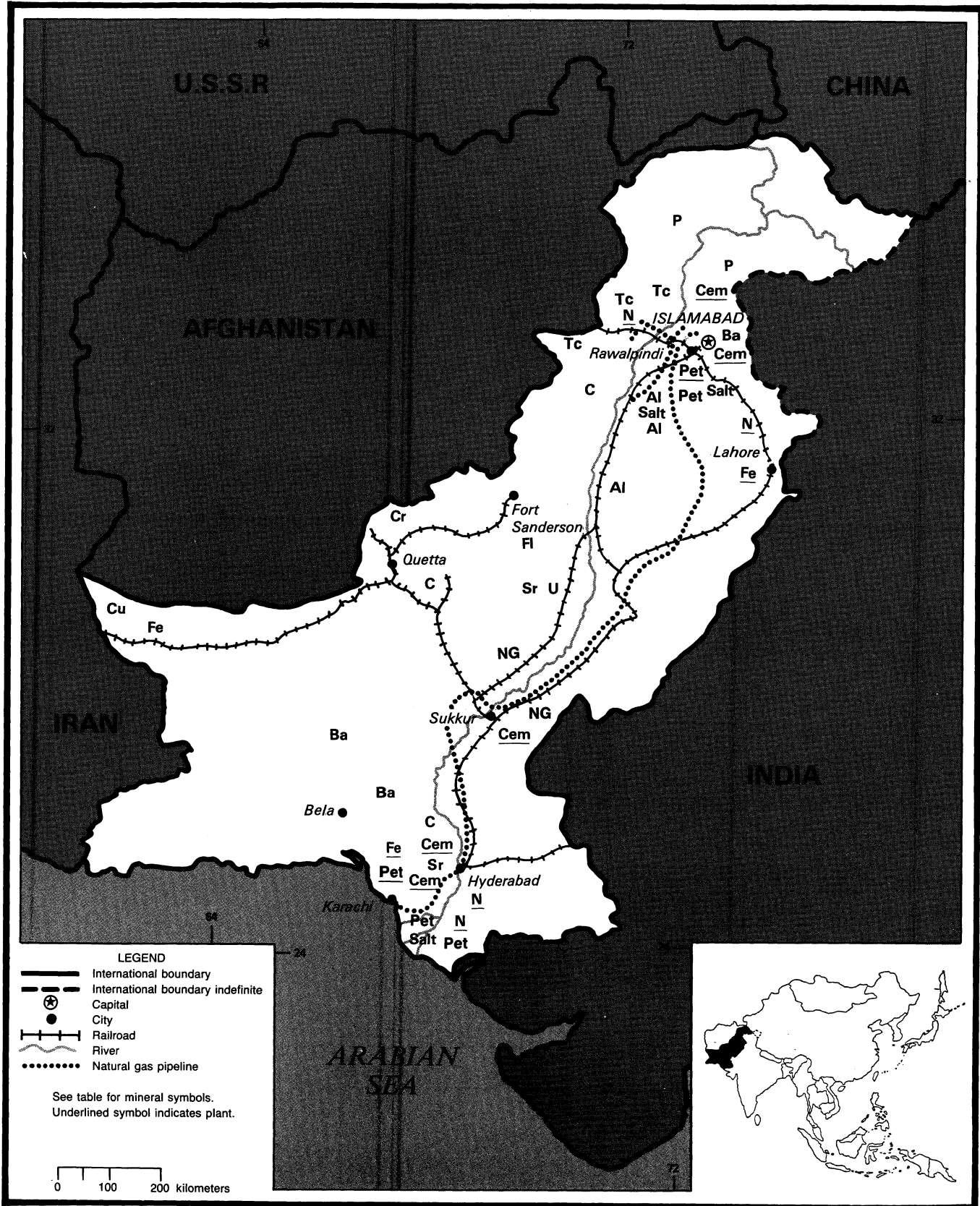
²Less than 1/2 unit.

³Reported under SITC item number as "selenium, phosphorus, etc."

PAKISTAN

AREA 803,940 km²

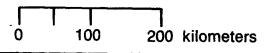
POPULATION 117.5 million



LEGEND

- International boundary
- International boundary indefinite
- Capital
- City
- Railroad
- River
- Natural gas pipeline

See table for mineral symbols.
Underlined symbol indicates plant.



THE MINERAL INDUSTRY OF

PAKISTAN

By Chin S. Kuo

Pakistan's economy continued to grow at a healthy pace in fiscal year 1991, with the GDP expanding 5.6%¹ in real terms.

Agriculture, which accounts for almost one-quarter of GDP and employs more than one-half of the work force, grew 5.1%. Manufacturing output increased 5.7% and came from major industries such as apparel and textiles, cement, edible oil, fertilizer, food processing, machinery, steel, and sugar. Despite these growths, however, the fiscal deficit plunged even further into the red during fiscal year 1991.

The Government provided a new policy of incentives to promote industrialization. There will be no restrictions on imports of industrial raw materials or components to manufacture spare parts locally. The rate of increased imports of machinery for cash payment will be allowed to rise to double the inflation rate every year. There will be no tax on payment of royalties and technical fees. Entrepreneurs will be free to negotiate terms and conditions appropriate for them.

The privatization and divestiture policy entails the sale of controlling shares in certain industrial entities as well as the transfer of management to the private sector. Such entities include General Refractories, Karachi Pipe Mill, Pioneer Steel, Hazara Phosphate Fertilizer, and various cement plants. Investment incentives (including tax holidays, duty exemptions, and others) are also being offered for private investment in less developed regions of the country.

The Government's liberal oil policy was announced to attract private-sector investment and ease procedures for foreign investors by rationalizing oil and gas prices and other measures. The new policy covers exploration, refining, pricing and marketing, quality control,

research and development, and security. It will cut the time for granting oil concessions from years to weeks. Local companies will be encouraged to forge joint ventures with foreign firms and the state-owned Oil and Gas Development Corp. The country planned to increase oil production from existing wells and increase output of petroleum products from enhanced refining. It also encouraged private investment in power generation facilities.

Pakistan is relatively rich in energy reserves with estimated proven oil at 118 Mmt and natural gas at 736 billion m³. However, production levels are low. Domestic energy demand grew by more than 10% per year, outstripping supply.

Oil, about two-thirds of it imported, met 40% of Pakistan's total energy needs, with the rest supplied by coal, hydroelectricity, LPG, natural gas, and nuclear power. (See table 1).

Rupee devaluation and strong demand for Pakistan's cotton-based textiles and apparel in foreign markets helped boost exports by 19%. But a 12% increase in imports and a decline in remittances from Pakistani workers abroad pushed the current account deficit to a record \$2.1 billion.²

Kazakhstan asked Pakistan for a medium-term credit of \$300 million against deliveries of copper, lead, zinc, wheat, and other commodities throughout 1992. Pakistan had already offered \$5 million in supplier's credit for exports of engineering goods to Kazakhstan in 1991.

The development of infrastructural facilities for the Saindak copper and gold project in Chagai District, Baluchistan Province, was delayed because of expenditure cuts by Resource Development Corp. The company had been allocated \$24.3 million. The total cost of the Saindak Project was estimated

at \$243 million, including a foreign exchange funding of \$122 million. The project was also held up by problems attributed to the localized effects of global recession, the Gulf War, and the suspension of U.S. aid. The final cost of the project was to rise by a massive 50%. China Metallurgical Construction Corp. started construction in December. When completed, the project was expected to produce 14,300 mt/a of blister copper, 1,337 kg/a of gold, and 2,488 kg/a of silver over a 21-year life.

Employees of Exxon Chemical Pakistan Ltd. bought out Exxon Chemical Co.'s 27.8% interest in its subsidiary because of the parent company's reluctance to make further investment in fertilizers. The Pakistani subsidiary was renamed Engro Chemical Pakistan Ltd.

Azad Kashmir Mineral and Industrial Development Corp. planned to establish a \$3.2 million graphite processing plant with a capacity of 3,000 mt/a at Kel in the Muzaffarabad District to produce concentrate having 85% graphite carbon. Proven reserves of graphite were estimated to be 1 Mmt at Neelum Valley.

The country planned to invest \$45 million to develop mechanized coal mines in the southern Province of Sind to supply 750,000 mt/a of coal to three 50-MW power stations in the area. Currently, Pakistan Mineral Development Corp. operated three coal mines in Baluchistan Province, one in Punjab Province, and one in Sind Province.

The Fuel Research Center of Pakistan was reported to have developed a technology for the optimum utilization of low-grade, subbituminous, high-sulfur Lakhra coal, which is currently used as briquettes. Humic acid is extracted from coal for use as fertilizers.

Pakistan signed separate exploration agreements with Occidental Petroleum

Corp. and Amoco Exploration Co. of the United States. Occidental planned to explore the Ratana area of 482 km² in Attock District, Punjab Province, and drill a \$10 million exploratory well. Amoco was to conduct a seismic survey over a 275-km² area and drill an exploratory well, spending \$6 million in 3 years. The Government also signed separate concession agreements with Northwest Energy Ltd. of Canada and Hurricane International of the United Kingdom. Both companies were to provide a combined outlay of \$3.7 million covering a total of 500 line km of seismic surveys and two exploratory wells in either Jacobabad or Sukkur District, Sind Province, and Rahimyar Khan District, Punjab Province.

Tullow Oil PLC of Ireland acquired three exploration blocks covering 7,485 km² in Pakistan and brought its interest to six blocks covering 24,000 km². Tullow holds a 60% interest and was to operate the new blocks in partnership with Sabre Petroleum Ltd. (30%) and Oil and Gas Development Corp. (10%).

Oil and Gas Development Corp. signed a concession agreement with a joint venture of Karak Petroleum of Pakistan and Edward Callan Interests of the United States to explore a 774-km² area in Karak District, Northwest Frontier Province, and Attock District, Punjab Province. The first phase at a cost of \$5 million was to interpret existing seismic data and drill a wildcat. The former U.S.S.R. proposed joint oil and gas exploration ventures with Iran and Pakistan in Punjab Province. Pakistan and Iran signed an agreement providing cooperation in oil and gas exploration.

Oil and Gas Development Corp.'s \$141 million development program included 12 wildcats and 23 development wells and seismic surveys. The Asian Development Bank approved a \$50 million loan for field development in lower Sind Province. Additional funding was to come from the company's resources and foreign exchange borrowing from the World Bank.

Two oil discoveries were reported in the Potuhar region: an exploratory well at Pindori near Chal Beli Khan produced

6,000 bbl/d of oil and 510,000 m³/d of natural gas and another near Missa Kaswal produced 7,000 bbl/d of oil. Oil and Gas Development Corp. also reported five oil discoveries. A sixth discovery was found at Meyun Ismail in Sind Province. A large natural gas reserve was discovered in Mehdi Qadirpur of Sukkur District, Sind Province.

Lasmo International of the United Kingdom planned to develop its Kadanwari gas discovery on the Tajjal block in Pakistan. Lasmo owns a 35% interest in partnership with Kufpec Ltd. of Pakistan, Idemitsu Pakistan Oil Exploration Co. Ltd., 30% each, and Oil and Gas Development Corp., 5%. The state-owned company might choose to increase its share to 50% in the development and production stages of the project. The Asian Development Bank approved assistance to Sui Northern Gas Co. to establish a gas-processing plant, improve and construct new pipelines, and expand and improve a gas distribution system.

About 40% of Pakistan's energy requirement was met by oil, 35% by natural gas, and the rest by coal. The country produced 65,000 bbl/d of crude oil and imported 80,000 bbl/d while the demand was 180,000 bbl/d. Gas production was about 42 Mm³/d.

Pakistan intended to boost refining capacity by setting up three more refineries at Badin, Karachi, and Multan. The Government was studying a proposal to build a large oil refinery in the northeastern Province of Multan in collaboration with Abu Dhabi National Oil Co. of the United Arab Emirates. A proposal was also being studied for the construction of a 1,207-km pipeline from Karachi harbor's bulk oil piers to the site of the proposed refinery.

A memorandum of understanding was signed with Iran for the Karachi refinery that was to process 120,000 bbl/d of heavy Iranian crude oil. Surplus petroleum products were to be sold to Iran or in overseas markets. A \$285 million hydrocracker was also planned at the Karachi site for operation by 1994. The Badin refinery was to go to the private-sector, which submitted 12 offers.

¹American Embassy (Islamabad), Foreign Economic Trends, Pakistan, Apr. 1992.

²When necessary, values have been converted from Pakistani rupees (R) to U.S. dollars at the rate of R22.4=US\$1.00 for 1991.

TABLE 1
PAKISTAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ^P
METALS					
Aluminum: Bauxite, gross weight	3,447	2,452	1,967	2,581	4,324
Antimony ore:					
Gross weight	45	—	51	59	75
Sb content*	7	—	8	9	11
Chromium: Chromite:					
Gross weight	10,181	3,327	27,105	18,191	31,474
Cr content*	3,330	1,090	8,900	6,000	10,380
Iron and steel:					
Pig iron thousand tons	897	933	*1,000	*1,000	*1,100
Steel, crude* do.	1,100	1,000	1,000	1,000	1,000
Lead, refined, secondary*	2,000	2,000	2,000	2,500	2,500
Manganese ore:					
Gross weight	30	—	—	—	—
Mn content*	9	—	—	—	—
INDUSTRIAL MINERALS					
Abrasives, natural: Emery	*3,500	2,005	1,360	54,961	10,819
Barite	10,031	22,198	29,718	23,329	28,751
Cement, hydraulic thousand tons	6,832	7,041	*6,936	*7,488	7,762
Chalk	4,292	5,035	4,165	3,175	5,428
Clays:					
Bentonite	2,537	4,880	5,466	3,235	5,106
Fire clay	122,513	124,581	130,627	81,856	136,184
Fuller's earth	17,945	12,395	15,436	16,489	22,075
Kaolin (china clay)	32,208	41,968	39,907	61,630	44,738
Other	680,661	924,237	880,382	1,012,083	1,855,013
Feldspar	6,675	9,026	7,703	10,249	10,210
Fluorspar	3,528	284	4,741	5,312	*5,300
Gypsum, crude	449,013	374,258	466,969	477,671	521,891
Magnesite, crude	3,824	3,081	8,750	4,274	5,191
Nitrogen: N content of ammonia	1,179,000	1,173,000	*1,175,000	*1,180,000	*1,185,000
Phosphate rock:					
Gross weight	*32,000	*35,000	*40,000	*42,000	18,985
P ₂ O ₅ content	*10,000	*11,000	*12,800	*13,000	5,930
Pigments, mineral, natural: Ocher	1,792	1,040	2,394	1,382	1,889
Salt:					
Rock thousand tons	268	406	721	763	769
Marine do.	251	266	250	14	12
Total do.	519	672	971	777	781
Sand and gravel:					
Gravel	10,750	—	—	—	—
Sand:					
Bajri and common	208,339	*210,000	*210,000	*220,000	*220,000
Glass	148,783	133,991	181,187	131,042	151,070
Sodium compounds, n.e.s.:					
Caustic soda	56,571	61,344	*60,000	*61,000	78,500
Soda ash, manufactured	133,133	134,106	*135,000	*135,000	147,000

See footnotes at end of table.

TABLE 1—Continued
PAKISTAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ^a
INDUSTRIAL MINERALS—Continued					
Stone:					
Aragonite and marble	228,619	211,896	260,178	254,305	331,820
Dolomite	141,846	69,131	59,228	82,642	213,117
Limestone	7,278	6,428	7,897	7,810	8,432
Other (reported as "ordinary stone")	551	*580	*600	*600	46
Strontium minerals: Celestite	1,114	488	956	1,799	1,472
Sulfur:					
Native	*1,120	690	—	175	255
Byproduct, all sources ^a	26,000	25,000	25,000	25,000	26,000
Total ^a	27,120	25,690	25,000	25,175	26,255
Talc and related materials: Soapstone	23,278	37,429	38,290	30,177	33,643
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades	2,419	3,199	2,642	2,733	3,040
Coke	526	*600	*600	*620	*650
Gas, natural:					
Gross production	410,849	437,300	*450,000	499,685	518,483
Marketed production (sales) ^a	388,000	413,000	425,000	425,000	450,000
Natural gas liquids ^a	70	75	75	80	80
Petroleum:					
Crude	15,230	16,310	*16,500	19,033	23,027
Refinery products:					
Gasoline	7,012	*7,000	*7,000	*7,200	*7,200
Jet fuel	3,712	*3,700	*4,000	*4,000	*4,200
Kerosene	3,015	*3,000	*3,000	*3,200	*3,200
Distillate fuel oil	13,040	*13,000	*13,000	*13,200	*13,500
Residual fuel oil	11,635	*12,000	*12,000	*12,100	*12,200
Lubricants	1,005	*1,000	*1,000	*1,000	*1,200
Other	3,615	*4,000	*4,000	*4,100	*4,100
Total	43,034	*43,700	*44,000	*44,800	*45,600

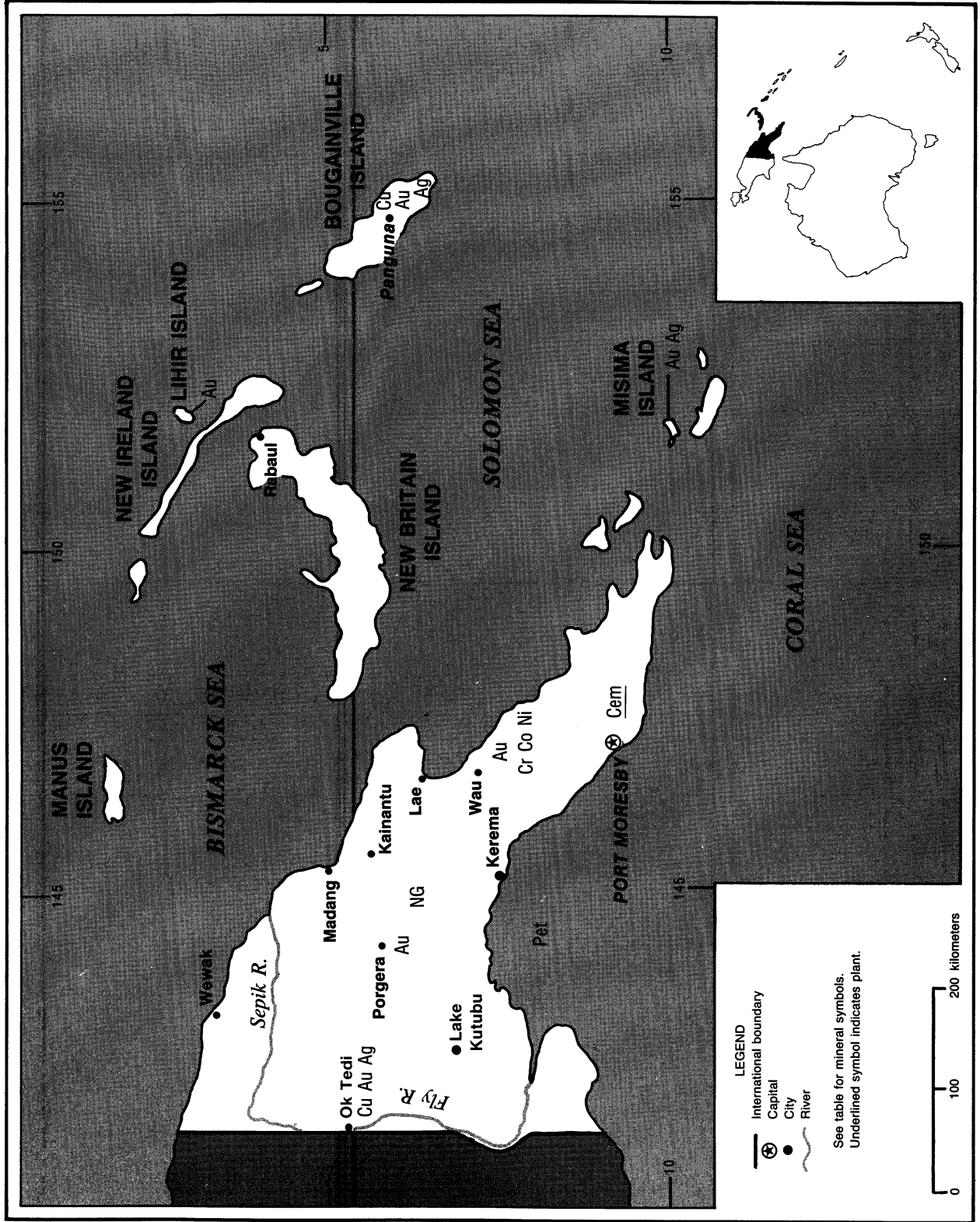
Estimated. *Preliminary. Revised.

¹Table includes data available through July 22, 1992.

PAPUA NEW GUINEA

AREA 461,690 km²

POPULATION 3.9 million



THE MINERAL INDUSTRY OF

PAPUA NEW GUINEA

By Travis Q. Lyday

Mining in Papua New Guinea during 1991 ranged from primitive panning and sluicing (remnants of the 1988 Mount Kare gold rush during the first part of the year, Southern Highlands Province) gold operations to modern mechanized copper (Ok Tedi Mine, Western Province) and gold (Misima open-cast, Milne Bay Province, and Porgera underground mine, Enga Province) operations.

Papua New Guinea's 1991 GDP increased at a record-high 9.3% rate, mainly due to the remarkable growth attributed to the minerals sector, including exploration programs, mining, and associated construction and development such as that at the Porgera Mine or the Kutubu Oilfield.¹

The mining industry in Papua New Guinea paid more than \$12.2 million² in mineral royalty payments to Provincial governments and landowners in 1991. The owners of the Ok Tedi Mine had the largest payout, more than \$5.5 million, followed by Porgera with more than \$5 million. Misima paid an estimated \$1.6 million, and the mines at Wau and Mount Kare paid more than \$21,000 and \$16,000, respectively.³

GOVERNMENT POLICIES AND PROGRAMS

In November, the Government enacted a kina-for-kina tax rebate for investment in the development of mining or petroleum project infrastructure that impartially benefits local communities or Provinces. The deduction will apply to associated projects not directly affiliated with the primary undertaking but which, nevertheless, would improve the standard of living of the local population. Infrastructure developments that are required by the Mining Act or the Petroleum Act will not qualify, although

these normally would qualify for tax relief as a capital write off over 8 or 10 years for petroleum and mining projects, respectively. The policy was aimed to win the support and cooperation of traditional landowner groups who in the past have obstructed minerals development projects.⁴

PRODUCTION

Four mines (Misima, Mount Kare, Ok Tedi, and Porgera) and one gas project (Hides) were in operation at the end of the year. These produced virtually all of the country's mineral production, excluding clays, sand and gravel, and stone for construction purposes. Another mine, the Panguna Mine on Bougainville Island, North Solomons Province, remained closed throughout the year owing to civil unrest by Bougainville Revolutionary Army militants (*See table 1*).

TRADE

Papua New Guinea's economy remained agrarian, relying mainly on coffee, cocoa, and copra and palm oils for export earnings. Agriculture was estimated to have accounted for more than one-third of both the GDP and foreign exchange earnings of the country. The country's mineral industry was the second most important sector of the economy, however. Before its closing, the Panguna Mine on Bougainville Island was the nation's largest single income earner, accounting for 40% of all export revenues and 10% of Government income in 1988. The Porgera Mine has largely replaced Panguna's role in the national economy with the completion of its first full year of production in 1991.

Large-scale smelting and refining did not occur in the country; however, Metals Refining Operations Pty. Ltd. served small-scale producers. Virtually the entire mineral production was exported in the form of doré, bullion, and copper-gold-silver concentrates (*See Table 2*).

STRUCTURE OF THE MINERAL INDUSTRY

Papua New Guinea is a mineral-rich country with a modern mining industry. Mining is the only large-scale industry in the country, directly accounting for more than 15% of the GDP. In addition to several large, world-class mining operations, there are numerous small-scale mining activities. The country has a long history of mining, beginning in 1888 with the discovery of gold on what is now Misima Island, and is a world-class producer of both copper and gold, ranking 11th in copper and 6th in gold in 1991.

At yearend, there were 112 active Prospecting Authorities (PA), or licenses, in the country covering about 14% of the land area and expending about \$22 million on exploration programs; and 33 active Petroleum Prospecting Licenses (PPL) covering about 240,000 km² and spending about \$150 million on work programs. There were about 40 and 17 companies exploring for minerals and petroleum, respectively, in Papua New Guinea at yearend⁵ (*See table 3*).

COMMODITY REVIEW

Metals

Copper.—All copper production in the country was mined at the Ok Tedi Mine on Mount Fubilan in the Star Mountains of Western Province, 18 km from the

Indonesian Province of Irian Jaya. Production in 1991 set a new record high for the Ok Tedi Mine and was less than 15,000 tons shy of the previous record high production for the country, set in 1988 when Bougainville Copper Ltd.'s copper mine at Panguna on Bougainville Island, North Solomons Province, was still in full operation.

In March, Pacific Minerals Pty. Ltd., a wholly owned subsidiary of CRA Ltd., obtained 100% of the Wafi copper-gold prospect about 60 km southwest of Lae in Morobe Province by repurchasing the 45% stake it had previously sold to Elders Mining PNG Pty. Ltd. Although perfunctory test drilling has indicated high grades of porphyry copper mineralization, it is at a depth that may preclude opencast mining. While considerably more drilling will have to be done in order to prove up a minable resource, Pacific Minerals began metallurgical testing of the ore. Within the confines of a best-case scenario, there was some speculation that the prospect could induce CRA to sell its 100% stake, held through its wholly owned subsidiary Bougainville Copper Ltd., in the closed Panguna Mine in return for the mining rights at Wafi.⁶

Gold.—The Mount Kare alluvial-colluvial gold mine in Enga Province in the Southern Highlands, 18 km southwest of the huge Porgera Mine, was commissioned in September. Extensive trial mining begun earlier in the year produced 128 kg of gold. The Mount Kare Mine was expected to produce 560 to 800 kg of gold annually using two dredges at the site.⁷

CRA suspended test drilling of structural targets for the hard-rock source mineralization of its Mount Kare alluvials during the third quarter because of delays in renewing its PA. CRA planned to recommence the drilling program when its exploration license was renewed.⁸

In an effort to get the Ladolam (Lihir) gold project to move forward faster, the PA that covered the whole of the island of Lihir and all of the Lihir gold deposit was renewed in midyear by the Government only for 9 months instead of

the customary 2-year term. The granting of the new PA required that a feasibility report be submitted to the Government's Department of Minerals and Energy (DME) during the first quarter of 1992 and, in addition, a proposal for a mine development program be submitted prior to March 31, 1992, to the Mining Advisory Board and the DME, provided mining the deposit is deemed a feasible economic proposition.⁹ The PA originally was issued to the joint-venture partners in 1983. A prefeasibility study was completed in July 1985. A full-scale study was started in July 1986, but had not been completed by the time for renewal of the PA. The Ladolam deposit, more commonly called Lihir, is on Lihir Island in the Bismarck Archipelago in New Ireland Province. Gold mineralization occurs within an elliptical volcanic crater (caldera) in four separate areas; namely, Coastal, Kapit, Lienetz, and Minifie.¹⁰ The prospect was being developed by a joint venture composed of Kennecott Explorations (Australia) Ltd., 80% and manager, and Niugini Mining Ltd., 20%. The Government also retained the option to purchase up to a 30% interest in the project.

In October, Niugini Mining announced the results of a complete engineering and cost review, including infrastructure, work practices, mining proposals, and milling processes, performed during the third quarter. The new study suggested that the deposit could be mined at the rate of 2.8 Mmt/a for 36 years at an estimated capital cost of \$697 million. Such a project would annually produce about 18,500 kg of gold at a cost of about \$4.42/g during the first 5 years, averaging about 10,800 kg of gold annually for the life of the mine. The previous study was based on mining 4.8 Mmt/a for 40 years at an estimated capital cost of \$1.141 billion. Operating costs for the production of almost 25,000 kg of gold per year for the first 9 years in that scenario were estimated at \$5.78/g.¹¹ The Lihir deposit was considered the world's largest known undeveloped gold resource outside the Republic of South Africa.

The country's only precious-metals refinery, Metals Refining Operations Pty. Ltd., shipped in August the first-ever gold bars for the international bullion market stamped with the "kumul," or Bird of Paradise, as having originated from Papua New Guinea. Previously, since it first was mined more than 100 years ago, gold was exported to other refiners and end users for use in jewelry, coin, and bar manufacture. The shipment was exported to Hong Kong as 1-kg, 99.99%-pure gold bars. Metals Refining Operations, established in 1989, has the capacity to refine 15 mt/a of gold, although this could be doubled or tripled with minimal delay and capital expense.¹²

Output at the high-grade Porgera Mine at Mount Waruwari in Enga Province surpassed the millionth-ounce milestone (31,104 kg) ahead of schedule and in less than 1 year after going into official production. The mine produced almost 42,612 kg (1.37 million oz) during the 12 months to August 30. In addition, commissioning of the phase-one treatment facilities progressed on schedule, with all three of the autoclaves and the oxygen plant for recovery of stockpiled lower grade refractory sulfide gold ore by pressure oxidation becoming operational by the beginning of the last quarter.

Potentially rich deposits of gold, along with copper and zinc, were discovered in the Bewani Mountains, West Sepik Province, near the Irian Jaya, Indonesia, border. Named the Bewani Prospect, the discovery, held by Carpenters Investment Trading Co. Ltd., was centered on Mount Mokofiang.

Gold production, in kg by mine (See table 4).

Mineral Fuels

Natural Gas.—Construction, begun in the fall of 1990, on the Hides natural gas production facility in Southern Highlands Province was completed in June. The Hides output supplies natural gas for power to the Porgera Mine 70 km distant in Enga Province. The Hides Project became Papua New Guinea's first commercial gasfield when commissioning was completed in December. It was to

provide up to 142,000 m³/d of natural gas from two wells, generating 60 MW of electrical power for the Porgera Mine when fully operational, projected for March 1992.¹³ Significant cost savings at Porgera were expected to result from switching from diesel fuel to power from the Hides gas-power station.

Petroleum.—The Kutubu joint-venture petroleum development project in Southern Highlands and Gulf Provinces of the Papuan Basin provided a major boost to the economy during the year. Construction involved the building of a large airstrip near Lake Kutubu, roads, storage tanks, and a 266.5-km pipeline, including 95 km in the Gulf of Papua for an offshore marine terminal for loading oil tankers for transshipment to refineries in Australia and Singapore. Also involved was the construction of a mini oil refinery for processing crude oil for on-site consumption during construction at the field. The refinery, completed in October, was expected to produce 233 bbl/d of jet fuel and 308 bbl/d of diesel fuel, with the option of substituting the production of kerosene for the diesel if demand were sufficient. Total capital cost for the project was estimated to be about \$1 billion. The project, composed of the closely spaced Agogo, Hedinia, Iagifu, and Usano Oilfields, was 44% complete at yearend. It was scheduled to produce the country's first commercial oil beginning in September 1992. Daily output was planned to be about 140,000 bbl.

Petroleum exploration continued at the South East Gobe petroleum joint-venture project, in Gulf Province near the Southern Highlands Province border and close to the planned route of the Kutubu pipeline, during the year. Two exploration wells were drilled—the discovery well Gobe-1 and an appraisal well Gobe-2. Participating interests in the PPL were the Japanese consortium Southern Highlands Petroleum Co. Ltd., 50.5%; Barracuda Pty. Ltd., 20% and permit operator; Command Petroleum Holdings NL, 20%; Nomenco PNG Oil Co., 7%; and Mountains West Exploration Inc., 2.5%.¹⁴ Although more

drilling will be needed before reserves figures can be estimated, it was hoped by the companies involved that sufficient reserves could be delineated to allow production to begin in late 1992. The South East Gobe Oilfield apparently contains at least tens of millions of barrels of oil. Early development of the field would be possible only because of the infrastructure already being developed for the nearby Kutubu Field.¹⁵

Reserves

Papua New Guinea, part of the largest of the islands of Oceania, also has the greatest share of Oceania's mineral resources. However, only three major mineral commodities—copper, gold, and silver—are produced. Although there is no immediate prospect of other major commodities being produced on a large scale, subeconomic resources of chromium, cobalt, and nickel are known. Mineral sands containing magnetite and titanomagnetite occur at many locations around the coasts of Papua New Guinea. Minor quantities of platinum-group metals have been recovered from alluvial gold workings. Resources of bauxite are known on Manus Island in the Admiralty Islands and on New Ireland Island. In addition, lead, manganese, molybdenum, and zinc mineralization, as well as occurrences of industrial minerals such as limestone, phosphate guano, and phosphate rock, are widely known.¹⁶

Natural gas and petroleum potential is thought to be large, but sufficient proven reserves necessary for commercial production are only now being delineated. (See table 5).

INFRASTRUCTURE

Essential elements of the transportation infrastructure include 19,200 km of roads, including 640 km paved; 10,960 km gravel, crushed stone, or stabilized-soil surface; and 7,600 km unimproved earth. The length of inland waterways totals about 10,940 km and is of little importance to the transportation industry. There are 19 principal airports with permanent-surface runways out of an

aggregate of 567 in the country. International shipping ports include Lae, Madang, Port Moresby, and Rabaul. There are no railroads. Electric generating capacity in 1990 was 397,000 kW.¹⁷

The vast majority of the in-place infrastructure in the country is concentrated in the provincial capitals.

OUTLOOK

The terrorist activity that forced the closure of the Panguna Mine in May 1989, coupled with other unrest, e.g., proliferous urban street crime, is continuing to make financiers edgy and, thus, will almost certainly make project financing for new projects, such as the Ladolam gold deposit at Lihir, much more difficult.

However, Papua New Guinea in 1991 was entering a phase of unprecedented mineral and petroleum development. New mining developments are replacing the losses that resulted following the closure of the Panguna Mine, which had become the mainstay of the country's economy, accounting for 10% of the GNP, 36% of export earnings, and 18% of the Government's internally generated revenues. Annual gold production in the country is estimated to increase to more than 70 mt/a by 1993, staying in excess of 40 mt/a well into the 21st century.¹⁸

Since Panguna's shutdown, the Porgera and Misima Mines have come on-stream; the Ok Tedi Mine, the country's largest, has become more profitable and is producing consistently; and natural gas from the Hides Gasfield began fueling the electricity generation plant that supplies power to Porgera, replacing the costly diesel generation plant previously used. In addition, the Kutubu Oilfield was expected to come on-stream in 1992, providing another major boost to the economy. This is accompanied by the construction of the major production facilities, roads, storage tanks, and pipelines, as well as a marine terminal and 1,700-m airstrip.

¹South Seas Digest (Sydney). V. 11, No. 25, Mar. 13, 1992, p. 3.

²Where necessary, the values have been converted from the Papua New Guinean kina (K) to U.S. dollars at the yearend rate of K0.9537=US\$1.00.

³South Seas Digest (Sydney). V. 11, No. 24, Feb. 28, 1992, p. 2.

⁴Australian Journal of Mining (Richmond North, Victoria). V. 6, No. 63, Dec. 1991, p. 16.

⁵Kennedy, D. M. Papua New Guinea. Ch. in Mining Annual Review 1992 (London). Mining J. (in press).

⁶South Seas Digest (Sydney). V. 11, No. 4, May 10, 1991, p. 2.

⁷Pacific Islands Monthly (Suva, Fiji). V. 61, No. 5, May 1991, p. 32.

⁸South-East Asia Mining Letter (Hong Kong). V. 3, No. 21, Nov. 8, 1991, p. 2.

⁹American Metal Market. V. 99, No. 128, July 8, 1991, p. 6.

¹⁰Moyle, A. J., B. J. Doyle, H. Hoogvliet, and A. R. Ware. Ladolam Gold Deposit, Lihir Island. Ch. in Geology of the Mineral Deposits of Australia and Papua New Guinea, ed. by F. E. Hughes. The Australasian Inst. of Min. and Metall., Melbourne, Australia, 1990, pp. 1793-1805.

¹¹Mining Journal (London). V. 317, No. 8146, Nov. 1, 1991, p. 325.

¹²Australian Journal of Mining (Richmond North, Victoria). V. 6, No. 60, Sept. 1991, p. 48.

¹³Australian Mining (Chippendale, New South Wales). V. 84, No. 3, Mar. 1992, p. 28.

¹⁴South Seas Digest (Sydney). V. 11, No. 16, Oct. 25, 1991, p. 2.

¹⁵Page 34 of work cited in footnote 7.

¹⁶Welsh, T. C. The Mineral Industry in Papua New Guinea. Ch. in Geology of the Mineral Deposits of Australia and Papua New Guinea, ed. by F. E. Hughes. The Australasian Inst. of Min. and Metall., Melbourne, Australia, 1990, pp. 1681-1688.

¹⁷U.S. Central Intelligence Agency. The World Factbook 1991, p. 245, Washington, DC.

¹⁸Pages 37-38 of work cited in footnote 12.

OTHER SOURCES OF INFORMATION

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TABLE 1
PAPUA NEW GUINEA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
Copper, mine output, Cu content	217,699	218,634	204,025	170,210	204,459
Gold, mine output, Au content kilograms	33,250	38,129	27,538	*31,938	60,780
Silver, mine output, Ag content do.	61,066	70,408	93,672	*130,000	124,880

¹Estimated. ²Preliminary. ³Revised.

²Table includes data available through June 12, 1992.

³In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates.

TABLE 2
PAPUA NEW GUINEA: EXPORTS OF
COPPER IN CONCENTRATES, BY
DESTINATION

(Metric tons of copper content)

Destination	1990	1991
Germany, Federal	30,337	17,338
Republic of		
Japan	77,460	35,415
Korea, Republic of	25,897	11,819
Unspecified	21,930	31,712
Total	155,624	96,284

Source: World Metal Statistics, May 1992.

TABLE 3
PAPUA NEW GUINEA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Copper, gold, silver	Ok Tedi Mining Ltd., operator. BHP Minerals Holdings Pty. Ltd., managing shareholder, 30%; Amoco Minerals (PNG) Co., 30%; State of Papua New Guinea, 20%; Metallgesellschaft AG, 7.5%; Degussa AG, 7.5%; and Deutsche Finanzierungsgesellschaft Fuer Beteiligungen in Entwicklungslaendern GmbH., (West German Development Co.), 5%	Ok Tedi Mine, Mount Fubilan, Western Province	¹ 145 Cu. 15 Au. 30 Ag.
Do.	Bougainville Copper Ltd., operator and manager. CRA Ltd., 53.6%; public shareholders, 27.3%; and State of Papua New Guinea, 19.1%	Panguna Mine, ² Bougainville North Solomons Province	¹ 180 Cu. 10 Au.
Gold	Kennecott Explorations (Australia) Ltd., 80%, and Niugini Mining Ltd., 20%	Ladolam (Ihbir) deposit, Lihir Island, New Ireland Province	³ 18.
Do.	Mt. Kare Alluvial Mining Co. Pty. Ltd., operator. CRA Minerals (PNG) Pty. Ltd., 51% and Kare-Puga Development Corp., 49% (Local landowners)	Mount Kare deposit, 18 kilometers southwest of Porgera, in Southern Highlands Province	4.7.
Gold and silver	Misima Mines Pty. Ltd., operator and manager. Placer Niugini Pty. Ltd., 80%, and State of Papua New Guinea, 20%	Misima Mine, Misima Island, Milne Bay Province	6 Au. 100 Ag.
Do.	Placer (P.N.G.) Pty. Ltd., manager, 30%; Highlands Gold Properties Pty. Ltd., 30%; RGC (Papua New Guinea) Pty. Ltd., 30%; and Mineral Resources Porgera Pty. Ltd., 10%; (State of Papua New Guinea)	Porgera Mine, 130 kilometers west of Mount Hagen, in Enga Province	30 Au.
Natural gas	BP Petroleum Development Ltd., operator and manager, 95%; and Oil Search Ltd., 5%	Hides Gasfield, Southern Highlands Province	⁴ 425.
Petroleum	Chevron Niugini Pty. Ltd., operator and manager, 19.375%; BP Petroleum Development, 19.375%; Ampol Exploration Ltd., 16.46%; BHP Petroleum (PNG) Inc., 9.69%; Oil Search Ltd., 7.76%; Merlin Pacific Petroleum Co., 4.84%; and State of Papua New Guinea, 22.5%	Kutubu oilfield, Southern Highlands Province	⁵ ⁶ 128.

¹Thousand metric tons.

²Closed since May 1989 because of civil unrest.

³Mine development planned to start in late 1992.

⁴Thousand cubic meters per day.

⁵Thousand barrels per day.

⁶Scheduled to begin midyear 1992.

TABLE 4
PAPUA NEW GUINEA: PRODUCTION
OF GOLD, BY MINE

(Kilograms)		
Mine	1990	1991
Misima Mine	9,865	10,050
Mount Kare Mine	—	498
Ok Tedi Mine	13,803	12,407
Porgera Mine	8,270	37,825
Total	31,938	60,780

TABLE 5
PAPUA NEW GUINEA: RESERVES OF MAJOR MINERAL COMMODITIES, BY
DEPOSIT, FOR 1991

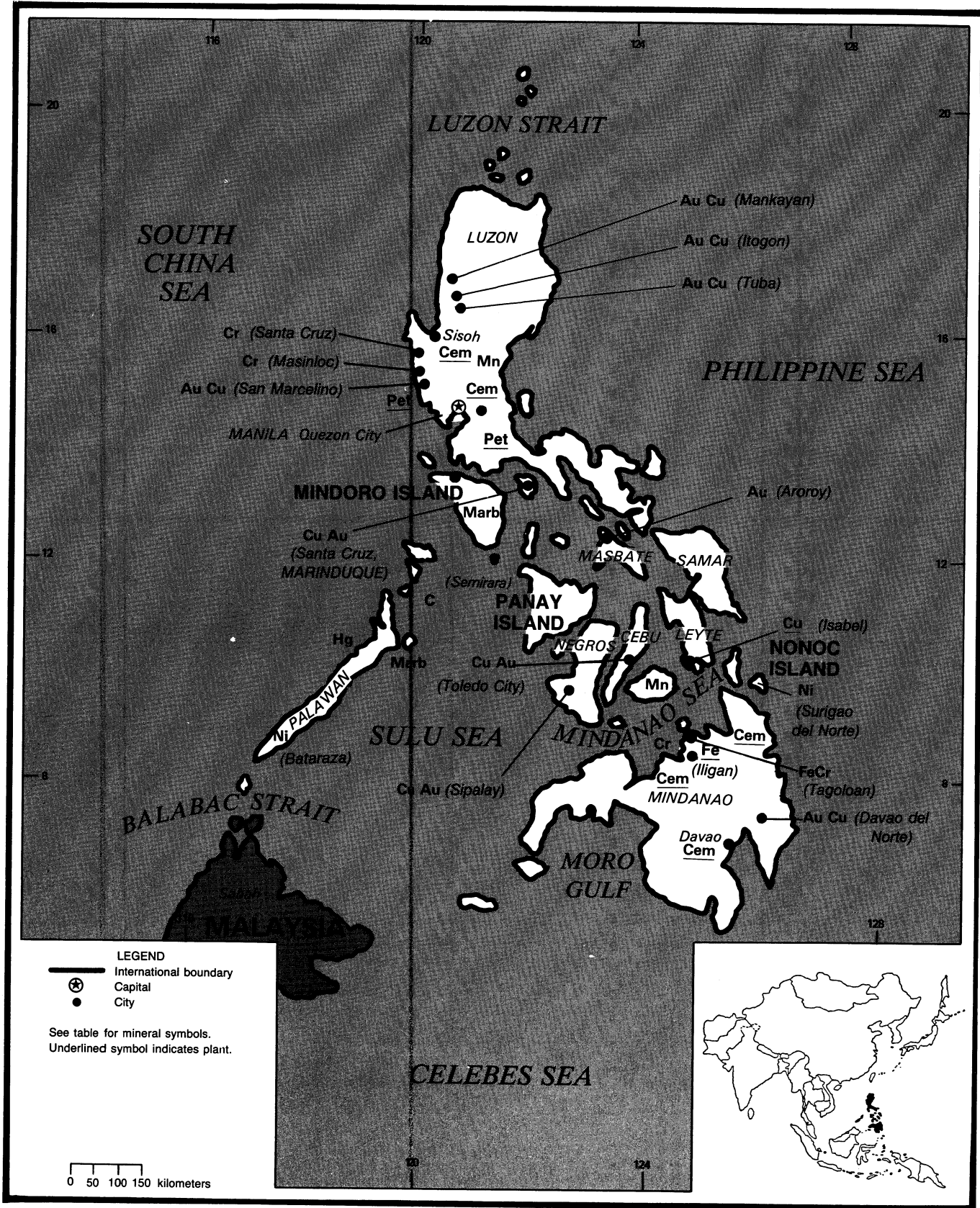
Commodity, deposit, and location	Reserves*
Copper:	
Ok Tedi, Western Province	470 million tons ore grading 0.6% copper.
Panguna, North Solomons Province	530 million tons ore grading 0.4% copper.
Gold:	
Hidden Valley, Morobe Province	60 tons recoverable gold.
Ladolam (Lihir), New Ireland Province	613 tons recoverable gold.
Misima, Milne Bay Province	77 tons recoverable gold.
Mount Kare, Enga Province	3 million cubic meters alluvium grading 5 grams gold per cubic meter.
Ok Tedi, Western Province	470 million tons ore grading 0.5 grams gold per ton.
Porgera, Enga Province	342 tons recoverable gold.
Wafi, Morobe Province	18 million tons ore grading 2.5 grams gold per ton, with associated copper.
Petroleum:	
Kutubu Oil field, Southern Highlands Province	236 million barrels recoverable petroleum.
Silver:	
Hidden Valley, Morobe Province	1,000 tons recoverable silver.
Misima, Milne Bay Province	1,175 tons recoverable silver.
Porgera, Enga Province	585 tons recoverable silver.

*Estimated.

PHILIPPINES

AREA 300,000 km²

POPULATION 65.7 million



THE PHILIPPINES

By Travis Q. Lyday

The Philippines' GDP decreased by 1.02%¹ on a constant dollar basis from that of 1990 to \$46.2 billion² in 1991, after 4 consecutive years of real growth. The economy was hampered by continued high inflation and interest rates, as well as natural disasters, including volcanic activity and tropical cyclones. The mining and quarrying sector of the minerals industry, however, grew by more than 3.5% during 1991, contributing almost 2% of the GDP. Copper and gold remained the backbone of the country's most important mineral products. As a whole, the value of production of cement raw materials, chromite, coal, iron ore, manganese, petroleum refining, and other mineral commodities added modestly to the GDP.

The Philippines was among the 10 largest producers of chromite, gold, and copper in the world in 1991, ranking 6th, 8th, and 10th, respectively. It was also an important regional producer of other commodities, including ferrochromium, ferrosilicon, mined nickel, and refined copper.

GOVERNMENT POLICIES AND PROGRAMS

A new mining code to encourage foreign investment, after being sent to the Filipino Congress, was set aside as most of the legislators in Congress concentrated on the 1992 national elections. The necessary laws to implement the new code were not passed by yearend.³ The mining code will be the enabling act that will implement Section 2, Article XII, of the 1987 Constitution. This will repeal the leasehold system, replacing it with coproduction, joint-venture, and production-sharing agreements, as well as introducing technical and financial

assistance agreements for large-scale mining projects (more than \$50 million). It also will allow foreign companies to own 100% equity in large-scale projects engaged in mineral exploration, development, and production, providing they divest down to not more than 60% equity once their initial investment is recovered.⁴

The Philippines was actively trying to encourage foreign mineral explorers and investors to its shores by promoting, along with the Chamber of Mines of the Philippines and the Philippine Mines and Geosciences Bureau, a series of three seminars early in 1992 in London, Manila, and Vancouver. The seminars, to be presented by senior representatives from Government and industry, will be funded by the United Nations Department of Technical Cooperation for Development under a mineral investment promotion project of the United Nations Development Program. The seminars will provide information to potential investors on current Philippine mining activities, investment prospects, and the legal framework under which mineral exploration is conducted, including laws and regulatory policies.⁵ Complementing the seminar will be a separately available prospectus with a complete description of the Philippines' geography, economic activity, and mining geology, mining laws, and the regulatory policies governing mineral exploration and production. The handbook includes a listing of current mining and quarrying activity by major companies, focusing on each mineral and area in turn.⁶

The People's Small-Scale Mining Law (SSM) was signed in June. The SSM, which recognizes prior existing rights and productivity, requires small-scale miners and panners to pay production share and taxes to the Government; pay a royalty to

claim owners; sell their gold production to buying stations of the Central Bank of the Philippines, regardless of volume or weight, at the London gold market price; and utilize standard mining methods and observe health and sanitation regulations.⁷

A reserve fund was established early in the year by the Department of Environment and Natural Resources to compensate for pollution-caused damage resulting from mining operations. Mining firms will pay semiannual fees based on the tonnages of mine waste produced and tailings discharged into approved disposal systems or dumped into the sea.⁸

PRODUCTION

The minerals industry of the Philippines employed an estimated 428,000 people, including about 300,000 engaged in small-scale mining and panning activities. Over the years, the metallic sector has consistently accounted for 75% of the industry's production value and nearly 100% of export earnings. Of the more than 20 mining companies producing metallic minerals in the country, 8 were mining primary gold, while 7 were involved in production of copper concentrates. Several of the copper miners also produced gold and silver as byproducts. Other companies produced other metals, including chromite, nickel ore, manganese, and zinc concentrates. Mineral production in 1991 increased more than 3.5% in value to about \$1 billion.

Refined gold was the country's most important mineral product, representing more than 35%, followed by copper with almost 35%, of total mineral value. (See table 1).

TRADE

The main market for the country's mineral products was Japan. Japan imported almost all of the Philippine production of chromite and nickel and more than 60% of its copper concentrates. The remaining copper concentrates were smelted by the Philippine Associated Smelting and Refining Corp. (PASAR) into copper cathodes at Isabel, Leyte Province, primarily for export to Japan.⁹ Although all primary and byproduct gold recovered domestically must be sold to the Central Bank, the gold contained in the copper concentrates that were exported to Japan was sold to the smelter along with the copper.¹⁰

STRUCTURE OF THE MINERAL INDUSTRY

The Philippines has one of the oldest and most active mining industries of Southeast Asia. It has a strong, established mining structure. Mining in the Philippines operated on a leasehold system until 1987 when this system was abolished in favor of a new system of joint-venture or production-sharing agreements under policies governed by interim regulations until a new mining law and enabling regulations could be passed. The proposed mining code drafted in 1988 was passed but not implemented by the Filipino Congress by yearend. The new mining code will promote the involvement of foreign investors in large-scale exploration, development, and utilization of mineral resources while retaining small-scale development by Filipinos. State control over mineral resources gives the flexibility to undertake mining as a Government activity or to enter into coproduction, joint-venture, or production-sharing agreements with the domestic private sector or with corporations and associations whose capital is owned 60% by Filipinos. In addition, the code will recognize the importance of foreign investment in the Filipino minerals industry by enabling

investors to undertake minerals operations for their own account, instead of acting as service companies for Filipino clients. For large-scale projects (with a capital value in excess of \$50 million), the requirement for a minimum 60% Filipino ownership of the project may be waived for a specific period, allowing 100% foreign equity in prospecting for and the processing of minerals.

The mining industry of the Philippines was dominated by a few large-scale private local companies mining chromite, copper, and gold. Coal was mined by numerous private companies and three subsidiaries of the state-owned Philippine National Oil Corp. (PNOC). One of the large Government-owned companies produced more than one-half of the country's coal. Copper, ferroalloys, and phosphate fertilizer were produced by three joint-venture firms. Cement was produced by 18 private companies. Most were Filipino-owned, with only minor foreign interests.

Foreign investment in the mining sector of the Philippines was about \$280 million in 1991, a decrease of 22% from that of 1990, representing 27 mining and 2 cement factory projects. The decline resulted primarily because of high inflation, high interest rates, and political concerns, discouraging investment on new or expanded production facilities. Major investors were from Australia, Canada, China, Europe, Hong Kong, and the United States.¹¹ (See table 2).

COMMODITY REVIEW

Metals

Chromium.—Chromite production was centered in the Province of Zambales in northern Luzon. Metallurgical- and refractory-grade chromite was produced from two principal deposits, mined by Acoje Mining Co. (Santa Cruz Mine) and Benguet Corp. (Coto Mine), respectively. Additionally, small-scale operations in the vicinity provided feed ore to the major producers' plants. There was also significant output of metallurgical- and chemical-grade chromite from alluvial and lateritic deposits on eastern Samar

Island, Samar Province, and on Dinagat Island, Surigao del Norte Province.¹²

Consolidated Mines Inc. was authorized in September by the Securities and Exchange Commission to proceed with rehabilitation plans and reopen its refractory chromite mines at Masinloc, once claimed to be the largest source of refractory-grade chromite in the world.¹³

Copper.—Five large operations supplied most of the country's copper output in 1991: Atlas Consolidated Mining and Development Corp.'s open pit (Biga and Carmen) and underground (Lutopan) mines in the Toledo district of central Cebu; Benguet Corp.'s Dizon Mine, Lepanto Consolidated Mining Co.'s Mankayan Mine, and Philex Mining Corp.'s Padcal Mine, all in Benguet Province, northern Luzon; and Maricalum Mining Corp.'s Sipalay Mine in the southern part of Negros Island. Other copper producers included Marcopper Mining Corp. on the Island of Marinduque and North Davao Mining Corp.'s Amacan Mine in Davao del Norte Province, Mindanao.¹⁴

Atlas Consolidated suspended development work in September on its Carmen Underground Project at its Cebu operations due to adverse economic conditions. The 5-year, \$35 million project was started in 1987 and was more than 50% completed when the suspension occurred. The development work on the ore body was scheduled to resume in the first quarter of 1992, with initial mine production, at an estimated rate of 3.5 Mmt/a of ore, commencing during the latter part of 1992.¹⁵

Flooding caused by a severe typhoon, which hit Leyte Province in early November, interrupted electrical power to the country's only copper smelter-refinery at its Leyte Industrial Development Authority site at Isabel, Leyte Province, in central Philippines. Production losses at the complex, operated by PASAR, were estimated at more than \$1 million per day. Normal operations were restored within 3 weeks.¹⁶ The refinery was being expanded and modernized from a capacity of 138,000 mt/a of copper cathode to 172,500 mt/a by October

1992. Upon completion, the refinery will be the fourth largest in the Asia-Pacific region. PASAR also produced refined gold and silver.¹⁷

Benguet Corp. resumed shipments near yearend of copper concentrates from its Dizon Copper-Gold Operation at San Marcelino on the main island of Luzon. Mining had been suspended following the accumulation of volcanic ash resulting from the eruption in June of Mount Pinatubo, 25 km away, and subsequent mudflows and flooding from torrential monsoon rains. The mine was cut off until an alternative access road to the mine was constructed, linking it with an unaffected road to Subic for loading at Port Dizon.¹⁸

Marcopper Mining continued development work at the mining and milling operations of its San Antonio Project. The San Antonio Mine was being developed to replace the Tapian operation, 3 km away, which was terminated in June because of ore reserve depletion. By yearend, all major construction contracts had been awarded; the majority of the equipment, including the semiautogenous mill, had been received; and the concrete for the primary crusher, coarse ore stockpile reclaim tunnel, and conveyor footings had been poured. Dredging of the Tapian Mine tailings dam to expose the ore body was completed in January, and preproduction mining was progressing.¹⁹ The \$60 million project, partly funded by loans of up to \$40 million awarded by the Asian Development Bank, was scheduled to come on-stream during the first quarter of 1992.²⁰ (See table 3).

Ferroalloys.—Integrated Chrome Corp. expanded its ferrochrome furnace facilities at Manticao, Mindanao, increasing output by 30%, following a forced shutdown in August when molten metal and slag broke through the furnace, damaging the lining and shell. Although mining operations were limited during the work, exports of chromite to Japan continued normally.²¹

Near yearend, six ferroalloy producers on Mindanao Island shut down their operations because of chronic 12-hour

blackouts. The blackouts were precipitated by low water levels in Lake Lanao, which drives the Agus-1 hydroelectric powerplant, causing the National Power Corp. to reduce electricity supplies by 60% to the island. Although the Ferro Alloy Producer's Association of the Philippines requested that the Government restart the plant, environmental groups and local residents opposing it for fear that the lake would completely dry up prevented operation of the plant through yearend. The affected producers were Christina Chemical, Ferrochrome Philippines Inc., Integrated Chrome, Mindanao Ferro-Alloy, Metro Alloy, and Philippine Mineral and Alloy.²²

Gold.—The principal gold-producing districts of the Philippines are Baguio, northern Luzon; Masara, southeastern Mindanao; Masbate Island; Paracale, southern Luzon; and Surigao, northeastern Mindanao. Primary gold production in 1991 was dominated by two companies, Atlas Consolidated and Benguet Corp., which between them accounted for more than one-half of the officially recorded Filipino primary production. Six additional companies produced the remainder. In addition, small-scale mining operations, primarily in Mindanao, produced an undeclared (and unknown, but estimated as 9 to 11 mt/a) amount for a thriving parallel, or black, market.²³

Benguet Corp. had almost completed the commissioning phase of its Benguet Antamok Gold Operation at Sitio Antamok, Benguet Province, by yearend and was preparing in early 1992 to begin commercial operations. The project was scheduled to produce 3,500 mt/d of 2.4 g/mt ore, which will be added to the company's current output of 3,000 mt/d at 3.17 g/mt. Antamok's total production during commercial operations was estimated to be almost 1.3 Mmt of ore. All production will be treated in a central recovery plant.

Philex Mining announced plans at yearend to develop the Philippines' largest primary gold project. The mine will be located in Bulawan, Negros

Occidental Province on Negros Island, and was expected to produce more than 30,000 kg of gold and 60,000 kg of silver over the 10-year life of the project. Development of the underground mine was estimated to take 2 years.²⁴ Earlier, Philex Mining suspended development of its proposed Sibutad Mine in Zamboanga del Norte Province, Mindanao Island, in the southern Philippines pending improvement in the gold price.²⁵ Gold production in kg by country is shown in table 4.

Iron and Steel.—Persistent power shortages, with power reductions of up to 80%, on Mindanao Island forced the closure during the latter part of the year of National Steel Corp.'s (NSC) billet plant at Iligan, Lanao del Norte Province. Before shutting down completely, the plant had been operating since spring for only 3 days per week. Closure of the hot and cold mills was also considered likely, but normal operations resumed as the year ended. NSC produced about 300,000 tons of the Philippine domestic consumption of 800,000 mt/a of billet.

NSC firmed plans for construction of its \$2 billion, 2.4-Mmt/a integrated iron and steel plant on the Island of Mindanao but had made no real progress in implementation of the plan by yearend. UEC, a subsidiary of USX Corp. of the United States, delivered in May its feasibility study of the blast furnace-based plant.

Manganese.—Manganese output was centered on the Islands of Busuanga, Marinduque, Masbate, and Siquijor, as well as in the Provinces of Zamboanga del Sur and Agusan del Norte on Mindanao. Many of the deposits, however, are small and unsuitable for large-scale mining operations.

Nickel.—The mainstay of Philippine nickel production in 1991 was Rio Tuba Nickel Mining Corp.'s Rio Tuba Mine in the far south of Palawan Island, Palawan Province. Hinatuan Mining Corp. and Taganito Mining Corp. both operated smaller mines in Surigao del Norte.

Until its closure in 1986, Philippine nickel mining was dominated by the Nonoc lateritic nickel mine on Nonoc Island in Surigao del Norte Province, off the coast of northeastern Mindanao Island. The Nonoc Mine was placed on care-and-maintenance in 1986 after escalating energy costs, beginning in the late 1970's, rendered it uneconomic. In 1984, the Government, through the Asset Privatization Trust (APT), took over the operation and control of the mine. After several unsuccessful tendering rounds, APT sold in 1990 both the mine and its associated refinery on nearby Marinduque Island to Philnico Mining and Industrial Corp. Both the mine and the mothballed refinery were being rehabilitated and modernized for production, scheduled to recommence in August 1992. When it returns to full production, the refinery was expected to produce about 25,000 mt/a of nickel briquettes, compared with the plant capacity of about 32,000 mt/a, and 1,000 to 1,400 mt/a of contained cobalt raw material.²⁶

Mineral Fuels

Coal.—Philippine coal production was dominated by Semirara Coal Co. and PNOC, both of which were Government-owned companies, producing almost 70% of the country's output. Semirara operated the Unong open pit on the Island of Semirara in Antique Province, while PNOC worked three underground mines in Cebu, eastern Mindanao, and at Malangas in western Mindanao. The remainder of production came from 30 to 35 small-scale private producers operating near-surface mines.

Much of the coal mined in the Philippines is low grade and is often blended with higher grade imported coals. Cement production remained the leading consumer, closely followed by power generation.

Petroleum.—Petron Corp., which operated the country's largest oil refinery, announced in April its plans to build a second refinery adjacent to its existing plant at Limay, Bataan Province, for about \$35 million. The 156,000-

bbl/d refinery, which already accounted for more than 50% of the country's capacity, was to be expanded to 225,000 bbl/d by 1996. The announcement marked the refinery's 30th anniversary of production in the Philippines.

Caltex (Philippines) Inc. also planned to increase the capacity of its Batangas refinery at San Pascual, Batangas Province, to 150,000 bbl/d to enable it to widen its share of the local market. Construction was planned to begin late in 1992 and planned for completion in 1996.²⁷

Reserves

Mineralization in the Philippines, although usually not rich, nonetheless is extensive. The Chamber of Mines of the Philippines ranks the mineral reserves of the country at the top in Southeast Asia and seventh worldwide.²⁸ There are abundant deposits of gold, especially on eastern Mindanao Island and in Benguet and Camarines Norte Provinces, Luzon Island; copper in Zambales Province on Luzon and in the Visayan Islands; zinc at Zamboanga on Mindanao; high-grade chromium in Zambales and Camarines Sur Provinces on Luzon, near Surigao on Mindanao, and near Puerto Princesa on Palawan Island; and nickel in Surigao del Norte Province, especially on Hinatuan and Nonoc Islands, Mindanao. Ores of iron, manganese, and mercury also occur in the country. Lead and silver, as well as less common cadmium and molybdenum, mineralization occurs in association with other ores. Deposits of industrial minerals include limestone on Cebu, Luzon, and Romblon Islands; salt and asbestos on Luzon; marble on Romblon and Panay Islands; gypsum on Luzon; sulfur on Luzon, Leyte, and Mindanao Islands; and phosphate rock on Cebu and Bohol Islands. Asphalt occurs on Leyte, and coal deposits are found on Cebu and Mindoro Islands. (See table 5).

INFRASTRUCTURE

The more than 300,000 km² of land area in the Philippines is distributed over more than 7,100 islands. This, coupled

with the fact that virtually any point on even the largest of the islands is within 100 km of the coast, dictates that sea and air transport are essential elements of the communications-transportation infrastructure. Railroads (378 km in length, all on Luzon) and pipelines (357 km for refined oil products) play only a modest role, but there is more than 156,000 km of roads, including 29,000 km paved, 77,000 km loose-surface improved (gravel, crushed stone, or stabilized soil surface), and 50,000 km unimproved earth. Inland waterways, of which there is 3,219 km, are relatively unimportant because of their shallowness. None can accommodate vessels with a draft greater than 1.5 m.

There are 235 usable airports in the country, 71 with permanent-surface runways, and most are on the larger islands such as Luzon and Mindanao. Two, those at Cebu and Manila, are international airports. Many of the smaller islands can only be reached by interisland ferries or small chartered vessels. International shipping uses eight major ports, including Cagayan de Oro, Cebu, Davao, General Santos, Iloilo, Manila, Polillo, and Zambales, out of 452 seaports in the country.

The Philippines has a considerable excess of power-generating capacity relative to present actual production levels, but power costs are relatively high. Generating capacity in 1990 was reportedly 6,755 MW, of which about 50% was from imported crude oil-, natural gas-, and/or coal-fired thermal plants; 35% from hydroelectric plants; and 15% from geothermal plants. The Philippines was the world's second largest producer, after the United States, of geothermal energy. Total power production in the same year was 28 billion kW · h.²⁹

Generally, the infrastructure for mineral industry operations is regarded as adequate for eastern Luzon and on the Islands of Cebu, Marinduque, Negros, and Palawan. Elsewhere, infrastructural development is less than ideal.

OUTLOOK

The slowdown of economic activity in the industrialized countries, particularly in the United States, the Philippines' biggest export market, was expected to have an effect on the Filipino economy. However, the Philippine mining sector was expected to sustain a steady, albeit small, growth in the near term.

Aside from this external factor, the country must continue to manage a number of domestic issues, including a large foreign debt, a widening budget deficit, a shortfall in foreign exchange, and inflation.³⁰

Inflation of up to 20% continued to be a major preoccupation of the Government as year-to-year increases in the consumer price index remained in the double-digit range. However, trade and currency reforms introduced by the Government should put the country's economy on a sounder base. Near yearend, inflation was down to under 10%, international reserves had been strengthened, and real interest rates were falling. The country's external debt, estimated to be \$30 billion, remained at a high level in 1991. The annual debt-service ratio of goods and services exports was estimated to have increased slightly. Economic growth of about 3% was expected for 1992.

Increased exploration and investment, especially for gold, was expected to help keep the Philippine economy stable. In addition, the increased construction activity over the past few years was expected to continue, ensuring a strong domestic minerals demand for cement and construction materials.

¹South-East Asia Mining Letter. V. 4, No. 6, Mar. 27, 1992, p. 7.

²Where necessary, values have been converted from the Philippine peso (P) to U.S. dollars at the rate of P24.06=US\$1.00.

³Metal Bulletin (London). No. 7661, Mar. 2, 1992, p. 7.

⁴_____. No. 7670, Apr. 2, 1992, p. 7.

⁵Chamber of Mines of the Philippines. Mining Investment Opportunities in the Philippines. Mar. 1992, 32 pp.

⁶Mining Journal Research Services. The Philippines: Investment Opportunities for International Mining Companies. Jan. 1992, 226 pp.

⁷U.S. Embassy (Manila, Philippines). State Dep. telegram 24205, Sept. 18, 1991, p. 4.

⁸Metal Bulletin Monthly. Mar. 1991, p. 75.

⁹Australian Journal of Mining (Richmond North, Australia). V. 7, No. 65, Feb. 1992, p. 20.

¹⁰Australian Journal of Mining (Richmond North, Australia). The 1992 AJM Mining Yearbook and Suppliers' Source. V. 7, No. 64, Jan. 1992, p. 16.

¹¹South-East Asia Mining Letter. V. 4, No. 3, Feb. 14, 1992, p. 2.

¹²Page 121 of work cited in footnote 6.

¹³Metal Bulletin (London). No. 7614, Sept. 12, 1991, p. 19.

¹⁴Pages 114 and 120 of work cited in footnote 6.

¹⁵Page 36 of work cited in footnote 9.

¹⁶South-East Asia Mining Letter. V. 3, No. 22, Nov. 22, 1991, p. 3.

¹⁷Mining Journal (London). V. 317, No. 8148, Nov. 15, 1991, p. 357.

¹⁸_____. V. 318, No. 8156, Jan. 17, 1992, p. 42.

¹⁹Metal Bulletin Monthly. Apr. 1992, p. 80.

²⁰Mining Journal (London). V. 317, No. 8135, Aug. 16, 1991, p. 117.

²¹Metal Bulletin (London). No. 7602, July 29, 1991, p. 11.

²²_____. No. 7645, Jan. 6, 1992, p. 11.

²³Pages 105-106 of work cited in footnote 6.

²⁴Metal Bulletin (London). No. 7643, Dec. 23, 1991, p. 9.

²⁵_____. No. 7622, Oct. 10, 1991, p. 10.

²⁶_____. No. 7607, Aug. 15, 1991, p. 5.

²⁷South-East Asia Mining Letter. V. 3, No. 18, Sept. 27, 1991, p. 8.

²⁸American Metal Market. V. 98, No. 104, May 28, 1990, p. 8.

²⁹U.S. Central Intelligence Agency. The World Factbook 1991, p. 251, Washington, DC.

³⁰Pages 9-10 of work cited in footnote 5.

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Mineral News Service and Annual Report.

TABLE 1
PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
METALS					
Arsenic: White (equivalent of arsenic acid)	⁶ 2,286	⁵ 0,046	⁴ 6,652	⁵ 0,092	5,000
Chromium: Chromite, gross weight:					
Metallurgical-grade	69,429	26,168	105,153	61,792	³ 79,000
Chemical-grade	19,899	15,211	18,424	20,240	³ 19,997
Refractory-grade	98,572	87,879	92,985	¹ 103,563	³ 85,013
Total	187,900	124,258	216,562	¹ 185,595	184,010
Copper:					
Mine output, Cu content	216,145	218,089	192,991	182,139	150,000
Metal:					
Smelter	124,700	¹ 59,200	105,000	¹ 110,000	100,000
Refined	132,118	132,183	132,200	¹ 125,938	³ 116,666
Gold, mine output, Au content kilograms	32,599	30,482	29,992	² 24,591	² 24,938
Iron and steel:					
Ferrous alloys, electric-furnace:					
Ferrosilicon	¹ 7,000	⁵ 9,000	⁶ 9,000	⁶ 2,000	18,000
Ferrosilicon ⁴	—	—	9,000	10,000	10,000
Steel, crude ⁵ thousand tons	250	³ 331	300	300	250
Lead: Metal, secondary refined ⁶	7,000	7,000	7,200	7,000	7,000
Manganese ore and concentrate gross weight	421	2,251	3,002	14,583	14,000
Nickel: Mine output, Ni content	7,818	10,349	15,380	15,818	³ 18,400
Silver, mine output, Ag content kilograms	52,374	54,634	50,630	⁴ 47,110	³ 38,414
Zinc, mine output, Zn content	1,129	1,435	1,200	53	100
INDUSTRIAL MINERALS					
Barite	—	349	348	⁵ 00	500
Cement, hydraulic ⁷ thousand tons	³ 3,320	⁴ 4,300	4,000	4,000	4,500
Clays:					
Bentonite	759	2,030	5,961	16,484	7,000
Red ⁸	300	300	350	³ 140	150
White ⁹	7,000	⁴ 4,730	5,000	² 25,849	25,000
Other	406,033	860,012	⁵ 00,000	⁵ 00,000	500,000
Feldspar	11,996	9,199	36,803	46,102	45,000
Gypsum and anhydrite:					
Natural	13,233	2,250	2,000	2,000	2,000
Synthetic ¹⁰	112,000	115,000	115,000	115,000	115,000
Lime	² 0,000	3,924	⁴ 0,000	12,470	10,000
Magnesite	⁶ 50	—	4,796	⁷ 00	700
Perlite ¹¹	5,500	6,900	1,100	³ 1,150	3,000
Phosphate:					
Guano	¹ 0,000	1,470	48,347	888	900
Phosphate rock	⁸ 0,000	8,103	4,139	2,963	4,000
Pyrite and pyrrhotite (including cuprous) gross weight	341,417	379,328	³ 59,155	⁴ 29,604	³ 66,684
Salt, marine	446,532	492,080	488,674	490,407	500,000
Sand and gravel:					
Silica sand thousand tons	213	308	185	292	300
Other ¹² thousand cubic meters	13,943	14,842	15,140	15,673	15,000

See footnotes at end of table.

TABLE 1—Continued
PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
INDUSTRIAL MINERALS—Continued					
Stone:					
Dolomite	*360,000	585,744	*500,000	320,424	350,000
Limestone ⁴ thousand tons	4,022	4,775	3,831	3,837	4,000
Marble (dimension), unfinished ⁵ cubic meters	5,000	5,000	5,000	*6,391	6,000
Volcanic cinder ⁶ do.	1,000	1,500	2,000	2,000	2,000
Tuff	—	47,515	*40,000	79,133	50,000
Quartz ⁷	80,000	*58,603	60,000	60,000	60,000
Crushed, broken, other ⁸ thousand cubic meters	1,000	1,000	1,000	1,000	1,000
Sulfur: S content of pyrite	158,179	*160,000	*195,000	134,316	150,000
Talc	—	27	—	—	—
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades	1,152,342	1,335,687	1,344,676	1,186,531	*1,267,102
Petroleum:					
Crude thousand 42-gallon barrels	1,800	2,170	1,876	1,727	1,500
Refinery products:					
Liquefied petroleum gas ⁹ do.	*2,297	2,500	2,500	2,500	2,500
Gasoline do.	11,824	*12,800	12,600	14,261	14,000
Jet fuel do.	4,144	*4,500	4,420	3,421	3,400
Kerosene ¹⁰ do.	2,500	2,500	3,415	*3,897	3,900
Distillate fuel oil do.	18,404	*19,900	20,806	23,729	24,000
Residual fuel oil do.	20,186	*21,800	22,160	26,428	25,000
Other:					
Naphtha do.	2,448	*2,600	4,367	—	—
White spirit ¹¹ do.	*248	300	200	—	—
Lubricants do.	763	*800	415	* ⁵⁷ (5,647)	* ⁷ (5,500)
Asphalt ¹² do.	*279	300	300	—	—
Refinery fuel and losses ¹³ do.	2,900	3,100	*3,052	*3,071	3,000
Total ¹⁴ do.	65,993	71,000	74,235	82,854	81,300

¹Estimate. ²Revised.

³Table includes data available through June 15, 1992.

⁴In addition to the commodities listed, the Philippines produces Platinum-group metals as byproducts of other metals, but output is not reported quantitatively, and no basis is available to make reliable estimates.

⁵Reported figure.

⁶Includes "pebbles" and "soil" not further described.

⁷Excludes limestone for road construction.

⁸Includes materials described as rock, crushed or broken; stones, cobbles, and boulders; rock aggregates; and broken adobe.

⁹Figure represents all production included under "other refinery products."

TABLE 2
PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Davao Union Cement Corp., 100%	Davao City plant, Mindanao Island	648
Do.	Floro Cement Corp., 100%	Higait plant, Mindanao Island	450
Do.	Iligan Cement Corp., 100%	Iligan City plant, Mindanao Island	420
Do.	Northern Cement Co. Inc., 100%	Sison plant, Luzon Island	640
Do.	Republic Cement Corp., 100%	Norzagaray plant, Luzon Island	950
Do.	Rizal Cement Co. Inc., 100%	Binangonan plant, Luzon Island	964
Chromite	Acoje Mining Co. Inc., operator. Voest Apline AG of Austria, 75.6%, and Merlin Mining NL of Australia, 24.4%	Sanata Cruz Mine, Zambales Province, Luzon	¹ 100
Do.	Alamag Processing Corp., operator. Pacific Shore Mining Co., 50%, and Rio Chico Mining Corp., 50%	Llorente, Eastern Samar Province, Samar Island	² 20
Do.	Benguet Corp., 70%, operator. Consolidated Mines Inc., 30%	Masinloc Chromite Operations, Zambales Province, Luzon Island	³ 105
Coal	Semirara Coal Co. (Government), manager. National Development Corp., 89%; and Development Bank of the Philippines, 11%	Unong Mine, Antique Province, Semirara Island	1,000
Copper and gold	Far Southeast Resources Inc., manager. Lepanto Consolidated Mining Co. Inc., 60%, and CRA Ltd. of Australia, 40%	Far Southeast project, Benguet Province, Luzon	⁴ 54,400
Do.	Marcopper Mining Corp., 60%; and Placer Dome Inc. of Canada, 40%	San Antonio Mine, Marinduque Province, Marinduque Island	⁴ 611,000
Do.	North Davao Mining Corp., manager. Asset Privatization Trust (Government), 100%	Amacan Mine, Davao del Norte Province, Mindanao Island	³ 9,900
Do.	Philex Mining, 100%	Padcal Mine, Benguet Province, Luzon Island.	⁴ 10,200
Copper, gold, silver	Atlas Consolidated Mining and Development Corp., 100%	Cebu Copper Operations, Cebu Province, Cebu Island	⁴ 24,250
Do.	Benguet Corp., 50% operator. Dizon Copper-Silver Mines, Inc., 50%	Dizon Copper-Gold Operation, Zambales Province, Luzon Island	⁴ 6,000
Do.	Lepanto Consolidated Mining Co. Inc., 100%	Mankayan Mine, Benguet Province, Luzon Island	⁴ 71,100
Copper, gold, molybdenum, silver	Maricalum Mining Corp., manager. Asset Privatization Trust (Government), 100%	Sipalay Mine, Negros Occidental Province, Negros Island.	⁴ 6,250
Copper, refined	Philippine Associated Smelting and Refining Corp., operator. National Development Corp. (Government), 42%; Japanese consortium of companies led by Marubeni Corp, 32%; domestic copper producers led by Atlas Consolidated Mining and Development Corp., 21%; and International Finance Corp. (United Nations agency), 5%	Isabel, Leyte Province, Leyte Island	⁴ 138
Ferrochromium	Ferrochrome Philippines Inc., Voest Apline AG of Austria, 100%	Tagoloan plant, Lanao del Norte, Mindanao Island	⁹ 60
Do.	Ferro-Chemicals Inc., 100%	Manticao plant, Misamis Oriental Province, Mindanao Island	⁹ 30

See footnotes at end of table.

TABLE 2—Continued
PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Ferrochromium—Continued:	Intergrated Chrome Corp., 100%	Cagayan de Oro plant, Misamis Oriental Province, Mindanao Island	⁹ 26
Gold and silver	Atlas Consolidated Mining and Development Corp., 100%	Masbate Gold Operations, Masbate Province, Masbate Island	⁴ 1,275
Do.	Benguet Corp., 100%	Benguet Gold Operations, Benguet Province, Luzon Island	⁴ 1,100
Do.	Benguet Corp., 70%, operator. Santa Rosa Mining Co. Ltd., La Sute Mining Corp., et al., 30%	Paracale Gold Operations, Camarines Norte Province, Luzon Island	⁵ 205
Do.	Manila Mining, 75%, Lepanto Consolidated Mining Co. Inc., 25%	Placer Mine, Surigao del Norte Province, Mindanao Island	⁴ 350
Do.	United Paragon Mining Corp., operator. Paragon Resources of Australia, 40%, and public shares, 60%	Longos Mine, Camarines Norte Province, Luzon Island	⁴ 2,200
Gold	Benguet Corp., 100%	Benguet Antamok Gold Operation, Benguet Province, Luzon Island	⁴ 1,275
Do.	Banahaw Mining and Development Corp., operator, 68%, and Muswellbrook Gold Exploration and Mining Ltd. of Australia, 32%	Co-O Mine, Agusan del Sur Province, Mindanao Island	⁴ 210
Do.	Gold Fields Philippines Corp., operator. Rension Goldfields Consolidated of Australia, 100%	Nalesbitan Mine, Camarines Norte Province, Luzon Island	⁴ 250
Do.	Itogon-Suyoc Mines, Inc., operator, 46%, and Benguet Corp., 54%	Itogon Mill, Benguet Province, Luzon Island	¹⁰ 146
Do.	Philex Mining, 100%	Tubao Mine, Benguet Province, Luzon Island	¹¹ 6,220
Do.	do.	Bulawan Mine, Negros Occidental Province, Negros Island	⁴ 1,300
Iron ore, sinter	Philippine Sinter Corp., operator. Kawasaki Steel Corp. of Japan, 100%	Cagayan de Oro, Misamis Oriental Province, Mindanao Island	¹² 5,000
Nickel	Rio Tuba Nickel Mining Corp., operator, 60%, and Japanese interests, 40%	Rio Tuba Mine, Palawan Province, Palawan Island	⁴ 500
Do.	Taganito Mining Corp., 100%	Near Surigao City, Surigao del Norte, Mindanao Island	⁴ 150
Nickel and cobalt	Hitatuan Mining Corp., 100%	Near Surigao City, Surigao del Norte, Mindanao Island	⁴ 100
Do.	Philnico Mining and Industrial Corp., 100%	Nonoc Mine, Surigao del Norte Province, Nonoc Island	⁴ ¹³ 2,000
Nickel and cobalt, refined	Philnico Mining and Industrial Corp., 100%	14Nonoc Refinery, Surigao del Norte Province, Marinduque Island	¹⁵ 31 ¹⁶ 1
Petroleum	Caltex (Philippines) Inc., 100%	Caltex Batangas Refinery, Batangas Province, Luzon Island	¹⁷ 68

See footnotes at end of table.

TABLE 2—Continued
PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Petroleum—Continued:	Petron Corp., operator. Philippine National Oil Co. (Government), 100%	Petron Bataan Refinery, Bataan Province, Luzon Island	¹⁷ 156
Do.	Pilipinas Shell Petroleum Corp., 100%	Shell Batangas Refinery, Batangas Province, Luzon Island	¹⁷ 70
Steel	National Steel Corp., operator. National Development Corp. (Government), 100%	Iligan, Lanao del Norte, Mindanao Island	300

¹Metallurgical-grade concentrates.

²Chemical-grade concentrates.

³Refractor-grade concentrates.

⁴Ore.

⁵Scheduled to start first quarter 1992, replacing the Tapian Mine, which was closed in June 1991 when ore reserves were exhausted.

⁶Scheduled to expand to 1.3 Mmt/a and 1.5 Mmt/a of ore in 1992 and 1993, respectively.

⁷Scheduled to increase to 172,500 mt/a of copper cathode in Oct. 1992.

⁸High-carbon ferrochromium.

⁹Scheduled to replace the nearby Mankayn Mine about 1995. Planned production was being revised upward to 7 to 8 Mmt/a of ore.

¹⁰Mill throughput.

¹¹Kilograms gold.

¹²Self-fluxing sinter.

¹³Scheduled to reopen mid-1992. Has been on care-and-maintenance since Mar. 1986.

¹⁴Operation was suspended in Mar. 1986; undergoing rehabilitation.

¹⁵Refined nickel (powder, briquettes, and mixed nickel-cobalt sulfides.)

¹⁶Refined cobalt.

¹⁷Thousand 42-gallon barrels per day.

TABLE 3
PHILIPPINES: PRODUCTION OF COPPER, BY COMPANY

(Metric tons)

Company	1990	1991
Atlas Consolidated Mining and Development Corp.	73,923	63,412
Maricalum Mining Corp.	33,922	29,018
Marcopper Mining Corp.	18,049	6,533
Benguet Corp.	16,424	14,127
Philex Mining	15,727	14,435
Lepanto Consolidated Mining Co. Inc.	13,487	12,784
North Davao Mining Corp.	10,607	7,858
Total	182,139	148,167

Source: Chamber of Mines of the Philippines.

TABLE 4
PHILIPPINES: PRODUCTION OF GOLD, BY COMPANY

(Kilograms)

Company	1990	1991
Benguet Corp. (primary and byproduct)	7,333	6,189
Atlas Consolidated Mining and Development Corp. (primary and byproduct)	4,324	3,862
Philex Mining Corp. (byproduct)	2,118	2,391
Lepanto Consolidated Mining Co. Inc. (byproduct)	1,868	1,590
Banahaw Mining and Development Corp. (primary)	572	62
United Paragon Mining Corp. (primary)	556	448
Itogon-Suyoc Mines Inc. (primary)	510	523
Marcopper Mining Corp.	454	190
Apex Mining Co. Inc. (primary)	353	35
Manila Mining Corp. (primary)	345	662
Surigao Consolidated Mining Co. (primary)	227	—
North Davao Mining Corp. (byproduct)	212	165
Maricalum Mining Corp. (byproduct)	156	247
Benguet Exploration Inc. (primary and byproduct)	16	—
Small-scale miners and gold panners	*5,547	*8,574
Total	*24,234	*24,938

*Estimated. †Revised.

Source: Chamber of Mines of the Philippines.

TABLE 5
PHILIPPINES: RESERVES OF
MAJOR MINERAL
COMMODITIES FOR 1991¹

(Thousand metric tons)

Commodity	Reserves*
METALS	
Chromite:	31,725
Chemical	3,710
Metallurgical	16,860
Refractory	11,154
Copper	4,180,219
Gold	129,796
Iron:	490,762
Aluminum laterite	292,010
Lump ore	80,732
Magnetic sand	118,020
Lead	6,313
Manganese	1,955
Mercury	16,243
Molybdenum	30,608
Nickel	1,586,928
Zinc	6,163
INDUSTRIAL MINERALS	
Asbestos	24,498
Barite	163
Bauxite	82,650
Clay:	1,126,965
Bentonite	1,385
Diatomaceous earth	3,903
Dolomitic limestone	485,431
Feldspar	29,380
Guano	1,014
Gypsum	1,883
Limestone:	9,556,168
Agricultural	312,949
Magnesite	26,534
Marble	4,058,472
Perlite	18,509
Phosphate rock	2,407
Pumice and pumicite	21,878
Pyrite	983,402
Silica pebbles/cobbles	6,804
Silica rock form	1,750,561
Silica sand	213,873
Sulfur	44,011
Talc	503

*Estimated.

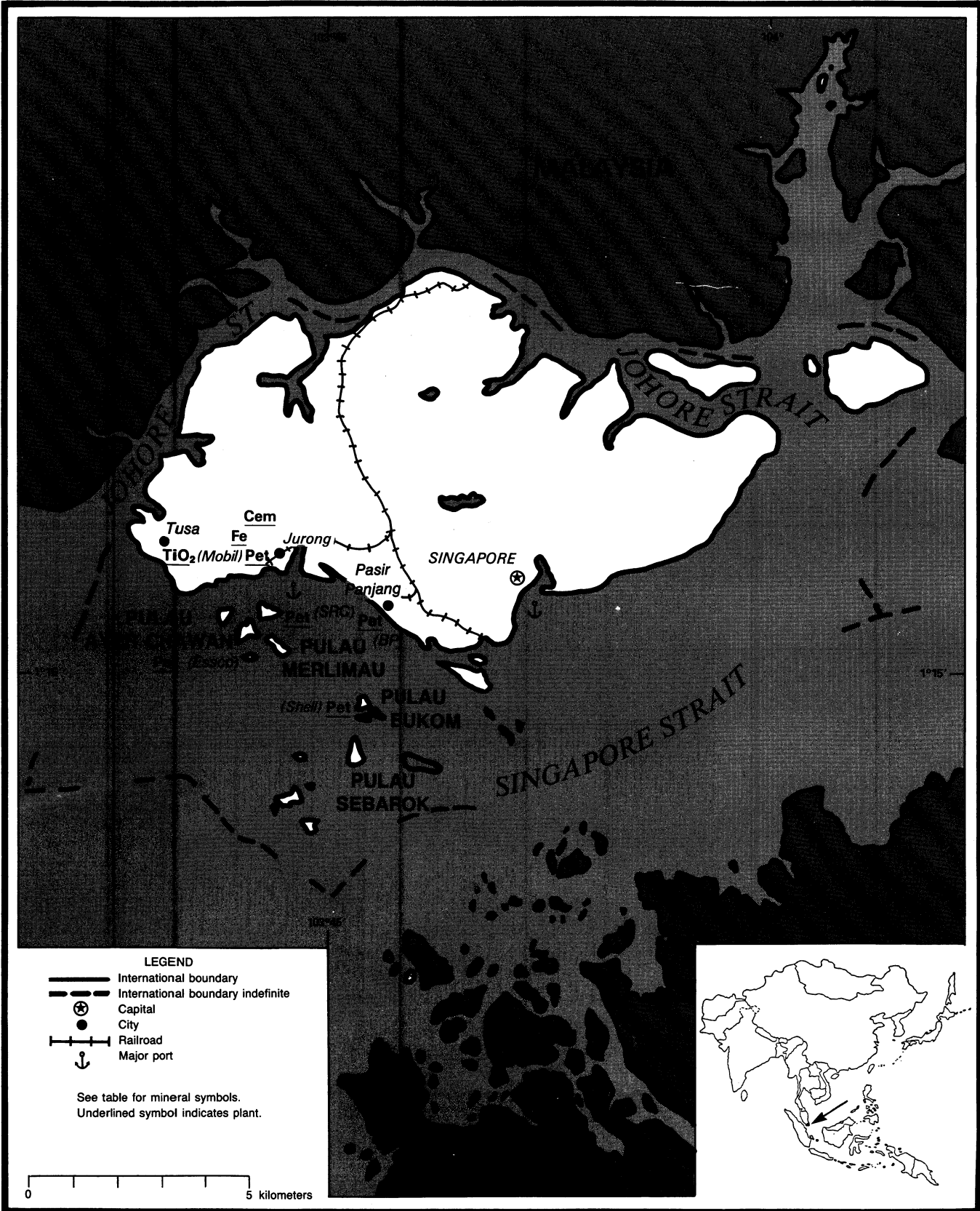
¹As of Dec. 31, 1990.

Source: Mines and Geosciences Bureau.

SINGAPORE

AREA 623 km²

POPULATION 2.8 million



THE MINERAL INDUSTRY OF SINGAPORE

By Pui-Kwan Tse

The Singapore economy continued to slow with a growth rate of 6.7% in 1991 compared with 8.3% growth in 1990 and 9.2% in 1989. The main factors affecting the economy were recession in the Western industrialized countries and the constraint caused by domestic labor. The Singapore economy remains excessively dependent on trade. The value of its total trade was more than three times that of its GDP. Singapore's total value of trade increased to \$125.1 billion¹ in 1991. The value of exports and imports was \$59.0 billion and \$66.1 billion, respectively. The United States continued to be Singapore's largest trade partner, followed by, in descending order, Malaysia, Japan, Hong Kong, Thailand, and Taiwan.

Singapore's unemployment rate was 1.9% in 1991, which in all practical terms denotes that the economy was operating at its full employment. The Government was reluctant to import foreign workers because it believed that these workers could spark social problems and would discourage local industries from moving on to more automated and higher value-added products. Nominal wages rose 9.2% in 1991, slightly lower than 9.3% in the previous year.

Hong Kong has been the financial, transport, and service center for northeast Asia and China for many years. Labor constraints, rising cost, and stiff competition have driven investors to shift much of the labor-intensive production activity to Southeast Asia. Similarly, Singapore was the service center for Indonesia, Malaysia, and Thailand. However, rising labor cost, lower profit margin, strong local currency, and shortage of skilled people have threatened local firms to move some or all operations out of Singapore. In the 1992

budget, the Government proposed to reduce the corporate tax rate from 31% to 30% in an attempt to remain competitive within the region. To stay ahead, the Singapore Government decided to move on new and more sophisticated financial services to replace the traditional ones. This program includes knowledge-intensive services such as financial engineering and financial research and development. To encourage the development of such services in Singapore, the Government proposes to grant a double tax deduction to financial institutions for expenses relating to the establishment and development of approved financial activities.

Due to increasing competition from Malaysian tin producers and a severe shortage of high-grade tin concentrates, Singapore's only tin smelter, Kimetal Ltd., was forced to shut down in 1991. The plant has only a capacity of 11,000 mt/a, but the annual production has rarely reached 5,000 tons. Estimated output was 2,500 tons in 1991. Kimetal's high-grade tin concentrates were mainly received from Africa, Australia, and China. Recently, Kimetal has had difficulties in obtaining tin concentrates from these sources to feed its smelter.

Singapore is the world's third largest refinery center following Rotterdam and Houston. The industry ran at full capacity in 1991 due to the regional demands and as a result of the Gulf war. The five major refiners, BP, Caltex, Esso, Mobil, and Shell, reached a new record production estimated to be worth \$1.08 billion in 1991, up 10% from the previous year.

Mobil Corp. will invest \$600 million to install new refinery units at its 235,000 bb1/d Singapore operation. Construction will consist of a continuous catalytic reformer (CCR) and an aromatics plant.

These units are expected to place on-stream in the third quarter of 1993. The CCR will boost Mobil's gasoline production by 17,000 bb1/d. The aromatics plant will produce 575,000 mt/a of paraffins, which are used in the production of polyester, nylon, and polystyrene.

Shell Singapore will invest about \$59 million each year for the next 5 years to upgrade its facilities on Bukon Island. Shell plans to automate the more labor-intensive operation in its primary and secondary refining units and to improve the information system between manufacturing and planning to accelerate decisionmaking.

Singapore remains the largest container port in the world. To retain its title as the world leader, the second phase of Oiltanking's Tank Terminal was completed. The terminal's container capacity increased from 158,000 cm to 408,000 cm. A new jetty for vessels up to 80,000 dwt was also completed. The construction of a third-phase terminal expansion began in July 1991. After completion, the terminal will have a total capacity of 600,000 cm.

¹Where necessary, values have been converted from Singapore dollars (S\$) to U.S. dollars at the rate of S\$1.7=US\$1.00 in 1991.

OTHER SOURCES OF INFORMATION

Publications

Department of Statistics, Singapore:
Monthly Digest of Statistics, monthly.

Economic Development Board, Singapore:
Report on the Census of Industrial
Production, annually.

TABLE 1
SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	3	—		
Aluminum:				
Ore and concentrate	9	224	—	India 200; Malaysia 14.
Oxides and hydroxides	29,300	20,581	—	Malaysia 9,564; Thailand 4,005.
Metal including alloys:				
Scrap	21,779	20,576	—	Japan 14,376; Malaysia 4,166; Republic of Korea 589.
Unwrought	65,907	21,819	—	Malaysia 11,656; Republic of Korea 2,589; Taiwan 1,785.
Semimanufactures	11,723	24,163	124	China 11,891; Malaysia 2,249; Australia 2,028.
Cadmium: Metal including alloys, all forms	5	6	—	India 5; Thailand 1.
Chromium:				
Ore and concentrate	633	3,359	20	Malaysia 1,005; Australia 272; unspecified Africa 1,718.
Oxides and hydroxides	62	94	—	Malaysia 57; Thailand 29.
Cobalt:				
Oxides and hydroxides	17	26	—	Republic of Korea 10; Thailand 7.
Metal including alloys, all forms	16	(^c)	—	All to India.
Columbium and tantalum: Metal including alloys, all forms, tantalum kilograms	50	—		
Copper:				
Ore and concentrate	65	54	—	Malaysia 34; Thailand 20.
Matte and speiss including cement copper	298	64	—	China 40; Malaysia 23.
Metal including alloys:				
Scrap	40,426	38,734	—	Japan 15,006; India 11,495; Republic of Korea 6,090.
Unwrought	53,903	41,881	—	Malaysia 22,924; Taiwan 6,935; Thailand 3,705.
Semimanufactures	24,508	24,051	26	Malaysia 11,598; Thailand 3,993; India 2,733.
Gold:				
Waste and sweepings kilograms	1,697	1,319	173	Japan 857; West Germany 170.
Metal including alloys, unwrought and partly wrought do.	5,176	20,099	115	Sri Lanka 11,056; Malaysia 4,379.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	132	167	27	Malaysia 140.
Metal:				
Scrap	238,193	299,835	36	Malaysia 203,693; Thailand 30,020.
Pig iron, cast iron, related materials	1,099	6,796	—	Malaysia 6,170; Thailand 188.
Ferrous alloys:				
Ferromanganese	5,610	2,868	—	Malaysia 2,728; India 100.
Ferrosilicon	\$2,589	6,328	1	Malaysia 3,545; India 1,530; Republic of Korea 1,087.
Unspecified	285	155	—	Malaysia 89; Taiwan 49; Thailand 16.
Steel, primary forms	1,786	3,070	—	Burma 1,988; Malaysia 368.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	166,817	114,810	93	Malaysia 97,638; Thailand 4,453; Sri Lanka 3,357.

See footnotes at end of table.

TABLE 1—Continued
SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued:				
Semimanufactures—Continued:				
Flat-rolled products—Continued:				
Of iron or nonalloy steel—Continued:				
Clad, plated, coated	52,500	72,549	110	Malaysia 31,000; Burma 12,969; Papua New Guinea 11,064.
Of alloy steel	13,804	12,536	112	Malaysia 7,411; Hong Kong 978; Philippines 660.
Bars, rods, angles, shapes, sections	294,226	289,208	1,213	Thailand 109,062; Malaysia 69,445; Brunei 28,279.
Rails and accessories	2,174	4,514	12	Malaysia 3,176; Japan 730; Thailand 474.
Wire	10,262	12,334	3	Thailand 4,574; Malaysia 2,940; Hong Kong 903.
Tubes, pipes, fittings	139,354	133,074	17,367	Malaysia 46,820; Brunei 11,947.
Lead:				
Ore and concentrate	7	76	—	Malaysia 56; India 20.
Oxides	403	288	—	Malaysia 114; Sri Lanka 76; Australia 35.
Metal including alloys:				
Scrap	7,535	5,202	—	Thailand 2,456; India 1,483.
Unwrought	7,494	16,863	—	India 6,403; Malaysia 4,043; Republic of Korea 1,697.
Semimanufactures	757	2,636	1	Malaysia 2,428; Thailand 73.
Magnesium: Metal including alloys, all forms				
	71	38	—	Japan 15; North Korea 7; Brunei 5.
Manganese:				
Ore and concentrate, metallurgical	9,598	9,696	—	Kenya 3,149; Philippines 2,558; India 1,153.
Oxides	9,352	11,239	—	Republic of Korea 3,494; Pakistan 1,497; India 1,232.
Mercury	6	7	(^c)	Papua New Guinea 1; unspecified Africa 6.
Molybdenum: Metal including alloys, all forms				
	12	(^c)	—	All to Malaysia.
Nickel:				
Ore and concentrate	31	51	—	Malaysia 25; Thailand 14.
Matte and speiss	1,314	1,667	—	India 1,526; Malaysia 126.
Metal including alloys:				
Scrap	140	174	78	Japan 73; United Kingdom 18.
Unwrought	5,521	633	—	Taiwan 191; Thailand 154; Hong Kong 93.
Platinum-group metals: Metals including alloys, unwrought and partly wrought				
value, thousands	\$345	\$675	—	Malaysia \$368; Japan \$80; France \$53.
Semimanufactures	760	1,457	(^c)	Malaysia 886; Thailand 173; Hong Kong 94.
Selenium: Elemental^f				
	541	671	—	India 417; Malaysia 147; Thailand 31.
Silver:				
Ore and concentrate ^g	3	105	—	India 74; Japan 31.
Waste and sweepings ^g kilograms	4,314	—		
Metal including alloys, unwrought and partly wrought				
value, thousands	\$22,236	\$23,436	\$4	India \$15,903; Thailand \$4,541.

See footnotes at end of table.

TABLE 1—Continued
SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Tin—Continued:				
Metal including alloys—Continued:				
Ore and concentrate	3,259	1,297	—	Malaysia 633; United Arab Emirates 274.
Ash and residue containing tin	544	NA		
Metal including alloys:				
Scrap	471	277	16	Taiwan 139; Malaysia 99.
Unwrought	27,954	26,826	5,260	Japan 10,634; Netherlands 2,390; Italy 2,082.
Semimanufactures	1,617	907	1	Hong Kong 431; Malaysia 284; India 45.
Titanium:				
Oxides	3,452	1,542	—	Malaysia 608; China 211; India 173.
Metal including alloys, all forms	32	61	40	India 10; Malaysia 10.
Tungsten:				
Ore and concentrate	614	707	59	West Germany 279; India 228.
Metal including alloys, all forms	119	23	18	Philippines 4; Thailand 1.
Uranium and thorium: Ore and concentrate value, thousands				
	\$268	\$641	\$630	Malaysia \$11.
Zinc:				
Ore and concentrate	201	283	—	India 180; Malaysia 103.
Oxides	1,631	1,439	—	Japan 864; Malaysia 159; Pakistan 131.
Blue powder	744	NA		
Metal including alloys:				
Scrap	2,366	1,360	—	Taiwan 548; India 383; Philippines 253.
Unwrought	40,378	22,542	—	India 11,635; Malaysia 3,878; Taiwan 3,449.
Semimanufactures	548	1,706	—	Malaysia 327; Pakistan 299; Thailand 268.
Zirconium: Metal including alloys all forms	20	26	—	All to Japan.
Other:				
Ores and concentrates	2,116	—		
Ashes and residues	64,598	65,099	—	Malaysia 28,461; United Arab Emirates 8,254; Brunei 7,097.
Base metals including alloys, all forms	863	338	(^c)	India 247; Netherlands 48; United Kingdom 24.
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,437	—		
Artificial: Corundum kilograms	117	75,000	—	All to Malaysia.
Dust and powder of precious and semi-precious stones including diamond value, thousands				
	\$1,268	\$268	—	United Kingdom \$125; Brazil \$68.
Grinding and polishing wheels and stones	797	1,396	1	Malaysia 1,043; Thailand 164; Bangladesh 87.
Asbestos, crude	250	2,177	—	Thailand 1,101; Maldives 499; China 339.
Barite and witherite	8,401	18,555	—	Papua New Guinea 4,698; Brunei 3,451; Burma 3,010.
Boron materials:				
Crude natural borates	235	204	—	Malaysia 155; Papua New Guinea 40.
Oxides and acids	79	82	—	Malaysia 80.
Cement	135,805	270,822	—	Malaysia 172,658; Papua New Guinea 45,510; Brunei 16,069.

See footnotes at end of table.

TABLE 1—Continued
SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS					
Chalk	2,197	1,533	24	Brunei 710; Bangladesh 294; Malaysia 279.	
Clays, crude	33,434	34,746	—	Malaysia 10,126; Republic of Korea 5,448; Thailand 4,731.	
Diamond:					
Gem, not set or strung	value, thousands	\$34,661	\$54,471	\$5,633	Belgium-Luxembourg \$12,198; Japan \$11,622; Hong Kong \$5,860.
Industrial stones	do.	11,290	999	595	Japan 126; Mauritius 85.
Diatomite and other infusorial earth		543	765	—	Malaysia 385; Thailand 145; Papua New Guinea 114.
Feldspar, fluorspar, related materials		7,950	7,515	—	Malaysia 6,716; Thailand 794.
Fertilizer materials:					
Crude, n.e.s.		23,461	15,476	—	Malaysia 14,808; Papua New Guinea 600.
Manufactured:					
Ammonia		414	83	—	Malaysia 51; Hong Kong 11.
Nitrogenous		18,278	24,906	—	Taiwan 12,229; Tanzania 6,713; Papua New Guinea 2,276.
Phosphatic		6,340	2,791	—	Malaysia 1,597; Papua New Guinea 694; Thailand 500.
Potassic		119,217	118,975	—	Sri Lanka 57,299; India 11,358; Hong Kong 10,048.
Unspecified and mixed		35,329	26,181	—	Malaysia 19,503; Hong Kong 2,003; Australia 1,842.
Graphite, natural		74	221	—	Sri Lanka 100; Malaysia 84.
Gypsum and plaster		9,215	4,934	—	Malaysia 3,358; Thailand 638; Brunei 351.
Iodine including bromine and fluorine	kilograms	2,380	8,000	—	Philippines 3,000; Brunei 2,000; Malaysia 2,000.
Lime		19,274	26,846	—	Papua New Guinea 25,459; Brunei 921.
Magnesium compounds: Magnesite, crude including calcined		337	1,002	—	Malaysia 660; Qatar 300.
Mica:					
Crude including splittings and waste		350	282	—	Malaysia 116; Thailand 38; Brunei 21.
Worked including agglomerated splittings		46	19	—	Republic of Korea 8; Malaysia 5; Thailand 4.
Nitrates, crude		165	266	—	Burma 83; Taiwan 78; Philippines 55.
Phosphates, crude		163	5,347	—	Malaysia 3,251; Philippines 2,000.
Pigments, mineral: Iron oxides and hydroxides, processed		902	1,484	—	Malaysia 1,013; Taiwan 157; Burma 116.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	\$28,669	\$33,751	\$2,173	Thailand \$15,705; Switzerland \$7,903.
Synthetic	do.	871	1,195	224	Thailand 297; Hong Kong 294.
Pyrite, unroasted		2			
Salt and brine		18,170	7,016,566	—	Malaysia 7,012,320; India 705.
Sodium compounds, n.e.s.: Sulfate, manufactured		11,889	10,777	—	Malaysia 8,299; Taiwan 2,269.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		770	1,160	15	Malaysia 676; Japan 114; Bangladesh 75.
Worked		7,194	8,087	605	Malaysia 3,193; Brunei 1,464; Taiwan 1,007.
Dolomite, chiefly refractory-grade		202	122	—	Brunei 120.
Gravel and crushed rock		7,579	3,876	—	Malaysia 3,358; Thailand 296.

See footnotes at end of table.

TABLE 1—Continued
SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued:				
Dimension stone—Continued:				
Limestone other than dimension	187	134	—	Malaysia 128; Brunei 5.
Quartz and quartzite	51	2	—	All to Malaysia.
Sand other than metal-bearing	68,872	9,232	—	Japan 4,700; Malaysia 2,476; Australia 1,613.
Sulfur:				
Elemental:				
Crude including native and byproduct	21,342	35,720	—	Thailand 20,955; Malaysia 11,071.
Colloidal, precipitated, sublimed	11,718	19,981	—	Malaysia 7,928; North Korea 4,357; Thailand 4,005.
Sulfuric acid	1,306	1,063	—	Malaysia 555; Papua New Guinea 167.
Talc, steatite, soapstone, pyrophyllite	1,890	1,345	—	Malaysia 710; Philippines 407; Taiwan 216.
Other:				
Crude	11,429	14,782	—	Sri Lanka 9,700; Philippines 2,015; Malaysia 1,119.
Slag and dross, not metal-bearing	35,535	26,052	2	Malaysia 19,771; Japan 5,810.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	15,381	13,876	—	Malaysia 12,524; India 913.
Carbon:				
Carbon black	5,072	7,209	594	Australia 2,237; Malaysia 500; North Korea 500.
Gas carbon	162	NA		
Coal, all grades including briquets	322	13,446	—	Thailand 12,699; Australia 398.
Coke and semicoke	14,845	21,702	—	Malaysia 15,562; Thailand 4,894.
Gas, natural: Liquefied	29,841	418,085	—	Malaysia 278,665; Thailand 61,457; Hong Kong 40,489.
Peat including briquets and litter	21	15	—	Malaysia 11; Brunei 4.
Petroleum:				
Crude	thousand 42-gallon barrels	(²)	(²)	— All to Malaysia.
Partly refined	do.	1,354	NA	
Refinery products:				
Liquefied petroleum gas	do.	3,222	—	
Gasoline:				
Aviation	do.	42,444	52,694	1,385 Japan 22,523; Hong Kong 11,670.
Motor	do.	31,713	60,596	156 Japan 20,157; Malaysia 11,516; Taiwan 9,177.
Naphtha (including white spirits)	do.	21,302	NA	
Kerosene and jet fuel	do.	9,283	8,782	— Hong Kong 2,936; Bangladesh 1,172; India 994.
Mineral jelly and wax	do.	189	171	— India 54; Madagascar 21; unspecified Africa 60.
Distillate fuel oil	do.	75,391	81,358	196 Thailand 34,910; Hong Kong 13,166; Malaysia 10,250.
Lubricants	do.	5,183	5,697	(³) Malaysia 1,323; Thailand 1,179; Taiwan 606.
Residual fuel oil	do.	134,170	126	— Hong Kong 104; Nauru 16.
Bitumen and other residues	do.	2,325	2,759	— Malaysia 669; Australia 379; Taiwan 339.
Bituminous mixtures	do.	19	22	— Malaysia 15; Burma 6.
Petroleum coke	do.	6	6	— Malaysia 3; Australia 2.

NA Not available.

¹Table prepared by Audrey D. Willms.

²Unreported quantity valued at \$2,000.

³Less than 1/2 unit.

⁴Unreported quantity valued at \$4,000.

⁵Includes tellurium and phosphorus.

⁶May include other precious metals.

⁷Includes fuel oil for aircraft and ships.

TABLE 2
SINGAPORE: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	13	—		
Aluminium:				
Ore and concentrate	111	224	—	Brazil 200; Mozambique 20.
Oxides and hydroxides	70,188	63,684	178	Australia 54,617; Japan 8,106; China 446.
Metal including alloys:				
Scrap	4,452	3,347	79	Malaysia 2,289; Brunei 250.
Unwrought	38,576	46,123	3,501	Australia 10,984; India 8,911; Bahrain 6,431.
Semimanufactures	43,585	50,464	1,814	Malaysia 8,640; Taiwan 8,523; Japan 8,442.
Beryllium: Metal including alloys, all forms	3	—		
Cadmium: Metal including alloys, all forms	21	25	1	Australia 19; Mexico 5.
Chromium:				
Ore and concentrate	7,010	1,072	—	Mozambique 775; Japan 276.
Oxides and hydroxides	318	396	208	United Kingdom 93; Japan 22.
Cobalt:				
Ore and concentrate	—	19	—	Mainly from Japan.
Oxides and hydroxides	21	28	—	Canada 19; Finland 4.
Metal including alloys, all forms	35	25	(²)	Mainly from Netherlands.
Columbium and tantalum: Tantalum metal including alloys, all forms	4	44	—	Japan 43.
Copper:				
Ore and concentrate	6	—		
Matte and speiss including cement copper	10	60	(²)	Malaysia 33; Australia 15.
Metal including alloys:				
Scrap	12,646	45,826	25,572	Malaysia 13,007; Australia 1,451.
Unwrought	55,594	65,984	4,769	Chile 21,831; Zambia 15,209.
Semimanufactures	78,385	72,374	725	Japan 21,501; Malaysia 20,703; Taiwan 11,910.
Gold:				
Waste and sweepings value, thousands	\$3,081	\$5,236	\$2	Malaysia \$863; Hong Kong \$745.
Metal including alloys, unwrought and partly wrought kilograms	7,903	11,857	1,200	Japan 7,023; Republic of Korea 2,300.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	1,036	4,565	907	Malaysia 3,508; India 150.
Metal:				
Scrap	196,577	220,865	55,303	Malaysia 45,750; United Kingdom 44,601.
Pig iron, cast iron, related materials	182,690	95,762	91	Brazil 32,865; Iran 24,618; Malaysia 19,421.
Ferroalloys:				
Ferromanganese	3,876	2,401	—	China 1,390; Australia 181; Japan 159.
Ferrosilicon	11,995	9,611	118	China 6,719; Hong Kong 1,100; Australia 496.
Unspecified	330	375	43	Malaysia 103; United Kingdom 60.
Steel, primary forms	260,654	164,922	107	Brazil 65,033; Turkey 54,546; Netherlands 14,989

See footnotes at end of table.

TABLE 2—Continued
SINGAPORE: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
METALS—Continued					
Iron and steel—Continued:					
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated	thousand tons	977	932	3	Japan 368; Brazil 151; Republic of Korea 120.
Clad, plated, coated	do.	190	180	2	Japan 110; Australia 25; Republic of Korea 21.
Of alloy steel	do.	79	118	2	Japan 45; Romania 34.
Bars, rods, angles, shapes, sections	do.	479	634	20	Malaysia 127; Japan 94; Belgium-Luxembourg 67.
Rails and accessories	do.	4	8	(²)	Republic of Korea 4; China 1.
Wire	do.	35	40	(²)	China 14; Republic of Korea 5.
Tubes, pipes, fittings	do.	377	550	24	Japan 263; United Kingdom 34; West Germany 30.
Lead:					
Ore and concentrate		21	—		
Oxides		458	471	1	West Germany 129; United Kingdom 111.
Metal including alloys:					
Scrap		4,387	3,038	33	Malaysia 2,398; Brunei 417.
Unwrought		12,247	37,169	12,194	China 8,029; Canada 4,353; Australia 2,822.
Semimanufactures		1,400	1,557	66	Australia 433; Japan 296; Canada 268.
Magnesium: Metal including alloys:					
Scrap		—	3	1	United Arab Emirates 2.
Unwrought		91	59	33	Australia 12; France 4.
Semimanufactures		190			
Manganese:					
Ore and concentrate		26,180	80,014	—	Gabon 70,253; Ghana 9,500.
Oxides		4,295	7,287	—	Brazil 3,312; Japan 2,591.
Mercury		151	19	1	China 7; Japan 4; France 3.
Molybdenum: Metal including alloys, all forms		164	(²)	(²)	
Nickel:					
Ore and concentrate		11	—		
Matte and speiss		1,106	1,423	—	Canada 1,422; Australia 1.
Metal including alloys:					
Scrap		185	277	30	Malaysia 158; Netherlands 55.
Unwrought		3,355	672	3	U.S.S.R. 214; Canada 194; Netherlands 100.
Semimanufactures		1,000	2,304	265	Japan 965; Canada 314; Norway 169.
Platinum-group metals:					
Waste and sweepings ^d	kilograms	5,775	3,182	(²)	Malaysia 2,841; United Arab Emirates 253.
Metals including alloys, unwrought and partly wrought	value, thousands	\$4,552	\$5,996	\$69	West Germany \$3,048; United Kingdom \$935.
Selenium: Elemental ^e		826	1,885	39	China 1,139; Hong Kong 436.
Silver:					
Ore and concentrate		1	1	1	
Metal including alloys, unwrought and partly wrought	value, thousands	\$89,504	\$167,947	\$10,246	Belgium-Luxembourg \$36,421; West Germany \$18,203.

See footnotes at end of table.

TABLE 2—Continued
SINGAPORE: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Tin:				
Ore and concentrate	3,831	4,210	—	Thailand 2,700; West Germany 507.
Ash and residue containing tin	2,085	NA		
Metal including alloys:				
Scrap	510	365	20	Malaysia 258; United Kingdom 86.
Unwrought	2,506	3,835	8	Malaysia 1,334; Thailand 1,195.
Semimanufactures	2,684	2,537	123	Japan 1,501; Malaysia 391; Hong Kong 363.
Titanium:				
Oxides	14,976	5,784	326	Australia 1,699; Japan 1,632.
Metal including alloys, all forms	154	2	(^o)	United Kingdom 1; United Arab Emirates 1.
Tungsten:				
Ore and concentrate	685	976	(^o)	Burma 701; Taiwan 230.
Metal including alloys, all forms	155	41	34	Thailand 3; China 2.
Uranium and thorium: Ores and concentrates				
value, thousands	—	\$6	—	All from Thailand.
Zinc:				
Ore and concentrate	162	59	1	Australia 58.
Oxides	2,337	2,186	47	China 785; India 212.
Blue powder	2,085	NA		
Metal including alloys:				
Scrap	737	547	—	Malaysia 485; Hong Kong 21.
Unwrought	52,520	56,188	3	United Kingdom 21,321; Australia 11,875.
Semimanufactures	378	2,824	536	Norway 858; Republic of Korea 638.
Zirconium: Metal including alloys, all forms	—	170	—	All from Hong Kong.
Other:				
Ores and concentrates	38,360	28,181	48	Japan 16,413; Australia 8,370.
Ashes and residues	243,560	373,197	4	Japan 268,897; Philippines 96,699.
Base metals including alloys, all forms	1,032	883	6	Australia 500; Hong Kong 179; China 163.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.				
value, thousands	\$2,264	\$2,048	\$284	Japan \$1,085; India \$471.
Artificial: Corundum				
	45	81	(^o)	Mainly from China.
Dust and powder of precious and semi-precious stones including diamond				
value, thousands	\$861	\$518	\$114	Japan \$161; Ireland \$90.
Grinding and polishing wheels and stones	6,975	4,989	75	China 2,019; Japan 860; Taiwan 633.
Asbestos, crude	1,733	4,737	100	Malaysia 688; Canada 181; unspecified Africa 3,029.
Barite and witherite	10,056	30,830	—	China 17,154; Thailand 11,449.
Boron materials:				
Crude natural borates	(^o)	182	38	Chile 140; Malaysia 4.
Oxides and acids	493	583	130	Italy 365; China 48.

See footnotes at end of table.

TABLE 2—Continued
SINGAPORE: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Cement	thousand tons	1,526	2,121	(²)	Japan 883; Malaysia 501; Jordan 403.
Chalk		2,344	4,408	—	Taiwan 3,016; Australia 621.
Clays, crude:					
Bentonite		27,750	54,713	46,017	India 5,664; China 1,220; United Kingdom 1,165.
Fuller's earth		4,531	NA		
Unspecified		25,461	36,984	24,204	Australia 2,794; United Kingdom 2,334; Mozambique 2,037.
Diamond: Natural:					
Gem, not set or strung	value, thousands	\$81,823	\$132,740	\$15,928	India \$33,142; Israel \$25,154; Belgium-Luxembourg \$24,580.
Industrial stones	do.	\$4,279	\$12,814	\$793	U.S.S.R. \$6,133; Israel \$2,545.
Diatomite and other infusorial earth		1,645	1,937	1,753	Philippines 70; Malaysia 30.
Feldspar, fluorspar, related materials		13,385	20,885	15	Japan 5,510; Norway 5,000.
Fertilizer materials:					
Crude, n.e.s.		377	686	53	Italy 220; Malaysia 189.
Manufactured:					
Ammonia		2,160	2,318	11	Malaysia 1,996; Netherlands 94.
Nitrogenous		21,920	19,763	165	Canada 12,692; Malaysia 2,196.
Phosphatic		1,545	1,323	—	China 1,300; Malaysia 23.
Potassic		81,604	119,565	15	Canada 68,457; West Germany 26,919; Jordan 23,500.
Unspecified and mixed		34,709	47,114	829	West Germany 19,703; Norway 8,602.
Graphite, natural		715	994	19	Japan 376; China 315; Switzerland 127.
Gypsum and plaster		51,702	67,932	668	Thailand 45,896; Australia 17,448.
Iodine including bromine and flourine		26	37	1	New Zealand 29; West Germany 3.
Lime		15,957	18,929	—	Malaysia 16,642; China 1,200; United Kingdom 663.
Magnesium compounds: Magnesite, crude including calcined		25,020	16,000	121	China 14,977; Norway 450.
Mica:					
Crude including splittings and waste		951	1,347	31	India 919; China 305.
Worked including agglomerated splittings		398	743	—	United Kingdom 681; Japan 37.
Nitrates, crude		2,204	2,546	12	Belgium-Luxembourg 902; West Germany 798.
Phosphates, crude		725	10,197	9,500	Malaysia 514; China 109.
Pigments, mineral: Iron oxides and hydroxides, processed		8,806	9,602	748	Japan 3,809; China 1,355; West Germany 1,137.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	\$11,764	\$10,952	\$1,431	Thailand \$2,533; China \$1,165; Hong Kong \$1,078.
Synthetic	do.	\$4,721	\$2,770	\$202	Japan \$598; U.S.S.R. \$510; China \$362.
Salt and brine		67,459	87,354	79	Australia 39,380; United Kingdom 22,164.
Sodium compounds, n.e.s.: Sulfate manufactured		17,289	30,146	90	China 28,019; Taiwan 936.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		27,926	20,190	22	Malaysia 12,817; China 3,061.

See footnotes at end of table.

TABLE 2—Continued
SINGAPORE: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued:				
Stone, Sand and gravel—Continued:				
Dimension stone—Continued:				
Worked	57,627	67,918	243	Italy 31,440; China 12,857.
Dolomite, chiefly refractory-grade	1,223	740	—	Taiwan 520; France 121; Thailand 50.
Gravel and crushed rock	164,395	125,459	334	Malaysia 122,260; Philippines 1,045.
Limestone other than dimension	46,262	20,109	—	Malaysia 20,101; China 8.
Quartz and quartzite	298	460	229	India 109; China 70.
Sand other than metal-bearing thousand tons	943	1,049	33	Malaysia 946; Australia 56.
Sulfur:				
Elemental:				
Crude including native and byproduct	174	233	14	China 70; Republic of Korea 62.
Colloidal, precipitated, sublimed	127	195	3	China 73; Poland 72.
Sulfuric acid	744	1,266	629	Malaysia 349; West Germany 252.
Talc, steatite, soapstone, pyrophyllite	6,508	6,108	1,218	China 2,464; Norway 901; Japan 669.
Other:				
Crude	59,363	51,919	41	West Germany 49,375; Mozambique 440.
Slag and dross, not metal-bearing	70,435	37,733	(²)	Taiwan 20,616; Japan 14,532.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	1,427	2,192	877	United Kingdom 443; Japan 381; Malaysia 223.
Carbon black	3,705	4,573	787	China 1,539; Malaysia 585; Taiwan 471.
Coal, all grades including briquets	2,112	2,736	2,242	Australia 222; United Kingdom 78.
Coke and semicoke	33,008	52,747	38	Taiwan 16,688; Japan 16,551.
Peat including briquets and litter	115	110	—	United Kingdom 38; Ireland 23; Malaysia 22.
Petroleum:				
Crude thousand 42-gallon barrels	273,146	317,350	—	Saudi Arabia 116,652; United Arab Emirates 63,311; Malaysia 39,305.
Partly refined do.	4,360	NA		
Refinery products:				
Liquefied petroleum gas do.	143	33	(²)	Norway 30.
Gasoline:				
Aviation do.	901	1,915	100	Italy 736; Hong Kong 368.
Motor do.	24,406	3,522	—	Malaysia 980; Kuwait 628; Bahrain 467.
Naptha (including white spirits) do.	4,688	NA		
Kerosene and jet fuel do.	1,644	713	(²)	Malaysia 407; Saudi Arabia 196.
Mineral jelly and wax do.	193	224	2	China 203; Japan 7.
Distillate fuel oil do.	12,874	6,180	309	Israel 37,415; Saudi Arabia 1,566.
Lubricants do.	1,190	272	190	Australia 1,377; Japan 291.
Residual fuel oil do.	536	63	(²)	Mainly from U.S.S.R.
Bitumen and other residues do.	2	3	(²)	Japan 2; Malaysia 1.
Bituminous mixtures do.	12	21	3	Malaysia 5; United Kingdom 4.
Petroleum coke do.	59	77	73	West Germany 4.

NA Not available.

¹Table prepared by Ronald L. Hatch and Audrey D. Wilkes.

²Less than 1/2 unit.

³Unreported quantity valued at \$7,000; imported from the United States.

⁴May include other precious metals.

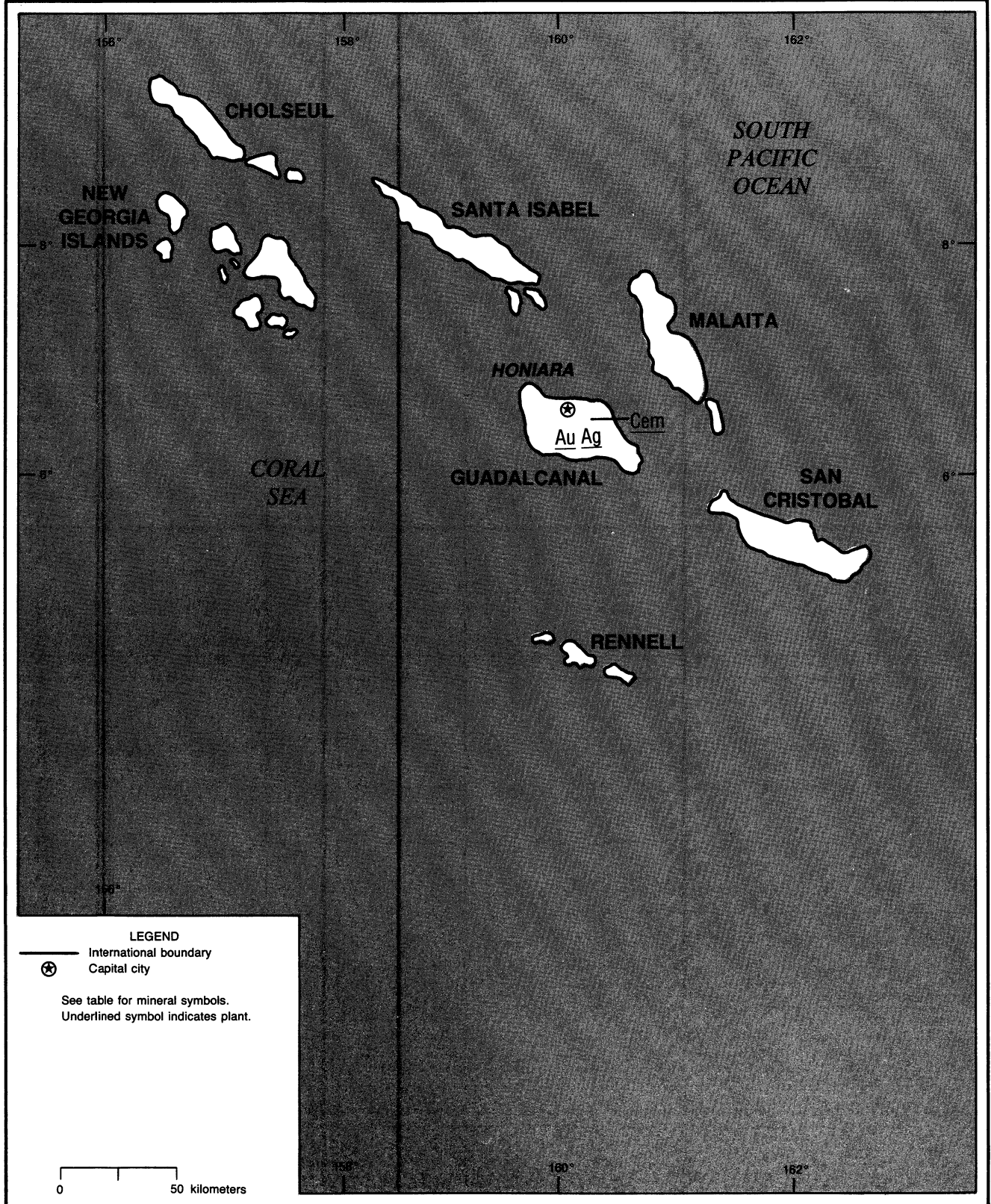
⁵Includes tellurium and phosphorus.

⁶Excludes unreported quantity valued at \$598,095,000.

SOLOMON ISLANDS

AREA 28,450 km²

POPULATION 347,000



THE MINERAL INDUSTRY OF THE SOLOMON ISLANDS

By Travis Q. Lyday

Mineral production in the Solomons remained restricted to minor amounts of construction materials used domestically and small quantities of alluvial gold with contained silver, which was exported.

Although the Solomon Archipelago was named in the 16th century for the legendary gold mines of King Solomon, the Melanesian state has had only minor gold production. The operation at Mavu, on the Chovohio River 30 km southeast of the capital city of Honiara on Guadalcanal Island, was granted a mining lease by the Government in 1985 to the Australian firm Zanex Ltd. (70%) in joint venture with the local firm Mavu Gold Development Ltd. (30%). Mining began in November of that year, with a recovery plant opening in early 1986. The operation was closed in 1987 owing to destruction caused by a tropical cyclone and internal company problems. The joint venture produced a total of 40 kg of gold.

Arimco (Solomon Islands) Ltd., a 50-50 joint venture of Australia's Arimco NL and Cyprus Minerals Ltd. of the United States, deferred development of its planned openpit gold mine near Gold Ridge, 25 km from Honiara, pending the results of a feasibility study. Gold production was expected to start in early 1992 at a rate of 350,000 mt/a of ore, producing about 1,000 kg/a of gold. Identified reserves were 1.34 Mmt of ore grading 3.86 g/mt.¹

Although the mine at Gold Ridge will be small by world standards, it will have a significant role in the economic development of the Solomon Islands. Currently, the mining sector contributes less than 1% to the country's export earnings. Export earnings from gold produced at the Gold Ridge Mine are expected to increase the sector's share to become the country's third largest, after fishing and forestry, and accounting for about 15% of the total.²

Most of the country's land mass was covered by applications for prospecting licenses or by issued licenses. However, with the development of Gold Ridge, exploration interest and expenditures were expected to increase substantially, boosting chances of new gold discoveries.

Essential elements of the transportation infrastructure include about 2,100 km of roads, including 30 km sealed, 290 km of gravel, 980 km of earth, and 800 km of private logging and plantation roads of varied construction. There are 2 permanent-surface airports, out of 30 total in the country, and 2 shipping ports, Honiara and Ringi Cove. Electric generating capacity in 1991 was reportedly 21,000 kW.³ Generally, infrastructure for mining is not in place, and each potential site must be upgraded with respect to access and logistics.

¹South-East Asia Mining Letter (Hong Kong). V. 4, No. 2, Jan. 19, 1992, p. 7.

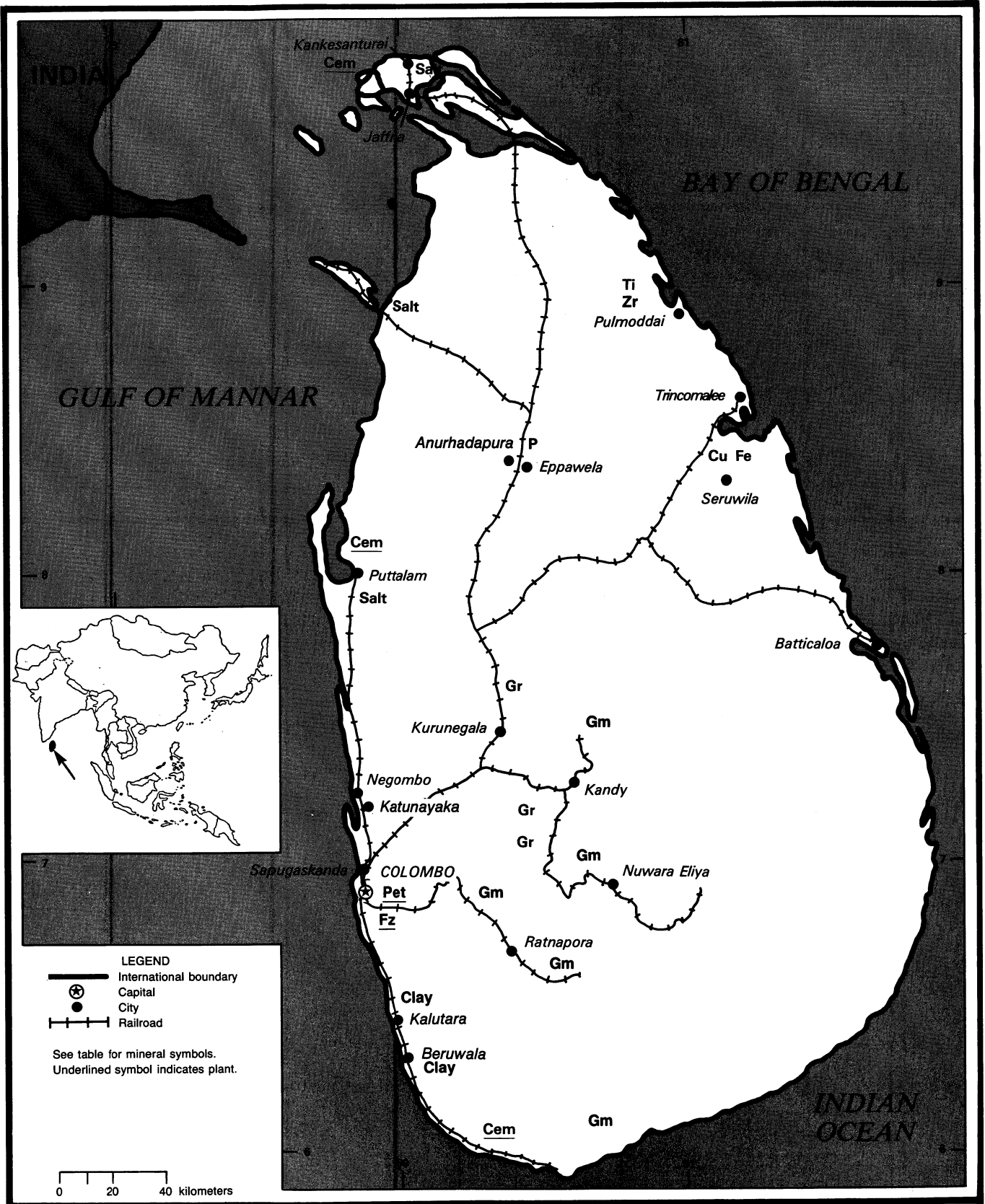
²Pacific Islands Monthly (Suva, Fiji). V. 62, No. 3, Mar. 1992, p. 16.

³U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1992, p. 311.

SRI LANKA

AREA 65,610 km²

POPULATION 17.4 million



THE MINERAL INDUSTRY OF

SRI LANKA

By Chin S. Kuo

The mineral industry of Sri Lanka centers around harvesting gemstones and heavy-mineral sands from alluvial deposits and the mining of graphite. A lapidary industry has been developed for the international marketing of cut and polished precious and semiprecious gemstones, although the ilmenite and rutile, monazite, and zircon components of mineral sands were exported without further processing. The country's economy continued to be dominated by the agricultural sector—tea, coconut, rubber, and various other associated products, and the textile sector, which accounted for 31% and 39%, respectively, of Sri Lanka's export earnings. Despite continued hostility in the northeast and a political crisis during the year, the GDP grew 4.8% in real terms in 1991 compared with 6.2% in 1990.¹

GOVERNMENT POLICIES AND PROGRAMS

Mineral production is driven by exports to earn foreign exchange credits. The Government has recognized the value of sponsored development in the form of free-trade zones. Projects in these zones, managed by the Greater Colombo Economic Commission (GCEC), permit up to 100% foreign ownership. In addition, the GCEC offers ombudsman-type service to foreign investors by facilitating investor relations with Government agencies, helping with labor recruitment and utility connections, and various other business needs.

The Government has also set up specific territorial areas to enable both local and foreign investors to establish export-oriented operations, for instance, the lapidary industry. The Government actively seeks foreign investment and

offers tax reductions and holidays and other concessions. The initial attention was to the garment industry and tourism. Investments in other fields were being encouraged, including raw materials processing and electronics assembly.

PRODUCTION

By value, Sri Lanka's mining sector centers around gemstones, principally sapphire and topaz. Output of other gemstones includes alexandrite, amethyst, aquamarine, chrysoberyl, garnet, ruby, and tourmaline. The second most important component is heavy-mineral sands, containing titaniferous minerals (ilmenite and rutile), monazite with associated thorium, and zircon. In addition, there is small mine production of a limited array of industrial minerals, which include apatite, clays, feldspar, graphite, quartz, and salt. Downstream production includes cement manufacture and refinery products from imported petroleum.

Hostilities between the Tamil insurgents and Government forces, as well as ancillary terrorism, have exerted a depressing effect on the mineral industry, particularly for salt and cement manufacture. Gemstone and graphite mining in central Sri Lanka have also been affected, as well as the recovery of minerals sands in the Pulmoddai region of the northeast coast.

TRADE

The value of total trade in 1991 was \$5,075 million compared with \$4,670 million in 1990.² Exports in 1991 in million dollars consisted of textiles and apparel, 804; agricultural products, 641; petroleum products 83; gemstones, 57; and other, 458. Imports in million

dollars consisted of textile and apparel, 498, petroleum, 312; machinery and equipment, 287; transport equipment, 184; sugar and wheat, 204; building materials, 165; and other, 1,385. The United States was Sri Lanka's largest export market, accounting for 27% of the value of the total shipments. Japan was Sri Lanka's largest supplier, accounting for 12% of the value of the country's imports.

STRUCTURE OF THE INDUSTRY

The Government virtually owns the mining and processing operations as well as the related trade enterprises. The exceptions are the many nonmechanized small-scale gemstone workings, which are privately owned and operated. Depending on the intensity of mining activity, the mineral industry labor force consisted of 2,000 to 3,000 people out of a total national labor force of 6.6 million.

COMMODITY REVIEW

Metals

Iron and Steel.—Ceylon Steel Corp. has a small melting and milling operation at Ornawala. The electric furnace utilized scrap and imported ingot to provide hot metal for the mill to produce billet, wire rod, drawn wire, and sheet.

Industrial Minerals

Gemstones.—The Government-owned State Gem Corp. (SGC) operates the large gemstone mines as well as regulates the sales and trade of gemstones mined by the small, numerous, privately owned operations. SGC exploits rich topaz occurrences at Polwatta near Matale in

central Sri Lanka and operates a topaz marketing center. SGC established lapidary facilities at Matale and Ratnapura for the cutting and polishing of precious and semiprecious stones, including diamonds.

Graphite.—The State Graphite Corp. operates large mines at Bogala, Kahatagaha, and Kalangaha, as well as several small mines. The State Mining and Mineral Development Corp. operates underground mines in Kegalle and Kurunegala.

Phosphate.—The country's phosphate rock resources are in the Eppawala area, where the State Mining and Mineral Development Corp. has an open pit operation. Mine output is ground and bagged, shipped, and consumed in direct fertilizer application.

Salt.—Sri Lanka National Salt Corp. produces solar salt from evaporation ponds at three centers—Elephant Pass, Hambantota, and Palavi. Insurgency in the northeast has affected production in that area.

Sands.—Ceylon Mineral Sands Corp. (CMSC) dominates the mining of heavy-mineral sands at its operation in Pulmoddai. After harvesting the mineral sands, CMSC separates, bags, and exports the ilmenite, rutile, and zircon components.³

Mineral Fuels

There is no domestic production of oil in Sri Lanka. Ceylon Petroleum Corp. imports crude oil for refining at its operation at Sapugaskanda. Most of the refinery output is domestically consumed. However, a portion is exported to garner foreign exchange currency.

Reserves

Archean rocks, which date from the earth's oldest geological era, constitute nine-tenths of the area of the country. Geochemical remobilization during

metamorphism has resulted in various mineral concentrations ranging from magnetite to gemstones. The extent of mineralization for many of these deposits is not yet determined. Sri Lanka's Geological Survey continued geologic investigations, especially for gemstones and heavy-mineral sands.

One mineral commodity for which no method of reserve estimation has been devised is gemstones, which Sri Lanka has in abundance and variety. Most are precious and semiprecious colored stones mined from alluvial deposits in the hilly terrain of the southwest part of the country. Their presence in streambeds and terraces indicates that in all probability there are occurrences upstream in lode deposits more difficult to mine.

INFRASTRUCTURE

Sri Lanka has a relatively extensive network of roads and railroads capable of providing good support to mineral exploration and development. The country has about 75,263 km of highways, consisting of 27,637 km of paved surface, 32,887 km of loose-surface gravel or crushed-stone surface, and about 14,739 km of drained or undrained packed-earth surface. In addition, there are several thousand km of undrained tracks. Railroads include about 1,948 km of 1.868-m broad-gauge track, 102 km of this being double track. There are no electrified railways. The entire railroad system is Government-owned.

Inland waterways comprise about 430 km navigable by shallow-draft boats. Principal seaports are Colombo and Trincomalee, with smaller ports around the periphery of the island. A seagoing ferry connects the smaller port of Talaimannar with the Indian port of Danushkodi. The country has 13 usable airports, 12 having paved runways. One airport has runways 2,440 to 3,659 m in length; seven of the others have runways 1,220 to 2,430 m long. There was 62 km of pipeline for transporting crude oil and refinery products.

Electricity is generated by hydroelectric and thermal powerplants, some fired by

diesel fuel. Total capacity is 1,300 MW, with about 4,200 Mkw•h produced per year or approximately 250 kw•h per capita. New powerplants are in various stages of study.

OUTLOOK

Although Sri Lanka has a limited variety of known minerals, there appear to be good prospects for the discovery of other minerals. The country's dominantly Archean geology offers many possibilities depending only on the advancement of exploration. The probabilities for discovery of petroleum both on and offshore are not unattractive. Finds could reduce the country's present degree of foreign energy dependence.

Sri Lanka is torn by ethnic insurgency and political upheaval that has hampered economic development and threatens the country's survival in its present democratic form.

¹U.S. Dep. of Commerce. Sri Lanka. Washington, DC, Aug. 1992, 8 pp.

²Where necessary, values have been converted from Sri Lankan rupees (SLR) to U.S. dollars at the rate of SLR 41.37=US\$1.00.

³Industrial Minerals (London). Aug. 1992, pp. 23.

OTHER SOURCES OF INFORMATION

Agencies

Ceylon Petroleum Corp.
P.O. Box 634
Colombo 3, Sri Lanka

Lanka Ceramic Ltd.
Colombo, Sri Lanka

Sri Lanka Government
Colombo, Sri Lanka

State Gem Corp.
Colombo, Sri Lanka

State Mining and Mineral Development Corp.
Colombo, Sri Lanka

TABLE 1
SRI LANKA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991 ³
Cement, hydraulic* thousand tons	600	400	400	400	400
Clays:					
Ball clay	20,210	17,330	20,866	27,695	*25,000
Kaolin	6,869	7,100	7,761	7,731	7,737
Brick and tile clay*	60,000	60,000	60,000	60,000	75,000
Clays for cement manufacture	23,277	12,487	*12,500	*12,500	320
Feldspar, crude and ground	7,442	6,345	6,656	9,698	9,908
Gemstones, precious and semiprecious, other than diamond value, thousands	\$13,196	*\$14,000	*\$14,000	*\$14,000	*\$57,000
Graphite, all grades	*9,400	8,547	4,163	5,469	6,381
Iron and steel: Metal: Semimanufactures	33,508	*35,000	*35,000	33,422	47,659
Mica, scrap*	200	200	200	200	200
Petroleum refinery products:					
Gasoline thousand 42-gallon barrels	1,190	*2,040	3,128	5,460	1,168
Jet fuel do.	552	*420	384	805	722
Kerosene do.	1,162	*1,010	961	1,325	1,173
Distillate fuel oil do.	3,819	*3,580	3,327	4,345	3,450
Residual fuel oil do.	4,062	*2,000	—	—	3,801
Other do.	1,628	*1,500	1,166	620	1,030
Refinery fuel and losses do.	395	*440	553	630	464
Total do.	12,808	*10,990	9,519	13,185	11,808
Phosphate rock	20,600	22,995	24,440	32,564	19,693
Rare-earth metals: Monazite concentrate, gross weight*	200	200	200	200	200
Salt	115,274	106,794	*150,223	53,031	52,888
Stone:					
Limestone thousand tons	2,044	733	608	642	621
Quartz, massive	1,190	953	961	1,300	978
Titanium concentrate, gross weight:					
Ilmenite	128,500	74,305	*75,000	*66,413	60,861
Rutile	7,200	5,255	*5,200	5,460	3,085
Zirconium: Zircon concentrate, gross weight	*4,000	*4,000	*4,000	19,727	26,123

*Estimated. †Preliminary. ‡Revised.

¹Table includes data available through Dec. 29, 1992.

²In addition to the commodities listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

TABLE 2
SRI LANKA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Thousand U.S. dollars unless otherwise specified)

Commodity	1990	Destinations, 1990	
		United States	Other (principal)
METALS			
Aluminum: Metal:			
Scrap	metric tons 20	—	Hong Kong 10; Kenya 10.
Semimanufactures	\$154	—	United Arab Emirates \$55; Bangladesh \$51; Kenya \$26.
Copper: Metal:			
Scrap	\$1,834	—	India \$931; Republic of Korea \$343; Singapore \$312.
Unwrought and semimanufactures	\$23	\$2	India \$11; West Germany \$6.
Gold: Metal including alloys, unwrought and partly wrought	\$4,451	—	All to Australia.
Iron and steel: Metal:			
Scrap	\$9,892	—	India \$9,863; Republic of Korea \$12; Maldives \$11.
Semimanufactures:			
Flat-rolled products:			
Of iron or nonalloy steel:			
Not clad, plated, coated	\$485	—	United Arab Emirates \$452; Saudi Arabia \$32.
Clad, plated, coated	metric tons 230	—	United Arab Emirates 221; Japan 9.
Of alloy steel			
Bars, rods, angles, sections	\$215	—	Taiwan \$208; Maldives \$6.
Rails and accessories	metric tons 50	—	All to India.
Wire	do. 242	—	Taiwan 182; Singapore 60.
Tubes, pipes, fittings	do. 292	—	India 90; Malaysia \$1; Singapore \$1.
Mercury	\$3	—	All to South Africa.
Molybdenum: Ore and concentrate	\$2,014	—	All to Japan.
Silver: Waste and sweepings ²	\$65	\$53	Japan \$12.
Tin: Metal including alloys, all forms, semimanufactures	metric tons 18	—	All to Japan.
Titanium: Ore and concentrate	do. 6,965	—	Netherlands Antilles 6,200; Japan 740.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	\$2	—	All to Maldives.
Cement	\$1	—	Do.
Chalk	\$9	\$9	
Clays, crude	\$10	—	Japan \$9; Maldives \$1.
Diamond:			
Gem, not set or strung	\$89,201	\$37	Belgium-Luxembourg \$76,979; Japan \$3,478; Singapore \$3,169.
Industrial stones	\$2,730	\$28	Belgium-Luxembourg \$1,560; Japan \$648; Israel \$458.
Diatomite	metric tons 20	—	All to West Germany.
Feldspar	do. 104	—	All to Taiwan.
Fertilizer materials:			
Crude, n.e.s.			
Manufactured:	\$40	—	Japan \$28; Maldives \$10.
Nitrogenous	\$10	—	All to Maldives.
Phosphatic	\$9	—	Seychelles \$7; Maldives \$1.
Unspecified and mixed	\$13	—	India \$7; Maldives \$4.
Graphite, natural	\$4,281	\$695	Japan \$1,794; United Kingdom \$1,163.
Mica: Crude including splittings and waste	metric tons 1,288	—	Japan 1,108; Belgium-Luxembourg 140; Republic of Korea 40.

See footnotes at end of table.

TABLE 2—Continued
SRI LANKA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Thousand U.S. dollars unless otherwise specified)

Commodity	1990	Destinations, 1990	
		United States	Other (principal)
INDUSTRIAL MINERALS—Continued			
Precious and semiprecious stones other than diamond:			
Natural	\$73,226	\$7,558	Japan \$31,208; Thailand \$16,421.
Synthetic	\$4	\$4	
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	\$459	\$17	Italy \$355; Austria \$19; Singapore \$19.
Worked	\$1	—	All to Maldives.
Quartz and quartzite	metric tons 7,534	—	Japan 7,533.
Talc, steatite, soapstone, pyrophyllite	do. 143	—	Japan 83; Republic of Korea 40; Belgium-Luxembourg 20.
Other: Crude	do. 15,028	—	Japan 15,000; West Germany 26.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	\$1	—	All to Maldives.
Petroleum refinery products:			
Mineral jelly and wax	\$2	—	Italy \$1; Switzerland \$1.
Bituminous mixtures	\$13	—	All to Maldives.

¹Table prepared by Audrey D. Willms.

²Unreported quantity valued at \$100,000.

³May include other precious metals.

TABLE 3
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹

(Thousand U.S. dollars unless otherwise specified)

Commodity	1990	Sources, 1990	
		United States	Other (principal)
METALS			
Alkali and alkaline-earth metals	\$10	—	West Germany \$6; Japan \$4.
Aluminum:			
Ore and concentrate	metric tons 72	—	All from China.
Oxides and hydroxides	\$748	\$9	West Germany \$319; Japan \$297; Singapore \$37.
Metal:			
Scrap	\$34	—	Singapore \$27; United Kingdom \$7.
Unwrought	\$1,621	\$96	Republic of South Africa \$1,093; Bahrain \$206.
Semimanufactures	\$9,321	\$54	Malaysia \$1,968; India \$1,281; Hong Kong \$770.
Antimony: Metal including alloys, all forms	metric tons 22	—	China 20; United Kingdom 2.
Chromium: Oxides and hydroxides	\$24	—	United Kingdom \$17; Australia \$6.
Cobalt:			
Oxides and hydroxides	\$1	—	All from West Germany.
Metal including alloys, all forms	\$1	—	All from Hong Kong.
Columbium and tantalum: ² Ore and concentrate	metric tons 14	—	All from Japan.
Copper:			
Ore and concentrate	do. 40	—	Singapore 30; Hong Kong 10.
Metal:			
Scrap	\$8	—	All from Singapore.
Unwrought	\$36	—	Republic of South Africa \$12; West Germany \$6; Switzerland \$4.
Semimanufactures	\$7,521	\$7	United Kingdom \$3,421; Japan \$1,142; Saudi Arabia \$576.
Gold: Metal including alloys, unwrought and partly wrought	\$1,233	—	All from Switzerland.
Iron and steel:			
Iron ore and concentrate including roasted pyrite	\$4	—	China \$3.
Metal:			
Scrap	\$258	—	United Kingdom \$115; Republic of South Africa \$94.
Pig iron, cast iron, related materials	metric tons 71	—	Republic of South Africa 58; China 13.
Ferroalloys:			
Ferromanganese	do. 5	—	Taiwan 3; United Kingdom 2.
Ferrosilicon	\$9	—	All from United Kingdom.
Ferrosilicochromium	metric tons 5	—	Do.
Unspecified	\$1	—	All from India.
Steel, primary forms	metric tons \$37,705	—	Republic of South Africa 22,553; China 15,148.
Semimanufactures:			
Flat-rolled products:			
Of iron or nonalloy steel:			
Not clad, plated, coated	\$19,142	\$65	Republic of South Africa \$3,880; Japan \$3,551; Republic of Korea \$3,524.
Clad, plated, coated	\$9,435	\$26	Japan \$4,296; Australia \$1,621; United Kingdom \$1,204.
Of alloy steel	\$2,055	—	Singapore \$705; Japan \$562; Taiwan \$384.
Bars, rods, angles, shapes, sections	\$19,949	\$6	Republic of South Africa \$6,691; Japan \$3,139; Republic of Korea \$2,202.
Rails and accessories	\$863	\$12	Australia \$338; United Kingdom \$280; Malaysia \$71.
Wire	\$6,759	—	China \$2,277; Republic of South Africa \$2,197; Republic of Korea \$1,467.
Tubes, pipes, fittings	\$8,506	\$41	Thailand \$1,697; France \$1,434; Singapore \$1,258.

See footnotes at end of table.

TABLE 3—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹

(Thousand U.S. dollars unless otherwise specified)

Commodity	1990	Sources, 1990	
		United States	Other (principal)
METALS—Continued			
Lead:			
Oxides	\$115	—	Singapore \$91; United Kingdom \$13; Japan \$5.
Metal:			
Unwrought	\$793	—	Australia \$704; Malaysia \$38; Singapore \$21.
Semimanufactures	\$143	—	Japan \$40; United Kingdom \$36; Singapore \$35.
Magnesium: Metal including alloys, all forms	\$22	—	Republic of Korea \$18; Singapore \$4.
Manganese: Oxides	\$1,658	—	Belgium-Luxembourg \$888; Singapore \$485; Japan \$194.
Mercury	\$14	\$1	West Germany \$11.
Nickel:			
Ore and concentrate	\$2	—	All from Singapore.
Metal including alloys, all forms	\$106	—	West Germany \$27; Japan \$23; Singapore \$17.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	\$9	—	All from Pakistan.
Silicon, high-purity	\$20	\$7	Taiwan \$6; Republic of Korea \$5.
Silver:			
Waste and sweepings ²	\$9	—	All from Pakistan.
Metal including alloys, unwrought and partly wrought	\$64	—	West Germany \$50; Singapore \$11.
Tin: Metal including alloys:			
Scrap	\$17	—	United Kingdom \$6; unspecified \$10.
Unwrought	\$103	—	United Kingdom \$38; Malaysia \$28; Belgium-Luxembourg \$26.
Semimanufactures	\$42	—	Japan \$17; United Kingdom \$13; Singapore \$7.
Titanium: Oxides	\$586	\$9	Republic of Korea \$150; United Kingdom \$188; West Germany \$103.
Tungsten: Metal including alloys, all forms	\$15	—	Mainly from Sweden.
Zinc:			
Oxides	\$1,451	\$6	China \$463; Republic of Korea \$376; Hong Kong \$197.
Metal including alloys:			
Scrap	\$2	—	All from Japan.
Unwrought	\$2,285	—	Canada \$1,094; Australia \$682; Republic of Korea \$292.
Semimanufactures	\$229	—	Singapore \$185; Australia \$15.
Zirconium: Ore and concentrate	metric tons 38	—	All from Japan.
Other:			
Ores and concentrates of precious metals	kilograms 75	—	All from India.
Ashes and residues	\$2	—	All from Netherlands.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	\$130	—	Indonesia \$73; Hong Kong \$30.
Artificial: Corundum	metric tons 24	—	Italy 21; West Germany 2.
Dust and powder of precious and semiprecious stones including diamond	\$878	\$21	Belgium-Luxembourg \$789; Republic of South Africa \$39.
Grinding and polishing wheels and stones	\$600	\$7	United Kingdom \$111; Italy \$81; India \$71.
Asbestos, crude	\$4,173	—	Canada \$3,031; Zimbabwe \$888; Barbados \$252.
Barite and witherite	metric tons 10	—	All from West Germany.

See footnotes at end of table.

TABLE 3—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹

(Thousand U.S. dollars unless otherwise specified)

Commodity	1990	Sources, 1990	
		United States	Other (principal)
INDUSTRIAL MINERALS—Continued			
Boron materials:			
Crude natural borates	\$16	\$6	Hong Kong \$7; China \$3.
Oxides and acids	\$70	—	China \$42; Turkey \$12; Hong Kong \$6.
Cement	\$35,790	\$35	United Arab Emirates \$9,353; Indonesia \$7,953.
Chalk	\$168	—	
Clays, crude:			
Bentonite	\$27	\$1	India \$15; Japan \$6; Singapore \$3.
Kaolin	\$212	\$3	Japan \$150; Malaysia \$23; United Kingdom \$16.
Unspecified	\$859	\$8	Japan \$402; United Kingdom \$384.
Cryolite and chiolite	metric tons 82	—	India 42; China 40.
Diamond:			
Gem, not set or strung	\$73,471	\$1	Belgium-Luxembourg \$39,286; Ghana \$23,230.
Industrial stones	\$4,998	\$5	Israel \$2,366; Belgium-Luxembourg \$1,823; Hong Kong \$459.
Diatomite and other infusorial earth	\$69	\$40	West Germany \$16; Taiwan \$4; China \$2.
Fertilizer materials: Manufactured:			
Ammonia	\$241	—	United Kingdom \$105; Malaysia \$84; West Germany \$17.
Nitrogenous	\$36,337	\$6	Indonesia \$9,883; Bangladesh \$8,223; Japan \$6,524.
Phosphatic	\$8,304	—	China \$6,756; Iraq \$928; Singapore \$604.
Potassic	\$17,796	—	Canada \$6,153; Jordan \$5,745; U.S.S.R. \$1,289.
Unspecified and mixed	\$2,267	\$57	Japan \$2,102; United Kingdom \$30.
Graphite	\$5	\$5	
Gypsum and plaster	\$1,084	—	Thailand \$357; West Germany \$250; Greece \$201.
Iodine ⁶	\$21	—	Mainly from United Kingdom.
Lime	metric tons 7	—	Singapore 6; United Kingdom 1.
Magnesium compounds:			
Magnesite, crude	do. 15	—	Republic of Korea 12; China 3.
Oxides and hydroxides	\$13	—	Japan \$11; China \$1.
Mica:			
Crude including splittings and waste	\$4	—	All from United Kingdom.
Worked including agglomerated splittings	\$4	—	Mainly from United Kingdom.
Phosphates, crude	metric tons 16,405	—	Jordan 8,250; Egypt 6,500.
Pigments, mineral: Iron oxides and hydroxides, processed	\$1,339	\$4	West Germany \$695; Netherlands \$404; United Kingdom \$56.
Precious and semiprecious stones other than diamond:			
Natural	\$762	\$277	Hong Kong \$264; China \$144.
Synthetic	\$33	\$27	Belgium-Luxembourg \$6.
Salt and brine	\$84	—	United Kingdom \$59; Taiwan \$19; Australia \$2.
Sodium compounds, n.e.s.:			
Soda ash, natural and manufactured	\$682	—	Republic of South Africa \$278; Kenya \$182; Republic of Korea \$143.
Sulfate, manufactured	\$61	—	Indonesia \$23; China \$18; Netherlands \$15.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	metric tons 147	—	India 101; Italy 38; United Kingdom 7.

See footnotes at end of table.

TABLE 3—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹

(Thousand U.S. dollars unless otherwise specified)

Commodity	1990	Sources, 1990	
		United States	Other (principal)
INDUSTRIAL MINERALS—Continued			
Stone, sand and gravel—Continued:			
Dimension stone—Continued:			
Worked	\$79	—	Italy \$60; Belgium-Luxembourg \$10.
Gravel and crushed rock	\$134	—	India \$80; France \$22; China \$18.
Limestone other than dimension	metric tons 20	—	All from India.
Quartz and quartzite	do. 9	—	All from Belgium-Luxembourg.
Sand other than metal-bearing	\$14	—	West Germany \$4; Japan \$3; United Kingdom \$3.
Sulfur:			
Elemental:			
Crude including native and byproduct	metric tons 742	—	Republic of Korea 27; Thailand 10.
Colloidal, precipitated, sublimed	\$189	—	Singapore \$149; Kuwait \$15; United Arab Emirates \$10.
Sulfuric acid	\$207	—	Malaysia \$104; Bahrain \$25; Singapore \$25.
Talc, steatite, soapstone, pyrophyllite	\$362	\$15	China \$188; India \$121; Norway \$24.
Other:			
Crude	\$702	—	West Germany \$581; Singapore \$114.
Slag and dross, not metal-bearing	\$626	—	All from Singapore.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	\$13	—	Japan \$12; Singapore \$1.
Carbon black	\$3,624	—	Republic of Korea \$1,976; Republic of South Africa \$473; Singapore \$440.
Coal: Anthracite	\$145	—	All from United Kingdom.
Coke and semicoke	\$496	—	Australia \$365; Belgium-Luxembourg \$53; Japan \$47.
Petroleum:			
Crude	\$282,273	—	Iran \$219,196; Malaysia \$63,077.
Refinery products:			
Liquefied petroleum gas	\$4,063	—	Singapore \$2,594; Indonesia \$1,461.
Mineral jelly and wax	\$1,577	\$17	Japan \$416; United Kingdom \$399; China \$273.
Bitumen and other residues	\$65	\$10	Republic of South Africa \$15; Singapore \$14; United Kingdom \$14.
Bituminous mixtures	\$25	\$2	United Kingdom \$22.

¹Table prepared by Audrey D. Wilkes.

²May include vanadium.

³Excludes unreported quantity valued at \$64,000.

⁴Excludes unreported quantity valued at \$681,000.

⁵May include other precious metals.

⁶May include bromine and fluorine.

⁷Excludes unreported quantity valued at \$229,000.

TABLE 4
SRI LANKA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Lanka Cement Corp.	Kankasanturai	1,000
Do.	do.	Puttalam	400
Gemstones	State Gem Corp. (sales and trade)	Colombo	NA
Graphite	State Mining and Mineral Development Corp.	Kahatagaha-Kolongaha Mines, 27 kilometers northeast of Kurunegala	4
Do.	do.	Bogala Mine, 80 kilometers northeast of Colombo	7
Petroleum, refinery products thousand 42-gallon barrels per day	Ceylon Petroleum Corp	Sapugaskanda	50
Phosphate rock	State Mining and Mineral Development Corp.	Eppawela	50
Salt	Sri Lanka National Salt Corp.	Hambantota, Elephant Pass and Palavi	120
Steel	Ceylon Steel Corp.	Ornawala, Athurugiriya	40
Titanium, ilmenite concentrate	Ceylon Mineral Sands Corp.	Pulmoddai	150

NA Not available.

TABLE 5
SRI LANKA: ESTIMATED
RESERVES OF MAJOR MINERAL
COMMODITIES

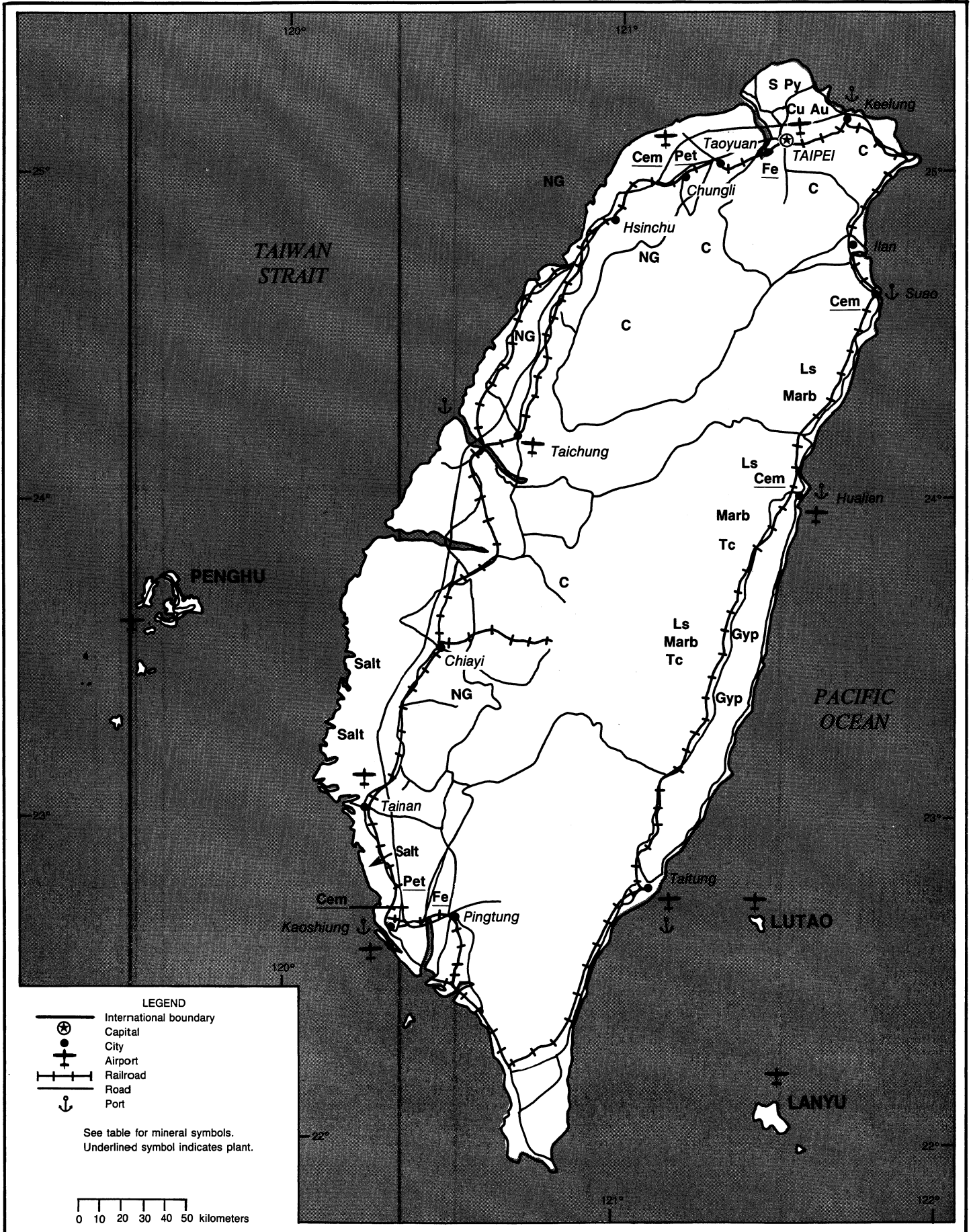
(Thousand metric tons unless
otherwise specified)

Commodity	Reserves
Ball clay	500
Dolomite	30,000
Iron ore	25,000
Graphite	40
Limestone	20,000
Phosphate rock	25,000
Silica sand	20,000
Titanium minerals:	
Ilmenite	7,200
Rutile	820

TAIWAN

AREA 35,980 km²

POPULATION 20.5 million



THE MINERAL INDUSTRY OF

TAIWAN

By Pui-Kwan Tse

While advanced, industrialized, economically developing countries in Europe and North America were in recession, Taiwan had economic growth of 7.32% in 1991. Taiwan has a very poor mineral resource base. Most of the raw materials and fuels that are used for industrial output are imported. According to the Industrial Development Bureau, the labor force in the manufacturing sector was 2.2 million in 1991, a decrease of 3.3% from that of the previous year. In 1991, the value of per capita production grew to \$76,000, an increase of 11.8% from that of last year. The structure of Taiwan's manufacturing sector changed from a labor-intensive industry to an automated high value-added industry. Technology-intensive companies accounted for 29.2% of the total industry output in 1991, compared with 23.9% 5 years ago and 20% a decade ago. The rising labor costs in the manufacturing sector over the past few years has engendered Taiwan's international competitiveness. Taiwan's salary in the manufacturing sector increased by 10.9% in 1991, following a record high of 13.5% in 1990. Unless the climbing wages trend is rectified, high wage costs would pose a big problem for local manufacturers to stay in the forefront in a more competitive global market.

Taiwan's population grew from 20.3 million in 1990 to 20.5 million in 1991, and the per capita GNP increased from \$7,954 in 1990 to \$8,815 in 1991. The total labor force in Taiwan was 8.7 million, and the unemployment rate was 1.5%. Employment in the mining and quarrying industry only accounted for 19,000 in 1991, a decrease of 1,000 from that of 1990. The output value of the mining sector was 0.4% of the GDP, which is insignificant compared with other sectors. The import value of

minerals accounted for 12% of Taiwan's total import value. Taiwan imports 100% of the metals needed for its industry output. Because of the worldwide recession, domestic and international markets were weak; therefore, Taiwan imported fewer industrial raw materials in 1991 compared with those of 1990.

GOVERNMENT POLICIES AND PROGRAMS

The Taiwan Government planned to lift its 43-year-old restriction on gold exports by the second quarter of 1992 and allow gold to be imported freely instead of through a licensing system. The amount of smuggled gold was as high as 1.5 times the official import figures. Market reforms would reduce domestic market distortion, cut local gold prices, and discourage smuggling.

Taiwan's Parliament passed revisions to its copyright law in May 1992. The law strengthened the protection of foreign patents and copyrights in a bid to avert U.S. trade sanctions after the United States placed Taiwan on a "priority watch list" of countries failing to prevent piracy of U.S. copyrights. The new law gave explicit legal protection to a wide range of products.

In December 1990, Taiwan's Securities and Exchange Commission (SEC) issued a complicated set of regulations for foreign institutional investors. In November 1991, the SEC proposed two rule changes. First, the extension from the 3 months to 6 months period during which investments must be brought into Taiwan after applications were approved. Second, under the original rule, profits from investments may only be taken out of Taiwan once a year. Under the proposed revision, investors would be

allowed to remit their capital gains once a quarter.

In February 1992, the Government implemented its first Fair Trade Law. The law is divided into two parts: the first regulates monopolies, mergers, and collusion to ensure adequate market competition; and the second prohibits unfair competition. Upon approval by the Executive Yuan, state-owned enterprises, public utilities, and transportation enterprises will be exempt from regulation by the law for 5 years. When the 5-year grace period expires, state-owned enterprises will have to face competition from the private sector in the markets where they are currently monopolizing. The new law will apply to all companies, including branches or subsidiaries of foreign companies.

In June 1991, the Ministry of Finance awarded banking licenses to 15 private bank investors. This move ended a long-term delay on liberalization of the country's financial sector. The three state-owned banks dominated the financial sector, which was regarded as unimaginative and unsophisticated.

PRODUCTION

Taiwan has successfully developed the upgrading of its production capabilities over the past decade. During this time, the Taiwanese dollar appreciated more than 50% against the U.S. dollar. The labor cost increased more than tenfold in the past 10 years. Taiwan's firms have made various efforts to improve their competition in the region. For improving productivity, automation of the textile section rose from 29% to 65%; plastics, from 8% to 41%; machinery, from 21% to 55%; and electronics, from 27% to 59% over a period of 10 years. Employment in the manufacturing sector

dropped to 2.6 million in 1991 from its peak of 2.8 million in 1987. During the same period, the labor productivity index rose from 108 to 153.

The electronics sector grew at an average annual rate of about 20% from 1981 to 1990. The Government has given investment incentives, low interest loans, and other favorable financial help in promoting this sector.

The value of the output of the mining sector was only \$393.6 million in 1991, a decrease of 18.2% from that of 1990. By value, natural gas continued to be the most important mine output, \$209.5 million, followed by coal, \$41.8 million. The domestic production of mineral fuels provided only 3% of the country's supply of energy.

Marble and limestone dominated the minerals output by the hard-rock mining sector; most of the operations are in the eastern part of the country. Natural gas and coal are mined in the western part of the country. Most of the large minerals producing and metals-producing companies in Taiwan are state-owned enterprises. (See table 1.)

TRADE

Despite a worldwide recession, Taiwan's total trade value increased to \$147.49 billion in 1991, up 20.0% over that of 1990. The value of exports and imports were \$80.66 billion and \$66.83 billion, respectively, resulting in a trade surplus of \$13.83 billion. The United States continued to be Taiwan's largest export destination, followed by Hong Kong, Japan, the Federal Republic of Germany, and Singapore. Because the Government continues to ban direct trade with China, more than \$5 billion worth of goods was exported to China via Hong Kong. The largest supplier of Taiwan's imports remained Japan, followed by the United States, the Federal Republic of Germany, Australia, and Hong Kong. Because Taiwan has heavily invested in Southeast Asia in the past several years, exports to that region increased rapidly during 1990-91 compared to that of 1989-90.

The United States and Japan continued to be Taiwan's most important trade partners. The United States provides the largest export market for Taiwan. However, the trade surplus with the United States continued to decline in the past few years because Taiwan exported less and imported more. On the contrary, Taiwan's imports from Japan increased annually. The unfavorable balance of trade worsened in 1991. The trade imbalance was related to the structure of Taiwan's manufacturing sector. Most of the parts and machinery used in the manufacturing sector were made in Japan. Thus, when Taiwan increased its exports of manufactured goods, it also increased its imports from Japan. Until Taiwanese industry reduces its reliance on Japan, the deficit with Japan otherwise will continue to widen. (See tables 2 and 3.)

STRUCTURE OF THE MINERAL INDUSTRY

Taiwan's industrial development has registered an impressive growth, but the mineral industry continued to decline. Coal, oil, and natural gas are the country's most valuable mine products. Carbonate minerals such as dolomite, limestone, and marble composed the most important nonfuel mining sector. In addition to the aggregates, clays, feldspar, salt, and talc make up the remaining mine production. In the metals production sector, the country produces iron and steel and processes copper, lead, tin, and zinc from imported raw materials.

To ensure stability for the national economy, the major industrial firms, which require large capitalization, are state-owned such as China Steel Corp., China Petroleum Corp., Tang Eng Iron Works, and Taiwan Power Co. In the Government's privatization program, six state-owned enterprises, including China Steel Corp. and China Petroleum Development Co., were scheduled for listing on local, international, or both stock exchanges in early 1992. (See table 4.)

COMMODITY REVIEW

Metals

There were no domestic metal mining activities in Taiwan. The primary metals industry is limited to copper, iron and steel, lead, nickel, and zinc, all of which used imported raw materials. The charges of massive lead poisoning of workers and the rigidity of the environmental law have forced the country's scrap processors to reduce their imports in secondary metals. The target for curtailing scrap imports will be in 1993. Taiwan is one of the United States' largest foreign markets for secondary metals. Such a ban may affect nonferrous scrap industry in the United States.

Aluminum.—In 1991, Taiwan Aluminum Corp., a subsidiary of China Steel Corp., produced 40,000 tons of fabricated aluminum products, including plates, wire, and foil from imported aluminum ingot. The Government's Commission planned to diversify its sources of imported primary aluminum ingot and negotiated with a trading company from the Commonwealth of Independent States (CIS) to barter CIS aluminum ingot for Taiwanese consumer goods, including shoes and computers.

Cobalt.—Chempro Uranus Co., a joint venture between Uranus Chemical Co., Taiwan, and Chempro, a subsidiary of Sassoon Group, Switzerland, planned the production of cobalt acetate in Uranus's existing facilities in Hsinchu. Cobalt acetate is mainly used as a catalyst in the plastics industry. Initial production was expected to come on-stream in July 1992.

Gold.—Gold has been found in Chinkuashih, Taipei County. Initial estimates are that the 1,700-hectare site may contain as much as 100 tons of gold. Samples have been sent to laboratories in the Republic of South Africa for analysis. The results were very encouraging for a major development. Further studies are required before total new reserves can be calculated.

Iron and Steel.—China Steel Corp. (CSC), a state-owned enterprise, had officially canceled its \$102 million investment for the construction of a steel mill in Malaysia that would have an annual output of 2.5 Mmt of crude steel and 2.2 Mmt of steel products. The Government decided to suspend any further action on the Malaysian joint venture until the Malaysian Government provided more attractive investment incentives. CSC will instead concentrate on its fourth phase expansion at its present facilities in Taiwan. CSC is now falling behind Chinese, Japanese, and South Korean firms that are moving to construct steel plants in lower wage offshore markets. CSC's fourth phase expansion includes construction of a blast furnace.

An Feng, Taiwan's largest independent hot roller, with an annual capacity of 1.5 Mmt of hot-rolled sheet had installed a new 1 Mmt/a capacity continuous casting mill to produce high-quality hot-rolled coils in 1991. The mill was built by Ube Industries of Japan. The company plans to export 30% of its output to countries in Southeast Asia and the Middle East, and the remainder will be for domestic consumption. After satisfactory testing of the initial 30,000 tons of slab steel from the former Soviet Union in October 1991, An Feng signed an agreement with Novolipetsk for a supply of up to 1 Mmt/a of slab for 5 years. In 1991, An Feng also obtained 30,000 tons of slab from East Slovak Iron and Steel, Czechoslovakia. A Japanese trading company arranged for An Feng to take about 10,000 mt/month of slab from the Shanghai Baoshan Iron and Steel Co. of China.

Kawasaki Steel of Japan signed a contract to build a 110-ton DC electric furnace for Tung Ho Steel. Under the contract, Kawasaki will also supply continuous casting equipment and rolling facilities. After expansion is completed in 1993, Tung Ho will become Taiwan's largest independent electric arc steel producer. Tung Ho now operates two conventional AC furnaces and produces about 300,000 mt/a of bars.

Mineral Fuels

The Taiwan Government plans to diversify its supply of energy resources under the 6-year plan. By 1996, the anticipated capacity of the country's power generating system is to reach 27 MkW and would emphasize nuclear, thermal, and hydroelectric power generation. At the present time, the country's configuration of energy output is: coal (23.7%), oil (54.8%), liquefied petroleum gas (1.6%), natural gas (2.3%), hydropower (3.5%), and nuclear (14.1%).

In 1991, Taiwan's coal production dropped 15% from that of 1990 to 402,575 tons and accounted for only 0.5% of the total supply of energy. This was attributed mainly to reduced domestic coal resources and the strict environmental controls in the country. In 1991, Taiwan's coal imports decreased 3.1% to 18.4 Mmt. The major coal suppliers were Australia, Canada, the Republic of South Africa, and the United States. Taipower was Taiwan's largest coal consumer, accounting for 46%, and China Steel Corp. used 25% of total imports. Even though the Taiwan Government maintains a ban on direct trade with China, imports of coal from China through a third country, however, increased in 1991. In mid-1992, a new 550-MW coal-fired powerplant in Taichung will be placed in operation, and a second on the west coast will be placed in operation in 1993. Taipower has asked permission from the Government to permit coal imports from China via third parties, and this petition is expected to be granted.

Formosa Plastics Group (FPG), after wading through 5 years of delay caused by the protests of environmentalists, will start construction of its first naphtha cracker plant in April 1992 on the west coast of Yunlin County. The \$4 billion naphtha cracking facility will become the sixth in Taiwan and, to date, is the largest private industrial investment in the country. The plant is scheduled to be completed in 4 to 5 years. After completion, the refinery will produce 9 Mmt of naphtha, 450,000 tons of

ethylene, and 225,000 tons of propylene annually to supply downstream plastic and petrochemical plants in the country. Having settled the environmental protest problem, FPG now faces a labor shortage problem in the country. Reportedly, 10,000 laborers are required for the construction of the plant. FPG has applied for permission from the Government to employ foreign laborers.

Chinese Petroleum Corp. (CPC), a state-owned enterprise, under the instruction of the Government, has diversified its crude oil imports from its traditional supplier in the Middle East. The total import volume from the Middle East has been reduced to 63% of the total crude oil imports of 155.4 Mbbbl in 1991. There was a slight increase for crude oils imported from west Africa, Australia, Brunei, Ecuador, Indonesia, and Malaysia.

To meet strong domestic demand for low sulfur oil and reformat, CPC signed a letter of intent in early 1991 with Hawaii-based Pacific Resources International Inc. (PRI), a subsidiary of Broken Hill Proprietary Co. of Australia, with 50-50 equity to build a refinery in Southeast Asia. In December 1991, the Ministry of Economics approved the application for CPC a 45% share to participate in a joint venture with PRI (45%) and Petronas (10%), Malaysia, to build a \$1.3 billion refinery plant at Bintulu, Sabah. The plant will have the capacity to refine 150,000 bbl/d from Malaysia using crude oil.

In order to ensure more LNG supply from Indonesia and Malaysia, CPC started the expansion of its Yung An LNG receiving terminal at Yungan, Kaohsiung. After the completion of the first phase expansion in 1997, the terminal will be able to accommodate 4.5 Mmt of LNG per year. To meet the growing demand for LNG in the late 1990's, a feasibility study for a second LNG receiving terminal in the northern coast of the country is underway.

Fuels trade between Taiwan and China flourished in 1991. While direct trade across the Taiwan Strait is prohibited, Singapore has been involved as an entrepot in the China-Taiwan fuel trade.

Taiwan imported from China more than 800,000 bbl of gasoline monthly to meet domestic demand.

Reserves

Taiwan has a very weak mineral resource base, and output is limited to mostly carbonate minerals and small amounts of other industrial minerals and negligible amounts of fossil fuels, the overall value of which is significant only to the local economy. (See table 5.)

INFRASTRUCTURE

Construction of the South Link Railway was completed and put in operation on December 6, 1991. It took more than 11 years and \$770 million to construct the 98-km South Link Railway. The railway extends from Fangliao, Pingtung County, to Peinan, Taitung County. The completion of the round-the-island railway will strengthen the country's economy in the south and east. The economic development of eastern Taiwan has been impeded owing to its isolation from other parts of the island, a result of the Central Mountain Range forming a north-to-south 270-km-long barrier.

OUTLOOK

Because Taiwan lacks a strong and varied mineral resource base, the domestic mining sector will never contribute significantly to the output of downstream manufacturing. Rising wages and a strong international currency exchange rate have affected export competitiveness and have forced domestic businesses to establish operations in lower cost neighboring countries such as China, Indonesia, Malaysia, Thailand, and Vietnam. Taiwan is a top investor in Malaysia and Vietnam. The future for Taiwan-based industry seems to lie in high-technology intensive manufacturing.

¹Where necessary, values have been converted from New Taiwan dollars (NT\$) to U.S. dollars at the rate of NT\$25.3=US\$1.00 in 1991 and NT\$27.2=US\$1.00 in 1990.

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Taipei, Taiwan

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Department of Reconstruction
2 Chenkiang Street
Taipei, Taiwan

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TABLE 1
TAIWAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons, unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²
METALS					
Copper: Metal, refined	46,961	43,333	43,237	16,090	—
Gold, primary kilograms	532	237	269	72	—
Iron and steel: Metal:					
Pig iron thousand tons	*3,900	5,675	5,780	5,474	5,561
Ferroalloys:					
Ferromanganese	17,026	25,822	30,623	43,631	40,110
Ferrosilicomanganese	18,944	30,745	25,510	20,587	12,801
Ferrosilicon	7,058	19,601	19,277	15,501	6,252
Steel, crude thousand tons	5,949	8,313	9,047	*9,747	10,957
Nickel, refined ³	8,200	8,200	8,200	8,200	7,000
Silver, primary kilograms	9,856	8,388	6,491	3,926	—
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	15,663	17,281	18,043	18,459	19,389
Clays:					
Fire clay	76,005	131,370	85,803	99,389	79,497
Kaolin	67,525	81,879	98,115	*105,084	92,970
Feldspar	28,116	19,101	9,806	7,321	1,339
Gypsum: Precipitated	1,378	2,438	3,904	*1,743	3,723
Lime	105,005	105,701	*615,047	*553,517	613,942
Mica	787	4,387	4,290	*4,946	8,596
Nitrogen: N content of ammonia	*243,727	*278,928	*202,916	*216,306	243,389
Salt, marine	99,943	111,341	169,982	82,820	195,319
Sodium compounds, n.e.s.:					
Caustic soda	*148,300	*144,800	*86,100	*110,600	119,600
Soda ash	127,332	126,828	115,572	*120,000	109,320
Stone:					
Dolomite thousand tons	340	448	419	339	363
Limestone do.	12,407	13,653	14,069	13,924	15,352
Marble do.	11,062	11,213	12,231	11,349	11,352
Serpentine do.	253	328	469	388	414
Sulfur	89,082	86,541	76,060	95,533	125,819
Talc	22,102	21,603	22,559	*22,123	18,518
MINERAL FUELS AND RELATED MATERIALS					
Carbon black	53,559	52,982	57,632	62,230	60,330
Coal, bituminous thousand tons	1,499	1,225	784	*473	403
Coke do.	118	97	88	70	14
Gas, natural:					
Gross ⁴ million cubic meters	1,057	1,158	1,158	1,129	776
Marketed do.	1,017	1,100	1,094	*1,100	*700
Petroleum:					
Crude thousand 42-gallon barrels	934	880	850	*1,148	*1,100
Refinery products:					
Gasoline do.	24,480	26,640	27,084	*32,610	37,070
Kerosene do.	547	1,201	2,032	*2,200	*2,200
Distillate fuel oil do.	25,581	23,131	27,015	*29,260	30,240

See footnotes at the end of table.

TABLE 1—Continued
TAIWAN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons, unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ^P
METALS					
Residual fuel oil thousand 42-gallon barrels	51,622	60,538	71,207	*76,470	83,580
Lubricants fuel oil do.	1,887	969	1,038	*1,000	*1,000
Asphalt do.	2,291	2,567	2,901	*3,000	*3,000
Other do.	4,835	6,408	14,531	*13,560	12,960
Refinery fuel, losses and not reported ² do.	21,680	11,176	8,695	*10,000	*10,000
Total ^a do.	132,923	132,630	154,503	*168,100	*180,050

^aEstimated. ^PPreliminary. ^RRevised.

¹Includes data available through May 19, 1992.

²Naphtha, solvent oil, and base oil.

³Includes liquefied petroleum gas and jet fuel.

TABLE 2
TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	35	25	—	Indonesia 18; Hong Kong 7.
Aluminum:				
Ore and concentrate	18	43	—	Indonesia 40; Austria 3.
Oxides and hydroxides	3,459	3,833	(?)	Thailand 1,635; Philippines 1,018; Morocco 460.
Metal including alloys:				
Scrap	4,412	5,577	20	Japan 5,156; Malaysia 163.
Unwrought	30,204	47,686	408	Japan 39,220; Republic of Korea 3,297; Thailand 2,499.
Semimanufactures	24,950	34,076	329	Hong Kong 8,262; Japan 3,972; Singapore 3,901.
Antimony:				
Oxides	586	555	—	Japan 350; Netherlands 151.
Metal including alloys, all forms	2	2	(?)	Mainly to Saudi Arabia.
Arsenic: Oxides and acids kilograms	27	—		
Beryllium: Metal including alloys, all forms				
do.	97	3,462	3,462	
Cadmium: Metal including alloys, all forms				
do.	40,183	100,716	19,602	Japan 78,821.
Chromium:				
Ore and concentrate	110	21	—	Indonesia 20; Hong Kong 1.
Oxides and hydroxides	3	27	—	Hong Kong 23; Philippines 2.
Metal including alloys, all forms	22	66	41	Japan 14; West Germany 4.
Cobalt:				
Oxides and hydroxides	23	17	—	Indonesia 8; Canada 5; Philippines 4.
Metal including alloys, all forms	2	14	—	Japan 6; Paraguay 5.
Columbium and tantalum: Tantalum metal including alloys, all forms	30	21	12	Japan 8.
Copper:				
Matte and speiss including cement copper	501	2	(?)	Philippines 1.
Oxides and hydroxides	1	49	—	Malaysia 47.
Sulfate	3,663	5,367	116	New Zealand 1,330; Australia 893; Netherlands 600.

See footnotes at end of table.

TABLE 2—Continued
TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Copper—Continued:				
Metal including alloys:				
Scrap	15,665	30,497	48	Republic of Korea 9,614; Japan 9,329; India 4,552.
Unwrought	2,983	7,439	63	Singapore 2,797; Chile 1,499; Indonesia 1,018.
Semimanufactures	101,615	118,941	2,767	Hong Kong 34,241; Japan 20,675; Republic of Korea 19,126.
Gold:				
Waste and sweepings kilograms	41,621	42,946	13,111	Japan 17,343; Hong Kong 12,324.
Metal including alloys, unwrought and partly wrought do.	6	2,048	1,736	Singapore 201; Japan 110.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	114	(^o)		
Metal:				
Scrap	51,786	68,731	2	Japan 62,777; United Kingdom 1,477.
Pig iron, cast iron, related materials	4,303	1,689	34	Indonesia 789; Japan 562.
Ferroalloys:				
Ferromanganese	2,568	2,460	—	Japan 2,236; Republic of Korea 223.
Ferromanganese	273	62	17	Kenya 42.
Ferronickel	38	(^o)	—	All to Hong Kong.
Ferrosilicon	1,694	751	—	Hong Kong 691; Pakistan 40.
Silicon metal	1	4	—	Hong Kong 3.
Unspecified	1,114	56	—	Hong Kong 25; Malaysia 18.
Steel, primary forms	311,145	204,667	22,699	Indonesia 114,029; Australia 19,459; Japan 18,446.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	842,866	1,024,811	60,825	Japan 539,497; Republic of Korea 100,540.
Clad, plated, coated	110,826	92,704	27,939	Japan 35,210; Hong Kong 18,514.
Of alloy steel	36,828	6,762	54	Republic of Korea 1,998; Thailand 1,574; Indonesia 544.
Bars, rods, angles, shapes, sections	170,615	225,124	4,805	Thailand 46,145; Hong Kong 37,975.
Rails and accessories	884	527	41	Hong Kong 159; Japan 143; Thailand 127.
Wire	28,855	31,047	7,771	Indonesia 10,195; Philippines 3,558.
Tubes, pipes, fittings	176,558	186,438	87,853	Japan 23,904; Saudi Arabia 16,634.
Lead:				
Oxides	3,969	12,226	—	Japan 11,280; Thailand 400; Philippines 280.
Metal including alloys:				
Scrap	(^o)	317	—	Indonesia 231; Japan 54; Hong Kong 32.
Unwrought	19,305	16,690	—	Republic of Korea 9,568; Japan 5,279; Thailand 813.
Semimanufactures	291	361	21	Singapore 93; Hong Kong 88.
Magnesium: Metal including alloys:				
Scrap	560	500	—	Japan 465; Netherlands 19.
Unwrought	6	3	—	Indonesia 2.
Semimanufactures	11	25	19	Hong Kong 4.

See footnotes at end of table.

TABLE 2—Continued
TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade	116	89	—	Nigeria 77; Indonesia 6; Australia 5.
Oxides	120	16	—	Mainly to Thailand.
Metal including alloys, all forms	1	6	1	Japan 3; Thailand 2.
Mercury	139	4	1	Japan 3.
Molybdenum:				
Oxides	128	108	—	Netherlands 72; Belgium-Luxembourg 36.
Metal including alloys:				
Scrap	kilograms	202	1,449	— All to Japan.
Unwrought	do.	1,267	—	
Semimanufactures	do.	7,036	33,100	4,489 Philippines 21,036; Thailand 5,018.
Nickel:				
Matte and speiss		2	16	— All to Republic of Korea.
Oxides and hydroxides	kilograms	—	500	— All to Hong Kong.
Metal including alloys:				
Scrap		3,111	3,041	48 Japan 2,425; India 348.
Unwrought		1,403	1,421	— Belgium-Luxembourg 1,020; Australia 238; Japan 160.
Semimanufactures		106	139	5 Japan 28; Malaysia 19.
Platinum-group metals: Metals including alloys, unwrought and partly wrought				
	kilograms	11,425	11,524	1,245 Japan 9,585; United Kingdom 469.
Rare-earth metals	do.	4,478	13,567	550 Netherlands 6,700; Malaysia 4,864.
Selenium, elemental	do.	114	1,000	— Indonesia 500; Nigeria 500.
Silicon, high-purity	do.	24,597	41,394	36 Hong Kong 17,726; Thailand 14,044; Indonesia 5,018.
Silver:				
Waste and sweepings ^d	do.	2,215,408	358,105	282,630 Canada 55,040; Hong Kong 11,445.
Metal including alloys, unwrought and partly wrought	do.	32,123	740	— Hong Kong 434; Malaysia 269.
Tin:				
Oxides	kilograms	—	8	— All to Malaysia.
Metal including alloys:				
Scrap		28	41	1 Japan 25; Hong Kong 15.
Unwrought		27	18	— Japan 12; United Kingdom 4.
Semimanufactures		1,255	1,151	171 Hong Kong 513; Philippines 94; Italy 70.
Titanium:				
Ore and concentrate		139	84	— Indonesia 56; Thailand 27.
Oxides		293	3,840	— Hong Kong 3,700; Indonesia 37.
Metal including alloys, all forms		58	108	6 Italy 40; Japan 31; Singapore 18.
Tungsten:				
Ore and concentrate		(^e)	—	
Metal including alloys:				
Scrap		22	18	— Japan 9; Netherlands 7; West Germany 2.
Unwrought		15	—	

See footnotes at end of table.

TABLE 2—Continued
TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued:				
Tungsten—Continued:				
Metals including alloys—Continued:				
Semimanufactures	145	195	(¹)	Philippines 144; Hong Kong 48.
Uranium and thorium: Oxides and other compounds	—	17	17	
Vanadium: Oxides	320	225	—	All to Japan.
Zinc:				
Oxides	5,928	4,060	158	Japan 2,536; Thailand 518.
Blue powder kilograms	182,923	24,160	—	Australia 15,300; Hong Kong 8,860.
Metal including alloys:				
Scrap	659	357	20	Japan 120; Malaysia 68; Hong Kong 34.
Unwrought	8,434	2,410	73	Hong Kong 1,332; Malaysia 277; Japan 199.
Semimanufactures	1,003	1,689	378	Japan 288; Canada 229; Hong Kong 208.
Zirconium:				
Ore and concentrate	18	129	—	Hong Kong 56; Republic of Korea 38; Thailand 20.
Oxides	30	10	10	
Metal including alloys, all forms	95	6	—	All to Hong Kong.
Other:				
Ores and concentrates	481	724	—	Japan 361; Hong Kong 178; Republic of Korea 85.
Oxides and hydroxides	290	251	11	Japan 128; Singapore 45.
Ashes and residues	1,358	1,692	—	Japan 1,649; Canada 20.
Base metals including alloys, all forms	288	123	5	Hong Kong 55; Singapore 32.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	204	1,169	(¹)	Japan 214; Indonesia 81; unspecified 671.
Artificial:				
Corundum	19	(¹)	—	All to Canada.
Silicon carbide	835	583	—	Japan 342; Indonesia 162; Italy 50.
Dust and powder of precious and semi-precious stones including diamond	10	2	(¹)	Thailand 1.
Grinding and polishing wheels and stones	6,442	8,378	1,995	Thailand 2,410; Singapore 682; Australia 676.
Asbestos, crude	(¹)	—		
Barite	—	2	—	All to Hong Kong.
Boron materials: Oxides and acids	76	55	—	Republic of Korea 24; Sri Lanka 16; Hong Kong 8.
Cement thousand tons	2,203	893	—	Japan 644; Hong Kong 233.
Chalk	1,794	56	—	Hong Kong 17; unspecified 35.
Clays, crude:				
Bentonite	(¹)	—		
Fire clay	56	176	—	Hong Kong 111; Indonesia 60.
Kaolin	2,587	3,423	17	Philippines 1,629; Indonesia 502; Thailand 417.
Unspecified	1,222	3,392	(¹)	Philippines 1,441; Thailand 848; Hong Kong 460.
Diamond:				
Natural:				
Gem, not set or strung thousand carats	13,170	85	—	Belgium-Luxembourg 45; Hong Kong 25.
Industrial stones do.	57,225	—		

See footnotes at end of table.

TABLE 2—Continued
TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamonds—Continued:				
Synthetic:				
Gem, not set or strung	thousand carats	5,015	15	— All to Japan.
Industrial stones	do.	19,990	59,835	— Japan 59,090; Hong Kong 565.
Diatomite and other infusorial earth		156	195	— Thailand 108; Philippines 36.
Feldspar, fluorspar, related materials		285	268	— Philippines 191; Japan 37; Singapore 20.
Fertilizer materials:				
Crude, n.e.s.				
		386	156	— Hong Kong 127; Republic of Korea 11.
Manufactured:				
Ammonia		38	41	— Hong Kong 40.
Nitrogenous		16,131	30,551	22 Thailand 15,800; Fiji 11,704.
Phosphatic		6,552	7,299	— Fiji 7,281; Indonesia 17.
Potassic		48,267	80,895	163 Hong Kong 35,503; Singapore 21,395; Japan 15,692.
Unspecified and mixed		4,425	679	— Hong Kong 651; Japan 20.
Graphite, natural		144	16	— Republic of Korea 10; Hong Kong 2; Nigeria 2.
Gypsum and plaster		5,104	3,299	(?) Philippines 1,156; Indonesia 931; Hong Kong 463.
Iodine	kilograms	611	—	
Kyanite and related materials		4	2	— All to Japan.
Lime		10	31	3 Hong Kong 10; unspecified 11.
Magnesium compounds:				
Magnesite, crude				
		4	—	
Oxides and hydroxides		448	949	— Philippines 417; Indonesia 250.
Meerschaum, amber, jet		31	36	22 West Germany 5; Hong Kong 3.
Mica:				
Crude including splittings and waste		307	273	3 New Zealand 162; United Kingdom 52; Japan 44.
Worked including agglomerated splittings		35	95	26 Hong Kong 48; Japan 17.
Phosphates, crude		80	134	— Indonesia 60; Hong Kong 54.
Phosphorus, elemental		208	(?)	— All to Saudi Arabia.
Pigments, mineral:				
Crude				
		—	50	— All to Hong Kong.
Iron oxides and hydroxides, processed		9,268	201	(?) Malaysia 84; Indonesia 74; Philippines 23.
Precious and semiprecious stones other than diamond:				
Natural	kilograms	471,960	404,425	40,124 Hong Kong 138,778; Thailand 117,082.
Synthetic	do.	191,026	130,612	29,433 Turkey 53,085; Italy 14,014.
Quartz crystal, piezoelectric	do.	2,300	295	— Thailand 200; Hong Kong 90.
Salt and brine		6,834	8,000	— All to Hong Kong.
Sodium compounds, n.e.s.:				
Soda ash, manufactured				
		35,323	10,804	— Indonesia 5,003; Hong Kong 4,501; Vietnam 1,050.
Sulfate, manufactured				
		30,064	26,075	— Republic of Korea 9,560; Philippines 8,885; Thailand 2,160.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked				
		5,696	5,899	480 Japan 4,600; Republic of Korea 293.
Worked				
		59,767	52,117	13,735 Japan 14,484; West Germany 4,706.

See footnotes at end of table.

TABLE 2—Continued
TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued:				
Stone, sand and gravel—Continued:				
Dolomite, chiefly refractory-grade	213,349	105,197	—	Japan 104,400; Singapore 480.
Gravel and crushed rock	358,493	382,700	13	Japan 369,468; Indonesia 2,066.
Limestone other than dimension	1,697	118	—	Indonesia 100; Thailand 18.
Quartz and quartzite	35	115	(²)	Singapore 78; Thailand 8.
Sand other than metal-bearing	406,108	407,992	55	Japan 401,456.
Sulfur:				
Elemental:				
Crude including native and byproduct	146	94	—	Hong Kong 49; Malaysia 28.
Colloidal, precipitated, sublimed	9	26	—	Hong Kong 18; Thailand 5.
Sulfuric acid	95	194	—	Hong Kong 131; Thailand 25; Malaysia 18.
Talc, steatite, soapstone, pyrophyllite	290	1,741	—	Thailand 1,374; Philippines 263.
Other:				
Crude	48,522	8,277	22	Indonesia 6,220; Philippines 494; Singapore 467.
Slag and dross, not metal-bearing	141,516	92,888	(²)	Japan 60,626; Singapore 20,612.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	61	(²)	—	Mainly to Hong Kong.
Carbon:				
Carbon black	8,158	10,822	—	Indonesia 6,010; Philippines 1,241.
Gas carbon	120	137	—	Hong Kong 49; Malaysia 40; Indonesia 20.
Coal, all grades including briquets	19	9	—	NA.
Coke and semicoke	51,246	24,527	2	Singapore 16,688; Philippines 6,832; Japan 841.
Petroleum refinery products:				
Gasoline, motor				
thousand 42-gallon barrels	2,371	3,085	—	NA.
Mineral jelly and wax	do.	142	12	— Egypt 1; New Zealand 1; Thailand 1.
Kerosene and jet fuel	do.	1,362	1,013	— NA.
Distillate fuel oil	do.	3,485	2,813	— Panama 924; Japan 369; unspecified 1,465.
Lubricants	do.	753	756	(²) Republic of Korea 171; France 155; Indonesia 116.
Residual fuel oil	do.	14,766	8,094	— Japan 456; Philippines 388; unspecified 4,683.
Bitumen and other residues	do.	309	278	— Indonesia 116; Hong Kong 105.
Bituminous mixtures	do.	1	1	— NA.
Petroleum coke	do.	118	104	— Mainly to Japan.

¹Revised. NA Not available.

²Table prepared by Audrey D. Wilkes.

³Less than 1/2 unit.

⁴Unreported quantity valued at \$5,000 exported to United States (\$3,000); and Austria (\$2,000).

⁵Includes other precious metals.

TABLE 3
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	43	64	2	Japan 61.
Aluminum:				
Ore and concentrate	31,297	48,025	6	Malaysia 43,327; Japan 2,012.
Oxides and hydroxides	36,644	55,276	491	Japan 28,714; Australia 15,620.
Metal including alloys:				
Scrap	71,711	70,265	55,504	Australia 5,967; Hong Kong 916.
Unwrought	222,824	245,356	31,429	Australia 120,142; United Arab Emirates 17,536.
Semimanufactures	67,914	63,801	10,833	Japan 25,984; Australia 9,037.
Antimony:				
Oxides	987	1,075	51	France 274; Japan 214; Thailand 140.
Metal including alloys, all forms	1,242	1,954	—	Thailand 55; unspecified Asian countries 1,886.
Arsenic:				
Elemental kilograms	194	250	68	Japan 181.
Oxides and acids	298	479	(²)	France 431; Belgium-Luxembourg 48.
Beryllium: Metal including alloys, all forms kilograms				
	15	7	—	All from Japan.
Bismuth: Metal including alloys, all forms				
	20	13	1	Japan 4; United Kingdom 3.
Cadmium:				
Oxides and hydroxides	274	254	87	Belgium-Luxembourg 110; Republic of Korea 53.
Metal including alloys, all forms kilograms	296	25,640	—	Australia 16,000; Yugoslavia 5,014; Poland 3,126.
Chromium:				
Ore and concentrate	35,709	4,492	(²)	Philippines 906; unspecified African countries 3,445.
Oxides and hydroxides	2,497	3,009	163	Japan 1,505; West Germany 930.
Metal including alloys, all forms	60	27	(²)	United Kingdom 15; Japan 9.
Cobalt:				
Oxides and hydroxides	195	148	9	Belgium-Luxembourg 72; United Kingdom 46.
Metal including alloys, all forms	118	101	4	Zaire 40; West Germany 15.
Columbium and tantalum: Tantalum metal including alloys, all forms kilograms				
	388	411	145	Japan 258.
Copper:				
Ore and concentrate	152,261	10,625	—	Chile 10,226; Singapore 398.
Matte and speiss including cement copper	5	19	—	Japan 12; Hong Kong 6.
Oxides and hydroxides	254	362	60	Japan 221; Belgium-Luxembourg 26.
Sulfate	738	872	82	Japan 649; Thailand 60.
Metal including alloys:				
Scrap	30,444	15,333	8,550	Japan 2,076; Hong Kong 1,786.
Unwrought	278,666	256,168	77,533	Chile 95,588; Philippines 30,912.
Semimanufactures	64,306	56,490	4,003	Japan 37,088; Indonesia 1,057.
Germanium: Oxides kilograms				
	92	145	—	West Germany 135; Japan 10.
Gold:				
Bullion do.	152,419	98,767	(²)	Switzerland 42,392; United Kingdom 22,739; Hong Kong 15,184.
Metal including alloys, unwrought and partly wrought do.	4,245	2,400	284	Japan 905; Singapore 572.

See footnotes at end of table.

TABLE 3—Continued
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	8,371	7,762	(^c)	Austria 4,608; Brazil 2,881.
Pyrite, roasted	8	2	—	All from Philippines.
Metal:				
Scrap	1,552,971	1,286,723	555,637	Hong Kong 253,874; Australia 135,327.
Pig iron, cast iron, related materials	628,429	708,700	3,891	Brazil 364,036; Albania 54,416.
Ferrous alloys:				
Ferrochromium	41,341	35,182	2	Unspecified African countries 34,616.
Ferromanganese	18,982	21,120	(^c)	Japan 2,882; unspecified African countries 14,314.
Ferromolybdenum	328	434	165	Chile 73; Netherlands 62.
Ferronickel	19	(^c)	—	All from France.
Ferrosilicomanganese	3,991	12,430	—	Republic of Korea 960; Philippines 900; unspecified African countries 9,784.
Ferrosilicon	23,556	36,207	785	Norway 8,577; unspecified African countries 13,599.
Silicon metal	5,297	11,037	38	Australia 842; Canada 566; unspecified Asian countries 8,945.
Unspecified	2,012	1,820	454	Japan 306; United Kingdom 163.
Steel, primary forms	2,251,534	2,461,379	23,788	Turkey 607,113; Brazil 329,628; unspecified African countries 462,950.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	1,157,754	991,933	9,731	Japan 508,610; Brazil 224,257.
Clad, plated, coated	633,739	618,948	8,986	Japan 472,206; Republic of Korea 59,907.
Of alloy steel	221,838	212,165	5,579	Japan 145,760; Republic of Korea 12,745.
Bars, rods, angles, shapes, sections	1,374,939	1,271,979	2,666	Japan 343,355; Brazil 166,406; unspecified African countries 199,913.
Rails and accessories	33,065	24,372	2,134	Japan 15,543; Republic of Korea 2,935.
Wire	375,809	27,493	1,804	Japan 13,272; Republic of Korea 5,205.
Tubes, pipes, fittings	193,168	178,227	1,212	Japan 110,625; East Germany 7,324.
Lead:				
Ore and concentrate	1	—	—	—
Oxides	2,040	2,073	3	France 964; West Germany 739.
Metal including alloys:				
Scrap	72,741	34,251	5,690	Japan 14,306; Australia 5,380.
Unwrought	26,387	64,031	14,217	Australia 14,632; Peru 5,107.
Semimanufactures	203	112	9	Japan 53; Australia 20; Indonesia 20.
Lithium: Oxides and hydroxides kilograms	11,478	24,338	18,131	Japan 6,180.
Magnesium: Metal including alloys:				
Scrap	—	17	—	All from Hong Kong.
Unwrought	899	1,022	510	Norway 273; France 198.
Semimanufactures	178	148	52	Japan 76.

See footnotes at end of table.

TABLE 3—Continued
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade	196,032	141,392	—	Australia 32,910; Indonesia 12,784; Gabon 12,200.
Oxides	2,949	3,893	2	India 1,915; Japan 756.
Metal including alloys, all forms	295	89	4	West Germany 32; United Kingdom 23.
Mercury:				
Cinnabar and vermillion	18	15	—	Hong Kong 3; unspecified Asian countries 12.
Metal	18	11	3	Spain 4; Japan 2.
Molybdenum:				
Oxides kilograms	6,043	10,020	9,990	Singapore 29.
Metal including alloys:				
Unwrought	102	109	59	West Germany 46.
Semimanufactures	32	30	17	Japan 9; West Germany 2.
Nickel:				
Matte and speiss	9,923	6,035	—	Canada 3,407; Australia 2,628.
Oxides and hydroxides	335	398	([^])	Canada 290; Finland 33; West Germany 30.
Metal including alloys:				
Scrap	7	14	—	Malaysia 13; Hong Kong 1.
Unwrought	7,060	11,153	79	Belgium-Luxembourg 5,746; Canada 3,349.
Semimanufactures	779	952	126	Japan 499; Canada 62; Sweden 61.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms				
	3,596	1,712	796	Japan 600; Canada 194.
Rare-earth:				
Ores and concentrates	500	332	313	Japan 19.
Oxides and other compounds	497	340	201	Japan 119; United Kingdom 11.
Metals including alloys, all forms	2	56	4	Japan 51.
Selenium, elemental	28	24	([^])	Australia 14; Japan 10.
Silicon, high-purity	80	229	25	Australia 100; West Germany 67.
Silver:				
Ore and concentrate ³ value, thousands	\$79	\$2	\$2	
Waste and sweepings ³ kilograms	490	8	2	Japan 6.
Metal including alloys, unwrought and partly wrought	129	121	39	Japan 26; Australia 25.
Tellurium: Elemental kilograms	404	249	7	U.S.S.R. 168; Belgium-Luxembourg 50.
Tin:				
Oxides	24	24	—	West Germany 7; United Kingdom 6; Japan 5.
Metal including alloys:				
Scrap	654	332	—	Singapore 211; Hong Kong 111.
Unwrought	4,588	5,164	7	Malaysia 2,669; Indonesia 1,256.
Semimanufactures	360	338	74	Hong Kong 176; Singapore 32.
Titanium:				
Ore and concentrate	19,096	18,617	16	Malaysia 12,612; Australia 4,162.
Oxides	19,399	24,217	1,936	Japan 13,150; West Germany 4,622.
Metal including alloys, semimanufactures	109	254	28	Japan 129; United Kingdom 94.

See footnotes at end of table.

TABLE 3—Continued
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Tungsten:				
Ore and concentrate	—	(^o)	(^o)	
Metal including alloys:				
Scrap	26	29	—	All from Japan.
Unwrought kilograms	10,461	11,273	6,616	Japan 2,360; West Germany 1,085.
Semimanufactures	94	584	42	Austria 505; Japan 19.
Uranium and thorium: Oxides and other compounds kilograms	1,110	—		
Vanadium:				
Oxides and hydroxides	10	31	12	West Germany 11; Japan 8.
Metal including alloys, all forms	21	38	5	Unspecified African countries 33.
Zinc:				
Oxides	937	2,870	199	Brazil 721; Thailand 679; Republic of Korea 405.
Blue powder	509	652	—	Australia 256; Japan 210; Republic of Korea 125.
Metal including alloys:				
Scrap	163,383	155,345	83,835	Netherlands 12,194; West Germany 11,856.
Unwrought	70,818	85,728	357	Australia 26,382; Canada 16,808; Japan 10,097.
Semimanufactures	942	1,507	93	Japan 728; Thailand 343.
Zirconium:				
Ore and concentrate	26,078	7,064	342	Australia 5,735; unspecified African countries 764.
Oxides	244	203	56	Japan 52; United Kingdom 35.
Metal including alloys, all forms	6	1	1	
Other:				
Ores and concentrates	3,192	3,097	138	Australia 1,633; Canada 1,080.
Oxides and hydroxides	813	1,416	24	Japan 1,236; Belgium-Luxembourg 53.
Ashes and residues	37,674	47,818	5,516	Japan 39,099; Australia 726.
Base metals including alloys, all forms	28	9	2	Japan 6.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.				
	19,927	13,637	302	Indonesia 8,123; Japan 1,689; France 1,425.
Artificial:				
Corundum	8,441	4,128	5	Japan 1,216; Hong Kong 354; unspecified Asian countries 2,035.
Silicon carbide	7,842	5,948	4	Italy 1,112; Japan 855; West Germany 699.
Dust and powder of precious and semiprecious stones including diamond kilograms				
	5,612	13,423	834	Thailand 10,000; Japan 1,380.
Grinding and polishing wheels and stones	3,545	3,727	310	Italy 1,543; Japan 846.
Asbestos, crude	29,464	15,165	—	Canada 8,301; unspecified African countries 5,984.
Barite and witherite	1,719	11,960	—	Thailand 6,683; unspecified Asian countries 5,222.
Boron materials:				
Crude natural borates				
Elemental kilograms	287	382	215	West Germany 167.
Oxides and acids	3,672	4,668	3,225	Italy 690; Chile 636.
Bromine kilograms	259	20,517	1	Israel 20,370; Japan 115.
Cement	412,448	930,024	5	Indonesia 223,299; unspecified Asian countries 538,861.

See footnotes at end of table.

TABLE 3—Continued
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Clays, crude:				
Bentonite	26,533	49,133	24,692	Australia 23,323.
Fire clay	7,069	4,691	65	India 1,600; Hong Kong 840; Japan 638.
Kaolin	358,541	568,628	106,066	Indonesia 85,777; Hong Kong 56,376; Malaysia 54,572.
Unspecified	202,448	115,594	8,557	Hong Kong 56,765; Malaysia 18,206.
Cryolite and chiolite	116	4	—	All from Japan.
Diamond:				
Natural:				
Gem, not set or strung thousand carats	250	4,940	140	Hong Kong 4,775.
Industrial stones do.	490	25	(^c)	Mainly from Japan.
Synthetic:				
Gem, not set or strung do.	(^c)	1,570	(^c)	Japan 1,500; Thailand 50.
Industrial stones do.	2,100	2,115	60	Japan 1,895; Ireland 160.
Diatomite and other infusorial earth	11,039	6,117	5,086	Japan 712; West Germany 224.
Feldspar, fluorspar, related materials	499,914	571,520	990	Thailand 252,835; Hong Kong 90,488; unspecified Asian countries 96,260.
Fertilizer materials:				
Crude, n.e.s.				
	1,075	1,034	64	Japan 583; Malaysia 116; Philippines 100.
Manufactured:				
Ammonia	238,781	201,356	29	Saudi Arabia 59,316; Indonesia 44,607; Qatar 44,433.
Nitrogenous	357,852	80,167	40	Indonesia 56,966; Bangladesh 9,258.
Phosphatic	209	197	—	Japan 196.
Potassic	245,185	257,412	170	Canada 153,778; Israel 48,484.
Unspecified and mixed	19,314	19,208	5,109	Japan 8,411; West Germany 1,845.
Graphite, natural	10,106	7,393	140	Republic of Korea 4,009; Zimbabwe 1,258.
Gypsum and plaster	483,786	462,635	498	Thailand 460,031; Japan 1,343.
Iodine	33	25	2	Japan 19; Belgium-Luxembourg 2.
Kyanite and related materials	2,461	4,229	527	Australia 127; unspecified African countries 3,544.
Lime	17	42	9	Japan 33.
Magnesium compounds:				
Magnesite	4,491	123	—	Japan 103; Thailand 20.
Oxides and hydroxides	51,080	60,921	915	Japan 14,432; India 12,121; Malaysia 4,400.
Meerschaum, amber, jet	45	382	17	Philippines 208; Netherlands 140.
Mica:				
Crude including splittings and waste	992	1,116	140	Malaysia 468; Thailand 260.
Worked including agglomerated splittings	359	280	14	Japan 134; Belgium-Luxembourg 49.
Phosphates, crude	391,353	420,425	60	Jordan 338,363; Israel 37,037; Morocco 31,498.
Phosphorus, elemental	3,039	1,752	1	U.S.S.R. 919; unspecified Asian countries 465.
Pigments, mineral:				
Natural, crude	327	706	—	Hong Kong 254; France 231; Italy 192.
Iron oxides and hydroxides, processed	35,540	31,066	534	Japan 22,931; West Germany 1,781.
Potassium salts, crude	22	44	—	All from West Germany.

See footnotes at end of table.

TABLE 3—Continued
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond:				
Natural	3,135	2,847	67	Brazil 1,135; Hong Kong 161; unspecified Asian countries 371.
Synthetic	8	48	26	Republic of Korea 7; Hong Kong 4; Japan 4.
Pyrite, unroasted	27	14	—	All from Japan.
Quartz, piezoelectric:				
Natural kilograms	7	29	—	Japan 25; Israel 4.
Synthetic do.	231	105	—	All from Japan.
Salt and brine	851,667	942,384	78	Australia 819,232; Mexico 122,791.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	96,629	121,182	105,615	Poland 9,623; Kenya 2,962.
Sulfate, manufactured	1,806	371	83	Thailand 103; Japan 93.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	394,458	424,017	13,573	India 90,249; Spain 60,428; Thailand 45,520.
Worked	18,580	26,046	258	Italy 13,710; Hong Kong 4,645.
Dolomite, chiefly refractory-grade	3,967	40,412	32	Philippines 16,474; Republic of Korea 10,900.
Gravel and crushed rock	23,700	16,920	1,065	France 8,063; Japan 1,803; Philippines 1,604.
Limestone other than dimension	558,673	462,217	—	All from Japan.
Quartz and quartzite	16,260	2,154	5	Japan 1,113; India 390.
Sand other than metal-bearing	66,108	216,081	4,151	Australia 100,771; Malaysia 44,400; Vietnam 33,416.
Sulfur:				
Elemental:				
Crude including native and byproduct	93,505	114,827	2,525	Canada 99,110; Japan 13,189.
Colloidal, precipitated, sublimed	152,578	116,400	15,250	Canada 78,067; Japan 22,977.
Dioxide	25	29	(²)	Japan 20; West Germany 9.
Sulfuric acid	258,408	306,728	422	Japan 210,417; Republic of Korea 95,663.
Talc, steatite, soapstone, pyrophyllite	54,693	62,663	3,698	Hong Kong 4,265; unspecified Asian countries 45,893.
Vermiculite, perlite, chlorites	9,464	8,840	89	Philippines 2,844; Japan 2,536; unspecified African countries 2,586.
Other:				
Crude	133,734	135,536	591	Republic of Korea 115,133; Japan 9,122.
Slag and dross, not metal-bearing	38,279	110,286	134	Japan 109,349; Norway 236.
MINERAL FUELS AND RELATED MINERALS				
Asphalt and bitumen, natural	121	6	—	All from Japan.
Carbon:				
Carbon black	18,496	18,506	5,580	Australia 4,235; Republic of Korea 3,677.
Gas carbon	1,627	2,295	—	U.S.S.R. 2,220; Japan 18.
Coal, all grades including briquets thousand tons	17,067	19,012	4,471	Australia 6,741; unspecified African countries 5,685.
Coke and semicoke	155,881	164,379	—	Japan 134,480; unspecified Asian countries 29,841.
Peat including briquets and litter	1,640	2,530	117	Netherlands 550; Canada 501; Finland 420.

See footnotes at end of table.

TABLE 3—Continued
TAIWAN: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum:				
Crude thousand 42-gallon barrels	152,493	151,431	303	Saudi Arabia 56,088; Kuwait 20,653; Oman 17,287.
Refinery products:				
Liquefied petroleum gas	do.	10,262	17,990	(²) Indonesia 6,954; Saudi Arabia 6,722.
Gasoline	do.	816	377	— Singapore 242; Republic of Korea 135.
Mineral jelly and wax	do.	194	211	29 Japan 63; Indonesia 30.
Kerosene and jet fuel	do.	6,216	16,676	691 Singapore 10,547; Republic of Korea 1,310.
Distillate fuel oil	do.	5,373	5,035	1,216 Republic of Korea 1,148; Singapore 886.
Lubricants	do.	³ 1,126	1,284	417 Japan 311; Singapore 250.
Residual fuel oil	do.	17,377	16,400	9,794 Japan 3,971; Singapore 2,392.
Bituminous mixtures	do.	(²)	3	2 Japan 1.
Petroleum coke	do.	45	105	95 Japan 10.

¹Revised.

²Table prepared by Audrey D. Wilkes.

³Less than 1/2 unit.

⁴May include other precious metals.

⁵Unreported quantity valued at \$17,300 imported mainly from the United States, West Germany, and Hong Kong.

TABLE 4
TAIWAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity	
Cement	Asia Cement Corp.	Hsinchu	1,800	
Do.	do.	Hualien	11,150	
Do.	Chia Hsin Cement Corp.	Kaohsiung	2,200	
Do.	Lucky Cement Corp.	Tungao	1,800	
Do.	Chien Tai Cement Co. Ltd.	Kaohsiung	1,758	
Do.	Hsing Tai Cement Co. Ltd.	Taipei	1,300	
Do.	Taiwan Cement Corp.	Chutung	1,400	
Do.	do.	Hualien	280	
Do.	do.	Kaohsiung	1,900	
Do.	do.	Suao	2,230	
Do.	Universal Cement Corp.	Kaohsiung	1,400	
Coal, bituminous	Numerous independent operators	Taipei Prefecture (74 pits)	1,200	
Marble	Taiwan Marble Co., Ltd.	Panchiao	10	
Nickel	Taiwan Nickel Refinery Corp.	Kaohsiung	8	
Petroleum:				
Crude	thousand barrels per year	Chinese Petroleum Corp.	Chuhuangkeng and Tungtzuchiao	850
Refinery products	do.	Chinese Petrochemical Development Corp.	Taipei	150,000
Do.	do.	do.	Taoyuan	33,000
Steel		China Steel Corp.	do.	6,400
Do.		Tung Eng Iron Work Co. Ltd.	Kaohsiung	90
Sulfur		China Petrochemical Development Corp.	Taipei	50

TABLE 5
TAIWAN: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1991

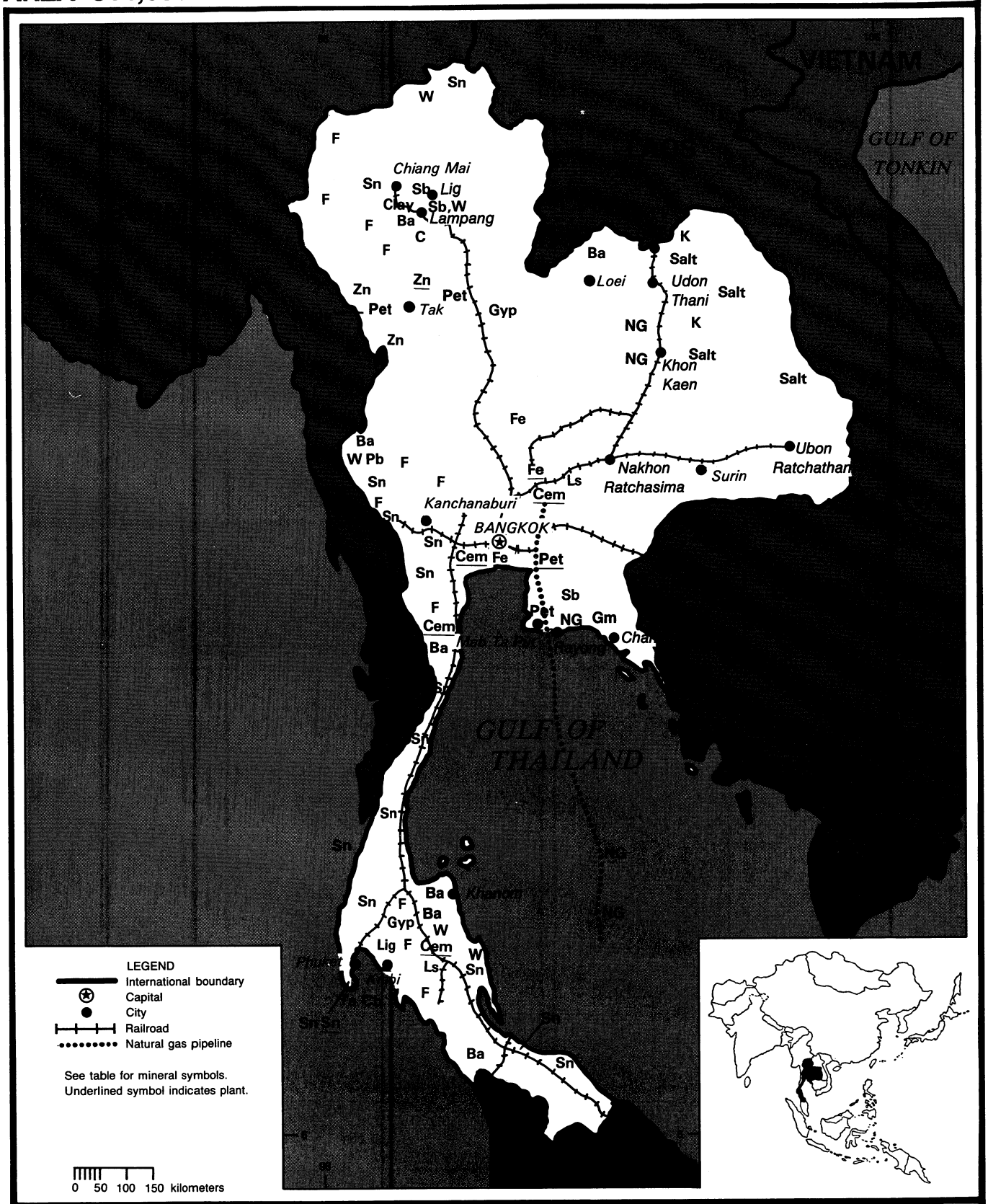
(Metric tons unless otherwise specified)

Commodity	Reserves	
Coal	170,000	
Dolomite	110,000	
Limestone	395,000	
Marble	280,000,000	
Natural gas	thousand cubic meters	20,000,000
Talc	2,000	

THAILAND

AREA 514,000 km²

POPULATION 57.0 million



THE MINERAL INDUSTRY OF

THAILAND

By Pui-Kwan Tse

After 4 successive years of remarkable growth, the Thai economy appeared to return to a high growth rate but at a more sustainable level. The period from the second half of 1990 to 1991 was an eventful period for the Thai economy. The effects of the Persian Gulf crisis, the recession in the United States, the financial scandal in Japan, domestic political unrest, and restrictive monetary policy imposed by the Bank of Thailand all combined to slow the Thai economy's double-digit growth rate that was sustained over the past several years. In 1991, economic growth moderated to 7.9%. The infrastructure and current accounting system could not readily absorb the overheated economy during the past several years. The economic slowdown should be a useful pause to regroup to prepare for the next economic boom.

Thailand is an open economy. Exports accounted for almost 30% of GDP. Imports, mostly of capital goods, raw materials, and energy, accounted for 42% of GDP. Uncertainties in the world economy would significantly affect Thailand's export performance. Import growth declined from 29% in 1990 to 16.4% in 1991 in line with demand. New investment fell by as much as 30% in 1991. Despite strong export performance, the slowdown in service and unrequited transfer surpluses led to a large trade deficit of \$8.0 billion. With a relatively high domestic interest rate of 16%, net capital inflow increased and more than offset the current account deficit, resulting in a balance of payment surplus of \$4.4 billion. At the end of 1991, international reserves increased to \$18.4 billion or 5.7 months of imports.

After a year of low output, agricultural production in 1991 increased 3.6%. The growth was attributed to favorable weather and attractive prices. Fishery also recovered owing to the expansion of coastal prawn farming and deep-sea fishing after being granted more off-territorial-water fishing concessions. Forestry output continued to decline at a slower pace owing to the availability of eucalyptus logging from the Forest Industry Organization concession and the remaining stock of logs uprooted by Typhoon Gay in 1990.

In 1991, manufacturing output rose 9.5%, declining from last year's 14.9% increase. Manufacturers slowed down production and depleted their stocks at yearend preparation for the introduction of Value Added Tax (VAT) beginning January 1, 1992.

Mining production expansion moderated to 12.6% as the growth in quarrying output reflected the increase in construction activities. The output of exporting minerals, particularly tin, tungsten, and fluorspar, declined due to depressed overseas prices. However, output of minerals and fuel minerals for domestic industry consumption increased at relatively high rates.

The service sector grew 5.1% compared with 5.8% in 1990. Tourism and related businesses were sluggish, especially during the first half of the year when the Persian Gulf war broke out.

At the end of 1991, Thailand's population was 57 million, an increase of 1.2% from that of 1990. Per capital GDP increased 12.5% to \$1,622. The labor force was 31.9 million. The unemployment rate increased from 3.8% in 1990 to 4.2% in 1991. Thailand has a shortage of engineers and skilled laborers.

GOVERNMENT POLICIES AND PROGRAMS

Thailand's economic development policies were based on a competitive, export-oriented, free-market philosophy. Building from a base of strong agricultural production, the Thai Government pursued a policy of encouraging diversification toward export-oriented light industries and increased reliance on earnings from tourism. During 1991, the monetary policy was to ensure sufficient credit expansion whose distribution was beneficial to further economic growth and further development. A number of deregulations were undertaken to promote efficient management of financial institutions, such as relaxing branch openings, reducing commercial banks' Government bond holding from 9.5% to 8% of total deposit, and redefining "rural credit" to encompass enterprises related to rural job creation. The second phase of foreign exchange deregulation was also implemented to promote flexible capital movement. The authorities amended the revenue code to eliminate double taxation, setting a uniform rate of income tax at 15%. Preparations were made for the introduction of the Securities Exchange Act, which would be the groundwork for capital market and financial instrument development.

Increased public awareness of the environmental impact of mining, abetted by numerous of inadequate reclamation of mined-out areas seriously constrained the expansion of the mining sector. Under pressure from environmental groups and the general public, the Government was reluctant to open up national forest reserves, the last areas in Thailand with

high potential for exploration and mining large mineral deposits. The Thai Development Research Institute, an influential private think tank, proposed that the mining industry finance a bulk of \$30 million for the reclamation. Miners would pay a set fee, or "bond," per ton to extract ores. The set fee depends on the value of the mineral and on relevant environmental factors. The proposal remained under study.

PRODUCTION

At one time, the mineral industry in Thailand was an important economic force. In recent years, the mining sector has diminished greatly in relative importance with the rapid rise of the manufacturing and service sectors. The value of mineral exports has fallen from 15% to less than 1% of Thailand's total exports. The number of individuals employed in the mining sector has dropped from a peak of about 100,000 in 1980 to less than 40,000 in 1991.

The output value of the mining sector was about \$668 million in 1991, an increase of 0.4% from that of last year. There were more than 40 minerals produced in Thailand. However, only about 20 of them were considered to be economically significant. The major minerals produced were feldspar, kaolin, lignite, limestone, tin, and zinc. Zinc has replaced tin as the major metallic mineral produced and consumed domestically. Lignite production increased by 18% in 1991 over that of 1990. The increase resulted in use in the power and industrial sectors as a substitute for oil imports. Because of a slowdown in economic growth, the production of gypsum and limestone for cement production decreased slightly in 1991. (See table 1.)

TRADE

In 1991, Thailand's balance of trade registered a deficit of \$10 billion, up \$89 million from last year. This reflected a 23% rise in exports to \$27.7 billion while imports were \$37.7 billion, an increase of 16%.

The United States remained the most important export market for Thailand, although its share declined to 21.3% of the total exports value in 1991, partly reflecting the economic slowdown in the United States as well as the implementation of the U.S. Trade Retaliation Measure. The second largest market was the EC whose share declined to 21% of the total export value. However, the export market share of Japan rose to 18.1% of the total export value owing to the depreciation of the baht against the yen. The share of Association of Southeast Asian Nations (ASEAN) rose slightly to 11.5%.

In 1991, imports from Japan continued to account for the largest share of the total imports, 30.3%, followed by the EC, 14.5%. ASEAN and the United States each accounted for a share of 12.6%. Notably, imports from the Republic of Korea and Hong Kong grew by almost 60% and more than 80%, respectively, over those of the previous year.

STRUCTURE OF THE MINERAL INDUSTRY

Minerals were counted as state-owned properties. All activities regarding mineral development were supervised by the Government to ensure that benefits will be maximized for the country. All mining companies were privately owned, except the lignite mine at Mae Moh in Lampang Province, which was owned by the Electricity Generating Authority of Thailand (EGAT), a state enterprise designated to mine lignite for power generation. Most mining companies in Thailand conducted small-scale operations. There were several large-scale mines in Thailand such as the zinc mine owned by Padaeng Co.; lignite mines operated by EGAT, Lanna Lignite Co., and Ban Pu Co.; and a lead mine operated by Kanchanaburi Exploration and Mining Co. (KEMCO).

The country's mineral resources were distributed throughout the country. Petroleum occurrences were in the Gulf of Thailand, in a northern offshoot of the

central plain, and in the central part of the Khorat basin in northeast Thailand. Principal companies and operating locations are shown in table 2. (See table 2.)

COMMODITY REVIEW

Metals

Copper.—At present, Thailand has not exploited its copper reserves, which are estimated at about 75 Mmt. The Rayong Copper Industry, a joint venture of Padaeng Industry Co. (51%), Mitsubishi Material Corp. (13%), MIM (12%), Marc Rich (9%), and Mitsubishi Corp. (7.5%), planned to build a \$250 million copper smelter with an annual capacity of 150,000 tons. Rayong Copper was negotiating a site for the smelter. Construction of the smelter was to begin in February 1993, and the smelter was to come on-stream in early 1995.

Sumitomo Metal Mining, a subsidiary of Sumiko Consulting, Japan, reached an agreement with Padaeng Industry to survey for copper, gold, nickel, and zinc deposits in Loei Province. The area of exploration spans several square kilometers. If the survey results proved positive, an agreement was to be signed for boring and drilling operations.

Iron and Steel.—Construction of an \$8 million stainless bright bar plant was completed in December 1991, and trial operation was to begin in January 1992. The plant was in the Bangpoo industrial estate, about 30 km southeast of Bangkok, with a capacity of 3,600 mt/a of bar ranging from 4.76 mm to 19.05 mm in diameter. The plant had a modern continuous drawing machine and cutting equipment. The plant was managed by SKJ Metal Industries, a joint venture between Pinthong Steel, a local special steel distributor, and Japan's Sanyo Special Steel. Pinthong and Sanyo each held 33% of SKJ, while the Japanese trader, Kanematsu, held 16% and Kanematsu's subsidiary Wattana International held the remaining 18%. Sanyo supplied black bars from Japan

while Pinthong was responsible for the marketing and distribution of the finished products.

The Thai Government endorsed the construction of a 750,000-mt/a direct-reduced-iron (DRI) plant at a cost of \$230 million in the Mab Ta Phud industrial district in Rayong Province on Thailand's eastern seacoast. The Industry Ministry will hold 40% of the shareholding in the project, and the Thai private sector will hold the balance. Recent Industry Ministry study indicated that the demand for scrap was about 3.2 Mmt/a, while domestic sources could only provide about 700,000 mt/a. Thailand's scrap imports averaged 2.8 Mmt/a, primarily from Australia and the United States.

Sahaviriya Group, Siam Steel Pipe Group, and the trading firm of Dufenco formed a joint venture to build a plant to produce stainless sheets and slabs in Prachuab Kiri Khan. The proposed project was submitted to Thailand's Board of Investment for approval. The plant is designed to produce 60,000 mt/a of sheet and 120,000 mt/a of slab. The production technology will either be imported from Europe or Japan.

Tin.—The world tin market continued in the doldrums throughout 1991 and world tin stocks showed no signs of diminishing. In 1991, Thailand produced less than 12,000 tons of refined tin, a decrease of 27% from that of 1990. Despite the market slump, the Billiton-owned Thaisarco tin smelter at Phuket Island decided to start up its second reverberatory furnace during the monsoon season. The Thaisarco tin smelter had four furnaces with a total designed output capacity of 38,000 mt/a. Because of the tin crisis, only one or two furnaces have been in operation. Thaisarco depended essentially on Thai high-grade concentrate (averaging more than 70% Sn) to feed its furnaces. Thaisarco produced two brands of tin—Thaisarco (99.93% Sn) and Phuket (99.85% Sn). Thaisarco was working on improvements to its smelting and refining process, including the installation of a Chinese crystallizer that

would reduce lead and bismuth levels in the tin.

After several failed attempts, Thai Pioneer Enterprises finally succeeded in trial runs to produce about 40 tons of refined tin at its smelter in Pathum Thani near Bangkok. The smelter had a designed capacity to produce 5,000 mt/a of tin. Samples were being tested by assayers and end users, and the smelter was expected to be in full production at the end of 1992. The smelter was designed to use high-grade concentrates from Thailand and Burma.

Zinc.—Thai zinc production came entirely from the Padaeng Industry's mining and smelting operations in Thailand's northern Tak Province. The company was planning a \$650 million expansion program to take place over the next 4 years. It will install a second zinc smelter in cooperation with Metalgesellschaft AG of Germany. An output of 80,000 mt/a of zinc and 30,000 mt/a of lead is planned, and the smelter would cost about \$400 million. The company was also negotiating exploration and production rights for zinc on two plots in Burma.

Other Metals.—Padaeng Industry Co. opened a cadmium refinery with a production capacity of 750 mt/a in early 1991. In early 1991, a Thai-American-Canadian joint venture signed an agreement with the Department of Mineral Resources (DMR) to explore for gold in Chon Buri Province.

Industrial Minerals

About one-half of the total active mines in Thailand were producing industrial minerals, including barite, feldspar, fluor spar, granite, gypsum, kaolin, limestone, and marble. The industrial minerals sector employed 28% of the total work force in the mining industry. In terms of tonnages, the total production value of industrial minerals in Thailand for 1991 was more than \$200 million. The output of limestone remained the largest in 1991. Almost all production was for domestic consumption with 80%

used as construction material and 20% used in the cement sector. The second largest tonnage was gypsum with a production of 4.3 M mt/a in 1991. However, only 20% of the production was consumed locally in the cement, gypsum board, and plaster sectors, and the rest was exported. Under Thai law, glass sand was prohibited for export. Together with the slowdown in demand in the construction sector, production of sand used for glassmaking decreased substantially in 1991.

Thailand imported several kinds of industrial minerals. The two largest in volume were asbestos and sulfur. Without any indigenous commercial asbestos deposit and rapid growth in the construction sector, Thailand increased its imports of asbestos as insulation board in the past several years. Sulfur was used mainly for the production of sulfuric acid in the zinc refining process and for chemical usages.

Six countries signed an agreement on January 17, 1991, to set up a \$320 million potash project—ASIAN Potash Mining Holding Co. Ltd. Financing was Thailand, 71%; Indonesia, 13%; Malaysia, 13%; Brunei, 1%; Philippines, 1%; and Singapore, 1%. The company will develop a potash deposit at Bamnet Narong district in Chaiyaphum Province. The deposit covers an area of 2,468 acres and the estimated reserve is 570 Mmt. Production is scheduled to start in 1996 and projected to produce 1 Mmt/a of potash. Currently, Thailand consumed about 172,000 mt/a of imported potash. When potash production starts, Thailand will save more than \$30 million in foreign exchange annually.

Gemstones.—Thailand emerged as a major gem and jewelry trading center. It also became a center for cutting and polishing colored precious stones. It was the world's second largest exporter of jewelry after Italy. In 1991, Thailand exported about \$503 million of colored stones and pearls.

Most of the domestic gemstone output came from two major areas, Kanchanaburi Province on the Thai-Burmese border and Trat and Chantaburi

Provinces on the Thai-Cambodian border. Most of the output from these areas came from small-scale, individual miners, often operating temporary concessions to dig for gems. Local businessmen generally controlled the trading in rough stones, negotiating contracts for cutting and selling the stones to Bangkok-based agents. Also, large quantities of stones were mined in neighboring countries, especially Cambodia, and brought into Thailand, processed, and entered into the world market as Thai in origin. Therefore, there are no reliable production statistics for gemstones.

Owing to intense mining in the past decades, Thailand's gem deposits were being depleted. With a large pool of skilled craftsmen and unregulated gem movement, Thailand became the world's colored gem cutting and polishing center, serving miners of rough gems in Africa, Australia, and neighboring Indochinese countries.

Mineral Fuels

Thailand lacked large mineral fuels reserves. The country relied on imports to meet its petroleum and other energy demands. Thailand's energy policy had concentrated on reducing the country's dependence on imported energy by developing indigenous energy resources and promoting energy efficiency. Thailand's Seventh Five-Year Plan (1992-96) continued to stress securing stable sources of energy supply at a reasonable price. Thailand was accelerating indigenous energy resource development and was participating in the development of energy resources in neighboring countries.

Coal.—In 1991, Thailand produced 14.7 Mmt of lignite worth \$294 million from the mine of EGAT and by two private companies, Ban Pu Coal and Lanna Lignite. Most of the output went into the generation of electricity at EGAT's Mae Moh plant in northern Thailand, next to an EGAT-owned and operated mine. Anthracite production was only 14,300 tons. Thai coal was low rank with high ash and high moisture content and a

heating value of 2,500 to 3,000 kcal/kg. Lignite production grew rapidly from 1.5 Mmt in 1980 as a result of burgeoning demand for power generation. Demand was larger than domestic supply. Thailand imported about 366,000 tons of coal in 1991, primarily from Australia, China, and Indonesia. Thailand will probably import 500,000 tons of coal in 1992.

Natural Gas.—Thailand's output of natural gas rose to 8 billion m³ in 1991, an increase of 28% over that of 1990. The large increase was the result of the development of natural deposits in the Gulf of Thailand. The use of natural gas allowed Thailand to save an estimated \$1 billion per year in oil and petrochemical imports, equivalent to about 10% of total imports.

Unocal Thailand Ltd. had a vast offshore operation in the Gulf of Thailand, where seven fields produced 19 Mm³/d in 1991. In addition, Unocal produced 7.9 Mbbbl of condensate in 1991. Because local refineries were not geared to process Unocal's condensate, the company exported three-quarters of the condensate to its U.S. refineries. The company sold the gas to the state-owned oil firm Petroleum Authority of Thailand (PTT), the sole legal buyer. More than 40% of Unocal's gas and condensate came from Erawan, in 60-m deep water. Another 40% was produced from the nearby Satun field in 72-m deep water. Funan, a new field in 72-m depth, began producing 2.1 Mm³/d of gas and 3,000 bbl/d of condensate in March 1992. Erawan's production probably reached its peak and will decline until reserves are exhausted about the year 2004. The Satun field will decline in production until exhausted in the year 2005. The Funan has estimated gas reserves of 25 billion m³ and condensate reserves of 33 Mbbbl. At the current production rate, the Funan can be maintained for another 20 years or more as the field is developed and brought on-stream. Unocal is currently exploring additional offshore areas for gas, both on its own and in partnership with Amerada Hess and Britoil.

In August 1991, British Gas announced its intention to invest \$110 million to find gas in the Gulf of Thailand. The company expected to bring on-stream in 1995 the Bongkot field, which would be linked by pipeline with the Erawan field. The field has estimated gas reserves of 139 billion m³ and will produce 4.2 Mm³/d of gas and 2,500 bbl/d of condensate initially and 7 Mm³/d of gas and 4,000 bbl/d of condensate within 3 years.

In 1991, Thailand and Malaysia established a joint authority to decide on the terms for exploration, production, and profit sharing in the 7,300-km² Thai-Malaysian Joint Development Area, further south in the Gulf of Thailand. U.S. Triton Oil Co. holds the right for development activity in the area, which may have up to 100 Mm³ of gas reserves. PTT expects the area to begin producing gas in 1998.

The Thai and Burmese Governments are negotiating to develop an offshore field in Mataban Gulf of Burma. The field has estimated gas reserves of 190 Mm³. Thailand is considering importing the natural gas produced from the field for electricity generation via a 500-km pipeline to Kanchanaburi, west of Bangkok near the Burmese border.

Petroleum, Crude.—Output of crude increased 4% to a total of 8.94 Mbbbl in 1991. More than 90% of oil output came from Royal Dutch Shell's Sirkit field in Kampaeng Phet Province in central Thailand. In addition, Shell produced crude from the Pru Krathiam field and Pratu Tao field in nearby Phitsanulok Province. Oil experts have estimated that these fields will be exhausted by 1998. Shell also produced crude from the Nang Nuan offshore field briefly in 1988 but ceased operations due to serious technical problems. In early 1991, Shell announced plans to recommence production from this field in 1993. However, tests in late 1991 proved disappointing and cast doubt on this plan.

BP brought on-stream two fields near Bangkok in July and August 1991. Currently, the two fields have a total output of about 1,300 bbl/d. BP expected to increase output to 2,500 bbl/d by

1993. Estimated recoverable crude reserves were 3.9 Mbbbl. North Central International's Bung Ya and Bung Muang fields in central Thailand began operation in September 1991. Currently the fields produce 230 bbl/d. Estimated recoverable reserves in these fields were 930,000 bbl. The Defense Energy Department's Fang field in northern Thailand produced an average of 1,209 bbl/d in 1991. An estimated million barrels remained in recoverable reserves.

Thailand also had reserves of oil shale in Tak Province in the north close to the Burmese border. The DMR estimated that the 18.5 billion mt of oil shale could yield 620 Mmt of petroleum. However, exploitation of this resource was not feasible at any oil price below \$35/bbl.

Thailand had three refineries with a total capacity of 249,000 bbl/d. The three refineries supplied approximately one-half of Thailand's demand. The largest refinery, at Sri Racha, was owned by Thai Oil, a joint venture of PTT (49%), Shell (15%), Caltex (5%), and private Thai shareholders. Currently, the refinery has a capacity of 110,000 bbl/d. Thai Oil is engaging in expansion to increase its refinery capacity to 183,500 bbl/d by mid-1993. Esso's refinery at Sri Racha has a current refinery capacity of 63,000 bbl/d. Esso has received permission from the Thai Government to invest \$900 million in its expansion project to raise the facility's production capacity to 145,000 bbl/d in 1995 and to 185,000 bbl/d in the year 2000. The state-owned Bangchak refinery near Bangkok had a capacity of about 73,000 bbl/d. The company received an approval from the Government to invest \$300 million in an expansion project to increase capacity to 120,000 bbl/d by March 1993.

In February 1992, the National Energy Policy Office agreed to allow the free establishment of oil refineries. The Thai Government hoped that this would help Thailand become a regional export center for refined oil.

Reserves

Thailand is endowed with diverse mineral resources. There are extensive

deposits of salt-type minerals such as rock salt and potash. Gypsum, feldspar, limestone, kaolin, glass sand, diatomite, dolomite, and barites were also present in substantial amounts. Exploration in Thailand had been aggressive and well organized, utilizing high-technology methods. Land-use conflicts between mineral resources development and other sectors have become a major source of difficulty for the mining industry in Thailand. The conflicts have become so serious that emerging from the exploration activities will become more complex.

INFRASTRUCTURE

Thailand has 3,940 km of 1-m-gauge railroad, extending to most parts of the country, and 99 km of double track. The country has a total 44,534 km of highway, including 28,016 km of paved, 5,132 km of earth surface, and 11,386 km of under development. Thailand has 4,000 km of inland waterways, with 3,700 km navigable of 0.9 m or more throughout the year and other minor waterways navigable by shallow-draft native craft.

Bangkok, Pattani, Phuket, Sattahip, and Sri Racha are Thailand's major seaports. At least 15 other minor seaports are located elsewhere along the Thai coast. The country has a total of 129 airfields. Among them, 103 were usable. Permanent, paved runways were utilized at 56 of these fields, 1 with runways more than 3,659 m, 12 with runways 2,440 m to 3,659 m, and 28 with runways 1,220 m to 2,439 m. Navigation aids are modern and sophisticated.

OUTLOOK

The Thai Government is promoting the development of the petrochemicals industry on a priority basis to help to fully exploit natural gas from the Gulf of Thailand. The Government sees such an industry as a means to add value to the gas, to provide raw materials at internationally competitive prices for downstream industries, to boost Thailand's exports, to develop the

manufacturing industry, and to promote employment through the growth of labor-intensive downstream industries such as textiles.

The Thai Government recognizes the importance of energy conservation as a means of coping with rapidly increasing demand for both electricity and refined petroleum products. However, it has so far implemented only a few concrete measures. In a major step to combat Bangkok's severe air pollution by motor car emissions, the Government will require that all refineries produce unleaded gasoline by September 1993.

On the whole, Thailand has the potential to grow into a major economic and industrial nation through tax reforms to stimulate production, investment, and export. Thailand's economic policy will continue to emphasize production efficiency and competitiveness of its exports.

¹Where appropriate, values have been converted from Thai baht (B) to U.S. dollars at the rate of B25.81=US\$1.00 in 1991.

OTHER SOURCES OF INFORMATION

Agencies

Department of Mineral Resources
Thanon Rama 6
Phaya Thai
Bangkok 10400, Thailand

National Statistical Office
Office of the Prime Minister
Bangkok, Thailand

Mining Industry Council of Thailand
132 Sinhorn Building
Room 11, Wireless Road
Bangkok 10500, Thailand

Publications

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Statistical Summary of Thailand, 1987 et seq. Statistical Yearbook of Thailand.

Annual Economic Report 1991, Bank of Thailand.

Business in Thailand

**185 Soi Putta-O-Soth New Road,
Bangkok 10500, Thailand.**

TABLE 1
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²
METALS					
Antimony:					
Ore and concentrate:					
Gross weight	962	1,048	1,166	767	141
Sb content ^a	409	445	495	326	60
Metal, smelter	959	1,769	2,275	2,833	2,256
Chromium: Chromite, gross weight	5	776	416	—	—
Columbium and tantalum ores and concentrates, gross weight:²					
Columbite and tantalite:					
Gross weight kilograms	183,000	124,000	109,000	9,000	3,000
Cb content do.	31,110	21,080	18,530	1,530	*510
Ta content do.	49,410	33,480	29,430	2,430	*810
Stuverite:					
Gross weight do.	423,000	788,000	99,000	122,000	*100,000
Cb content do.	34,003	63,343	7,958	9,807	*8,040
Ta content	32,912	61,310	7,703	9,492	*7,780
Iron and steel:					
Iron ore:					
Gross weight	97,026	99,257	177,373	128,626	240,075
Fe content	53,364	54,591	97,555	70,744	132,040
Metal: Steel:					
Crude	534,172	552,000	689,421	684,678	711,134
Semimanufactures (selected):					
Bars	319,835	356,000	498,986	597,899	620,438
Galvanized iron sheets	165,445	189,996	200,616	208,483	210,953
Tinned plates	119,342	147,337	149,478	173,110	190,386
Lead:					
Mine output, Pb content of 42.5% Pb concentrate	23,503	29,474	25,075	22,231	16,680
Metal: Ingot, secondary	11,366	15,614	18,711	15,861	12,843
Manganese ore:					
Chemical-grade, over 75% MnO ₂	50	—	—	—	—
Battery- and chemical-grade, 75% MnO ₂	5,012	3,530	3,115	2,405	2,539
Metallurgical-grade, 46% to 50% MnO ₂	4,086	4,417	7,390	14,247	8,493
Total, gross weight	9,148	7,947	*10,505	16,652	11,032
Total Mn content	4,391	3,815	5,301	7,993	5,300
Rare-earth minerals:					
Monazite concentrate, gross weight	458	590	631	377	400
Xenotime	30	101	35	14	15
Tin:					
Mine output, Sn content	14,852	14,225	14,922	14,635	14,937
Metal, smelter, primary	15,438	14,675	14,571	15,512	11,255
Titanium:					
Ilmenite concentrate, gross weight	26,278	16,455	16,955	10,554	17,071
Leucoxene concentrate, gross weight	800	1,799	30	120	4

See footnotes at end of table.

TABLE 1—Continued
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ²	
METALS—Continued						
Titanium—Continued:						
Rutile concentrate, gross weight	92	128	—	—	76	
Tungsten concentrate:						
Mine output, gross weight	1,269	1,173	1,086	552	440	
Mine output, W content	705	651	603	290	230	
Zinc:						
Mine output, gross weight	341,145	420,102	412,620	404,100	496,006	
Mine output, Zn content	88,698	78,000	62,831	61,534	87,000	
Metal, smelter, primary	66,868	68,600	68,376	63,257	62,152	
Zirconium concentrate, gross weight	1,532	5,098	1,496	490	2,573	
INDUSTRIAL MINERALS						
Barite	33,370	40,587	*87,052	*107,707	*100,000	
Cement, hydraulic	thousand tons	9,850	11,514	15,024	18,054	18,054
Clays:						
Ball clay	57,719	86,890	134,921	183,313	178,192	
Kaolin, marketable:						
Beneficiated	184,179	222,964	176,281	208,029	255,543	
Nonbeneficiated	22,389	46,724	152,266	139,342	125,563	
Filler ³	NA	288	277	319	733	
Diatomite	177	470	1,412	4,593	7,328	
Feldspar	168,881	293,678	515,206	311,249	702,603	
Fluorspar:						
Crude mine output:						
High-grade	102,398	76,321	98,375	94,757	60,617	
Low-grade	2,514	573	—	—	1,450	
Total	104,912	76,894	98,375	94,757	62,067	
Salable product:						
Acid-grade (beneficiated low-grade)	—	—	—	—	1,450	
Metallurgical-grade	102,398	76,321	98,375	94,757	60,617	
Total	102,398	76,321	98,375	94,757	62,067	
Gemstones	carats	36,500	933,985	*2,000,000	3,577,000	4,351,641
Gypsum	3,030,919	4,549,011	5,477,237	5,753,351	7,196,390	
Phosphate rock, crude	4,502	8,348	6,584	9,547	5,936	
Salt:						
Rock	3,268	5,670	15,384	119,179	124,500	
Other ⁴	165,000	165,000	165,000	100,000	100,000	
Sand, silica	153,516	242,385	296,130	421,508	157,464	
Stone:						
Calcite	2,170	171	2,400	40,160	18,000	
Dolomite	50,767	140,455	257,576	379,548	481,866	
Limestone for cement manufacture only	thousand tons	11,391	14,101	15,966	19,521	19,517
Marble	22,786	42,553	54,459	55,337	74,984	
Marl for cement manufacture only	thousand tons	296	136	535	367	718
Quartz, not further described	27,459	28,449	33,850	22,074	20,312	
Shale for cement manufacture only	thousand tons	1,403	2,283	2,452	2,686	2,448

See footnotes at end of table.

TABLE 1—Continued
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991 ^P
INDUSTRIAL MINERALS—Continued					
Talc and related materials:					
Pyrophyllite	37,749	37,285	39,799	29,290	42,960
Talc	4,101	4,843	7,242	4,360	5,575
MINERAL FUELS AND RELATED MATERIALS					
Anthracite	8,350	15,330	8,740	20,600	14,300
Coal: Lignite	6,929	7,274	8,899	12,421	14,689
Natural gas, gross production	5,063	5,997	5,990	6,525	8,079
Petroleum:					
Crude	6,108	7,437	7,793	8,748	8,938
Natural gas condensate	5,541	5,433	6,731	7,208	7,938
Refinery products:					
Liquefied petroleum gas	*1,600	1,931	2,189	*2,300	*2,350
Gasoline	*13,900	15,781	16,980	*18,000	*18,200
Jet fuel	*7,200	8,183	10,380	*12,000	*12,000
Kerosene	*1,000	811	811	*900	*900
Distillate fuel oil	*23,200	22,021	26,493	*28,000	*28,400
Residual fuel oil	*13,800	15,907	21,933	*22,000	*22,300
Unspecified ⁴	*2,000	2,447	3,000	*3,300	*3,400
Total	*62,700	67,081	81,786	*86,500	*87,650

*Estimated. ^PPreliminary. ^RRevised. NA Not available.

¹Includes data available through July 15, 1992.

²Excludes columbium- and tantalum-bearing tin slags.

³Kaolin for use as filler was not reported before 1988.

⁴Includes refinery fuel plus refinery gains or losses.

TABLE 2
THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	—	1	—	Mainly to Bangladesh.
Aluminum:				
Oxides and hydroxides	106	65	—	China 60; Laos 5.
Metal including alloys:				
Scrap	—	38	—	Japan 19; Singapore 19.
Unwrought	24	41	—	Mainly to Japan.
Semimanufactures	6,818	4,843	3	United Arab Emirates 1,211; Singapore 1,205.
Antimony:				
Ore and concentrate	2,480	NA		
Metal including alloys, all forms	—	1,132	296	Republic of Korea 300; Spain 160.
Bismuth: Metal including alloys, all forms	—	18	(?)	Singapore 10; Australia 2; Japan 2.
Cobalt: Oxides and hydroxides	1	—		
Columbium and tantalum: ² Ores and concentrates	4,015	726	—	West Germany 469; Netherlands 108.
Copper:				
Sulfate	259	NA		
Metal including alloys:				
Scrap	318	NA		
Unwrought	85	500	—	Mainly to Republic of Korea.
Semimanufactures	920	1,342	793	Singapore 146; Hong Kong 138.
Gold:				
Waste and sweepings	value, thousands	\$119	NA	
Metal including alloys, unwrought and partly wrought	do.	\$39,361	NA	
Iron and steel:				
Ore and concentrate excluding roasted pyrite	150	—		
Metal:				
Scrap	7,216	9,763	3	Japan 7,133; India 840; Taiwan 784.
Pig iron, cast iron, related materials	809	1,365	—	Japan 479; Taiwan 438; Malaysia 324.
Ferrous alloys: Ferrosilicon	637	—		
Steel, primary forms	3	6	—	Japan 3; Italy 1.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	39,124	20,398	—	Singapore 17,218; Hong Kong 551.
Clad, plated, coated	2,856	4,139	—	Laos 2,852; Fiji 541; Finland 457.
Of alloy steel	908	159	—	Singapore 66; Philippines 46; Japan 25.
Bars, rods, angles, sections	31,221	10,099	3	Singapore 7,854; Malaysia 927.
Rails and accessories	11	10	—	Laos 6; Singapore 2.
Wire	1,172	1,904	174	Japan 879; Philippines 245; Sweden 126.
Tubes, pipes, fittings	160,841	137,523	28,930	United Arab Emirates 20,468; Japan 19,991.
Lead:				
Ore and concentrate	48,984	34,379	—	Japan 18,837; Italy 4,017; Republic of Korea 3,315.
Oxides	kilograms	200	NA	

See footnotes at end of table.

TABLE 2—Continued
THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Lead—Continued:				
Metal including alloys:				
Scrap	1	21	—	All to Japan.
Unwrought	—	1	1	
Semimanufactures	1	2	—	Mainly to Hong Kong.
Manganese:				
Ore and concentrate: Metallurgical-grade	1,610	120	—	Indonesia 100; Singapore 20.
Oxides	6	60	—	All to India.
Nickel: Metal including alloys:				
Scrap	2	—		
Unwrought value, thousands	\$18	\$11	—	Do.
Semimanufactures do.	\$7	\$1	—	All to Singapore.
Platinum-group metals: Metals including alloys, unwrought and partly wrought do.	\$10	\$93	—	Japan \$67; Hong Kong \$26.
Rare-earth metals:				
Monazite concentrate	466	NA		
Xenotime	22	NA		
Silver:				
Waste and sweepings ⁴ kilograms	—	349,727	15,285	Canada 256,920; Israel 77,522.
Metal including alloys, unwrought and partly wrought value, thousands	\$198	\$153	\$96	France \$53; Singapore \$4.
Tin:				
Ore and concentrate	40	—		
Metal including alloys:				
Unwrought	11,564	11,881	90	Japan 6,908; Netherlands 3,440.
Semimanufactures	187	8	(⁵)	Mainly to Singapore.
Titanium:				
Ore and concentrate	40,474	13,033	—	Malaysia 5,406; Republic of Korea 5,050.
Oxides	1	—		
Metal including alloys, all forms	3	—		
Tungsten: Ore and concentrate	864	590	20	Sweden 184; Japan 145.
Uranium and thorium: Oxides and other compounds kilograms	4	NA		
Zinc:				
Oxides	605	824	—	Japan 336; Singapore 232.
Metal including alloys:				
Unwrought	13,837	6,059	(⁶)	Philippines 3,908; Malaysia 933; Australia 380.
Semimanufactures	4,617			
Zirconium: Ore and concentrate	964	23	—	Mainly to Taiwan.
Other:				
Ores and concentrates	179	—	—	
Ashes and residues	3,569	4,046	—	India 3,027; Taiwan 320.
Metalloids, n.e.s. ³	—	2	—	All to Hong Kong.
Base metals including alloys, all forms	—	1,658	578	Belgium-Luxembourg 494; Republic of Korea 180.

See footnotes at end of table.

TABLE 2—Continued
THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.	(^o)	7	—	Laos 4; Japan 2.	
Artificial: Silicon carbide	55	NA			
Dust and powder of precious and semiprecious stones including diamond	value, thousands	\$34	\$71	\$2	Republic of Korea \$32; Hong Kong \$21.
Grinding and polishing wheels and stones		394	923	60	Japan 279; Singapore 221; Malaysia 102.
Barite and witherite		99,316	105,232	20	Indonesia 64,642; Brunei 9,050.
Cement		121,162	43,599	1	Malaysia 18,920; Laos 15,780; Taiwan 2,852.
Chalk		1	—		
Clays, crude		8,613	16,302	6	Taiwan 8,206; Malaysia 3,732.
Diamond: Natural:					
Gem, not set or strung	value, thousands	\$184,889	\$304,342	\$20,098	Belgium-Luxembourg \$138,086; Japan \$45,521.
Industrial stones	do.	\$9,510	\$8,698	\$105	Belgium-Luxembourg \$6,698; Israel \$626.
Diatomite and other infusorial earth		76	50	—	All to Republic of Korea.
Feldspar		380,217	333,739	—	Taiwan 282,772; Malaysia 34,183.
Fertilizer materials:					
Crude, n.e.s.					
		105	51	—	All to Japan.
Manufactured:					
Ammonia		31	7	—	Laos 5; China 2.
Nitrogenous		278	4,530	2	Laos 4,507.
Phosphatic		7	—		
Potassic		2	—		
Unspecified and mixed		72	2,583	—	Laos 2,579.
Fluorspar		73,864	79,695	—	Japan 44,510; Republic of Korea 24,360.
Gypsum and plaster		8,762,409	32,501	(^o)	Japan 13,709; Singapore 13,089.
Lime		—	1,023	—	Malaysia 843; Laos 180.
Mica: Worked including agglomerated splittings		22	(^o)	—	All to Singapore.
Phosphates, crude		—	1	—	All to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed		3	—		
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	\$444,602	\$549,489	\$116,442	Japan \$210,513; Switzerland \$74,011.
Synthetic	do.	\$22,310	\$24,746	\$7,058	Switzerland \$5,052; Italy \$4,358.
Sodium compounds, n.e.s.:					
Soda ash, natural	kilograms	60	NA		
Sulfate, manufactured		25	3,965	—	Indonesia 2,100; Philippines 1,500.

See footnotes at end of table.

TABLE 2—Continued
THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	24,212	14,822	—	Taiwan 14,216; Japan 370.
Worked	1,314	740	20	Japan 622; Netherlands 41.
Dolomite, chiefly refractory-grade	206,598	280,639	—	Japan 280,222; Saudi Arabia 300.
Gravel and crushed rock	444	103	—	Laos 85; Taiwan 17.
Limestone other than dimension	7,894	3,759	—	Malaysia 2,680; Bangladesh 810.
Quartz and quartzite	26,307	16,800	—	All to Japan.
Sand other than metal-bearing	217	1,949	—	Singapore 1,595; Philippines 315.
Sulfur:				
Elemental:				
Crude including native and byproduct	133	1,824	—	Bangladesh 1,600; Hong Kong 76.
Colloidal, precipitated, sublimed	—	35	—	All to Burma.
Sulfuric acid	59	344	—	All to Laos.
Talc, steatite, soapstone, pyrophyllite	4,999	1,074	—	Philippines 560; Indonesia 266; Malaysia 223.
Other:				
Crude	2,959	2,221	—	Philippines 2,000; France 220.
Slag and dross, not metal-bearing	17,275	15,346	—	West Germany 9,920; Netherlands 1,531.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	662	6,527	1	Indonesia 3,285; India 2,154.
Coal, all grades including briquets	162	108	—	Pakistan 72; Indonesia 36.
Coke and semicoke	(²)	—	—	—
Gas, natural: Liquefied	551,429	625,402	554,494	North Korea 33,528; U.S.S.R. 30,629.
Petroleum:				
Partly refined	42-gallon barrels	262,308	NA	—
Refinery products:				
Liquefied petroleum gas	do.	5	10,231	— All to Singapore.
Gasoline	do.	198,646	163,616	— Laos 85,484; unspecified 78,089.
Mineral jelly and wax	do.	865	6	— All to Taiwan.
Kerosene and jet fuel	thousand 42-gallon barrels	2,262	1,920	— Malaysia 11; 1,899.
Distillate fuel oil	42-gallon barrels	58,375	150,356	— Laos 115,988; unspecified 32,436.
Lubricants	do.	39,221	24,437	7 Indonesia 1,257; unspecified 169,848.
Residual fuel oil	do.	1	—	—
Bitumen and other residues	do.	96	103	— Laos 60.

NA Not available.

¹Table prepared by Audrey D. Willms.

²Less than 1/2 unit.

³May include vanadium.

⁴May include other precious metals.

⁵Reported under SITC item number as "selenium, tellurium, phosphorus, etc."

⁶Unreported quantity valued at \$3,000.

TABLE 3
THAILAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals: Alkali metals	11	23	(²)	France 11; Japan 9.
Aluminum:				
Ore and concentrate	32,131	25,102	—	China 12,907; Malaysia 12,002.
Oxides and hydroxides	36,423	27,800	304	Japan 16,408; China 4,427.
Metal including alloys:				
Scrap	4,570	2,012	12	Laos 1,392; Cambodia 357.
Unwrought	98,264	128,135	12,083	Australia 79,189; United Arab Emirates 9,914.
Semimanufactures	11,759	16,853	2,291	Japan 5,431; Australia 1,676.
Antimony:				
Ore and concentrate	5,167	NA		
Oxides	470	NA		
Metal including alloys, all forms	17	1	—	Mainly from Japan.
Arsenic:				
Elemental	34	NA		
Oxides and acids	56	NA		
Bismuth: Metal including alloys, all forms	6	8	(²)	Japan 4; Belgium-Luxembourg 1.
Cadmium: Metal including alloys, all forms	(²)	2	—	Australia 1; Japan 1.
Chromium:				
Ore and concentrate	7,359	5,872	3	Philippines 5,087; Netherlands 420.
Oxides and hydroxides	608	1,047	167	West Germany 496; United Kingdom 193.
Metal including alloys, all forms	6	9	1	Japan 7; West Germany 1.
Cobalt:				
Oxides and hydroxides	18	18	3	Belgium-Luxembourg 7; Canada 5.
Metal including alloys, all forms value, thousands	\$300	\$229	—	West Germany \$140; Belgium-Luxembourg \$73.
Columbium and tantalum: Ores and concentrates ²	1,900	420	—	Malaysia 320; Australia 100.
Copper:				
Matte and speiss including cement copper	24	514	—	All from Singapore.
Oxides and hydroxides	270	NA		
Sulfate	165	NA		
Metal including alloys:				
Scrap	4,281	2,450	42	Cambodia 1,383; Laos 694.
Unwrought	34,184	53,725	2,714	Zambia 30,311; Japan 8,794.
Semimanufactures	48,189	43,510	1,291	Indonesia 12,627; Japan 10,689.
Gold:				
Waste and sweepings value, thousands	\$1	NA		
Metal including alloys, unwrought and partly wrought do.	\$103,997	NA		
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	25	NA		
Pyrite, roasted	3	NA		

See footnotes at end of table.

TABLE 3—Continued
THAILAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
METALS—Continued					
Iron and steel—Continued:					
Metal:					
Scrap	thousand tons	1,081	1,101	105	U.S.S.R. 171; Brazil 156; China 87.
Pig iron, cast iron, related materials		92,815	110,475	(^c)	China 78,531; Vietnam 10,491; Brazil 8,060.
Ferrous alloys:					
Ferrochromium		333	234	10	China 72; France 40; Zambia 40.
Ferromanganese		6,723	6,783	—	China 2,839; Australia 1,364; Japan 708.
Ferromolybdenum		52	NA		
Ferronickel		—	86	—	United Kingdom 36; Austria 15; Japan 14.
Ferrosilicomanganese		817	1,171	—	China 462; Australia 302; Spain 108.
Ferrosilicon		6,009	6,452	79	China 2,673; Norway 2,484.
Silicon metal		58	NA		
Unspecified		283	9,011	103	Malaysia 8,675; China 108.
Steel, primary forms		268,682	979,645	30,261	China 559,191; Poland 155,749.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated		3,167,102	2,381,740	18,286	Japan 992,283; Brazil 295,949.
Clad, plated, coated		238,157	260,512	11,486	Japan 171,593; Republic of Korea 54,031.
Of alloy steel		99,390	142,819	357	Japan 107,225; Spain 10,886.
Bars, rods, angles, shapes, sections		878,807	1,648,700	5,675	Japan 296,426; China 185,702.
Rails and accessories		4,488	2,734	—	Japan 935; Belgium-Luxembourg 451.
Wire		40,110	39,433	70	Japan 12,111; Republic of Korea 8,008.
Tubes, pipes, fittings		69,795	86,556	696	Japan 63,200; Republic of Korea 4,344.
Lead:					
Ore and concentrate	kilograms	267	—		
Oxides		531	1,611	—	France 612; Taiwan 401; West Germany 258.
Metal including alloys:					
Scrap		11,212	7,592	—	Singapore 2,551; United Arab Emirates 1,188.
Unwrought		15,316	14,338	676	Australia 9,571; Indonesia 1,219.
Semimanufactures		269	182	1	Belgium-Luxembourg 108; Australia 45.
Lithium: Oxides and hydroxides		48	—	—	
Magnesium: Metal including alloys, all forms		154	201	82	France 40; Norway 37.
Manganese:					
Ore and concentrate: Metallurgical-grade		2	—		
Oxides		1,641	1,616	—	China 611; Australia 480; Japan 264.
Metal including alloys, all forms		45	34	—	Japan 18; United Kingdom 12.
Mercury		22	10	(^c)	West Germany 7; U.S.S.R. 3.
Molybdenum: Metal including alloys, all forms		4	2	—	All from Japan.
Nickel:					
Matte and speiss	value, thousands	\$5	\$2	—	Do.
Oxides and hydroxides		31	NA		
Metal including alloys:					
Scrap		—	1	—	All from Singapore.

See footnotes at end of table.

TABLE 3—Continued
THAILAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Nickel—Continued:				
Metal including alloys—Continued:				
Unwrought	5,479	928	1	Norway 397; Canada 316.
Semimanufactures	133	145	58	Sweden 30; Japan 21.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	\$3,212	\$8,485	\$1	Japan \$8,302; West Germany \$104.
Rare-earth metals including alloys, all forms do.	\$10	NA		
Selenium, elemental	4	NA		
Silicon, high-purity	20	77	—	Australia 65; Japan 11.
Silver:				
Waste and sweepings ^d value, thousands	\$33	NA		
Metal including alloys, unwrought and partly wrought do.	\$6,097	\$5,843	\$892	Australia \$1,027; Hong Kong \$893.
Tin:				
Ore and concentrate	23	118	—	Burma 78; Rwanda 40.
Oxides	9			
Metal including alloys, all forms	34	115	2	Japan 107; West Germany 2.
Titanium:				
Ore and concentrate	4,273	5,796	—	Australia 5,746; Taiwan 27.
Oxides	3,244	2,288	127	Japan 688; France 295; Australia 258.
Metal including alloys, all forms	36	(^e)	—	All from Japan.
Tungsten: Metal including alloys, all forms	6	1	(^e)	NA.
Uranium and thorium: Oxides and other compounds	18	NA		
Vanadium: Oxides and hydroxides	3	NA		
Zinc:				
Ore and concentrate	(^e)	1,000	—	All from Vietnam.
Oxides	1,629	2,965	3	China 1,953; Taiwan 574.
Blue powder	438	NA		
Metal including alloys:				
Scrap	20	84	—	Japan 43; Singapore 21; United Kingdom 19.
Unwrought	2,783	4,737	11	Australia 1,798; Canada 695.
Semimanufactures	289	1,068	(^e)	Japan 348; West Germany 196.
Zirconium:				
Ore and concentrate	1,658	1,108	—	All from Vietnam.
Metal including alloys, all forms	10	NA		
Other:				
Ores and concentrates	298	8,172	—	China 6,691; Burma 1,263.
Ashes and residues	—	208	55	Austria 96; France 38.
Metalloids, n.e.s.	—	*84	—	China 51; Japan 17; India 10.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	12,422	14,232	—	Indonesia 10,731; Netherlands 1,375.

See footnotes at end of table.

TABLE 3—Continued
THAILAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Abrasives—Continued:				
Artificial:				
Corundum	383	742	—	Italy 618; Austria 80.
Silicon carbide	1,643			
Dust and powder of precious and semi precious stones including diamond value, thousands	\$356	\$732	\$57	Japan \$332; Belgium-Luxembourg \$212.
Grinding and polishing wheels and stones	3,073	4,070	12	Japan 873; China 848; Taiwan 769.
Asbestos, crude	118,520	116,652	730	Canada 66,464; Greece 11,820; Brazil 11,694.
Barite and witherite	37	1,037	2	China 984; West Germany 43.
Boron materials: Oxides and acids	404	663	596	Italy 36; Japan 20.
Cement	375,471	3,057,832	881	Japan 565,985; Jordan 558,147; Turkey 372,762.
Chalk	22	111	1	Belgium-Luxembourg 84; United Kingdom 20.
Clays, crude	56,698	82,080	29,521	China 14,287; Indonesia 10,719.
Cryolite and chiolite	47	26	—	Japan 17; Singapore 7.
Diamond: Natural:				
Gem, not set or strung value, thousands	\$516,404	\$689,708	\$52,688	Belgium-Luxembourg \$282,425; India \$164,749.
Industrial stones do.	\$42,879	\$37,035	\$6,262	United Kingdom \$20,389; Netherlands \$9,348.
Diatomite and other infusorial earth	143	275	254	China 20.
Feldspar, fluorspar, related materials	1,411	3,116	22	Norway 794; Japan 705.
Fertilizer materials:				
Crude, n.e.s.	121	27	27	
Manufactured:				
Ammonia	14,013	18,289	(²)	Indonesia 10,982; Malaysia 6,753.
Nitrogenous	1,058,719	1,039,270	27,248	Japan 234,584; Malaysia 214,309.
Phosphatic	4,175	6,233	—	China 3,230; Iraq 1,500; Netherlands 700.
Potassic	83,730	122,382	5,250	Canada 49,764; U.S.S.R. 40,624.
Unspecified and mixed	1,393,625	1,652,456	97,948	Republic of Korea 506,175; Norway 286,948; Philippines 282,566.
Graphite, natural	1,275	984	(²)	China 325; Republic of Korea 320.
Gypsum and plaster	35,739	3,230	128	West Germany 2,240; France 339.
Iodine ⁷	6	6	—	Japan 4; West Germany 2.
Kyanite and related materials	100	NA		
Lime	109	114	—	United Kingdom 104; China 10.
Magnesium compounds:				
Magnesite, crude	28,127	20,563	—	China 11,320; Japan 8,904.
Oxides and hydroxides	3,586	4,515	195	China 2,225; Japan 1,517.
Sulfate	870	NA		
Mica:				
Crude including splittings and waste	542	596	44	India 208; Malaysia 180.
Worked including agglomerated splittings	105	132	—	Japan 91; Belgium-Luxembourg 16.
Nitrates, crude	1,198	1,580	—	Chile 1,315; Belgium Luxembourg 63.
Phosphates, crude	1	1	—	All from Japan.
Phosphorus, elemental	22	NA		
Pigments, mineral:				
Natural, crude	281	NA		

See footnotes at end of table.

TABLE 3—Continued
THAILAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Iron oxides and hydroxides, processed	4,046	5,385	376	West Germany 2,435; India 716.	
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	\$189,791	\$387,273	\$47,291	India \$189,989; Sri Lanka \$23,626; Brazil \$22,692.
Synthetic	do.	\$12,278	\$12,626	\$2,069	Switzerland \$3,471; Taiwan \$2,638.
Pyrite, unroasted	61	25	—	East Germany 11; Sweden 9.	
Quartz crystal, piezoelectric	17	NA	—	—	
Salt and brine	895	828	51	United Kingdom 317; West Germany 216.	
Sodium compounds, n.e.s.:					
Soda ash, natural and manufactured	179,800	240,454	122,262	Kenya 39,600; Poland 26,200; Australia 24,826.	
Sulfate, manufactured	37,131	56,497	572	China 19,456; Canada 17,125.	
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	1,860	2,537	2	India 1,015; Finland 472; Italy 408.	
Worked	952	978	3	Italy 948; Indonesia 2.	
Dolomite, chiefly refractory-grade	883	1,339	—	United Kingdom 1,047; Norway 288.	
Gravel and crushed rock	2,976	3,017	—	France 2,265; China 260.	
Limestone other than dimension	45	19	(²)	Taiwan 18.	
Quartz and quartzite	163	218	(²)	Italy 156; Taiwan 20.	
Sand other than metal-bearing	932	982	179	Japan 383; West Germany 119.	
Sulfur:					
Elemental:					
Crude including native and byproduct	71,444	84,429	—	Canada 51,001; Singapore 30,626.	
Colloidal, precipitated, sublimed	205	255	(²)	West Germany 183; Republic of Korea 36.	
Dioxide	22	21	—	All from Australia.	
Sulfuric acid	25,123	17,681	62	Japan 17,471; West Germany 60.	
Talc, steatite, soapstone, pyrophyllite	33,625	36,611	141	China 23,822; Republic of Korea 12,032.	
Vermiculite ³	295	261	—	China 241; Zimbabwe 18.	
Other:					
Crude	8,730	11,145	4	France 3,163; China 2,503; Taiwan 2,045.	
Slag and dross, not metal-bearing	32,458	17,183	—	Japan 16,520; United Kingdom 503.	
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural	56	36	35	NA.	
Carbon black	⁴ 11,731	13,162	390	China 6,978; Australia 2,441.	
Coal:					
Anthracite and bituminous	370,408	249,614	—	Indonesia 165,099; China 45,533; Vietnam 12,303.	
Briquets of anthracite and bituminous coal	48	33	(²)	Republic of Korea 32.	
Coke and semicoke	84,419	91,250	16	Japan 43,774; China 25,452; Switzerland 20,135.	
Gas, natural: Liquefied	value, thousands	\$5	\$12	—	France \$5; Singapore \$4.
Petroleum:					
Crude	thousand 42-gallon barrels	72,424	69,254	—	Malaysia 20,816; United Arab Emirates 11,722;

See footnotes at end of table.

TABLE 3—Continued
THAILAND: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum—Continued:				
Refinery products:				
Liquefied petroleum gas				
thousand 42-gallon barrels	4,474	1,162	(²)	Saudi Arabia 407; United Arab Emirates 330.
Gasoline	3,627	3,870	—	Singapore 3,854; Republic of Korea 13.
Mineral jelly and wax	100	121	4	China 85; Japan 2.
Kerosene and jet fuel	3,039	2,925	—	All from Singapore.
Distillate fuel oil	27,809	32,661	—	Singapore 29,281; China 1,182.
Lubricants	2,018	9,386	55	Saudi Arabia 5,606; Singapore 1,465.
Residual fuel oil	6,923	8,136	—	Singapore 6,431; Kuwait 1,109.
Bitumen and other residues	56	215	—	Singapore 183; Japan 28.
Bituminous mixtures	29	21	(²)	United Kingdom 16; Republic of Korea 4.
Petroleum coke	19	—	—	

NA Not available.

¹Table prepared by Audrey D. Wilkes.

²Less than 1/2 unit.

³May include vanadium.

⁴May include other precious metals.

⁵Unreported quantity valued at \$3,000.

⁶Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

⁷Includes bromine and fluorine.

⁸May include perlite.

⁹May include gas carbon.

TABLE 4
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Antimony, concentrate	Associated Minerals Co. Ltd.	Bo Thang, 130 kilometers southeast of Bangkok (temporarily inactive)	6
Do.	Parasit Mining Co.	Doi Ngoem, 100 kilometers southeast of Chiang Mai	2
Barite	American Thai Barite Co. Ltd.	Siam Mine, 200 kilometers southeast of Phuket	25
Do.	P&S Mining Co. Ltd.	Loei Mine, 10 kilometers northwest of Loei	70
Do.	STA Mining Co. Ltd.	STA Mine, 105 kilometers southeast of Chiang Mai	100
Cement	Siam Cement Co. Ltd.	Kaeng Khoi, 90 kilometers north of Bangkok	3,300
Do.	do.	Tambol Tabkwang, Kaeng Khoi District, 90 kilometers northeast of Bangkok	2,800
Do.	do.	Tha Luang, 90 kilometers northeast of Phuket	3,200
Do.	do.	Thung Song, 130 kilometers east of Phuket	900
Fluorspar, concentrate	Phanom Thuan Mining Co. Ltd.	Phanom Thuan, 45 kilometers north of Kanchanaburi	60
Do.	Skt Minerals Co. Ltd.	Mine is 47 kilometers southeast of Krabi	65
Do.	Thai Fluorite Processing Co. Ltd.	Ban Lad, Phet Buri	120
Do.	United Fluorite Co. Ltd.	Salak Pra, 80 kilometers northwest of Kanchanaburi	26
Do.	Universal Mining Co. Ltd.	Mae la Luang, 120 kilometers west of Chiang Mai	35
Lead, concentrate	Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, 250 kilometers northwest of Bangkok	45
Steel, rolled	Bangkok Iron & Steel Co. Ltd.	Bangkok	160
Do.	Bangkok Steel Industry Co. Ltd.	Samut Prakan Province, south of Bangkok	210
Do.	Siam Iron & Steel Co. Ltd.	Saraburi Province, 100 kilometers north of Bangkok	220
Tantalum and columbium, in tin slag	Thailand Smelting and Refining Co. Ltd.	Phuket	XX
Tin:			
Concentrate	Numerous small companies	Offshore Andaman Sea from southern tip of Burma to south of Phuket	NA
Do.	do.	Mostly south Thailand and along southern Burma border	NA
Refined	Thailand Smelting and Refining Co. Ltd.	Phuket	38
Tungsten, concentrate	Parasit Mining Co.	Doi Ngeom, 100 kilometers east	.1
Do.	Siamerican Mining Enterprise Co. Ltd.	Khao Soon, 185 kilometers east of Phuket (temporarily inactive)	1.2
Do.	Sirithai Scheelite Thailand Co. Ltd.	Doi Mok, 120 kilometers northeast of Chiang Mai (temporarily inactive)	.4
Zinc:			
Ore	Padaeng Industry Co. Ltd.	Mae Sot, 64 kilometers west of Tak	350
Refined	do.	Tak	60

NA Not available. XX Not applicable.

TABLE 5
THAILAND: RESERVES OF MAJOR MINERAL COMMODITIES
FOR 1991

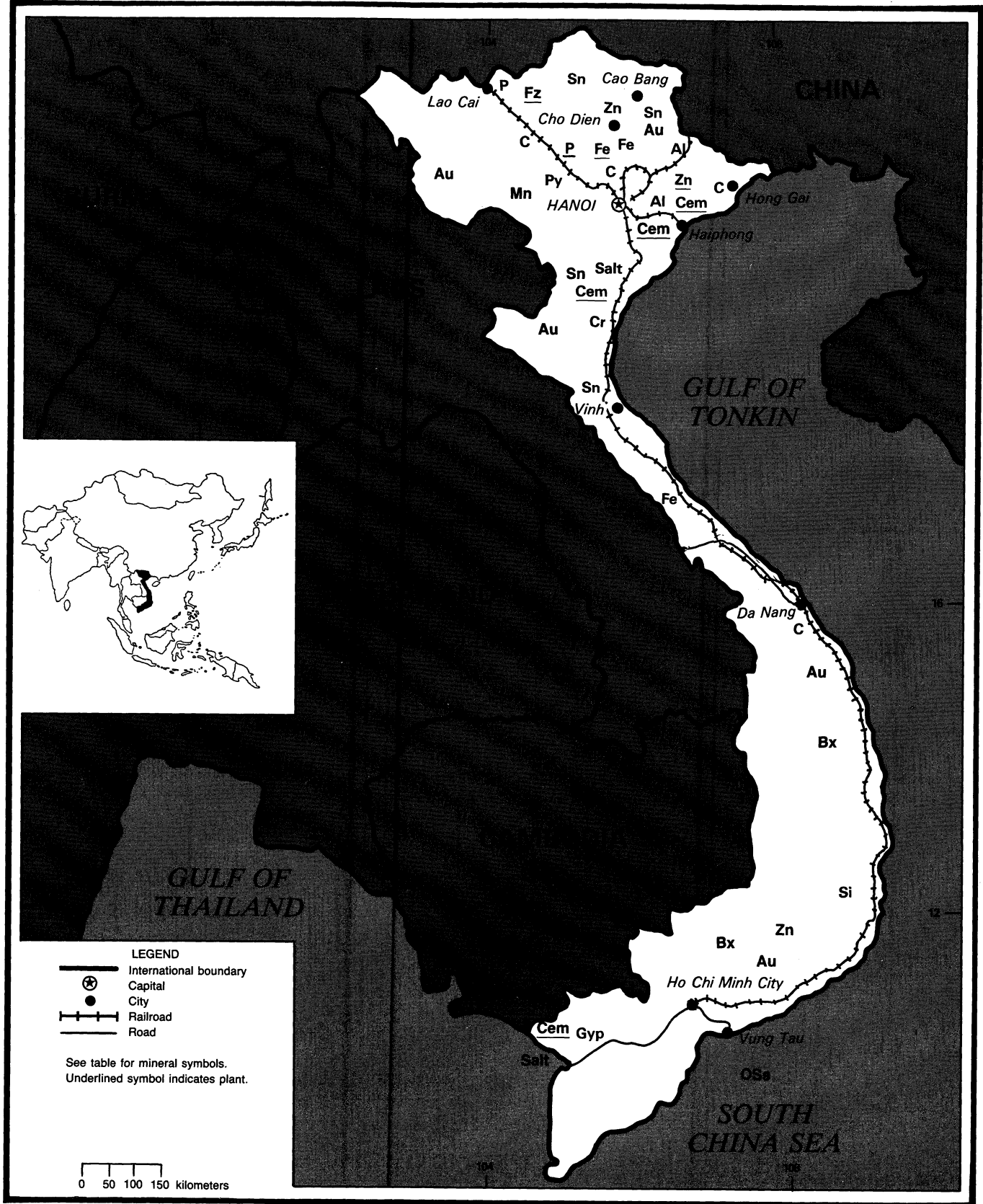
(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Antimony	300
Barite	14,000
Clay, kaolin	500
Feldspar	43,000
Fluorspar	1,000
Gas, natural	6,950
	billion cubic feet
Gypsum	42,300
Lead	1,500
Lignite	2,100,000
Limestone	5,500,000
Petroleum, crude	231
	million 42-gallon barrels
Potash	570,000
Tantalum (including tantalum-bearing tin slags)	3,000
Tin	270
Tungsten	3
Zinc	3,800

VIETNAM

AREA 330,000 km²

POPULATION 68 million



THE MINERAL INDUSTRY OF VIETNAM

By Travis Q. Lyday

The Socialist Republic of Vietnam has had a centrally planned economy since 1976 when the former northern and southern areas partitioned in 1954 by the Geneva accords were officially reunited. Its economy has been one of devastation since 1945 when Japan's World War II occupation ended and the country first proclaimed independence. Agriculture, dominated by rice, provided more than one-half of the GDP, estimated to be \$14.6 billion¹ in 1991, and employed about 65% of the labor force. Inflation in 1991 was brought down from the average of about 300% in 1987 to about 40%.

Since 1989, upon the withdrawal of its military from Cambodia, Vietnam has concentrated on a broad policy of reform of internal development under doi moi, or renovation. The program encourages private enterprise and trade. In 1988, the Government passed a foreign investment code to encourage foreign investment and joint ventures, which appeared to be on the verge of bearing fruit at yearend.

Vietnam abounds with numerous minerals, including bauxite, chromite, coal, gold, iron ore, manganese, petroleum, phosphate rock, tin, and zinc. Most of the nonfuel mineral resources are in the north, with the petroleum fields lying off the southern coast in the South China Sea. (See table 1.)

Petroleum production for export continued to be the country's leading foreign exchange producer from the minerals sector. Petroleum production continued to increase as foreign capital focused on the exploration and development of new fields.

Coal continued to be an important mineral export, with estimated exports in 1991 of 783,000 tons representing about 25% of domestic production.²

Gold mining, predominantly by numerous small-scale operations, also was increasing rapidly, providing additional foreign exchange earnings.

Mineral resources in Vietnam are owned by the state, and, with the exception of the petroleum sector, all mines and mineral processing plants are owned and operated solely by the Government. Petroleum exploration, development, and production projects were joint ventures between the Government and foreign companies. Some mining, predominantly for gold, was done by individuals. (See table 2.)

Information relating to reserves is based primarily on news broadcasts by state radio (Hanoi Domestic Service), announcements or projections by representatives of foreign business interests in Vietnam, and Vietnamese newspaper articles. (See table 3.)

Essential elements of the transportation infrastructure included about 85,000 km of roads, including 9,400 km bituminous, 48,700 km gravel or improved earth, and 26,900 km unimproved earth. The length of navigable inland waterways totals about 17,702 km, with more than 5,100 km navigable at all times by vessels with less than 1.8-m draft. The rail system consisted of 3,059 km of track, including 2,454 km of 1,000-m narrow gauge, 151 km of 1,435-m standard gauge, 230 km of dual gauge having three rails; and 224 km of unserviceable track. There were 50 principal airports with permanent-surface runways out of an aggregate of 100 in the country. International shipping ports included Da Nang, Haiphong, and Ho Chi Minh City. The merchant marine fleet included eight petroleum, oils, and lubricant tankers and two bulk ore freighters. Pipelines included 150 km for refined oil products. Electric generating capacity in 1990 was 2,740 MW.³

¹Where necessary, the Vietnamese new dong (D) has been converted into U.S. dollars at the rate of D11,000=US\$1.00, the rate in Sept. 1991.

²Mining Magazine (London). V. 166, No. 3, Mar. 1992, p. 177.

³U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1991, p. 333.

OTHER SOURCES OF INFORMATION

Agencies

General Department of Chemicals
Hanoi

Ministry of Construction
Hanoi

Ministry of Energy
Hanoi

Ministry of Heavy Industry (formerly
Ministry of Engineering and Metals)
Hanoi

Ministry of Power and Coal
Hanoi

TABLE 1
VIETNAM: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1987	1988	1989	1990	1991	
Bauxite: Gross weight	6,000	6,000	6,000	6,500	6,000	
Cement, hydraulic	thousand tons	³ 1,665	³ 1,954	2,000	2,500	3,000
Chromium: Chromite	4,000	4,000	3,500	3,500	3,500	
Clays: Kaolin	1,000	700	750	750	800	
Coal: Anthracite	thousand tons	³ 6,839	³ 6,900	5,500	4,022	4,000
Gold	kilograms	500	1,000	1,200	1,200	1,300
Gypsum	25,000	25,000	25,000	25,000	25,000	
Iron and steel: Metal:						
Steel, ingot	thousand tons	110	115	115	115	115
Steel, rolled	do.	50	50	50	50	50
Nitrogen: N content of ammonia	36,000	36,000	36,000	36,000	36,000	
Petroleum: Crude	thousand 42-gallon barrels	600	5,475	10,850	19,700	13,670
Phosphate rock:						
Gross weight	thousand tons	300	330	500	274	274
P ₂ O ₅ content	do.	105	115	175	96	96
Salt	do.	229	300	320	340	350
Tin:						
Mine output, Sn content	680	700	850	850	850	
Metal, smelter	645	600	800	800	800	
Zinc:						
Mine output, Zn content	5,000	5,500	5,500	5,500	5,500	
Metal, smelter, primary	4,200	4,200	4,200	4,200	4,200	

¹Table includes data available through Oct. 7, 1991.

²In addition to the commodities listed, iron ore was mined in the past and pig iron was produced at industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to allow formulation of reliable estimates of output levels. Similarly, data on output of crude construction materials and natural gas are not available, and no basis is available to make reliable estimates of output levels.

³Statistical Yearbook of Members of the Council for Mutual Assistance, Moscow, U.S.S.R.

TABLE 2
VIETNAM: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

Commodity	Major operating companies	Location of main facilities	Annual capacity
Bauxite	Basic Chemical Corp.	Lo Son, believed to be in Hai Hung Province and Mieu, believed to be in Hai Hun Province	NA
Cement	Ministry of Construction	Bim Son, Thanh Hoa Province, 100 kilometers south of Hanoi	1,200
Do.	do.	Huang Thach, Hai Hung Province, 50 kilometers east of Hanoi	1,000
Do.	do.	Ha Tien, Kien Giang Province, 245 kilometers west of Ho Chi Minh City	1,300
Chromite	Basic Chemical Corp	Co Dihn, 100 kilometers north of Vinh, Thanh Hoa Province	4
Coal, anthracite	Ministry of Mines and Coal	Coc Sau, Deo Nai, Ha Tu, and Thong Nhat in the Hon Gai coalfield, north of Haiphong	6,000
Fertilizer:			
Apatite	General Department of Chemicals	Lao Cai, Hoang Lien Son Province, 250 kilometers northwest of Hanoi	300
Phosphate, single superphosphate	do.	Lam Thao, Vinh Phu Province, 70 kilometers north of Hanoi	¹ 300
Iron:			
Ore	Ministry of Mines and Coal	Thach Khe, coast of Thach Ha District, Nghe Tinh Province, 175 kilometers southeast of Vinh	NA
Steel	do.	Thai Nguyen, 60 kilometers north of Hanoi	200
Tin:			
Ore	Ministry of Heavy Industry	Tinh Tuc mining area near Cao Bang	NA
Do.	do.	Son Duong mining area, Ha Tuyen Province, 75 kilometers west of Hanoi	NA
Do.	do.	Qui Hop, Nghe Tinh Province, 25 kilometers north-northwest of Vinh	NA
Metal	do.	Tinh Tuc, Cao Bang Province	1
Zinc:			
Ore	do.	Cho Dien, Bac Thai Province	10
Do.	do.	Trang Da Mine, location unknown	NA
Metal	do.	Quang Yen, near Haiphong	6,000

NA Not available.

¹Plant produced single superphosphate (SSP) fertilizer but it is not clear whether capacity is in P₂O₅ content or gross weight of SSP at 16% P₂O₅.

TABLE 3
VIETNAM: ESTIMATED
RESERVES OF MAJOR MINERAL
COMMODITIES FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Reserves*
Apatite	1,700,000
Chromite	750,000
Coal	200,000
Gold	1.5
Graphite	100
Iron ore	250,000
Kaolinite	50
Manganese	2,500
Petroleum, crude thousand barrels	800,000
Tin	2,000
Zinc	200

*Estimated.

REFERENCE

MAP SYMBOLS

Commodity	Symbol
Alunite	Alu
Alumina	<u>Al</u>
Aluminum	<u>AL</u>
Andalusite	And
Antimony	Sb
Arsenic	As
Asbestos	Asb
Asphalt	Asp
Barite	Ba
Bauxite	Bx
Bentonite	Bent
Beryllium/beryl	Be
Bismuth	Bi
Bitumen (natural)	Bit
Boron	B
Bromine	Br
Cadmium	Cd
Calcium/calcite	Ca
Carbon black	<u>CBI</u>
Cement	<u>Cem</u>
Cesium	Cs
Chromite	Cr
Clays	Clay
Coal	C
Cobalt	Co
Columbium (niobium)	Cb
Copper	Cu
Corundum	Cn
Cryolite	Cry
Diamond	Dm
Diatomite	Dia
Dolomite	Ds
Emerald	Em
Emery	E
Feldspar	Feld
Ferroalloys	<u>FA</u>
Ferrochrome	<u>FeCr</u>
Ferromanganese	<u>FeMn</u>
Ferronickel	<u>FeNi</u>
Ferrosilicon	<u>FeSi</u>
Fertilizer	<u>Fz</u>
Fluorspar	F
Gallium	Ga
Garnet	Gt
Gemstones	Gm
Germanium	Ge
Gold	Au
Graphite	Gr
Gypsum	Gyp
Indium	In
Iron and steel	<u>Fe</u>

Iron ore	Fe
Jade	J
Kaolin	Kao
Kyanite	Ky
Lapis lazuli	Laz
Lead	Pb
Lignite	Lig
Lime	<u>Lime</u>
Limestone	Ls
Liquefied natural gas	<u>LNG</u>
Liquefied petroleum gas	<u>LPG</u>
Lithium	Li
Magnesite	Mag
Magnesium	<u>Mg</u>
Manganese	Mn
Marble and alabaster	Marb
Marl	Ma
Mercury	Hg
Mica	M
Molybdenum	Mo
Natural gas	NG
Natural gas liquids	<u>NGL</u>
Nepheline syenite	Neph
Nickel	Ni
Nitrates	Nit
Nitrogen (ammonia plants)	<u>N</u>
Ochre	Oc
Oil sands	OSs
Oil shale	OSh
Olivine	Ol
Opal	Opal
Peat	Peat
Perlite	Per
Petroleum, crude	Pet
Petroleum refinery products	<u>Pet</u>
Phosphate	P
Pig iron	<u>Pig</u>
Pigments, iron	Pigm
Platinum-group metals	PGM
Potash	K
Pozzolana	Pz
Pumice	Pum
Pyrite	Py
Pyrophyllite	Pyrp
Quartz or quartzite	Qtz
Rare earths	RE
Rhenium	Re
Salt	Salt
Sand and gravel	S/Gvl
Sandstone	Ss
Selenium	Se
Sepiolite, meerschaum	Sep
Serpentine	Serp
Shale	Sh

Silicon	<u>Si</u>
Sillimanite	Slm
Silver	Ag
Soapstone	So
Soda ash, trona	NaAsh
Sodium sulfate	NaSO ₄
Stone	St
Strontium	Sr
Sulfur	S
Talc	Tc
Tantalum	Ta
Tellurium	Te
Thorium	Th
Tin	Sn
Titanium (rutile or ilmenite)	Ti
Titanium dioxide (processed)	<u>TiO₂</u>
Tungsten	W
Umber	Um
Uranium	U
Vanadium	V
Vermiculite	Vm
Wollastonite	Wo
Yttrium	Y
Zinc	Zn
Zircon	Zr

MAP LEGEND

Symbol = Mine, including beneficiation plants, wells

Circled
Symbol = Group of producing mines or wells

Underlined
Symbol = Processing plant or oil refinery, including smelters and metal refineries

(Symbol) = Undeveloped significant resource

**UNITS OF MEASURE
AND ABBREVIATIONS**

Unit of Measure

a = year
 ° API = American Petroleum Institute gravity
 bbl = barrel(s)
 cal = calorie(s)
 c = centi (prefix)
 cm = centimeter(s)
 m³ = cubic meter(s)
 d = day(s)
 dwt = ton(s), deadweight
 G = giga (prefix)
 GW = gigawatt(s)
 GW•h = gigawatt hour(s)
 g = gram(s)
 g/mt = gram(s) per metric ton
 ha = hectare(s)
 k = thousand
 kcal = kilocalorie(s)
 kg = kilogram(s)
 kL = kiloliter(s)
 km = kilometer(s)
 km² = square kilometer(s)
 kmt = thousand metric ton(s)
 kV = kilovolt(s)
 kW = kilowatt(s)
 kW•h = kilowatt hour(s)
 L = liter(s)
 M = mega (prefix)
 MW = megawatt(s)
 MW•h = megawatt hour(s)
 m = meter(s)
 M = million
 Mmt = million metric ton(s)
 m² = square meter(s)
 mt = ton(s), metric
 SCE = standard coal equivalent
 V = volt
 W = watt
 W•h = watt hour

Abbreviation

API = American Petroleum Institute
 EC = European Community
 EFTA = European Free Trade Association
 FTA = Free Trade Agreement
 GATT = General Agreement on Tariffs and Trade
 GDP = gross domestic product
 GNP = gross national product
 LNG = liquefied natural gas (methane)
 LPG = liquefied petroleum gas (propane-butane)

NAFTA = North American Free Trade Agreement
 OECD = Organization for Economic Cooperation and Development
 OPEC = Organization of Petroleum Exporting Countries
 UN = United Nations
 UNDP = United Nations Development Program

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