THE MINERAL INDUSTRY OF

NEW ZEALAND

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New Zealand has a wide variety of economic mineral deposits that reflect its diverse geologic and dynamic tectonic history. Although New Zealand probably has been better known in the minerals industry community for its gold production, it also has been an important producer, for domestic and export use, of such industrial minerals as aggregate, clays, dolomite and limestone, perlite, phosphate, pumice, salt, serpentine, silica, sulfur, and zeolite; silver, as a byproduct of gold mining; and energy fuels (coal, natural gas, natural gas liquids, and petroleum). Furthermore, the country could potentially develop resources of antimony, bauxite, chromite, copper, ilmenite mineral sands, lead and zinc, manganese, mercury, molybdenum, nickel, platinum-group metals (PGM), rare-earth oxides, tin, titanium, and tungsten deposits. Nevertheless, in relation to the complexity of its geology and its many mineral environments, New Zealand can be considered to be underexplored (Crown Minerals, 2001a, p. 4).

New Zealand's mining industry contributed about 1% to the country's gross domestic product (GDP), which was estimated to be about $57 billion in 2000 (Mining Journal, 2000; U.S. Central Intelligence Agency, [undated], World factbook 2000—New Zealand—Economy, accessed March 16, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/nz.html). The GDP grew by an estimated 4.4% in 2000 compared with that of 1999 (Crown Minerals, 2001b, p. 8).

In 2000, mining activities in New Zealand included the mining of gold, often with silver as a byproduct; the production of iron ore from titanomagnetite sands; the quarrying of raw materials, such as clays, sand and gravel, and dimension stone, for use primarily in the construction and agricultural industries; and the extraction of coal by open cast and underground methods. Natural gas, natural gas liquids, and petroleum also were produced.

The mineral-processing sector, which consisted chiefly of the production of primary aluminum, concrete, manufactured fertilizer, refined petroleum products, and crude steel mostly produced from imported raw materials, provided an estimated 2% to 3% to the GDP, thus increasing the value of the minerals industry to the country to about 3% to 4% of the GDP.

New Zealand's mining industry was a $500 million sector that employed about 12,000 people (Mineral Resources of New Zealand, 2000a).

New Zealand's Crown (a term inherited from United Kingdom law and interpreted as meaning the state) minerals are owned and regulated by legislation passed by Parliament, namely the New Zealand Crown Minerals Act 1991 and the Crown Minerals Amendment Act (No. 2), which was passed in 1997. Crown-owned minerals include all naturally occurring gold, silver, and uranium; substantial amounts of coal; other metallic and nonmetallic minerals and aggregates; and all petroleum (Mineral Resources of New Zealand, 2000b). Minerals not designated as being Crown-owned are privately owned. A company or individual wanting to undertake prospecting, exploration, or mining of Crown-owned minerals must first have a permit granted under the Crown Minerals Act or a license granted under earlier legislation.

Unlike Australia, New Zealand has not enacted native title legislation to gain access to Maori land. Maori land claims are being handled through the Treaty of Waitangi Tribunal, which is altogether separate from the Crown Minerals Act, although permit holders must consult with local Maori under the Crown Minerals Act, usually for the purpose of identifying cultural areas or archaeological sites.

Environmental matters are governed under the Resource Management Act 1991. Normally, resource consents are required when a company or individual is taking or diverting water or discharging contaminants into water or the air or onto the land. Regional and district councils administered the act.

New Zealand Aluminum Smelters Ltd. operated the Tiwai Point Smelter on South Island. The smelter was owned by Rio Tinto plc. of the United Kingdom (79.36%) after taking over Australia's Comalco Ltd. in June; Sumitomo Chemical Co. of Japan owned the remaining 20.64%. The smelter ran four potlines with a capacity of 320,000 metric tons per year (t/yr) of primary aluminum. More than 90% of smelter production was exported, chiefly to Japan, Korea, and other Asian markets (Crown Minerals, 2001a, p. 72).

Gold has been considered to be the most attractive investment in the country's mining industry. New Zealand's two largest gold mines, the Macraes and the Martha Hill (also often referred to as the "Waihi") open cuts, increased production to record levels as a result of new investment in 2000 (Crown Minerals, 2001a, p. 6). Both were hard-rock mining operations; Macraes was the larger. In mid-2000, Perth-based Gold and Resource Developments NL's (GRD) wholly owned Macraes Mine produced its 1-millionth ounce (about 31,000 kilograms) of gold since the start of modern mining in 1994 (Crown Minerals, 2001a, p. 8). The Macraes is 55 kilometers (km) north of Dunedin in the Eastern Otago region of South Island. Australian producer Normandy Mining Ltd.'s majority-owned (67.06%) Martha Hill Mine is 120 km southeast of Auckland at the base of the Coromandel Peninsula at Waihi, North Island. Several smaller scale alluvial gold operations were on South Island and included the Grey River dredging operation (wholly owned by Birchfield Minerals Ltd.), which is 20 km north of Greymouth, and the Ross open cut operation (wholly owned by Birchfield Ross Mining Ltd.), which is 25 km southwest of Hokitika. In late 2000, L&M Mining Ltd. began construction of the Waikaka Valley dredging operation, which is 20 km north of Gore. It was to be commissioned in early 2001 and was scheduled to operate until 2008 (Resource Information Unit, 2001, p. 49).

A major new hard-rock gold mine may be opened 6 km southeast of Reefton on the western coast of South Island in 2001 or 2002. In March 2000, GRD began a $1.3 million optimization study to update its earlier definitive feasibility study. The major objectives were to add gold reserves, to improve the project's cost base and project value, and to allow a

project development decision to be made by January 2001, which was 6 months ahead of the original target date of July 2001 (Gold and Resource Developments NL, [undated], Overview—Reefton gold project, accessed April 3, 2001, at URL http://www.grd.com.au/macraes/2/default.html).

Iron ore in the form of titanomagnetite-bearing iron sand was mined from beach and dune sands and concentrated at two projects along the western coast of North Island by BHP New Zealand Steel Ltd. (NZ Steel) (a wholly owned subsidiary of Australia's BHP Ltd.). Titanomagnetite concentrate was produced by dry mining (bulldozing and bucketwheel excavation) methods at Waikato-North Head, which is 30 km south of Auckland, and pumped as a slurry through an 18-km-long high-pressure pipeline to NZ Steel's integrated Glenbrook Steelworks for direct-reduction steelmaking. NZ Steel had an exclusive license with the Government to mine iron sand for 100 years beginning in 1996. NZ Steel used wet- (suction dredging) and dry-mining methods and magnetic and gravity separation to produce an iron sand concentrate of 57% iron at its Taharoa project, which is 120 km farther south of the Waikato-North Head deposit. The Taharoa concentrate was pumped via twin 3-km-long slurry pipelines onto stockpiles near the offshore ship-loading plant at the port of Taharoa where it was shipped to China and Japan. The Taharoa site was leased by its Maori owners to NZ Steel for 70 years beginning in 1968 (Resource Information Unit, 2001 p. 81).

NZ Steel continued to produce more than 2 million metric tons per year of titanomagnetite iron sand and concentrate each from its North Island deposits, which were about equally divided between exports from Taharoa and production from Waikato-North Head for steelmaking at the integrated Glenbrook Steelworks, which is about 50 km south of Auckland (Mining Annual Review, 2000).

Considerable potential for PGMs from hard-rock deposits and alluvial concentrations exists in New Zealand. The Longwood Range in western Southland is to be considered the most prospective hard-rock area, and alluvial deposits in Nelson, Otago, Southland, and Westland are known to contain PGMs. New exploration, however, was not the only way to achieve a PGM industry in New Zealand. With greater improvement of the gravity and flotation recovery methods, increased recovery of PGMs and gold from alluvial deposits, were becoming increasingly more attractive (Crown Minerals, 2001a, p. 17).

NZ Steel's steelworks at Glenbrook specialized in flat and coated products, producing hot-rolled coils, sheet and plate for pipemaking, heavy and light engineering and barge construction; cold-rolled steel for tubing; hollow sections for agricultural products, commercial construction, and reticulation; and coated steels for construction (Crown Minerals, 2001a, p. 71).

New Zealand has a diverse range of industrial minerals, and some of the commodities have abundant estimated resources. Mining these commodities continued to contribute significantly to the country's economy.

Although New Zealand continued to have substantial export commerce in its industrial minerals sector, most output was for domestic use The main exports were, in descending order, iron sand, halloysite clay, lime, limestone, and cement, and smaller quantities of peat, salt, sulfur, and pumice (Crown Minerals, 2001a, p. 20).

New Zealand had two cement manufacturing plants—Golden Bay Cement Co. Ltd. at Portland (a wholly owned subsidiary of Fletcher Challenge Ltd.) on North Island's eastern coast near Whangarei and Milburn New Zealand Ltd. at Cape Foulwind (a wholly owned subsidiary of Switzerland-based Holderbank Group) on South Island's western coast near Westport. Both used domestic high-grade limestone mixed with marl for their feed (Crown Minerals, 2001a, p. 20). Bulk cement was transported by road, rail, and ship to cement supply centers throughout the country (Crown Minerals, April 11, 2000, New Zealand's industrial minerals potential, accessed March 26, 2001, at URL http://www.med.govt.nz/crown_minerals/minerals_info/99_indust_mins.html).

Halloysite clay was produced by New Zealand China Clays Ltd. from deposits at Matauri Bay, which is about 100 km north of Whangarei on North Island. The halloysite was exported to more than 20 countries for the manufacture of high-quality ceramics, which were principally porcelain but also fine bone china and technical ceramics (Crown Minerals, 2001a, p. 21).

Kaolinite clays were used for domestic brick, tile, pipe, ceramics, and pottery manufacture. Some kaolinite was used as a filler in adhesives, bitumen, and rubber. Higher purity kaolinite was used by the paper industry for paper coating and filling.

Deposits of limestone were widespread throughout New Zealand. Limestone that contains more than 70% calcium carbonate ($CaCO_3$) was used for agricultural fertilizer and road aggregate. High-grade limestone deposits and marble deposits suitable for domestic and export industrial use also were widespread (Crown Minerals, April 11, 2000, New Zealand's industrial minerals potential, accessed March 26, 2001, at URL http://www.med.govt.nz/crown_minerals/minerals_info/99_indust_mins.html). The best quality limestone in large-tonnage deposits, however, was quarried near Waikato (Crown Minerals, 2001a, p. 21). These limestones contain 97.4% to 99.5% $CaCO_3$ (Crown Minerals, April 11, 2000, New Zealand's industrial minerals potential, accessed March 26, 2001, at URL http://www.med.govt.nz/crown_minerals/minerals_info/99_indust_mins.html).

Pumice was quarried from very large pyroclastic deposits in the Taupo volcanic zone and dredged along with sand from alluvium in the lower reaches of the Waikato River on North Island. The main uses for pumice were as fill for road construction, sand in concrete block manufacture, and foundations and drainage (Crown Minerals, 2001a, p. 20).

Dominion Salt Ltd. produced about 60,000 t/yr of premium salt products for a variety of domestic industries, which included markets in agriculture, chlorine manufacture, dairy, edible salt, pharmaceutical, tanning, and water treatment. The salt is produced by solar evaporation of seawater pumped into Lake Grassmere near Blenheim, North Island (Crown Minerals, 2001a, p. 74). The evaporation ponds were constructed in low-lying areas and separated into paddocks with gates to admit and retain seawater. Low rainfall, many hours of sunshine, and adequate wind facilitated the process (Resource Information Unit, 2001, p. 95, 106).

Coal was produced from about 40 mines that operated in 42 distinct coalfields on North Island and South Island; about 20 mines produced more than 10,000 t/yr (Asian Mining Yearbook, 2000, p. 131; Crown Minerals, 2001a, p. 52). Low-ash, low-sulfur subbituminous coal was mined in the Waikato region and was used mainly as coking coal for steelmaking at the Glenbrook Mill and for steaming coal at the Huntly Station for power generation. The subbituminous coal and lignite

mined on South Island were mainly for domestic use in such industries as abattoirs, cement manufacturing, and dairies (Resource Information Unit, 2001, p. 28.) Bituminous coal was mined on the western coast of South Island; most of the production was exported. Production was dominated by state-owned Solid Energy New Zealand Ltd., which operated on a competitive, commercial basis and produced about 70% of production. Solid Energy also was the country's only significant exporter of coal (Asian Mining Yearbook, 2000, p. 131).

In March, Greymouth Coal Ltd.'s Spring Creek underground bituminous coal mine, which was the largest new coal project in many years, began production on South Island's western coast. Greymouth Coal was a 50-50 joint venture between Solid Energy and New Zealand's privately owned Todd Corp. Ltd. Todd expected to produce about 500,000 t/yr of high-quality blendable coking coal for steelmaking and steaming coal that is suitable for electricity generation and for the domestic industrial market (Asian Mining Yearbook, 2000, p. 131).

In August, Francis Mining Co. Ltd. signed a 3-year contract to supply 100,000 t/yr of specialist coking coal to a European customer. Its Roa Mine is 30 km from Greymouth in the Greymouth Coalfield (Resource Information Unit, 2001, p. 27).

Gas and oil seeps were known throughout New Zealand long before the first European settlers arrived. Although the modern petroleum industry in the country is only a little more than 30 years old, petroleum exploration first began in 1865 when the first lease was granted and the first well was drilled in what eventually became known as the Taranaki sedimentary basin along the western coastal region of North Island. Oil was first discovered in this area in 1866 and has been produced continuously from the basin since about 1900 (Crown Minerals, February 15, 2000, Petroleum—Overview, accessed March 14, 2000, at URL http://www.med.govt.nz/crown_minerals/petroleum.html).

In 2000, a record 26 wells were drilled in 50 permit areas that were operating in six of New Zealand's nine known petroleum basins (Crown Minerals, October 24, 2000, Petroleum—Overview, accessed March 28, 2001, at URL http://www.med.govt.nz/crown_minerals/petroleum.html).

Early in 2000, Swift Energy Corp. of Houston reported discoveries of oil, condensate, and gas in the Taranaki Basin that could increase New Zealand's crude and condensate reserves of a little more than 100 million barrels by 20%. The discovery wells were onshore and close to existing oil and gas infrastructure (Oil & Gas Journal, 2000).

The transportation infrastructure of New Zealand was well developed. International shipping ports included Auckland, Christchurch, Dunedin, Tauranga, and Wellington. The merchant marine fleet of 10 ships included a petroleum-oil-lubricant tanker. Pipelines included 1,000 km for natural gas, 160 km for refined petroleum products, and 150 km for liquefied petroleum gas (U.S. Central Intelligence Agency, 2000, World factbook 2000—New Zealand—Transportation, accessed March 16, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/nz.html).

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Major Source of Information

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TABLE 1
NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998 e/	1999 e/	2000 e/
METALS						
Aluminum metal, smelter:						
Primary		283,329	310,324	317,500 r/ 2/	326,700 r/ 2/	325,000
Secondary		12,200 r/	12,400 r/	21,400 r/ 2/	21,400 r/	21,500
Total		295,529 r/	322,724 r/	338,900 r/ 2/	348,100 r/ 2/	346,500
Gold, mine output, Au content	kilograms	11,879	11,359	7,544 r/ 2/	8,577 r/ 2/	8,600
Iron and steel:						
Iron sand (titaniferous magnetite), gross weight	thousand tons	2,334	2,478	2,120 2/	2,303 r/ 2/	2,400
Pig iron	do.	619	534	609 2/	620 2/	600
Steel, crude	do.	680	680	756 2/	744 2/	765 2/
Lead, refinery output, secondary e/		6,000	6,000	6,000	6,000	10,000
Silver, mine output, Ag content	kilograms	29,611	31,684	22,642 r/ 2/	24,308 r/ 2/	24,500
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	974	976	950	960 r/	950
Clays:						
Bentonite		13,734	12,802	14,000	15,000	10,000
Kaolin (pottery)		26,325	21,874	26,000	25,000	25,000
For brick and tile		27,159	33,396	27,000	30,000	30,000
Diatomaceous earth 3/		16	20 e/	20	20	20
Lime e/		20,916 2/	20,916 2/	20,000	20,000	20,000
Marble e/		15,000 r/	15,000 r/	15,000 r/	15,000 r/	15,000
Nitrogen, N content of ammonia		67,700	79,600	93,700 2/	110,100 2/	105,300 2/
Perlite 3/		1,880	4,960	5,000	5,000	7,000
Pumice		90,571	196,687	190,000	500,000 r/	500,000
Salt e/		67,000	67,000	65,000	65,000	60,000
Sand and gravel:						
Silica sand (glass sand)		23,867	25,931	25,000	25,000	25,000
Other industrial sand		508,950	463,438	500,000	500,000	500,000
For roads and ballast	thousand tons	15,566	15,000 e/	15,000	15,000	15,000
For building aggregate	do.	8,069	8,000 e/	8,000	8,000	1,000
Stone:						
Dolomite		21,718	20,000 e/	20,000	20,000	20,000
Limestone and marl:						
For agriculture	thousand tons	1,457	1,316	1,500	1,500	1,500
For cement	do.	1,520	1,623	1,500	1,500	1,500
For other industrial uses	do.	461	460 e/	450	450	450
For roads e/ 4/	do.	530 2/	550	550	550	550
Serpentine	do.	15,714	15,000 e/	15,000	15,000	15,000
Dimension		27,242	28,000 e/	15,000	15,000	15,000
Rock for harbor work e/	thousand tons	1,500	1,500	1,500	1,500	1,500
MINERAL FUELS AND RELATED MATERIALS						
Carbon dioxide, liquefied e/		10,000	10,000	10,000	10,000	10,000
Coal:						
Anthracite	thousand tons	240 r/	263 r/	420 r/ 2/	253 r/ 2/	250
Bituminous	do.	2,880 r/	2,643 r/	2,332 r/ 2/	3,197 r/ 2/	3,200
Lignite	do.	214 r/	232 r/	283 r/ 2/	255 r/ 2/	250
Total	do.	3,334 r/	3,138 r/	3,035 r/ 2/	3,705 r/ 2/	3,700
Gas: e/						
Manufactured (from gasworks)	thousand cubic meters	11,500	11,500	11,000	11,000	11,000
Natural:						
Gross production	million cubic meters	4,800 2/	5,721 r/ 2/	5,013 r/ 2/	5,000	5,000
Marketed production	do.	3,900	5,664 r/ 2/	4,596 r/ 2/	4,050	4,000
Natural gas liquids: e/						
Liquefied petroleum gas	thousand 42-gallon barrels	1,500	1,500	1,500	2,000	2,000
Natural gasoline	do.	500	500	500	700	700
Total	do.	2,000	2,000	2,000	2,700	2,700
Peat		109,982	107,041	110,000	110,000	110,000
Petroleum:						
Crude	thousand 42-gallon barrels	13,505 r/	21,170 r/	17,155 r/ 2/	15,330 r/ 2/	15,500
Refinery products:						
Gasoline	do.	12,634	13,219	8,395 r/ 2/	8,500 r/ 2/	8,500
Distillate fuel oil	do.	10,852	12,038	13,140 r/ 2/	13,000 r/ 2/	13,000
Residual fuel oil	do.	2,967	3,250	3,285 r/ 2/	3,500 r/ 2/	3,500

See footnotes at end of table.

TABLE 1--Continued
NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998 e/	1999 e/	2000 e/
MINERAL FUELS AND RELATED MATERIALS--Continued						
Petroleum--Continued:						
Refinery products--Continued:						
Other	thousand 42-gallon barrels	6,735	7,380	3,650 r/ 2/	3,500 r/ 2/	3,500
Refinery fuel and losses e/	do.	2,000	2,000	2,190 r/ 2/	2,000 r/ 2/	2,000
Total	do.	35,188	37,887	30,660 r/ 2/	30,500 r/ 2/	30,500

e/ Estimated. r/ Revised.
1/ Table includes data available through March 20, 2001.
2/ Reported figure.
3/ Includes zeolite.
4/ Includes dolomite.