THE MINERAL INDUSTRY OF

PAPUA NEW GUINEA

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Papua New Guinea comprises the eastern one-half of the island of New Guinea (which is the second largest island in the world), an archipelago of an additional three islands (Bougainville, New Britain, and New Ireland), and about 600 smaller islets, atolls, and coral reefs. The 463,000-square-kilometer (km^2) nation, which includes 9,980 km^2 of territorial waters, is located east of Indonesia between the Coral Sea and the South Pacific Ocean and lies just north of the Australian Continent. Papua New Guinea was formed by the merger of the Australian territory of Papua and the German colonial possession of New Guinea following World War I. Australia administered Papua New Guinea until 1975 when it became an independent state.

Historically, mining has played a prominent role in Papua New Guinea's economy. In 1888, the first significant discovery of gold was made when the search for new bonanza alluvial gold deposits brought Australian miners from Queensland to Sudest Island in the Louisiade Archipelago. This discovery was followed by gold rushes at Misima and Woodlark Islands in the Solomon Sea and then on the mainland, which culminated in discoveries at Wau in 1922 and the adjacent Edie Creek in 1926. Hardrock mines were established on Misima, Sudest, and Woodlark Islands when the alluvial gold was exhausted; of the three, however, gold mining continued only at Misima following World War I. The rich discoveries at Edie Creek lead to the establishment of a number of underground hardrock mines near there and at nearby Wau, as well as large-scale dredging operations in the Bulolo Valley, which started in 1932. By 1939, eight large dredges were operating in the Wau-Bulolo Valley, and, except for the interruption during World War II, dredging continued until 1965 when the last dredge was abandoned. Spurred by the fabulous riches of Edie Creek, prospectors ventured into other parts of the mainland and the outer islands; they eventually mined gold at Kainantu, Mount Hagen, and Porgera in the Highlands, along the Sepik River in the north, and at Kupei on Bougainville Island (Papua New Guinea Chamber of Mines and Petroleum, 2000, p. 9).

Petroleum exploration also is not new to Papua New Guinea. Oil companies have been searching diligently for recoverable oil and gas reserves since the first reports of oil seeps near Kerema along the coast of the Gulf of Papua in 1911. Although first oil was not discovered until 1922, 94 exploratory wells had been drilled by the time of independence in 1975. Buoyed by the successful discovery of oil in 1986, exploration activity increased, and in 1989 alone, 32 wells were drilled. Exploration drilling produced additional discoveries of oil at Agogo, Gobe Main, Southeast Gobe, and South Mananda and an even larger number of gas discoveries at Angore, Elevala, Hides, Ketu, Pandora A and B, P'nyang, and Southeast Hedinia, on which more than $1 billion had been spent (Papua New Guinea Chamber of Mines and Petroleum, 2000, p. 6-9).

Although changes in Government leadership have been peaceful since the country's independence in 1975, Papua New Guinea has struggled to develop nationhood status throughout its 27-year existence. The country's population is diverse and spread out in isolated villages. Ethnic strife has become commonplace as evidenced by civil unrest in Bougainville and tribal skirmishes in the Highlands. These conflicts have had a negative impact on exploration, financial investment, and mining. Land disputes have become common because land is communally held and the country has no real system of land registration.

In 2002, Papua New Guinea's real gross domestic product (GDP) declined by 0.5% at purchasing power parity, which was a continuation of the recessions of 2000 and 2001 when the GDP contracted by 1.2% and 3.3%, respectively (Asian Development Bank, 2001§[1]). The mining sector contributed an estimated 15.5% to the nation's GDP in 2002; the petroleum sector, about 9%. About 70% of Papua New Guinea's export income was derived from these two sectors, although they employed only about 2% of the country's workforce. An estimated 85% of the country's population of 5.2 million relied on subsistence and commercial agriculture and fishing for their livelihood. Papua New Guinea's mineral resources were difficult and expensive to mine, and exploration and production were hampered by rugged terrain, the high cost of developing infrastructure, and the nation's poor road infrastructure. Nevertheless, Papua New Guinea was the 11th leading gold and the 13th leading copper mining country in the world in 2002 (World Bureau of Metal Statistics, 2002, p. 37, 79).

Government Policies and Programs

Although the mining and petroleum industries together accounted for 28% of the country's GDP in 2002 (19% for mining and 9% for petroleum), the Federal Government began a review of the sectors with the intent of proposing even more attractive measures for investment. A number of incentives were adopted, which included the following:

- Abolition of additional profits tax in the mining sector;
- Relaxation of the "ring-fence" provision to allow a tax deduction of up to 25% of allowable exploration expenses provided that the deduction does not reduce the tax payable by more than 25%;
- Double deduction of preproduction exploration costs. The first 100% deduction would be allowed as a deduction against assessable income. The second deduction would arise only once commercial production begins;

[1] References that include a section mark (§) are found in the Internet References Cited section.

- A new accelerated depreciation arrangement of a 25% declining balance depreciation pool for all assets of any new development, irrespective of their useful life;
- Elimination of the loss carry-forward time limit; and
- Government agreement to review its position on equity participation in mining and petroleum projects. In 2002, the Government had the option of taking a paid equity stake of up to 30% in a project at the time a special mining lease was issued, which was considered by the industries to be a disincentive to investment in the country.

In Papua New Guinea, all minerals on and below the surface of any land are the property of the State, which has the right to allow suitable persons to explore for, mine, and sell mineral resources. The right to explore for, mine, and sell mineral resources is granted in the form of mineral tenements, which are for a fixed term over a fixed area and are granted to persons or companies committed to programs of exploration or mining development approved by the State. Tenements are not granted for the purpose of retaining mineral rights indefinitely. The Mining Act of 1992 simplified the administration of and reduced the types of tenements available, which are as follows:

- Exploration license—Granted for a term not exceeding 2 years and renewable for 2-year terms over an area not exceeding 2,500 km^2.
- Mining lease—Granted for a term not exceeding 20 years and renewable for terms of up to 10 years. Normally granted for small- to medium-scale mines and some alluvial mine developments. The holder must comply with approved proposals for development and other prescribed mining lease conditions.
- Special mining lease—Granted for a term not exceeding 40 years and renewable for terms of up to 20 years. Normally granted for large-scale projects and requires a mining development contract to be negotiated. The holder must comply with approved proposals for development and other prescribed mining lease conditions.
- Alluvial mining lease—Granted for a term not exceeding 5 years and renewable for terms of up to 5 years for an area not exceeding 5 hectares. The holder must be a landowning citizen.
- Lease for mining purposes—Granted for the same term as that of the tenement with which it is associated. It is granted for construction of the project infrastructure and facilities.
- Mining easement—Granted for the same term as that of the tenement with which it is associated. It is granted for construction and operation of project facilities such as roads, power transmission lines, waterways, pipelines, bridges, or tunnels.

All tenements, with the exception of special mining leases, are granted by the Minister for Mining on recommendation by the Mining Advisory Board. Special mining leases are granted by the head of state (Papua New Guinea Department of Mining, 2001, p. 4).

The Petroleum Act of 1992 deals with the types of petroleum licenses that are available, registration of interests and dealings in tenements, compensation for owners and occupiers of affected lands, and payments of rents, fees, and royalties. The following types of licenses may be issued under the Act:

- Petroleum prospecting license—Confers the exclusive right to explore for petroleum, but the holder is required to enter into an additional agreement with the Government regarding exploration and development within the tenement area.
- Petroleum development license—Gives tenure to recover and own the petroleum and to construct and operate all necessary facilities.
- Pipeline license—Confers the authority to construct and operate a pipeline system and related facilities.

Production

The country's producing mines consisted of four very large operations, one medium-sized enterprise, and a large small-scale sector that included numerous mechanized alluvial gold mines and primitive, individually operated manual gold panning/sluicing workings. The major operations were the Lihir gold mine in New Ireland Province, the Ok Tedi copper-gold mine in Western Province, the Misima gold-silver mine in Milne Bay Province, and the Porgera gold mine in Enga Province. The smaller Tolukuma gold-silver mine in Central Province also was a significant producer. Projects in the petroleum sector included the Central Moran, Gobe Main, Kutubu, and Southeast Gobe oilfields in the Gulf and Southern Highlands Provinces. These facilities produced virtually all the country's mine production, excluding clays, sand and gravel, and stone used for construction purposes. Two projects were in an advanced stage of exploration and development—the Morobe gold-silver prospect in Morobe Province and the Ramu nickel prospect in Madang Province.

Commodity Review

Metals

Copper.—In 2002, all the country's copper production was mined from the Ok Tedi Mine, which is located at the headwaters of the Ok Tedi River on Mount Fubilan in the Star Mountains about 18 kilometers (km) east of the border with the Indonesian Province of Papua and 20 km northwest of the town of Tabubil where the mine operator, Ok Tedi Mining Ltd. (OTML), was headquartered. Copper production at Ok Tedi began in 1987 following 3 years of gold-only production. The opencut operation used conventional truck-and-shovel methods to mine approximately 30 million metric tons per year (Mt/yr) of ore and 55 Mt/yr of waste rock. About

200,000 metric tons per year (t/yr) of copper-in-concentrate and 12,500 kilograms per year (kg/yr) of gold-in-concentrate were produced. The final concentrate, which contained about 34% copper and 20 grams per metric ton (g/t) gold, was then thickened and piped 137 km to handling facilities at Kiunga for filtering and drying before shipment down the Fly River in 2,500-metric-ton (t) barges (Resource Information Unit, 2002, p. 51). The OTML joint venture was owned by PNG Sustainable Development Program Co. Ltd. (52%), which was an independently managed trust company that had set up a long-term fund to receive allocations for sustainable development after the mine is closed; the Papua New Guinea Government (30%); and Canadian-based Inmet Mining Corp. (18%). Under the current life-of-mine plan, mining operations were expected to cease around mid-2010 when readily accessible ore was exhausted (BHP Billiton Ltd., 2001).

Gold.—Highlands Pacific Ltd. was granted a mining lease for underground development at the Irumafimpa mineralized zone within the Kainantu Goldfield, Eastern Highlands Province. The project was expected to become operational in 2004 following additional engineering studies. Japan's Nippon Mining and Metals Co. Ltd. had a $2 million production royalty for a project that would produce in excess of 25,000 troy ounces per year (710 kg/yr) of gold at Kainantu (Resource Information Unit, 2002, p. 104).

Lihir Gold Ltd. owned the Lihir open cut mine in the Luis Caldera, which is located about 700 km northeast of Port Moresby on Lihir Island, New Ireland Province. Processing of oxide ore at the $800 million 3.6-Mt/yr operation began in May 1997, and sulfide-ore-processing began later that year in September. The mine supplied high-grade ore for immediate processing and lower grade ore that was stockpiled for future gold production. Because nearly all the ore was refractory, it was treated by pressure oxidation technology. Mining was expected to end at Lihir around 2014, but processing of the lower grade stockpile was expected to continue during the following 20 years.

A grinding circuit pebble crusher was commissioned in September 2002 and was operating at full design rates by November. Although throughput was at record levels, lower gold grades and operational difficulties resulted in somewhat lower production than that of 2001.

Exploratory drilling during the year succeeded in increasing identified resources by 6.5 million troy ounces [184,300 kilograms (kg)] and reserves by 2.2 million troy ounces (62,400 kg).

Placer Dome Inc. of the United States increased its equity in the Porgera open cut operation to 75% in 2002 through a takeover offer by AurionGold Ltd.; the other shareholders were Orogen Minerals Ltd. with 20%, and Mineral Resources Porgera Pty. Ltd., 5%. Orogen Minerals and Mineral Resources represented the Government of Papua New Guinea and local landowners. In August, the Porgera joint venture was experiencing continued interruption of its power supply as a result of election-related vandalism of the power pylons along the Porgera-Hides line; the damage caused prolonged outages that brought on closure of the mill and a 10% reduction of production [60,000 troy ounces (about 1,700 kg)]. The open pit mine was opened in October 2002 and production at the underground mine, which had been suspended in 1997, was restarted in the last quarter 2002.

The Tolukuma Mine is located about 100 km north of Port Moresby in Central Province and was wholly owned and operated by Durban Roodepoort Deep Ltd. of South Africa, which obtained it through the takeover of Dome Resources NL. Access to the mine was solely by helicopter, and all mine activities were helicopter-supported. The mine has produced more than 431,532 troy ounces (12,200 kg) of gold and silver since the start of production in 1995. Although the mine life initially was estimated to be 5 years, exploration of the identified minable reserves has continued to be positive, and the mine life was expected to extend several more years. Resources at the end of December 2002 were 300,000 troy ounces (8,500 kg) of gold (Durban Roodepoort Deep Ltd., 2002).

Nickel.—At yearend 2001, the Ramu nickel project was owned by Highlands Pacific Ltd. (68.5%) and Orogen Minerals (31.5%) both of which were Papua New Guinea-registered companies. The Ramu site is a predevelopment nickel and cobalt project that is located about 75 km southwest of the provincial capital of Madang on the northern coast of Papua New Guinea. A $22 million bankable feasibility study was completed in 1998, which indicated that at a capital cost of $838 million, a lateritic nickel mining project could produce 33,000 t/yr of nickel metal and 3,200 t/yr of cobalt sulfate at an average operating cost of $0.41 per pound ($0.19 per kilogram) of nickel during a 20-year mine life, although the mineral resource was expected to support a mine life of 40 years. About 4.6 Mt/yr of ore was to be mined to feed 3.2 million metric tons (Mt) of upgraded ore by a 134-km slurry pipeline to a refinery on the adjacent Rai coast. The ore was to be processed by pressure acid leach technology. Construction of the project was projected to take up to 30 months (Highlands Pacific Ltd., undated§).

Silver.—Placer Dome owned 80% of the Misima Mine on Misima Island in Milne Bay Province along with Papua New Guinea's Orogen Minerals, which owned a 20% share and had its headquarters in Port Moresby. Mining was completed at the Misima Mine in May 2001, and production was diverted to the processing of stockpiled ore. Stockpile milling was anticipated to continue into 2004. As of December 2001, reserves were 11.72 Mt at 0.9 g/t gold and 9.8 g/t silver for a total of 327,000 troy ounces (9,270 kg) of gold and 3.7 million troy ounces (104,895 kg) of silver.

Mineral Fuels

Petroleum and Natural Gas.—The Hides gas project, which began production in 1992, was the country's first petroleum project. All gas produced was sold to the Porgera joint venture for power generation at its gold mine. In October 1996, the country's first successful oilfield, Kutubu, was developed in Southern Highlands Province and is located 480 km northwest of Port Moresby. This was followed by development of the Gobe oilfield, which included two production licenses for Southeast Gobe and Gobe Main. A third project, the Moran Project, started producing oil under an extended well test arrangement in 1998. The development license,

however, was not issued until February 2001, and construction of the facilities was not completed until 2002. The economic lives of these gasfields and oilfields are expected to end as follows: Hides in 2011 when the Porgera Mine was expected to close, the Kutubu fields in 2009, the Gobe fields in 2004, and the Moran Project in 2011.

Infrastructure

Essential elements of the country's transportation infrastructure included 19,600 km of roads, of which 686 km was paved and 18,914 km was unpaved. The length of island waterways totaled about 10,940 km and was of little importance to the transportation industry. Of the 492 airports, 19 principal airports had permanent-surface runways. International shipping ports included Kieta, Lae, Madang, Port Moresby, and Rabaul. The country had no railroads. The merchant marine fleet of ships of 1,000 t or more gross weight included 2 bulk and 10 cargo carriers, 1 chemical tanker, 1 combination ore carrier/oil tanker, 3 petroleum tankers, 1 container ship, and 3 rollon/rolloff carriers. The country's only crude oil pipeline was 264 km in length (U.S. Central Intelligence Agency, 2002§).

The vast majority of the country's infrastructure was concentrated in the Provincial capitals; therefore, the lack of infrastructure for most of the country remained a distinct hindrance to mineral exploration, mine construction and development, and transportation of mined products.

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Major Sources of Information

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TABLE 1

PAPUA NEW GUINEA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1998	1999	2000	2001	2002[p]
Copper, mine output, Cu content	metric tons	152,200	187,921	203,061	203,762	204,000
Gold, mine output, Au content	kilograms	61,641	65,747	74,540	67,043	70,000
Gas, natural	million cubic meters	1,378	1,353	1,438	1,434	1,450 [e]
Natural gas liquids	42-gallon barrels	105,527	105,460	224,857	186,190	200,000 [e]
Petroleum, crude	thousand 42-gallon barrels	29,479	32,020	24,967	20,423	20,000 [e]
Silver, mine output, Ag content	kilograms	59,294	66,542	79,197	69,368	73,000

[e]Estimated. [p]Preliminary.

[1]Table includes data available through February 10, 2004.

[2]In addition to the commodities listed, cement and 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: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
Cement thousand tons	PNG-Halla Cement Pty. Ltd. (Halla Cement Corp. of the Republic of Korea, 50%; Government of Papua New Guinea, 50%)	Lae, Morobe Province	500
Cobalt do.	Highlands Pacific Ltd., 68.5%, and Government of Papua New Guinea, 31.5%	Ramu nickel-cobalt project, Madang Province, 75 km southwest of Madang	3
Copper do.	Ok Tedi Mining Ltd., operator [BHP Billiton Ltd., 52%; Government of Papua New Guinea, 30%; Inmet Mining Corp. (Canada), 18%]	Ok Tedi open cut, Western Province, 20 km northwest of Tabubil, 390 km southwest of Wewak	210
Gold	Lihir Gold Ltd., operator, 100%	Lihir open cut, Lihir Island, New Ireland Province, 700 km northeast of Port Moresby	18
Do.	Misima Mines Pty. Ltd. (Placer Dome Inc., operator, 80%; Orogen Minerals Ltd., 20%)	Misima open cut, Misima Island, Milne Bay Province.	6
Do.	Aurora Gold Ltd., manager, 50%, and CDC Financial Services (Mauritius) Ltd., 50%	Morobe open cut, 250 km north of Port Moresby, Morobe Province	9
Do.	Ok Tedi Mining Ltd., operator [BHP Billiton Ltd., 52%; Government of Papua New Guinea, 30%; Inmet Mining Corp. (Canada), 18%]	Ok Tedi open cut, Western Province, 20 km northwest of Tabubil, 390 km southwest of Wewak	20
Do.	Placer Dome Inc., operator [Highlands Gold Properties Ltd., 25%; Placer (PNG) Ltd., 25%], Goldfields Porgera Ltd., 25%, Orogen Minerals Ltd., 20%, and Minerals Resources Porgera Ltd., 5%	Porgera open cut, Enga Province, 620 km northwest of Port Moresby	30
Do.	Dome Resources NL, 100%	Tolukuma underground mine, Central Province, 100 km north of Port Moresby	2
Natural gas thousand cubic meters per day	Oil Search Ltd., operator, 100%	Hides Gasfield, Southern Highlands Province. Onshore Papuan Basin, petroleum development license	425
Nickel thousand tons	Highlands Pacific Ltd., 68.5%, and Government of Papua New Guinea, 31.5%	Ramu nickel-cobalt project, Madang Province, 75 km southwest of Madang	33
Petroleum thousand 42-gallon barrels per day	Petroleum development license 2: Chevron Niugini Ltd., opeerator and manager, 19.37%, Oil Search (Kutubu) Ltd., 27.14%, Orogen Minerals Ltd., 25.44%, ExxonMobil Corp., 14.52%, Petroleum Resources (Kutubu) Ltd., 6.75%, and Merlin Petroleum Co., 6.78%. Petroleum development license 5: ExxonMobile Corp., operator Petroleum development license 5: ExxonMobile Corp., operator and manager, 47.5%, and Oil Search Ltd., 52.5%	Central Moran oilfield, Southern Highlands Province (includes Agogo and Iaqufi-Hedinia Fields). Onshore Papuan Basin, petroleum development licenses 2 and 5	15
Do. do.	Chevron Niugini Ltd., operator and manager, 19.37%; Oil Search Ltd., 27.14%, Orogen Minerals Ltd., 30.19%, ExxonMobil Corp., 14.52%, Merlin Petroleum Co., 6.78%, and Petroleum Resources Ltd. (Gobe), 2.0%	Gobe Main oilfield, Southern Highlands Province. Onshore Papuan Basin, petroleum development license 4	10
Do. do.	Chevron Niugini Ltd., operator and manager, 19.37%, Oil Search Ltd., 27.14%, Orogen Minerals Ltd., 25.44%, ExxonMobil Corp., 14.52%, Petroleum Resources (Kutubu) Pty. Ltd., 6.75%, and Merlin Petroleum Co., 6.78%	Kutubu oilfield, Southern Highlands Province. Onshore Papuan Basin, petroleum development license 2	50
Do. do.	Santos Ltd., operator and manager, 15.5%, Southern Highlands Petroleum Ltd., 39.14%, Orogen Minerals Ltd., 20.5%; Oil Search Ltd., 15.50%, Cue PNG Oil Co. Ltd., 5.42%, Petroleum Resources (Gobe) Ltd., 2.0%, and Mountains West Exploration, Inc., 1.94%	SE Gobe oilfield, Gulf and Southern Highlands Provinces. Onshore Papuan Basin, petroleum development licenses 3 and 4	10
Silver	Misima Mines Pty. Ltd. (Placer Dome Inc., operator, 80%, and Orogen Minerals Ltd., 20%)	Misima open cut, Misima Island, Milne Bay Province.	100
Do.	Aurora Gold Ltd., manager, 50%, and CDC Financial Services (Mauritius) Ltd., 50%	Morobe open cut, 250 km north of Port Moresby, Morobe Province	124

[e]Estimated. km--kilometer(s).