

PAPUA NEW GUINEA

*By Anthony Williamson
Director - Mining Division, Department of Mining*

Mining products maintained their position as the leading primary export commodity of Papua New Guinea during 2003 and also remained a significant contributor to Gross Domestic Product (GDP). Mineral product exports accounted for 55% of total merchandise exports, equivalent to some K4.2 billion (approximately US\$1.1 billion) (Table 1).

Mining is estimated by the PNG Department of Treasury to have accounted for 17.3% of GDP in 2003 (Table 2). This percentage may be expected to increase slightly in the medium term due to the new gold-mine developments at Kainantu and Hidden Valley, and the projected decrease in oil production.

Employment directly attributable to mining is estimated to account for 5% of the total available workforce. Furthermore, this figure represents about 20% of the total formal rural workforce. The indirect employment figure derived from support services, contractors etc (not classified as mining but working on mining-related projects), obviously makes the overall employment figure due to mining significantly higher (Table 3).

A review of the fiscal regime in PNG was undertaken in 2002 with the view to proposing a more attractive investment regime for the sector. A number of new incentives were adopted but there remains one outstanding disincentive that requires consideration, namely PNG the mining regulatory system that provides the government with an option to take a paid equity stake of up to 30% in a project at the time a Special Mining Lease is issued.

The mines

The mines produced 202,277 t of copper, 68.1 t of gold and 62.6 t of silver during 2003 (Table 4).

Ok Tedi maintained normal production throughout 2003 with 29.32 Mt of ore mined (approximately 240,000 t/d material movement) and 29.26 Mt milled (77,000 t/d) with a head grade of 0.78% Cu and 0.8 g/t Au. Respective gold and copper recoveries for 2003 at Ok Tedi stand at 68% and 84%. Cash operating costs amounted to some US\$0.50/lb of copper. Total reserves and resources for Ok Tedi as at end-December 2003 are given in Table 5.

The operating company Ok Tedi Mining Ltd (OTML) is owned 52% by PNG Sustainable Development Program Ltd (SDP), 30% by the PNG Government and 18% by Inmet Mining Corp of Canada. SDP is an independently-managed trust company. Benefit distribution from the Trust during the remaining estimated 10-year mine life will be 1/9th to the people of Western Province, 2/9th to the rest of PNG and 2/3rd to a Long Term Fund (LTF).

At **Porgera**, 13.94 Mt of ore was mined from underground and open-pit operations. Approximately 5.66 Mt of ore averaging 5.34 g/t Au was milled, with an average recovery of 87.5%. During 2003, the mine produced 851,920 oz of gold at an average cash operating cost of US\$256/oz and a total cost of US\$301/oz. Gold production was 12% above the 761,000 oz forecast at the beginning of the year

Placer Dome currently holds 75% in the joint venture, Durban Roodeport Deep purchased 20% during the year, retained 15%, and offered 5% to the Provincial Government and landowner entities to bring their holding to 10%.

Total proven and probable mineral reserves at the end of 2003 were 48.85 Mt averaging 3.4 g/t Au, equating to 5.391 Moz of contained gold. This gives a projected operational life of nine years.

During 2003, **Misima** treated 5.59 Mt of stockpiled low grade ore averaging 0.74 g/t Au and 7.5 g/t Ag. Total proven and probable reserves at the end of 2003 were 40,000 oz of contained gold and 374,000 oz of contained silver. Most non-operational activities at Misima currently relate to mine closure issues and rehabilitation. Operations will cease in May 2004.

At **Lihir**, gold production for the year was 550,772 oz. Total cash costs were US\$301/oz for the year. Annual production did not meet expectations and costs exceeded budget. This was in part due to unscheduled maintenance repairs, processing of metallurgically difficult ore types, and lower grades.

The total pit movement for the year of 34.92 Mt was a 12.7% decrease on the previous year. However, the total ore mined was 10.98 Mt, up from 9.29 Mt in 2002, with average grades of 3.46 g/t Au and 3.86 g/t Au respectively. A record 3.93 Mt of sulphide ore was processed. Average gold recovery stood at 88.6%.

A 6 MW geothermal power station was commissioned during the year. A further 30 MW geothermal power station is expected to be operational by mid-2005.

At year-end, measured, indicated and inferred mineral resources, inclusive of ore reserves, were 442.5 Mt averaging 3.14 g/t Au, for 44.7 Moz of contained gold. Included within this, and at a gold price of US\$340/oz, are proved and probable reserves of 163.5 Mt averaging 3.88 g/t Au for 20.4 Moz of contained gold, an approximately 22% increase over the 2002 estimate. It is anticipated that mining will finish in 2023 with the processing of low-grade stockpiles over the ensuing 18 years.

The **Tolukuma** underground mine is owned and operated by Durban Roodeport Deep Ltd (DRD) of South Africa. Access to the mine is by helicopter and all mine activities are helicopter-supported. Production from the 187,447 t of ore treated in 2003 totalled 81,074 oz (2,522 kg) of gold and

177,246 oz (5,513 kg) of silver, at a cost of US\$279/oz Au. The mine has produced over 512,000 oz of gold since the start of production in 1995.

The mine life was initially estimated to be five years. However, exploration activities surrounding the known mineable reserves continue to be positive, and potential exists to extend the mine life by several more years. Proved and probable reserves at the end of June 2003 were approximately 310,000 t at an average grade of 14.47 g/t Au, for 140,000 oz of contained gold.

Small-scale alluvial gold miners produced 69,688 oz of gold in 2003.

Exploration Activity

The Department of Mining estimates that K45.4 million (US\$13.2 million) was spent on mineral exploration during 2003, an increase from approximately US\$8.2 million in 2002. There were 15 Exploration Licence (EL) applications in 2003, compared with only 5 applications in 2002. The downward trend in the number of applications per annum has stopped, and some 25 applications are anticipated during 2004. There are at present a total of 72 ELs in the country.

The PNG Department of Mining has a strategy in place that should increase the level of exploration and mineral development in the country. The short-term aspect of this strategy was the fiscal review (mentioned previously) that was aimed at increasing the attractiveness of PNG to mineral investors. On a longer timeframe the World Bank project (mentioned later) below is being implemented. Apart from human capacity building, this should result in internet accessible, up-to-date e-format geoscience databases. The creation of new geophysical, geochemical and geological data will come in the future from an EU-sponsored Sysmin grant.

Papua New Guinea has several advanced prospects, some of which are at an advanced stage of economic evaluation.

Kainantu gold mine development. The proposal is for underground mining and ore treatment to produce 115,000 oz/y of gold. The project is on a granted Mining Lease. Technical studies are complete, as are the Compensation Agreement and the Memorandum of Agreement. Construction commenced in the first quarter of 2004, and initial production is expected in early 2005.

The project components will comprise underground mining at the Irumafimpa deposit, a processing plant, tailings management and supporting infrastructure, including an access road, power and water supply schemes and workforce accommodation.

Process facilities include a flotation circuit to produce high-grade gold concentrates for sale to a third party smelter/refiner. This circuit was found to be the better option from both an operating cost and environmental viewpoint – no cyanide will be used in this process. Around 99% of the gold will be

recovered to a sulphide concentrate by flotation which will be exported off-site for the recovery of the gold. The remaining tailing will be a clean silicate material, to be stored at site in a confined storage facility.

Capital costs at Kainantu are expected to be almost K138 million. Cash flow to local contractors and labour during construction is estimated to be K65 million, while employee and corporate tax is approximately K10 million.

Mine life is expected to be about six years, although there is good potential to extend the operation's life. The average cash operating costs are estimated to be US\$142 /oz.

Ramu nickel project. This is a pre-development nickel and cobalt project located in Madang Province on the north coast of PNG. The proposal is based on the mining of lateritic ores at the Kurumbukari mine site and processing them at a refinery site located at Basamuk Bay some 130 km from the mine site.

The completed feasibility study is based on an ore reserve of 75.7 Mt averaging 0.91% Ni and 0.10% Co that will support the operation for at least 20 years. Potential has been recognised to extend the life through exploration success in the surrounding area.

Ramu Nickel Ltd (RNL) entered into a Heads of Agreement on February 10, 2004 with the Chinese Metallurgical Construction Co (MCC) to develop the project. The key points of the HoA are:

- MCC will acquire an initial 85% interest in the project;
- RNL, MRDC and the Landowners will have a combined 15% interest in the project which will be 'free-carried' to the commencement of commercial production. Discussions are ongoing.

Wowo Gap nickel. The resource at Wowo Gap is less well defined than that at Ramu, but is about 120 Mt averaging 1.2% Ni. It is also similar in metallurgical characteristics to the Ramu ore, but is still at the exploration stage.

The inferred resource, based on a 0.8% Ni cut-off grade, as estimated from pitting and drilling completed prior to 2003, is:

Central Zone	Limonite	30.9 Mt at 1.09% Ni and 0.11% Co
	Saprolite	17.9 Mt at 1.44% Ni and 0.04% Co
Northern Zone	Limonite	18.0 Mt at 1.02% Ni and 0.11% Co
Total		66.8 Mt at 1.17% Ni and 0.09% Co

Within the diamond cores drilled in 2003, limonite laterite was intersected in all holes except one and ranged in thickness from 3.8 to 10.7 m. Using a 0.8% Ni cut-off, intersections include: 10.70 m at 1.03% Ni and 0.13% Co; 6.80 m at 1.03% Ni and 0.10% Co; 6.00 m at 1.06% Ni and 0.10% Co; 5.00 m at 1.03% Ni and 0.12% Co; 3.80 m at 1.05% Ni and 0.10% Co; and 2.80 m at 0.95% Ni and 0.19% Co.

Comparison of the limonite profile in the 2003 diamond drill holes with that of the more recent exploration indicate that the profile is approximately twice as thick. The underlying saprolite material occurred in all holes, with +0.8% nickel intersections ranging from 2.6 to 15.3 m thick.

This limited drilling of the Central Zone suggests that further drilling might increase the resource to over 120 Mt of limonite and saprolite ore. Significantly, the resource is open to the north and south. Pits and holes at the extremities of the deposit are high grade (eg, Lily Pit contains in excess of 5 m of 1.8% Ni in saprolite). This potential is currently being tested with the continuation of the 2003-drill programme across the Sivai Breccia and the immediate extensions to the north and south.

Preliminary leach tests demonstrate the suitability of pressure acid leach technology for the processing of both the limonite and saprolite ore types at Wowo Gap. Tests completed at 255°C indicate rapid leach kinetics with a very high ultimate extraction of both nickel and cobalt. Extractions of 92-98% were observed for nickel and cobalt after 15 minutes of leaching, with an ultimate extraction of 98% after 90 minutes of leaching. Lower than expected magnesium dissolution and acid consumption was observed.

Hidden Valley project. This gold project lies in the Wau area of Morobe Province and comprises three principal prospects, Hidden Valley, Kaveroi Creek and Hamata. The broad approach on current perceptions of resources is to mine Hamata, then the oxide and transition ores at Hidden Valley, then Hidden Valley and, lastly, possibly to access Kaveroi from underground. The current resource estimate for the project is summarised in Table 6.

The current conceptual mining plan is to install a standard 3-3.5 Mt/y (hard-rock capacity) CIP plant to treat Hamata ore with minor silver grades conventionally, then treat Hidden Valley ores using a CCD circuit due to the higher silver content. The sulphide ores are expected to undergo flotation and fine grinding before leaching. It is intended to site the plant at Hamata and have a 6 km conveyor link from Hidden Valley to Hamata.

Initial studies indicate likely annual production of 310,000 oz of gold and 5.2 Moz of silver (387,000 oz gold equivalent) over a nine-year mine life. A Mining Lease application and feasibility study was submitted to the Department of Mining early in 2004. Processing the submission will take some six months, construction should be able to commence in the latter half of 2004 with

production late in 2005 or early 2006. The Licence holder, Morobe Consolidated Golfields (subsidiary of Abelle Ltd), has several prospects currently being drilled that are located close to Hidden Valley which will probably further increase the reserves. Table 7 shows a summary of financial evaluation for Hidden Valley.

Frieda Project. A large porphyry copper deposit was first discovered at Frieda River in the 1960s. The Exploration Licence is held by Highlands Pacific Ltd and Japanese owned partner OMRD Frieda Co Ltd (12.1%). Noranda has a five-year option agreement to acquire a 72% interest in the Frieda, April R and Bundi tenements.

The total porphyry copper resource is estimated to be in excess of 1,000 Mt at 0.5% Cu and 0.3 g/t Au. The high sulphidation Nena resource, which lies adjacent to the porphyry system, has reserves of 52.8 Mt at 2.0% Cu and 0.7 g/t Au, with an additional oxide gold cap of 12.8 Mt averaging 1.4 g/t Au using a 0.25% Cu and 0.6 g/t Au cut off.

Drilling is ongoing at Frieda.

Wafi Project. Wafi Mining Ltd, a subsidiary of Abelle Ltd, holds the exploration licences over an advanced exploration prospect at Wafi situated in Morobe Province near Lae. The prospect has two distinct mineral occurrences. The Golpu porphyry copper prospect has been drilled out giving an indicated resource of 75.5 Mt at 1.22% Cu and 0.53 g/t Au, and an inferred resource of 24.7 Mt at 1.43% Cu and 0.96 g/t Au. Superimposed on the upper portions of the porphyry are high and low sulphidation, epithermal gold mineralisation of the Wafi prospect.

Golpu contains an estimated copper-gold resource of 106 Mt averaging 0.7 g/t Au and 1.2% Cu for 2.3 Moz contained gold and 1.3 Mt of contained copper. The company is presently compiling a pre-feasibility study for the project based on the production of 80,000 t/y of copper in concentrate. If the economics are good, there could be construction in 2006 and production in 2007.

Drilling at Wafi commenced early in 2003, with the objective of in-filling and extending the higher-grade Link Zone mineralisation. Drilling has returned good assay results, and is ongoing. The company is undertaking a significant revision to the Wafi gold resource and, on completion of the current drilling programme, will move into a pre-feasibility study. Development at Wafi could come in 2006 with production two years later. Resource estimates for the Wafi epithermal gold prospect adjacent to the porphyry are given in Table 8.

Simberi gold project. Completion of a bankable feasibility study for the Simberi mine was completed 2003. There still remains a few outstanding permits for the project. The developers have been negotiating a US\$20 million project-financing facility, which is expected to close early in the second

quarter of 2004. Construction would then be expected to commence in late 2004, with production late in 2005. Simberi is forecast to produce 35-50,000 oz/y of gold from low grade, surface oxide ores over a projected mine life of 8-10 years.

The capital cost for the mine is expected to be around US\$21-22 million, with average cash operating costs of approximately US\$170-175/oz. The oxide ores will be processed in a conventional CIL plant, where gold recoveries are expected to exceed 92%. Ore will be crushed and milled in pit and sent by pipeline in slurry form to the coastal processing plant. The oxide ores are mostly soft and friable, leading to low mining costs. The oxide ore deposits are all located on hilltops at an elevation of 150-250 m, resulting in a zero waste:ore stripping ratio.

World Bank capacity-building project

The project is well under way and consists of the following six main functional components:

- policy and regulatory institutional strengthening;
- development of departmental capacity to monitor and execute technical audits of exploration and mining activities;
- strengthening of departmental mineral tenements management;
- development of project co-ordination and liaison capacity for sustainable development in mining project areas;
- institutional strengthening of the Geological Survey and development of geological information system (GIS) capabilities in respect of remote sensing, geophysical data interpretation, national lithostratigraphic lexicon and map rectification, and development of a geological information system; and
- institutional strengthening and capacity building for an Internal Revenue Commission (IRC).

SYSMIN project

As a result of the loss of revenues from the mining sector attributable to the 1997 drought, the Department of Mining is the recipient of a €50 million programme that will safeguard the future revenue stream from the mining sector.

The projects fall under four main groupings:

- environmental management;
- rural enhancement through small-scale mining;
- infrastructure development; and
- mineral resource assessment.

The fundamental outcomes of this will be:

- implementation of globally acceptable environmental standards in waste management;
- increased awareness of the health and environmental damages associated with small-scale mining activities as presently practiced,

- while at the same time increasing yields from small-scale mining assisting poverty alleviation;
- construction of a purpose-built office and Womens Development centre; and
 - the promotion of PNG as an attractive destination for the limited global investment in the mining sector, by the production of extensive airborne geophysical, geochemical and geological maps.

The project has commenced and tenders are being called for the various components of the grant.

Tables next page.

Table 1 PNG exports 1991 – 2003 in US\$ millions

Year	Oil	Metals	Agric.	Forest	Marine	Other	Exports	Metals Share (%)
1991	-	1,055.4	189.9	94.7	10.9	84.0	1,434.9	74%
1992	305.2	1,083.7	226.4	150.1	9.4	111.4	1,886.3	57%
1993	833.3	968.1	275.2	418.2	7.9	72.6	2,575.3	38%
1994	596.2	916.4	317.8	419.5	8.7	-	2,258.7	41%
1995	624.5	1,213.0	379.1	339.3	9.3	-	2,565.1	47%
1996	811.1	884.2	437.0	362.8	7.9	-	2,503.0	35%
1997	594.1	687.8	541.8	302.3	6.7	-	2,132.6	32%
1998	374.0	753.9	469.3	79.7	19.4	-	1,696.3	44%
1999	542.2	839.9	456.9	104.3	11.9	-	1,955.2	43%
2000	696.2	922.1	346.2	111.9	12.2	-	2,088.6	44%
2001	562.3	894.6	238.4	92.5	23.0	-	1,810.8	49%
2002	368.2	798.6	279.3	82.6	17.3	-	1,546.1	52%
2003	456.9	1,192.7	381.4	116.4	35.1	-	2,182.6	55%

Source - Bank of PNG Quarterly Economic Bulletin.

Table 2 Sectoral Contributions to the PNG Economy.

Sector	Exports (%)	Nominal GDP (%)	Employment (%)
	2003	2003	Estimated 2000
Agric./Forestry/Fisheries	24	26.6	23
Mining	55	17.3	5
Petroleum	21	7.8	
Manufacturing	-	9.3	15
Construction	-	4.8	7
Wholesale, Retail Trade	-	9.7	17
Transport, storage, comms	-	4.8	
Electricity, gas, water		1.3	
Business Services	-	3.4	
Community/Social/Others	-	12.7	33
Other		1.8	
Total	100.0		100.0

Source; Dept Treasury; Lavantis, 2000

Table 3 Basic Economic Statistics

	2002 (US\$ million)	2003(US\$ million) ^P
Export Values	1,166.8	1,649.2
Gold	579.5	787.1
Copper	211.7	396.3
Crude Oil	368.2	456.9
Silver	7.4	8.9
Export Volumes		
Gold (t)*	58.2	68.4
Copper (t)	138.6	230.6
Crude Oil ('000 bbls)	15,370.5	14,983.4

Source: Bank of PNG; (p)=provisional; *includes alluvial sources

Table 4 Mineral Production 2002 and 2003.

Mine	Au (kg)	Au (kg)	Ag (kg)	Ag (kg)	Cu (t)	Cu (t)
	2003	2002	2003	2002	2003	2002
Ok Tedi	16,020.1	16,176	34,475	32,328	202,277	211,315
Porgera	26,500.0	19,962	5,123	3,944		-
Misima	3,761.9	4,496	16,830	22,347		-
Lihir	17,131.0	18,761	-	-		-
Tolukuma	2,521.7	1,983	5,512	4,730		-
Small Scale	2,170.8	1,779	702	658		-
Total	68,105.5	63,156	62,642	64,007	202,277	211,315

Table 5 OK Tedi

Category	Resource			Ore reserve			
	Mt	Cu(%)	Au (g/t)	Category	Mt	Cu (%)	Au (g/t)
Measured	432	0.87	0.97	Proven	215	0.91	0.97
Indicated	216	0.55	0.65	Probable	31	0.57	0.66
Inferred	15	0.45	0.46				
Total	663	0.76	0.85	Total	246	0.87	0.93

Table 6 Hidden Valley Prospects

Prospect	Mt	Au (g/t)	Ag (g/t)	Moz gold
HV / Kaveroi	31.02	3.1	54	3.07
Hamata	4.66	3.5		0.52
Kerimenge	14.64	1.6		0.75
Total	50.33	2.7		4.35

Table 7 Hidden Valley: summary of financial evaluation - the base case

Project Life, years	7
Total Initial Capex, Kina million	408
Total Net Cashflow over Project Life	496
Total Corporate Tax, Kina million	152
Govt Royalty, Kina million	59

Table 8 Wafi Project

Cut-off (g/t Au)	Zone A		North Zone		Link Zone		Total Au (Moz)
	Mt	g/t Au	Mt	g/t Au	Mt	g/t Au	
0.5	55.5	1.5	11.4	1.5	44.5	1.8	5.82
1	34.4	2	5	2.5	23.3	2.7	4.65
1.5	19.8	2.5	3.8	2.9	13.8	3.8	3.64
2	12.4	2.9	3.2	3.2	10.4	4.5	3
3	4	4.1	1.6	4	6.8	5.6	1.96