

Supplies, Mining and Exploration

South Africa

Supplies of platinum from South Africa fell by 100,000 oz to 3.8 million oz in 2000. The decline was mainly due to operational problems caused by heavy rainfall in February and March, and a strike at Anglo Platinum, factors which more than offset additional output from expansion projects. Sales of palladium were down slightly, at 1.86 million oz, but rhodium shipments rose by 47,000 oz to 457,000 oz, due to additional mining of UG2 ore and sales from stocks.

Although the South African platinum industry enjoyed record profits in 2000, the two largest producers had a disappointing year in terms of pgm production. Exceptionally heavy rainfall in early 2000 had a serious impact on operations at both Anglo Platinum and Impala, while the former also lost production later in the year due to a strike.

In contrast, Lonmin increased pgm production, as record milling rates offset a decline in pgm yields. Refined output at Northam was stable, while new producer Kroondal made its first significant contribution to pgm supplies.

A substantial increase in South African supplies of pgm can be expected during 2001. At Anglo Platinum, expansions at Bafokeng Rasimone, Middelpunt Hill and Amandelbult are due to approach full capacity. Lonmin's output is forecast to rise again, following the commissioning of new UG2 processing plant, while Kroondal is upgrading its concentrator. Refined production from UG2 mining will begin at Northam and at Impala's rehabilitated Crocodile River mine. Assuming that the industry encounters no serious

operational or labour problems, platinum output should breach the 4 million oz barrier for the first time.

Beyond 2001, a major expansion of platinum mining in South Africa is in prospect. In May 2000, Anglo Platinum stated its intention to raise platinum capacity from about 2 million oz in 1999 to 3.5 million oz by 2006. New projects at Maandagshoek, Waterval and Union have already been confirmed, and further announcements are expected this year.

The company is also to participate in the Pandora joint venture with Lonmin, exploiting mineral rights adjacent to the latter's Eastern Platinum mine.

Other producers also have ambitious expansion plans. Lonmin announced in November 2000 that it had raised its expansion target to 870,000 oz of platinum by 2007. Impala has confirmed that it will proceed with the construction of a mine at Winnaarshoek, and is also re-evaluating the Kennedy's Vale project. Aquarius Platinum expects to start construction of a new mine at Marikana during 2001, and is undertaking a feasibility study of a project at Everest South (which it acquired from Impala last year). Finally, a new entrant, SouthernEra, is redeveloping the mothballed Messina mine, with the intent of starting production on a limited scale from August 2001. Assuming that pgm prices remain strong, and that none of these projects encounters serious technical difficulties, South African platinum supplies could rise by over 2 million oz in the course of this decade.

Anglo Platinum

At Anglo Platinum, total refined platinum output fell by 7 per cent to

PGM Supplies: South Africa

'000 oz

	1999	2000
Platinum	3,900	3,800
Palladium	1,870	1,860
Rhodium	410	457



1.87 million oz in 2000. Early in the year, heavy rain caused flooding at some of the group's mines, while underground production was also hit by a four week strike during September and October. The company estimates that these problems resulted in the loss of around 120,000 oz of platinum.

Platinum output was also affected by a 6 per cent decline in the head grade, to 5.05 grams per tonne. This decrease was largely due to the processing of lower-grade ore during the build-up in production at expansion projects at Bafokeng Rasimone, Middelpunt Hill and Amandelbult. Higher throughput of UG2 at some of the group's mines also had an impact on grade; at Anglo Platinum's existing mines, this ore type generally has a lower pgm content than Merensky Reef.

Palladium production fell in line with that of platinum, down 7 per cent to 947,000 oz. However, rhodium output fell by less than 4 per cent, to 165,000 oz, largely because of the higher rhodium content of UG2 ore - typically over 10 per cent of the total pgm, compared with less than 5 per cent in the Merensky Reef.

During 2000 and early 2001, Anglo Platinum announced a number of new expansions. On the Eastern limb of the



The mill at Barplats' recently reopened Crocodile River mine

Bushveld Complex, a new UG2 mine is to be constructed at Maandagshoek; shaft sinking commenced in March this year and mining is expected to begin in early 2002. At full capacity, this operation will produce around 162,000 oz of platinum annually. On the Western Bushveld, an expansion at Rustenburg Section is planned to add 395,000 oz of platinum per annum, with production starting in 2002. This project involves the construction of a concentrator to process UG2 ore from new decline shafts on the farm Waterval as well as from existing Rustenburg shafts. There will also be an expansion of UG2 mining at Union Section, which is expected to contribute 94,000 oz of platinum annually from 2002.

Most recently, Anglo Platinum and Lonmin announced an agreement to establish a joint venture covering lease areas adjacent to the latter's Eastern Platinum mine. At full production, which will be attained in around six years, the new Pandora mine will process 3.6 million tonnes of ore yielding 250,000 oz of platinum annually.

A proposed joint venture with Kroondal Platinum was to have added a further 200,000 oz of platinum output. However, the project collapsed in February 2001 after failing to receive the approval of the boards of Kroondal and its majority shareholder, Aquarius Platinum.

In order to provide sufficient processing capacity for its expansion programme, in February 2001 Anglo Platinum announced plans to build a new smelter complex at Pietersburg on the Eastern Bushveld. Furnace matte from the new smelter will be transported to Rustenburg for further treatment. As pgm output builds up, the group is also expected to undertake some debottlenecking at its Rustenburg refineries.

Together with projects already underway, the new expansions described above will raise annual platinum production capacity at Anglo Platinum to nearly 3 million oz. Further capacity increases are expected to be announced during 2001, in order to meet the group's objective of raising platinum output to 3.5 million oz per annum by 2006.

Impala Platinum

Refined platinum output from Impala's mines fell last year by 7 per cent to 1 million oz, affected by a decline in mill throughput, lower head grades and a drop in recoveries. Palladium production was down 10 per cent at 471,000 oz, while that of rhodium (which was unusually high in 1999 due to the processing of residues) decreased by 16 per cent to 159,000 oz.

Heavy rains in early 2000 caused serious operational problems at the

concentrators, and led to the build up of a large stockpile of unprocessed ore. Attempts to work off this backlog during the second half of the year were halted because the increased milling rate caused a significant reduction in recoveries; Impala now intends to process this material once an upgrade of its UG2 concentrator has been completed. The expanded UG2 plant was due to be commissioned in March 2001, and processing of the stockpile should therefore add to production this year.

Over the last four years, platinum production from Impala's existing mines in the Rustenburg area has varied between 1 and 1.075 million oz per annum, and output is unlikely to change significantly in the future. However, the company has expansion prospects elsewhere in South Africa. In June 2000, it was announced that Impala was to acquire 100 per cent of the shares in Canadian company Platexco, owner of the Winnarshoek project on the Eastern Bushveld. The transaction was finalised in December, and development of a new underground mine is expected to commence by the beginning of 2002. Platinum output is planned to be nearly 200,000 oz per annum at full capacity. Impala may initially mine shallow UG2 ore from open pits in order to accelerate the start up of production.

A second, smaller project is already underway at Crocodile River. In February 2000, the board of Barplats (in which Impala has an 85 per cent stake) decided to reopen the mine, which has been mothballed since 1991. Opencast mining at the Maroelabult section began in December 2000, in preparation for the start of milling at the refurbished concentrator a month later. At full production, the plant will process 75,000 tonnes of ore per month, yielding 50,000 oz of platinum annually.

Impala has a third potential expansion at Barplats' Kennedy's Vale mine, though this project is still in its

early stages. A drilling programme is underway in order to provide more detailed information about the orebody; if the results are positive, a full feasibility study will be undertaken.

Lonmin Platinum

Lonmin's platinum output rose by 8 per cent to 660,000 oz in the financial year to September 2000, while that of palladium and rhodium rose by 4 per cent to 293,000 oz and 89,000 oz respectively. A strategy of maintaining substantial surface stockpiles of ore enabled the company to maximise capacity utilisation at the concentrators, leading to a 7 per cent increase in mill throughput. This more than offset a slight decline in the yield of pgm into matte.

Output is expected to rise again this year, with the build up in production from two new shafts: the Newman incline at Eastern Platinum, and a converted ventilation shaft at Karee. Ore from these projects will be concentrated at a new UG2 circuit (the Karee B-Stream), which was commissioned in January 2001. A bottleneck in smelter capacity will be addressed with the start up of a new furnace, planned for October 2001.

During 2000, Lonmin announced that it had raised its expansion target to 870,000 oz of platinum per annum by 2007. Two more vertical shafts are being developed in order to provide access to deeper ore reserves, which will be required during the later stages of the expansion programme. Development of Eastern Platinum's Saffy shaft began last year, while construction of the Wilkinson shaft at Karee got underway in early 2001; both are expected to enter production around 2006. By then, Lonmin will need to have invested in additional concentrating and refining capacity.

Lonmin is also to participate in a joint venture with Anglo Platinum to exploit mineral rights adjacent to its existing Eastern Platinum mine. The project will be managed by Lonmin and

the pgm output split equally between the partners. Further details are provided in the section on Anglo Platinum on page 14.

Northam Platinum

Northam's refined platinum output was stable in 2000, at around 190,000 oz, as a reduction in the refining pipeline offset declines in both milled tonnage and head grade. Production of palladium and rhodium was also little changed, at around 90,000 oz and 16,000 oz respectively.

Last year's mill throughput was affected by a shortage of developed ore reserves. The Merensky Reef in the upper areas of the mine had been largely mined out, while development at deeper levels had been restricted due to earlier cash shortages. During 2000, Northam's revitalised financial situation permitted a significant increase in the rate of underground development - essential to maintain platinum output from the Merensky Reef. The company has completed a decline system to access Merensky ore from the new 15 level, and has started to extend mining infrastructure into adjoining lease areas acquired from Anglo Platinum in January last year. As a result of this transaction, Anglo Platinum now has a shareholding of around 22.5 per cent in Northam.

In January 2000, Northam

announced plans to expand total pgm production by mining significant quantities of UG2 reef for the first time. A new UG2 concentrator was commissioned at the start of 2001, and the mill reached its design throughput of 75,000 tonnes of ore per month in February. The project is expected to add approximately 50,000 oz of platinum to Northam's annual output.

Aquarius Platinum

In 2000, the Kroondal Platinum mine (in which Aquarius holds an 86 per cent share) produced 124,000 oz of pgm in concentrate, up from around 25,000 oz the previous year. During the year, mill throughput built up to planned levels, while grades and recoveries improved as a higher proportion of ore was drawn from underground. However, Kroondal has yet to reach its target production rate of 100,000 oz of platinum per annum, mainly because the head grade of underground ore has been lower than expected.

In August 2000, Kroondal Platinum announced plans to set up a joint venture with Anglo Platinum, with the aim of trebling the mine's platinum production to 300,000 oz. The ore reserves for the expansion project were to have been contributed by Anglo, which owns adjacent mineral rights. However, the project failed to receive the final approval



Shallow UG2 ore is mined from this decline shaft at Kroondal Platinum

of the Kroondal and Aquarius boards, and the agreement lapsed at the beginning of February 2001.

Kroondal now intends to pursue a more modest expansion on its own. The concentrator is being upgraded by installing a regrind mill and additional flotation cells, with the aim of increasing capacity and improving recoveries. The new plant will be commissioned by mid 2001, and will add about 50,000 oz of platinum to Kroondal's annual capacity. As a result, the mine's life will be reduced to around eight years, compared with 13 years at the original production rate.

Aquarius has a second pgm project at Marikana, where construction is scheduled to begin in the first half of 2001 and open-cast mining of UG2 ore about a year later. At full production, annual output is forecast to average 94,000 oz of platinum, 48,000 oz of palladium and 17,000 oz of rhodium.

In July 2000, Aquarius acquired three Eastern Bushveld properties from Impala: Everest South, Chieftain's Plain and a portion of Everest North. A feasibility study is currently underway at Everest South, which will involve the sinking of a trial shaft in order to assess the structure of the orebody and extract a bulk sample of ore. The results of this study are due early in 2002.

Messina Platinum

The Messina Platinum project, located on the northern edge of the Eastern Bushveld, is being redeveloped by the Canadian company SouthernEra. The latter acquired Impala's 54 per cent stake in the project in 1999, and since then has increased its interest to over 70 per cent.

In February 2000, SouthernEra completed a feasibility study based on a mine producing around 160,000 oz of pgm per annum. Rehabilitation of the Voorspoed shaft began in mid year, and during the final quarter the company took a bulk ore sample and began trial mining in order to verify the feasibility

study assumptions.

Full-scale production at Messina is expected to commence in 2005. In the meantime, the company intends to build a small concentrator that will treat around 20,000 tonnes of ore per month, starting in August 2001. This is planned to yield just under 50,000 oz of combined pgm and gold per annum.

Russia

Russian sales of platinum and rhodium increased sharply in 2000 following the resolution of the Clause 19 issues that had prevented exports for much of the previous year. Sales of palladium had been less affected in 1999 as the primary producer Norilsk Nickel had been given a ten year quota and export licence for its production. With Norilsk exporting steadily, the major uncertainty for Russian palladium supplies during most of 2000 was the level of shipments from the stocks controlled by the government.

Early in January 2000 Vladimir Putin, then acting president of Russia, signed an amendment to Clause 19 of the 1999 budget bill removing the restriction on exports of platinum that had been imposed by the Duma in December 1998. However, it was not until March that export quotas for 2000 were signed and not until May that exports of platinum from Russia began to flow.

Throughout the year there were conflicting indications about Russian intentions on platinum sales, with the State treasury Gokhran indicating that it did not intend to sell any platinum in 2000. The major producer Norilsk Nickel had not been able to sell all its 1999 production due to Clause 19, and therefore had reserves on which to draw, though it seems unlikely that it would have been granted an export quota for more than its annual production.

The smaller, alluvial producers of the Far East of Russia, Kondyor and Koryak,

applied for export quotas for their platinum but were not granted them in 2000. Both were reluctant to sell to Gokhran or the Central Bank at internal prices that were set substantially below the level of the free market. However, Vneshtorgbank was granted a platinum export quota for the first time and is reported to have bought metal from the Amur artel that controls the Kondyor mine, before exporting via Almaz, the only body officially permitted to export pgm from Russia. It is believed that Koryak may have sold some metal to Gokhran and kept some in stock.

Norilsk is the only primary producer of palladium and in March 1999 a decree signed by President Yeltsin gave the company the right to export its output for a period of ten years. This long term arrangement is believed to have influenced the way in which Norilsk sells its metal, with more palladium being sold on long term contracts to western consumers and less being sold on a spot basis directly into the market. As a result, although several Norilsk spokesmen confirmed that the company was exporting palladium steadily throughout the year, the impression was gained in the market that only limited quantities of metal were being sold.

Even more uncertainty surrounded sales of palladium from government controlled stocks. From the middle of the 1990s the substantial growth in world demand for palladium has been satisfied in no small part by sales of stocks held by

PGM Supplies: Russia '000 oz

	1999	2000
Platinum	540	1,100
Palladium	5,400	5,200
Rhodium	65	290



either the Russian Ministry of Finance or the Central Bank of Russia. It is estimated that about half of the 29 million oz of palladium exported by Russia in the period from 1994 to 1999 came from these reserves. The exact holdings by these two bodies remains a secret under Russian law but there is much anecdotal evidence of a struggle between the Central Bank and Ministry of Finance for control of the stocks. It is believed that in the mid 1990s the Central Bank acquired much of the metal from the Ministry, but it appears that under the new Putin administration control of most of the metal has shifted back to the Ministry of Finance.

With its revenues boosted by high palladium and nickel prices, Norilsk was able to move forward with the \$5.5 billion ten year investment programme announced in April 1999. A major refurbishment of the Talnakh concentrator was completed with the commissioning in July last year of new flotation cells designed to improve efficiencies and increase the proportion of massive sulphide ore mined at the Talnakh shafts that can be treated locally rather than being transported to the older Norilsk concentrator. In October a plan to reconstruct the Norilsk concentrator, which dates back to 1948, was announced.

There is evidence that in the mid 1990s Norilsk Nickel was contemplating closing mining operations at the Medvezhiy Ruchey open pit of the original Norilsk-1 mining area, and perhaps also at the adjacent Zapolyarniy underground mine. Revenues from base metals were falling as most of the massive ores at these operations had been mined out many years earlier and grades of nickel and copper of the remaining disseminated ores were significantly lower than at the newer Talnakh mines. However, the rising prices of palladium and platinum have had a material impact on revenues from the Norilsk-1 operations, and it is now believed that Norilsk plans to expand mining here.



Aerial view of North American Palladium's open pit operations

North America

Supplies of platinum and palladium from North America were up slightly at 285,000 oz and 635,000 oz respectively in 2000. Stillwater and North American Palladium recorded increases in production, but these gains were partly offset by lower output from Falconbridge, which suffered a prolonged strike at its Sudbury operations.

Canada

Nickel production at Inco rose by 10 per cent to 199,000 tonnes in 2000. However, this had little impact on pgm output because the increase came mainly from the company's Manitoba division, where the pgm content of the ore is low, and from its Indonesian operation, PT Inco, where the ore does not contain pgm. Although the company reported further improvements in grade at its Sudbury operations, this was not reflected in pgm deliveries, which were down slightly at 342,000 oz.

In January 2001, Inco stated that it expects pgm production to rise by more than 20 per cent this year. We believe that part of this increase will come from the Copper Cliff North mine, where Inco has begun to extract a small deposit with a grade of over 16 grams of pgm per tonne. This is exceptionally rich in

comparison with typical Sudbury ores, which are believed to average less than 2 grams per tonne.

At Falconbridge, nickel and pgm output fell sharply in 2000. Industrial action at the company's Sudbury operations began in August, reducing mine output to about 20 per cent of normal levels. This was partly offset by expansion at the Raglan mine in northern Quebec, which achieved its design milling rate of 1 million tonnes per annum during the second half of 2000. Nevertheless, Falconbridge reported a 16 per cent decline in total nickel production from Canadian ores. The strike at Sudbury continued until late February 2001, and will have a significant impact on pgm output this year.

Production of pgm by Falconbridge was also affected by metallurgical difficulties, leading to a build-up in stocks of

PGM Supplies: North America '000 oz		
	1999	2000
Platinum	270	285
Palladium	630	635
Rhodium	18	16



unrefined metal. These problems were resolved towards the end of 2000, and release of metal from the refining pipeline should partly offset the effects of the strike this year.

The North American Palladium mine at Lac des Iles produced around 95,000 oz of palladium last year, up nearly 50 per cent compared with 1999. Although mill throughput was virtually unchanged at around 893,000 tonnes, the average pgm content improved significantly as the mine exploited a zone of higher-grade ore. Recoveries were also up on the previous year.

The company is currently undertaking an ambitious expansion programme which is planned to raise annual palladium output to at least 250,000 oz. Further details are given in a special feature on page 19.

United States of America

Expansion at Stillwater's Nye mine remains seriously behind schedule, and the mine is not expected to reach its design capacity of 3,000 tons per day for several years. In 2000, the milling rate improved by 10 per cent to just over 2,000 tons per day, but this gain was offset by a decline in head grade due to the processing of some lower-grade ores. As a result, pgm output increased by around 5 per cent to 350,000 oz of palladium and 100,000 oz of platinum. Stillwater expects to achieve a milling rate of 2,500 tons per day in 2001, with pgm production rising to approximately 500,000 oz.

The company is constructing a second pgm mine at East Boulder, about 18 miles from Nye, which is planned to produce more than 400,000 oz of pgm. Commissioning of a new concentrator started in late 2000, while development of mineable ore reserves is due to get underway this year. Further details of Stillwater's expansions can be found on page 20.

Exploration in North America

In the last two to three years, high palladium prices have triggered a surge of exploration for pgm in North America. Much of the exploration activity is concentrated in areas where pgm are already mined - for example, there are currently dozens of exploration projects at various stages of development in the Sudbury area. Among these are two which involve major South African producers: Impala has an agreement with Mustang Minerals, while Anglo Platinum is funding exploration by Pacific North West Capital. Both joint ventures are investigating potential deposits of shallow, relatively low-grade ore in River Valley area, about 50 kilometres east of the Sudbury nickel mines. These are probably the most advanced of the current wave of pgm exploration projects in North America.

Other sites of intensive exploration in North America include the Lac des Iles area in Ontario, close to the existing North American Palladium mine, and the Duluth Complex in northern Minnesota, which has long been known to host pgm. There are many other areas of activity, from Alaska in the far north to Nevada in the southern USA. However, most of the North American exploration projects are at a very early stage, and even the most advanced are still several years away from any possibility of commercial production.

Zimbabwe

Following the closure of Hartley Platinum in June 1999, Zimbabwe's only primary pgm production comes from the small Mimosa mine. Platinum supplies from Zimbabwe fell by 65,000 oz to around 15,000 oz in 2000.

The Mimosa mine, located close to Zvishavane in the south of Zimbabwe, is currently the country's only primary pgm producer. It is a small-scale operation,

with an annual mill feed of some 300,000 tonnes of ore yielding around 15,000 oz of platinum. In January 2000, it was announced that Anglo American was to acquire Mimosa as part of a buy-out of its parent company, Zimasco, but this deal has since fallen through. It remains possible that one of South Africa's platinum producers will purchase Mimosa.

In the past, mining investment in Zimbabwe has often been deterred by political and economic instability, combined with unfavourable fiscal and foreign exchange regimes. This year, there is the prospect of a new framework for investment in platinum mining, with the government expected to relax foreign exchange restrictions and reduce the tax rate on platinum operations.

In March 2001, this improved climate for investment was reflected in the announcement that funding had been obtained for the development of Zimplats' Ngezi open-cast mine. Impala is to pay \$50 million to acquire a 50 per cent stake in the project, with the remainder of the estimated \$50 million capital requirement being provided by debt finance. In addition, Impala and South African bank ABSA have spent \$16 million on purchasing a 50 per cent stake in Zimplats (which is listed on the Australian Stock Exchange) from its former majority shareholder, Delta Gold. Production at Ngezi is planned to start during 2002; further details of the project are provided in the special feature on page 21.

PGM Supplies: Zimbabwe & Others '000 oz

	1999	2000
Platinum	160	105
Palladium	160	95
Rhodium	8	3

