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Recent Strikes in South Africa's Platinum-Group Metal Mines: Effects Upon World Platinum-Group Metal Supplies

By Thomas R. Yager, Yadira Soto-Viruet, and James J. Barry

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Contents

Figures

Tables

Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Mass	
ounce, troy	31.103	gram (g)
pound, avoirdupois (lb)	0.4536	kilogram (kg)

SI to Inch/Pound

Multiply	By	To obtain
	Mass	
gram (g)	0.03215	ounce, troy
kilogram (kg)	2.205	pound avoirdupois (lb)

Recent Strikes in South Africa's Platinum-Group Metal Mines: Effects Upon World Platinum-Group Metal Supplies

By Thomas R. Yager, Yadira Soto-Viruet, and James J. Barry

The recent labor disputes over wages and working conditions that have affected South Africa's three leading platinum-group metal (PGM) producers have affected an industry already plagued by market pressures and labor unrest and raised the specter of constraints in the world's supply of these metals. Although low demand for these metals in 2011 and 2012 helped to offset production losses of recent years, and particularly those losses caused by the strikes in 2012, a prolonged resumption of strikes could cause severe shortages of iridium, platinum, rhodium, ruthenium, and, to a lesser extent, palladium.

South Africa is the world's leading producer of PGMs by value and volume. In 2011, it accounted for 74 percent of the world's platinum mine production, 38 percent of the world's palladium production, and 80 percent of the world's production of other PGMs. South Africa's production of refined PGMs was slightly greater than its mine output of PGMs because of companies processing imported concentrate from Zimbabwe and recycled materials (Loferski, 2012).

PGM mining is playing an increasingly important role in South Africa's mineral industry, which accounted for 8.8 percent of the country's gross domestic product in 2011. Mine output of PGMs totaled 288,581 kilograms (kg) in 2011 compared with about 229,500 kg in 2001. From 2001 to 2011, employment in PGM mining increased to 194,979 workers from about 100,000. During the same period, national gold mine production decreased to 180,200 kg from about 428,000 kg, and employment in gold mining decreased to 145,561 workers from about 200,000 (Chamber of Mines of South Africa, 2011, p. 12, 22–23, 32; 2012, p. 6–7, 12, 26).

PGMs were also South Africa's leading mineral commodity export. In 2011, South Africa's exports of PGMs amounted to $10.09 billion; gold, $8.99 billion; iron ore; $8.05 billion; coal, $6.96 billion; and ferrochromium, $3.28 billion. Platinum accounted for $7.18 billion of national PGM exports; palladium, $1.43 billion; rhodium, $1.17 billion; iridium, $210 million; and ruthenium, $101 million. Products derived from mining and mineral processing accounted for 45 percent of national exports, and PGMs composed 25 percent (Chamber of Mines of South Africa, 2012, p. 6–7; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., June 8, 2012).

Figure 1 shows the locations of economically significant PGM mines and refineries in South Africa. The mines and refineries are identified in tables 1 and 2, respectively, along with annual capacity, ownership, and labor strikes status.

South African Platinum-Group Metal Producers

Anglo American Platinum Ltd. (Amplats) of South Africa was the world's leading producer of platinum in 2011. The company operates the Amandelbult complex (the Tumela and the Dishaba Mines), the Rustenburg complex (the Bathopele, the Khomanani, the Khuseleka, the Siphumelele, and the Thembelani Mines) and the Union Mines. Amplats also has joint-venture agreements for the

Bafokeng-Rasimone Platinum, the Bokoni, the Kroondal, and the Modikwa Mines (fig. 1; table 1). The company's PGM refinery has a capacity of 81,000 kilograms per year (kg/yr) of refined platinum (table 2). Prior to the strikes, Amplats' production target for 2012 was between 78,000 and 81,000 kg of refined platinum (Anglo American Platinum Ltd., 2012d, p. 123).

Impala Platinum Ltd. (Implats) of South Africa owns the Impala Mines near Rustenburg in North West Province and the Marula Mine in Limpopo Province (fig. 1; table 1). The company's PGM refinery has a capacity of 71,500 kg/yr of platinum (table 2). Prior to the strikes, Implats had planned to increase its production at Impala to 31,000 kg/yr by 2014 (Impala Platinum Holdings Ltd., 2010, p. 81–83).

Lonmin plc of the United Kingdom produces PGMs at its Marikana operations east of Rustenburg in North West Province and at the Pandora Mine (fig. 1; table 1). The company's refinery has a capacity of 31,000 kg/yr of platinum (table 2). Its refined platinum production in 2011 was 23,452 kg compared with 20,754 kg in 2010. Before the strikes in 2012, Lonmin planned to ramp up to nearly 30,000 kg/yr of refined platinum after 2012 (Butler, 2012, p. 16).

Northam Platinum Ltd. of South Africa produced about 8,600 kg of PGMs at the Zondereinde Mine in 2011 compared with 8,200 kg in 2010. The company planned further increases in output in 2012. Aquarius Platinum Ltd. of South Africa operates the Everest Mine and has joint-venture agreements with Amplats for the Kroondal and the Marikana Mines. African Rainbow Minerals Ltd. of South Africa operates the Nkomati and the Two Rivers Mines in joint venture with OJSC MMC Norilsk Nickel of Russia and Implats, respectively. Platmin Ltd. of South Africa operates the Pilanesberg Platinum Mine on the western limb of the Bushveld Complex and Platinum Australia Pty Ltd. (PLA) of Australia operates the Smokey Hills Mine. Other producers include Xstrata plc of Switzerland, which operates the Eland Mine, and Eastern Platinum Ltd. of Canada, which operates the Crocodile River Mine (fig. 1; table 1; Butler, 2011, p. 18–19; 2012, p. 16).

Underlying Problems in the Platinum-Group Metal Industry

Before the large-scale strikes at the PGM mines in 2012, many PGM producers had already delayed, scaled back, or canceled the development of new mines and expansions of existing mines (table 3). South Africa's palladium and platinum production peaked in 2006, and iridium, rhodium, and ruthenium production peaked in 2007 (tables 4 and 5). The three leading PGM producers started cutting production in 2006, and the worldwide economic crisis that began in 2008 led to greater reductions in output. Power shortages also contributed to reduced production in recent years because underground PGM mines are power intensive. Smaller scale strikes also affected many PGM producers in 2011 (Ryan, 2010; Bleiwas, 2011, p. 60, 87; Butler, 2012, p. 16–19).

Platmin achieved between 53 percent and 63 percent of its PGM production target at Pilanesberg for 2011. PLA reached less than 40 percent of its production target for 2011 at Smokey Hills. In June 2012, Aquarius placed the Everest and the Marikana Mines on care-and-maintenance status and encouraged other PGM producers to reduce production. Lonmin announced plans to reduce spending on new projects by about 50 percent over 2 years in July 2012 because of low PGM demand in Europe (Maylie, 2012a; Butler, 2012, p. 16, 18; Mining Journal, 2012).

The 2012 Strikes

Strikes at many PGM mines in 2011 and earlier had already contributed to decreased production. The strikes in 2012 had considerably greater effects upon production and the PGM industry as a whole and spread to other types of mines, including gold mines. Conflict between the National Union of

Mineworkers (NUM) and the Association of Mineworkers and Construction Union (AMCU) played a central role in the strikes. The NUM is part of the Congress of South African Trade Unions, which is allied with the ruling African National Congress (ANC). The AMCU accuses the NUM of being insufficiently supportive of worker interests in its negotiations. A former ANC Youth League leader, who was expelled from the ANC, is a supporter of the AMCU (Raghavan, 2012). Lower paid mine workers make up an increasing share of the AMCU's membership, whereas the NUM's membership has shifted more toward higher paid skilled workers since the end of apartheid in the early 1990s (Maylie, 2012a, c, d).

Implats was the first PGM producer to be affected by strikes in 2012. In February, conflict between the AMCU and the NUM led to a 6-week shutdown of Implats' operations (Maylie, 2012a).

In August 2012, about 3,000 rock drillers initiated a strike at Lonmin's Marikana Mine. Conflict broke out between AMCU and NUM members, and 10 people were killed, including mine workers and police officers. At a subsequent protest at Marikana on August 16, 34 striking workers were killed by the police. In early September, Lonmin signed an agreement with some of the striking workers to increase wages by 22 percent. The AMCU refused to sign the agreement, and about 20 percent of the workers remained on strike in late September. More workers at the Marikana Mines resumed strikes in mid-October (Freeman, 2012; Maylie, 2012d).

In early September, unrest spread to Amplats's Rustenburg operations. Rustenburg employed 21,000 workers and accounted for about one-third of Amplats's mine production. In early October, the company fired 12,000 striking workers and confirmed labor strikes at its Union and Amandelbult operations. Amplats subsequently extended the deadline for the miners to resume work to late October, and, in mid-November, the miners accepted a revised offer from the company (Anglo American Platinum Ltd., 2012a–c; Létourneau, 2012; Maylie, 2012e, f).

Strikes also spread to other PGM, gold, and iron ore producers and to the transportation sector. In September and October, workers went on strike at Atlatsa Resources Corp.'s Bokoni Mine, Gold Fields Ltd.'s Beatrix and KDC West Mines, Gold One International Ltd.'s Ezulwini Mine, Harmony Gold Ltd.'s Kusasalethu Mine, Kumba Iron Ore Ltd.'s Sishen Mine, and Village Main Reef Ltd.'s Blyvoor Mine. AngloGold Ashanti Ltd. had strikes at all its gold mining operations (Kilby and Bishop, 2012; Létourneau, 2012).

In late October 2012, AngloGold Ashanti announced plans to fire 12,000 striking workers. Atlatsa fired about 2,000 striking workers; Gold Fields, about 1,500; and Gold One, more than 1,400. About 98 percent of Harmony Gold's striking workers resumed work by late October (Kilby and Bishop, 2012; Létourneau, 2012; Maylie, 2012b).

Implications for Global Markets

From 2001 to 2011, average annual prices for platinum increased by 223 percent; iridium, 149 percent; rhodium and ruthenium, 27 percent each; and palladium, 21 percent. Prices of all PGMs decreased sharply in 2009 because of the worldwide economic crisis and subsequently increased somewhat in 2010. In late October 2012, prices for rhodium and ruthenium remained 82 percent and 66 percent, respectively, below the average levels of 2008. Rhodium and ruthenium prices were 43 percent and 34 percent, respectively, below the average levels of 2011 in spite of supply disruptions from the strikes. Platinum prices fluctuated during September 2012 because of the strikes; however, platinum prices in late October remained 9 percent below the average levels of 2011. Palladium prices were 19 percent below the average levels of 2011 in late October. Iridium prices, which increased by 131 percent from 2008 to 2011, remained nearly unchanged in late October (table 7; Freeman, 2012).

Losses in platinum production because of the strikes were estimated to be about 5,900 kg at Amplats, 3,700 kg at Implats, and 3,400 kg at Lonmin. Low demand for PGMs in 2011 and 2012 has helped offset the effects of the strikes at Amplats, Implats, and Lonmin. The strikes are likely to greatly reduce or eliminate the previously expected global surplus of platinum. A prolonged resumption of strikes at any of the three leading PGM miners in South Africa could cause severe shortages of iridium, platinum, rhodium, ruthenium, and, to a lesser extent, palladium, in world markets. In 2010, Amplats mined more platinum than all non-South African producers combined. Even a partial shutdown of operations at Amplats would have serious implications for world markets. Implats produced 70 percent, and Lonmin produced 50 percent as much platinum as all non-South African producers combined (Anglo American Platinum Ltd., 2012c; Day, 2012; Maylie, 2012a, d–f).

Replacing losses in South African platinum production by increasing production elsewhere is inherently difficult because of the low platinum-to-palladium ratio in most other PGM deposits in the world. South Africa's ratio of platinum to palladium mine production is 1.87:1 compared with 0.29:1 for Russia, which is the world's second-ranked producer. Australia, Botswana, Canada, and the United States have platinum-to-palladium mine production ratios of less than 0.6:1. Zimbabwe is the only other globally significant producer, with a ratio of greater than 1:1 (table 6). Attempts to replace significant shares of South African platinum production would be difficult and could result in increases in global oversupplies of palladium.

Long-term platinum production losses could have substantial effects upon several industries. In 2011, catalysts for vehicle emission reduction accounted for 41 percent of worldwide platinum demand; jewelry, 33 percent; glass manufacturing, 7 percent; and chemical applications and investment, 6 percent each (Butler, 2012, p. 27–35).

In 2010, 46.8 metric tons of platinum was consumed in North America. Transportation was the largest sector, accounting for 32.3 percent of total platinum use. The transportation end uses include for gas turbine engine blades, oxygen sensors, spark plugs, and vehicle emission reduction catalysts. The investment tools (31.8 percent) and jewelry (11.5 percent) sectors were the next largest consumers. The chemical sector accounted for 6.6 percent of platinum consumption for uses that include catalysts and silicon production. The medical and biomedical sector (6 percent) consumed platinum in dental material, laboratory equipment manufacturing, implantable cardioverter defibrillators, and anti-cancer drugs. Petroleum refining and the electronics sector consumed 1.7 percent each. In the electronics sector, platinum was used primarily in hard disks. Glass end uses consumed 0.7 percent, and the remaining 7.7 percent was consumed in other sectors and applications.

In 2011, about 67 percent of worldwide demand for palladium was attributable to catalysts for vehicle emission reduction; electrical components, 15 percent; dental alloys, 7 percent; jewelry, 6 percent; and chemical applications, 5 percent. For rhodium, about 79 percent of worldwide demand was attributable to use in catalysts for vehicle emission reduction; liquid crystal display (LCD) glass manufacturing, 9 percent; and chemical applications, 8 percent. Computer hard disk manufacturing accounted for 62 percent of worldwide ruthenium demand; chlorine and sodium hydroxide production, 16 percent; and other chemical applications, 13 percent. The electrical sector accounted for 55 percent of worldwide iridium demand. Iridium was used primarily in crucibles to grow sapphire crystals for gallium nitride production (Butler, 2012, p. 36–37, 39–42, 44–45).

Outlook

South Africa's PGM mining industry remains the world's leading producer of PGMs in spite of recent strikes and such problems as increasing power costs, and it is highly likely to retain its status for the foreseeable future. Geologic factors, especially the low platinum-to-palladium ratio in other

PGM-producing countries, pose a nearly prohibitive challenge to replacing South Africa as the leading producer of iridium, platinum, rhodium, and ruthenium.

The strikes in 2012 had a substantial effect upon PGM production and led to delays in implementing increases in output. The effects of the strikes upon world markets were offset by low demand for PGMs. If large-scale labor disputes return to the industry, especially during periods of higher PGM demand, shortages of PGMs could become acute and lead to much higher prices that would affect many industries. Other potential challenges include support for nationalization of the mining industry among some factions of the ANC.

References Cited

Anglo American Platinum Ltd., 2012a, Anglo American Platinum update: Johannesburg, South Africa, Anglo American Platinum Ltd. press release, October 18, 1 p.

Anglo American Platinum Ltd., 2012b, Anglo American Platinum update: Johannesburg, South Africa, Anglo American Platinum Ltd. press release, November 9, 2 p.

Anglo American Platinum Ltd., 2012c, Anglo American Platinum's staff return to work: Johannesburg, South Africa, Anglo American Platinum Ltd. press release, November 15, 2 p.

Anglo American Platinum Ltd., 2012d, Annual report 2011: Johannesburg, South Africa, Anglo American Platinum Ltd., 320 p.

Bleiwas, D.I., 2011, Estimates of electricity requirements for the recovery of mineral commodities, with examples applied to sub-Saharan Africa: U.S. Geological Survey Open- File Report 2011–1253, 100 p., available online at http://pubs.usgs.gov/of/2011/1253/report/OF11-1253.pdf.

Butler, Jonathan, 2011, Platinum 2011: London, United Kingdom, Johnson Matthey plc, 60 p.

Butler, Jonathan, 2012, Platinum 2012: London, United Kingdom, Johnson Matthey plc, 60 p.

Chamber of Mines of South Africa, 2011, Facts & figures 2010: Johannesburg, South Africa, Chamber of Mines of South Africa, 40 p.

Chamber of Mines of South Africa, 2012, Facts & figures 2011: Johannesburg, South Africa, Chamber of Mines of South Africa, 41 p.

Day, Matt, 2012, Platinum plunges to 6-week low: The Wall Street Journal, October 23, p. C4.

Freeman, Francesca, 2012, Platinum swings on strife: The Wall Street Journal, September 24, p. C10.

Impala Platinum Holdings Ltd., 2010, Integrated annual report 2010: Northlands, South Africa, Impala Platinum Holdings Ltd., 260 p.

Kilby, Ben, and Bishop, Chris, 2012, AngloGold, Harmony workers begin returning after strike: Platts Metals Week, v. 83, no. 44, October 29, p. 9.

Létourneau, Alex, 2012, Recap of the major mines impacted by the South African mine strikes: Forbes, October 12. (Accessed October 12, 2012, at http://www.forbes.com/sites/kitconews/2012/10/12/recap-of-the-major-mines-impacted-by-the-south-african-mine-strikes-2/.)

Loferski, P.J., 2012, Platinum-group metals, *in* Metals and minerals: U.S. Geological Survey Minerals Yearbook 2011, v. I, p. 57.1–57.11. (Accessed November 19, 2012, at http://minerals.usgs.gov/minerals/pubs/commodity/platinum/myb1-2011-plati.pdf.)

Maylie, Devon, 2012a, African mine clash takes deadly turn: The Wall Street Journal, August 14, p. B6.

Maylie, Devon, 2012b, African miner plans mass layoffs: The Wall Street Journal, October 25, p. A13.

Maylie, Devon, 2012c, Lethal clashes shut platinum mine: The Wall Street Journal, August 15, p. B3.

Maylie, Devon, 2012d, Lonmin reaches accord at South Africa mine: The Wall Street Journal, September 7, p. B7.

Maylie, Devon, 2012e, South Africa sees new unrest at mine: The Wall Street Journal, October 31, p. A12.

Maylie, Devon, 2012f, Unrest hits platinum mines: The Wall Street Journal, September 13, p. A16.
Mining Journal, 2012, South Africa's platinum results show sector's woes: Mining Journal, July 27, p. 1.
Raghavan, Sudarsan, 2012, South Africa’s resurgent firebrand—Fallen ANC Youth League star tries to capitalize on mineworker killings: The Washington Post, November 6, p. A10.
Ryan, Brendan, 2010, More power woes for South Africa: Australia’s Paydirt, v. 1, no. 178, December/January, p. 73.

Table 1. South African platinum-group metal mines.

[PGM, platinum-group metal; --, not applicable or no data]

Corresponding number in figure 1	Mine name	Major operating companies and major equity owners	Annual capacity (kilograms)	Production in 2011 (kilograms)	Strike(s) held in 2012?	Length of strike	Expansion capacity (kilograms)	Year of planned expansion	Mine status
1	Bathopele Mine	Anglo American Platinum Ltd. (Amplats), 100%	24,000 platinum; 13,000 palladium; 3,300 rhodium	7,000 PGMs	Yes	6 weeks	--	--	Active.
2	Dishaba Mine	Anglo American Platinum Ltd. (Amplats), 100%	18,000 platinum; 8,700 palladium; 2,300 rhodium	8,000 PGMs	Yes	6 weeks	--	--	Active.
3	Khomanani Mine	Anglo American Platinum Ltd. (Amplats), 100%	24,000 platinum; 13,000 palladium; 3,300 rhodium	5,000 PGMs	Yes	6 weeks	--	--	Active.
4	Khuseleka Mine	Anglo American Platinum Ltd. (Amplats), 100%	24,000 platinum; 13,000 palladium; 3,300 rhodium	7,000 PGMs	Yes	6 weeks	--	--	Active.
5	Siphumelele Mine	Anglo American Platinum Ltd. (Amplats), 100%	24,000 platinum; 13,000 palladium; 3,300 rhodium	4,600 PGMs	Yes	6 weeks	--	--	Active.
6	Thembelani Mine	Anglo American Platinum Ltd. (Amplats), 100%	24,000 platinum; 13,000 palladium; 3,300 rhodium	6,000 PGMs	Yes	6 weeks	--	--	Active.
7	Tumela Mine	Anglo American Platinum Ltd. (Amplats), 100%	18,000 platinum; 8,700 palladium; 2,300 rhodium	15,000 PGMs	Yes	6 weeks	--	--	Active.
8	Union Mines	Anglo American Platinum Ltd. (Amplats), 85%	10,000 platinum; 4,800 palladium; 1,700 rhodium	14,000 PGMs	Yes	6 weeks	--	--	Active.

Table 1. South African platinum-group metal mines.—Continued

[PGM, platinum-group metal; --, not applicable or no data]

Corresponding number in figure 1	Mine name	Major operating companies and major equity owners	Annual capacity (kilograms)	Production in 2011 (kilograms)	Strike(s) held in 2012?	Length of strike	Expansion capacity (kilograms)	Year of planned expansion	Mine status
9	Kroondal Mine	Kroondal Platinum Mines [Anglo American Platinum Ltd. (Amplats), 50%, and Aquarius Platinum Ltd., 50%]	7,900 platinum; 3,800 palladium; 1,400 rhodium	6,900 platinum; 2,800 palladium; 1,000 rhodium	Yes	4 days	--	--	Active.
10	Mototolo Platinum Mine	Anglo American Platinum Ltd. (Amplats), 50%, and Xstrata Kagiso Platinum Partnership, 50%	3,400 platinum; 2,400 palladium; 580 rhodium	3,100 platinum	No	--	--	--	Active.
11	Mogalakwena Mine	Anglo American Platinum Ltd. (Amplats), 100%	9,600 platinum; 10,000 palladium; 580 rhodium	--	No	--	--	--	Active.
12	Twickenham Mine	Anglo American Platinum Ltd. (Amplats), 100%	Small	Small	No	--	--	--	Active.
13	Bokoni Mine (Lebowa Mine)	Anooraq Resources Corp., 51%, and Anglo American Platinum Ltd. (Amplats), 49%	4,100 platinum; 2,700 palladium; 470 rhodium	--	No		2,800 PGMs	2016	Active.
14	Bafokeng-Ramisone Platinum Mine	Bafokeng-Rasimone Platinum Mine [Royal Bafokeng Nation, 67%, and Anglo American Platinum Ltd. (Amplats), 33%]	6,100 platinum; 2,500 palladium; 420 rhodium	5,100 platinum	No	--	17,000 PGMs	2014	Active.
15	Marikana Mine	Marikana Platinum Mine [Anglo American Platinum Ltd. (Amplats), 50%, and Aquarius Platinum Ltd., 50%]	2,700 platinum; 1,300 palladium; 390 rhodium	1,700 platinum; 890 palladium; 316 rhodium	No	--	--	--	Care-and-maintenance status (June 2012).

Table 1. South African platinum-group metal mines.—Continued

[PGM, platinum-group metal; --, not applicable or no data]

Corresponding number in figure 1	Mine name	Major operating companies and major equity owners	Annual capacity (kilograms)	Production in 2011 (kilograms)	Strike(s) held in 2012?	Length of strike	Expansion capacity (kilograms)	Year of planned expansion	Mine status
16	Modikwa Mine	Modikwa Platinum Mine [Anglo American Platinum Ltd. (Amplats), 50%, and African Rainbow Minerals, 50%]	4,300 platinum; 4,200 palladium; 870 rhodium	3,500 platinum	No	--	--	--	Active.
17	Zondereinde Mine	Northam Platinum Ltd. [Anglo American Platinum Ltd. (Amplats), 22.5%, and Mvelaphanda Resources Ltd., 21.9%]	8,100 platinum; 3,900 palladium; 900 rhodium	8,600 PGMs	No		9,300 PGMs	2012	Active.
18	Pandora Mine	Rustenburg Platinum Mines Ltd. [Anglo American Platinum Ltd. (Amplats), 42.5%; Eastern Platinum Ltd. (Lonmin plc), 42.5%; Bapo-Ba-Mongale Mining Co., 7.5%; Mvelaphanda Resources, 7.5%]	--	700 platinum; 300 palladium; 109 rhodium; 1,300 PGMs	No	--	--	--	Active.
Anglo American Platinum Ltd.'stotal lost production in 2012 was about 5,900 kilograms (190,000 troy ounces) of platinum									
19	Everest Platinum Mine	Aquarius Platinum Ltd., 100%	6,200 platinum group metals	1,600 platinum; 900 palladium; 280 rhodium	Yes	2 weeks		--	Care-and-maintenance status (June 2012).
20	Impala Mines	Impala Platinum Ltd. (Implats), 100%	34,000 platinum; 15,000 palladium; 3,300 rhodium	26,700 platinum; 14,472 palladium; 3,000 rhodium	Yes	6 weeks	31,000 platinum	2014	Active.

Table 1. South African platinum-group metal mines.—Continued

[PGM, platinum-group metal; --, not applicable or no data]

Corresponding number in figure 1	Mine name	Major operating companies and major equity owners	Annual capacity (kilograms)	Production in 2011 (kilograms)	Strike(s) held in 2012?	Length of strike	Expansion capacity (kilograms)	Year of planned expansion	Mine status
21	Marula Mine	Impala Platinum Ltd. (Implats), 100%	3,900 platinum; 4,000 palladium; 820 rhodium	2,000 platinum; 2,000 palladium; 420 rhodium	No	--	2,200 platinum	2013	Active.
22	Two Rivers Platinum Mine	Two Rivers Platinum Mine (Pty) Ltd. (African Rainbow Minerals Ltd., 55%, and Impala Platinum Ltd., 45%)	4,100 platinum; 2,300 palladium; 660 rhodium	4,100 platinum 2,400 palladium 700 rhodium	No	--	--	--	Active.
Impala Platinum Ltd.'s total lost production in 2012 was about 3,700 kilograms (120,000 troy ounces) of platinum									
23	Marikana Mines	Lonmin plc	22,000 platinum; 10,000 palladium; 3,000 rhodium	19,700 platinum; 9,200 palladium; 2,600 rhodium; 37,000 PGMs	Yes	6 weeks	--	--	Active.
Lonmin plc's total lost production in 2012 was about 3,400 kilograms (110,000 troy ounces) of platinum									
24	Blue Ridge Mine	Aquarius Platinum Ltd., 50%	3,900 PGMs	300 platinum; 150 palladium; 50 rhodium	No	--	--	--	Care-and-maintenance status (June 2012).
25	Crocodile River Mine	Eastern Platinum Ltd., 85%	4,000 PGMs	2,900 PGMs	No	--	3,900 PGMs	2012	On hold.
26	Nkomati Joint Venture	OJSC MMS Norilsk Nickel, 50%, and African Rainbow Minerals Ltd., 50%	--	2,100 PGMs	No	--	3,400 PGMs	2014	Active.
27	Smokey Hills Platinum Mine	Platinum Australia Pty Ltd. (PLA), 69.75%	3,000 PGMs	1,000 PGMs	No	--	--	--	Active.

Table 1. South African platinum-group metal mines.—Continued

[PGM, platinum-group metal; --, not applicable or no data]

Corresponding number in figure 1	Mine name	Major operating companies and major equity owners	Annual capacity (kilograms)	Production in 2011 (kilograms)	Strike(s) held in 2012?	Length of strike	Expansion capacity (kilograms)	Year of planned expansion	Mine status
28	Pilanesberg Platinum Mine	Platmin Ltd., 72.39%, and Bakgatla Pallinghurst JV (Pty) Ltd., 25.96%	7,800 PGMs	--	No	--	--	--	Active.
29	Eland Mine	Xstrata plc, 74%	7,500 PGMs	1, 800 PGMs	No	--	9,300 platinum	2016	Active.

Tabel 2. South Africa platinum-group metal refineries.

Corresponding number in figure 1	Refinery	Major operating companies	Annual capacity (kilograms)	Production in 2011 (kilograms)
30	Precious metals refinery	Anglo American Platinum Ltd. (Amplats)	81,000 platinum; 44,000 palladium; 11,000 rhodium	78,700 platinum; 44,500 palladium; 10,500 rhodium.
31	Precious metals refinery, near Springs in Guateng Province	Impala Platinum Ltd. (Implats)	71,500 platinum; 33,400 palladium; 8,300 rhodium	53,800 platinum; 34,100 palladium; 7,800 rhodium.
32	Precious metals refinery at Western Platinum	Lonmin plc	31,000 platinum; 14,000 palladium; 4,000 rhodium	23,400 platinum; 11,000 palladium; 3,000 rhodium.

Table 3. Recent prospective platinum-group metal projects in South Africa.

[--, not applicable or no data]

Name	Major operating companies and major equity owners	Proposed capacity (in kilograms)	Proposed start date	Status
Booysendal	Northam Platinum Ltd., 100%	5,000 PGMs	2013	Active.
Kalahari Platinum project	Platinum Australia Pty Ltd. (PLA) and African Rainbow Minerals Ltd.	3,700 PGMs	--	Definitive feasibility study.
Western Bushveld project	Platinum Group Metals Ltd., 74%, and Wesizwe Platinum Ltd., 26%	8,600 PGMs	2013	Active.
Maphahlele project	Platmin Ltd.	7,800 PGMs	--	Hold.
Grootboom project	Platmin Ltd.	2700 PGMs	--	Hold.
Bakubung Platinum Mine	Wesizwe Platinum Ltd., 100%	10,900 PGMs	2018	Active.
Bafokeng-Rasimone Platinum Mine	Royal Bafokeng Platinum and Rustenburg Platinum Mines Ltd., 67.33 %, and Anglo American Platinum Ltd. (Amplats), 33%	17,000 PGMs	2014	Active.
Leeuwkop project	Impala Platinum Ltd. (Implats)	4,100 platinum	2013	Hold.

Table 4. Refined platinum-group metal production in South Africa, in kilograms.

[Sources: Anglo American Platinum Ltd., Impala Platinum Ltd., and Lonmin plc]

	2006	2007	2008	2009	2010	2011
Palladium	92,470	89,100	80,640	86,610	94,990	89,640
Platinum	173,000	163,800	149,900	149,500	156,600	155,900
Rhodium	21,340	21,510	20,020	21,630	21,380	21,300
Other[1]	33,200	36,300	32,900	34,600	37,600	36,400
Total	320,000	310,700	283,400	292,300	310,600	303,200

[1]Iridium, ruthenium, and probably small amounts of gold.

Table 5. Platinum-group metals mine production in South Africa, in kilograms.

[Source: Department of Mineral Resources of the Republic of South Africa. NA, not available]

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Iridium	NA	NA	3,682	6,444	5,769	6,280	6,172	7,211	6,415	6,378	6,445	6,813
Palladium	55,818	62,601	63,758	70,946	76,403	82,961	86,265	83,643	75,537	75,117	82,222	82,371
Platinum	114,459	130,307	132,897	148,348	153,239	163,711	168,125	160,940	146,141	140,819	147,790	148,008
Rhodium	12,067	13,507	15,175	16,816	16,294	20,224	19,633	21,056	19,348	20,007	20,001	20,332
Ruthenium	19,427	19,329	21,022	23,537	24,696	29,805	27,333	31,182	28,326	29,071	30,846	30,966
Total	201,771	225,744	236,534	266,091	276,401	302,981	307,528	304,032	275,767	271,392	287,304	288,490

Table 6. Platinum-group metals mine production in selected countries, in kilograms.

[Sources: Department of Mineral Resources of the Republic of South Africa and U.S. Geological Survey Minerals Yearbook. Pt, platinum; Pd, palladium]

	2006	2007	2008	2009	2010	2011	Pt/Pd ratio
Australia							
Palladium	750	600	580	800	650	600	
Platinum	209	142	120	230	130	130	0.2414573
Botswana							
Palladium	2,000	5,000	3,000	3,000	3,000	3,000	
Platinum	300	700	600	600	600	600	0.1789474
Canada							
Palladium	14,900	14,100	14,700	7,000	6,200	14,000	
Platinum	8,500	8,000	8,500	4,000	3,600	7,000	0.5585331
Russia							
Palladium	98,400	96,800	87,700	83,200	84,700	86,000	
Platinum	29,000	27,000	25,000	24,500	25,000	25,000	0.2896796
South Africa							
Palladium	86,265	83,643	75,537	75,117	82,222	82,000	
Platinum	168,125	160,940	146,141	140,819	147,790	145,000	1.8746803
United States							
Palladium	14,400	12,800	11,900	12,700	11,600	12,400	
Platinum	4,290	3,860	3,580	3,830	3,450	3,700	0.2996042
Zimbabwe							
Palladium	4,022	4,180	4,386	5,680	7,000	8,200	
Platinum	4,998	5,306	5,642	6,849	8,800	10,600	1.2607565

Table 7. World platinum-group metal prices from 2000 through 2011, in dollars per troy ounce.

[Source: Platts Metals Week]

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Iridium	415.00	415.25	294.62	93.02	185.33	169.51	349.45	444.43	448.34	420.40	642.15	1,035.87
Palladium	691.84	610.71	339.68	203.00	232.93	203.54	322.93	357.34	355.12	265.65	530.61	738.51
Platinum	549.30	533.29	542.56	694.44	848.76	899.51	1,144.42	1,308.44	1,578.26	1,207.55	1,615.56	1,724.51
Rhodium	1,990.00	1,598.67	838.88	530.28	983.24	2,060.00	4,561.06	6,203.09	6,533.57	1,591.32	2,459.07	2,024.35
Ruthenium	129.76	130.67	66.33	35.43	64.22	74.41	193.09	573.74	324.60	97.28	198.45	165.85

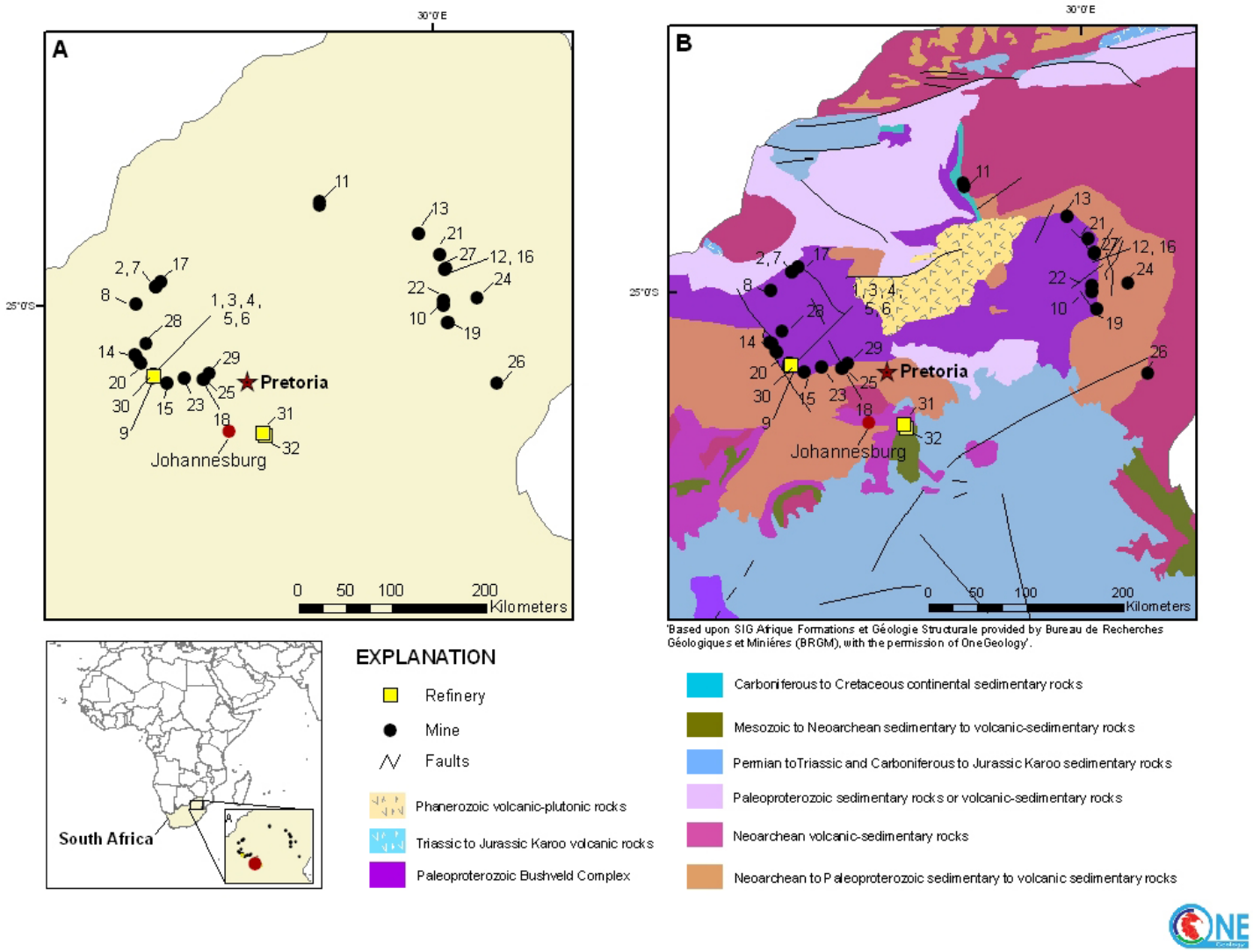

Figure 1. Maps showing the *(A)* distribution and *(B)* geology of South Africa's platinum-group metal (PGM) deposits. Numbers refer to entries in table 1. All the deposits, except for the Nkomati Mine, produce from the Bushveld Complex (shown in purple), a large layered intrusive complex in which PGMs are concentrated at three horizons. Geologic map reproduced with the pemission of the OneGeology Secretariat and registered participants. All rights reserved.