



# 2014 Minerals Yearbook

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## PLATINUM-GROUP METALS [ADVANCE RELEASE]

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# PLATINUM-GROUP METALS

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The platinum-group metals (PGMs) consist of iridium, osmium, palladium, platinum, rhodium, and ruthenium. The PGMs occur together in nature, but economic deposits are rare. PGMs are produced from deposits that are mined primarily for PGMs and are also produced as byproducts of nickel-copper mines.

In 2014, the United States was the world's fourth-leading producer of both palladium and platinum. Stillwater Mining Co. (SMC), the only domestic mine producer of PGMs, recovered PGMs from its Stillwater Mine southwest of Nye, MT, and its East Boulder Mine south of Big Timber, MT. Domestic production of palladium and platinum was 16,100 kilograms (kg), slightly less than that of 2013 (Stillwater Mining Co., 2015a, p. 1). Recycling has become a major source of PGMs as well, accounting for 30% of the total global supply of palladium, platinum, and rhodium in 2014, an increase from 18% in 2003.

Most of the world's supply of primary PGMs came from South Africa and Russia, which accounted for 48% and 30%, respectively, of global primary PGM production. World mine production of PGMs totaled 393,000 kg, a 14% decrease from that of 2013, owing to an unprecedented workers' strike in South Africa. On January 23, 2014, at least 70,000 workers at the three leading platinum mining companies in South Africa went on strike to demand higher wages. The strike ended on June 23 and was the longest in South Africa's mining history, resulting in lost revenue of \$2.3 billion for the mining companies and lost production of 33,600 kilograms of platinum. Rampup to full production levels took several months (CPM Group, 2015, p. 14).

The price of platinum remained steady in spite of the reduced mine production, owing to the release of material from aboveground stocks into the market. The average annual palladium price was 11% higher than in 2013, in part because political tensions in Ukraine led to concerns that sanctions might be enforced against Russia, the world's leading palladium supplier, and supply restrictions might follow (table 1).

In 2014, the automobile industry continued to be the major consumer of PGMs. Catalytic converters, also referred to as autocatalysts, accounted for approximately 84% of global rhodium consumption, 65% of palladium consumption, and 45% of platinum consumption (CPM Group, 2015, p. 39, 123, 189).

## Legislation and Government Programs

The Defense Logistics Agency Strategic Materials, Department of Defense, reported no PGM sales from U.S. Government stockpiles in 2014; 18 kg of iridium and 261 kg of platinum remained in the stockpile. Palladium stocks were exhausted in 2004.

## Production

**Primary.**—During 2014, U.S. palladium and platinum mine production was 12,400 kg and 3,660 kg, respectively, each slightly less than that of 2013 (table 1), and mine production of rhodium was 124 kg, 33% more than that in 2013. The Stillwater Mine produced 8,170 kg of palladium and 2,430 kg of platinum, decreases of 7% each compared with production in 2013. The East Boulder Mine produced 4,280 kg of palladium and 1,220 kg of platinum, increases of 13% and 10%, respectively, compared with 2013 production. SMC milled 1.07 million metric tons (Mt) of ore from the mines, slightly less than that of 2013. In 2014, the Stillwater Mine processed an average of 1,860 metric tons per day (t/d) of ore, 6% less than in 2013, having an average mill-head grade of 17 grams per metric ton (g/t) PGMs and a PGM mill recovery of 93%, slightly more than that in 2013. In 2014, the East Boulder Mine processed an average of 1,300 t/d of ore, 10% more than in 2013, having an average mill-head grade of 14 g/t PGMs and a PGM mill recovery rate of 90%, unchanged from that in 2013. The concentrates from the mines were smelted and then processed at SMC's base-metals refinery in Columbus, MT, producing a PGM-rich filter cake. Final refining of PGMs was done by a third-party refiner in New Jersey. Refined metal from SMC's mine production was sold to Tiffany & Co. and Johnson Matthey plc (Stillwater Mining Co., 2015a, p. 19–21; Stillwater Mining Co., 2015b, p. 2).

At yearend 2014, SMC reported proven and probable reserves at its Montana mines of 48.9 Mt of ore having an average grade of 14 g/t PGMs, a palladium-to-platinum ratio of 3.6 to 1, and 691,000 kg of contained palladium and platinum. These reserves are contained in the J-M Reef, an ore body within the layered mafic and ultramafic igneous rocks of the Stillwater Complex. SMC reported progress on two development projects, the Blitz and Graham Creek projects, which were planned to supplement or replace production from the existing mines. The Blitz project continued to make steady progress: the tunnel-boring machine completed a total of 1,520 meters (m) in 2014, for a total of 2,200 m, and the parallel drive completed a total of 2,700 m of ramp and infrastructure development. The Blitz project would ultimately consist of two parallel underground drifts that would extend about 7,000 m eastward from the Stillwater Mine. A new portal and decline to access the two new drifts were expected to be installed about 6 kilometers (km) to the east of the existing Stillwater Mine. The Blitz project infrastructure was expected to be completed in late 2018. The Graham Creek project, west of the East Boulder Mine, was completed and production began during the second quarter of 2014, ahead of schedule. About 930 kilograms per year of PGMs was expected to be produced from the Graham Creek project. Drilling continued along the 2,700 m of new development to delineate the best mining areas (Stillwater Mining Co., 2015a, p. 13–20, 58).

In 2014, PGM exploration continued in the Duluth Complex in Minnesota. Twin Metals Minnesota LLC completed a prefeasibility study on its Twin Metals Minnesota copper-nickel-PGM project and was in the process of developing mine plans. The Twin Metals project, planned as an underground mine, included three deposits in close proximity: the Birch Lake, Maturi, and Spruce Road deposits (Twin Metals Minnesota LLC, 2015).

PolyMet Mining Corp. reported that the final environmental impact statement (EIS) for its NorthMet copper-nickel-PGM project in the Duluth Complex, produced jointly by the Minnesota Department of Natural Resources, the U.S. Army Corps of Engineers, and the U.S. Forest Service, was expected to be completed in the early spring of 2015. The NorthMet project was planned as an open pit mine and ore was to be processed at the nearby Erie Plant facilities, originally used to process iron ore (PolyMet Mining Corp., 2014).

**Secondary.**—In 2014, PGMs were recycled from three main sources—catalytic converters, electronics, and jewelry. Globally, more than 123,000 kg of secondary PGMs was recovered, accounting for approximately 30% of the global supply of PGMs.

Catalytic converters were the predominant source of secondary PGMs. An estimated 55,000 kg of PGMs was recovered from catalytic converters in the United States, which was 53% of the world total; 33,300 kg was recovered in Europe, 12,800 kg in Japan, and 2,070 kg in China (CPM Group, 2015, p. 34, 35, 118, 119, 183).

Globally, 76,200 kg of palladium was recovered from secondary sources. Of the total, 61,300 kg of palladium was recovered from catalytic converters (3% more than 2013), 14,000 kg from electronics (the same as 2013), and 818 kg from jewelry (slightly less than 2013) (CPM Group, 2015, p. 118–119).

Globally, 39,700 kg of platinum was recovered from secondary sources including 34,300 kg from recycled catalytic converters, which was 6% less than that of 2013 as a result of lower platinum loadings on catalytic converters available for recycling. About 1,480 kg of platinum was recovered from electronics recycling in 2014, which was 6% more than the amount recovered in 2013. About 3,920 kg of platinum was recovered from the jewelry industry globally in 2014, 8% less than that of 2013. In 2014, recovery of rhodium from catalytic converters increased slightly to 7,200 kg (CPM Group, 2015, p. 34, 35, 118, 119, 183).

SMC reported that its recycling program recovered 14,600 kg of PGMs from spent catalytic converters in 2014, a 24% decrease compared with that of 2013. Of the total recycled, SMC toll-refined 2,300 kg of PGMs, an 11% increase from that in 2013; the remainder was material purchased for its own accounts. In 2014, SMC sold 6,900 kg, 4,200 kg, and 900 kg, respectively, of recycled palladium, platinum, and rhodium, which were decreases of 28%, 30%, and 34%, respectively, compared with amounts sold in 2013 (Stillwater Mining Co., 2015, p. 8).

## Consumption

**Palladium.**—Global palladium consumption was 281,000 kg in 2014, slightly more than that in 2013. About 65% of palladium

was used by the catalytic converter industry, 14% by the electronics industry, and 8% and 5% by the dental and chemical industries, respectively. About 5% of palladium was used in the jewelry industry and the remainder was used in others industries and as investment (CPM Group, 2015, p. 104–105). Apparent domestic palladium consumption, defined as mine production plus imports minus exports, was 82,400 kg, an 18% increase from 69,800 kg in 2013.

In 2014, global palladium use in catalytic converters reached an alltime high for the fourth consecutive year, increasing by 4% to 183,000 kg, owing to the greater number of vehicles sold in developed economies; tightening emissions standards globally; and the increase in the number of large vehicles, which require more PGMs, sold in the United States. North America was the leading autocatalyst-consuming region, and accounted for 32% of global consumption of palladium in catalytic converters (58,200 kg), 5% more than that of 2013. The United States accounted for 90% of the North American consumption in this category (CPM Group, 2014, p. 120–126).

Palladium consumption in European catalytic converters was 30,800 kg, 7% more than that of 2013, owing to an increase in auto sales, a decreased market share of diesel vehicles, and introduction of more stringent emissions standards. Consumption by China's catalytic converter industry was 34,200 kg, 7% more than that of 2013 owing to tightening emissions standards and growing demand for gasoline-powered vehicles. Consumption by Japan was 24,900 kg, which was a 4% increase compared with that of 2013. Palladium consumption for catalytic converters in the rest of the world decreased by 5% to 35,300 kg (CPM Group, 2015, p. 123).

Global palladium consumption by the jewelry industry, which declined for the fifth straight year, was 14,100 kg, a slight decrease from that of 2013. China remained the leading user of palladium for jewelry, accounting for 33% of world consumption in that industry. However, consumption by China's jewelry industry decreased by 5% relative to that of 2013 owing to a lack of marketing of palladium jewelry. Consumption in Europe was 1,990 kg of palladium, a 3% increase relative to that of 2013; consumption in North America was 2,150 kg, unchanged from that in 2013; and consumption in Japan was 3,260 kg, 3% less than that in 2013. Consumption in the rest of the world was slightly lower at 2,050 kg (CPM Group, 2015, p. 123).

World palladium consumption in dental alloys was 22,900 kg in 2014, down slightly from consumption in 2013. Japan and North America accounted for 35% and 31%, respectively, of the global palladium consumption in this industry. The chemical industry consumed 15,200 kg of palladium in 2014, slightly more than that in 2013. In the chemical industry, palladium was used as a catalyst in manufacturing bulk chemicals, including hydrogen peroxide, nitric acid, terephthalic acid, and vinyl acetate monomer, which in turn were used to produce many resins, plastics, and polyester and polyethylene terephthalate for use in textiles and packaging. Consumption of palladium by the electronics industry was 38,800 kg in 2014, slightly more than that of 2013 and the highest level since 2000. Most of the demand for palladium in the electronics industry was for multilayer ceramic capacitors, which have widespread use in electronic circuitry (CPM Group, 2015, p. 126–129).

The palladium investment sector was a net seller of palladium in 2014; the deficit in palladium production relative to consumption was met by net investor sales. Holdings in exchange-traded funds (ETFs), however, increased to 92,400 kg at yearend 2014, a 44% increase from holdings at yearend 2013 (CPM Group, 2015, p. 136–137; Thomson Reuters GFMS Surveys, 2015, p. 16–17).

**Platinum.**—In 2014, U.S. apparent consumption of refined platinum was 130,000 kg, a 20% increase from the apparent consumption of 108,000 kg in 2013.

In 2014, global platinum use, excluding investments, totaled 218,000 kg, a 3% decrease compared with that in 2013. About 45% of the total was used to produce catalytic converters, 34% by the jewelry industry, 9% for chemical and petroleum refining, and 3% in electronics. The remainder was used in other industries including glass manufacturing and the medical and biomedical industries. Worldwide use of platinum in the catalytic converter industry decreased by 3% to 98,000 kg in 2014 compared with that in 2013. Catalytic converter consumption in Europe was 33,300 kg of platinum, which was 7% more than that of 2013 owing to increased demand for commercial vehicles. Europe remained the leading consumer of platinum for catalytic converters, and accounted for 34% of total global consumption. Consumption of platinum for catalytic converters in the United States in 2014 was 21,400 kg, an 8% increase from 2013 owing to increased sales of large commercial vehicles that are typically powered by diesel engines that use platinum in their catalytic converters. The United States accounted for 22% of global catalytic converter consumption. In Japan, platinum consumption for catalytic converters was 19,100 kg, 6% more than that of 2013, largely the result of increased demand for commercial vehicles. In China, consumption of platinum for catalytic converters was 12,300 kg, 3% less than that in 2013 owing partly to a decline in sales of large commercial vehicles. Elsewhere, consumption of platinum for catalytic converters decreased by 40% in 2014 to 11,200 kg (CPM Group, 2015, p. 38–44).

In 2014, global consumption of platinum in the jewelry industry declined for the second consecutive year, and was 74,700 kg, slightly less than that of 2013. Consumption in the United States was 1,900 kg, slightly more than that of 2013. Consumption in China decreased slightly to 59,000 kg, and accounted for 79% of global consumption. Consumption in Europe was 1,280 kg, the same as that in 2013; consumption in Japan was 8,400 kg, 4% less than that in 2013; and consumption in the rest of the world increased by 7% to 4,800 kg (CPM Group, 2015, p. 39).

Global use of platinum in chemicals and petroleum refining was 20,000 kg in 2014, 3% more than that of 2013. The leading use for platinum in chemical production was for catalysts used in the production of silicones and other chemicals, such as terephthalic acid used in the production of polyester fabric and plastic containers. Worldwide consumption of platinum in electrical applications was 5,850 kg in 2014, slightly less than that of 2013 owing to lower demand for hard disk drives. The primary use of platinum by the electronics industry was in the manufacture of hard disks, but the shift away from desktop and laptop computers to tablets that do not

use PGMs has lowered platinum demand in this application (CPM Group, 2015, p. 46–47).

Consumption of platinum for dental and medical applications was 1,200 kg, which was 5% less than that in 2013. Consumption in other end uses decreased slightly to 16,700 kg relative to that of 2013. These other uses included platinum used in glassmaking equipment (CPM Group, 2015, p. 47).

Consumption of platinum for investment was 11,000 kg in 2014, 66% less than 2013. However, platinum holdings in ETFs globally totaled 83,300 kg at yearend 2014, 10% more than that at yearend 2013 (CPM Group, 2015, p. 57; Thomson Reuters GFMS Surveys, 2015, p. 16).

**Other PGMs.**—Global rhodium consumption in 2014 was 30,500 kg, 3% more than that of 2013, and the fifth consecutive year that global rhodium consumption increased. Most rhodium use, 84% in 2014, was in the production of catalytic converters. In 2014, rhodium use in catalytic converters was 25,600 kg, 4% more than that of 2013 owing to increased automobile production and tightening emissions standards. Use of rhodium in glass manufacturing increased slightly to 1,250 kg owing to the relatively low price of rhodium, which led to higher proportions of rhodium in platinum-rhodium alloys used in glassmaking equipment. Consumption of rhodium in chemical production increased by 5% to 1,600 kg in 2014 owing primarily to increased consumption in China. Use in electronics was 1,360 kg, slightly less than that in 2013, and use in other applications was 669 kg, slightly less than that in 2012. Holdings in the single rhodium ETF at yearend 2014 were 3,400 kg, 6% more than those at yearend 2013 (CPM Group, 2015, p. 169, 184–187).

Global consumption of ruthenium decreased by 4% to 26,800 kg in 2014 from that in 2013. Consumption of ruthenium in electrical applications was 11,500 kg, 10% more than that in 2013; electrochemical use was 4,300 kg, 5% less than 2013; use in chemical production was 7,500 kg, 21% less than that in 2013; and consumption in other applications increased slightly to 3,500 kg (Johnson Matthey plc, 2015, p. 36).

Global consumption of iridium was 6,100 kg in 2014, 5% more than that of 2013. Use in electrical applications increased by 17% to 1,300 kg; use in the electrochemical applications was 1,600 kg, the same as 2013; use in chemical production was 600 kg, the same as 2013; and use in other applications was 2,600 kg, a 5% increase from that in 2013 (Johnson Matthey plc, 2015, p. 35).

## Prices

According to Platts Metals Daily, in 2014, the Engelhard average annual prices for palladium and rhodium increased by 11% and 10%, respectively, whereas prices for platinum, iridium, and ruthenium decreased by 7%, 33%, and 14%, respectively, from those of 2013 (table 1).

**Iridium.**—The average annual iridium price in 2014 was \$556.19 per troy ounce, which was 33% lower than that of 2013. The iridium price began the year at \$400 per troy ounce, increased to \$630 per troy ounce in early August and then decreased steadily to \$500 per troy ounce in early December, ending the year at \$515 per troy ounce. The high price in August coincided with labor issues in South Africa that led

to supply concerns, which in turn led some manufacturers to replace iridium with silver in iridium tin oxide, used to make transparent conductive coatings for liquid crystal displays and touch screens. The substitution of silver reduced demand for iridium and the price decreased in the latter part of the year (CPM Group, 2015, p. 198–199).

**Palladium.**—The average annual palladium price in 2014 was \$808.89 per troy ounce, which was 11% more than that of 2013 owing to strong fabrication demand and tight supply. Palladium prices were supported by the continuing political crisis in Ukraine and concern that economic sanctions might be enforced against Russia, the world's leading producer of palladium. Prices were also supported by supply concerns owing to the 5-month-long workers' strike in South Africa. Palladium prices began 2014 at \$726 per troy ounce, increased to \$754 per troy ounce in mid-January and then dipped to \$707 per troy ounce in early February before increasing steadily to \$905 per troy ounce in August, the highest price for the year and the highest price since 2001. Prices then steadily decreased, reaching \$761 per troy ounce on October 6, after which the prices were erratic, but with an overall upward trend, ending the year at \$809 per troy ounce.

**Platinum.**—In 2014, the average annual platinum price was \$1,387.89 per troy ounce, which was 7% less than that of 2013, continuing a downward trend that began in 2012, despite supply disruption caused by the 5-month-long workers' strike at platinum mines in South Africa. Platinum began the year at \$1,388 per troy ounce, fluctuated within a relatively narrow range, and then rose to the year's high of \$1,517 per troy ounce on July 10. Prices then decreased nearly continuously, ending the year at \$1,210 per troy ounce. Platinum prices generally tracked along with gold prices in response to global economic conditions.

**Rhodium.**—The average annual rhodium price in 2013 was \$1,174.23 per troy ounce, which was 10% more than that of 2012, ending a decline that started in 2011. The rhodium price began the year at \$1,000 per troy ounce, was somewhat erratic until late July, and then spiked to \$1,475 per troy ounce in August, reportedly in response to increased industrial purchases. In August, for the first time since 2011, the rhodium prices were higher than those for platinum for several days before dropping below those for platinum. The rhodium price then decreased along with platinum and palladium prices, ending the year at \$1,250 per troy ounce.

**Ruthenium.**—The average annual ruthenium price in 2014 was \$65.13 per troy ounce, which was 14% less than that of 2013, continuing a downward trend that began in 2010. The ruthenium price began the year at \$57 per troy ounce, increased to \$72 per troy ounce in April, where it remained until July, and then decreased, ending the year at \$58 per troy ounce (CPM Group, 2015, p. 198).

## Foreign Trade

In 2014, the U.S. net import reliance as a percentage of apparent consumption, calculated excluding trade data for waste and scrap, was estimated to be 85% for refined palladium and 89% for refined platinum. Imports of refined palladium in 2014 totaled 92,400 kg, an 11% increase from those of 2013, with

four countries accounting for 75% of refined palladium imports in 2013—Italy (22%), South Africa (20%), Russia (19%), and Switzerland (14%). Imports of platinum, including waste, scrap, and coins, increased by 22% in 2014 to 141,000 kg, from 116,000 kg in 2013. Excluding waste and scrap, the leading sources of platinum imports in 2014 were South Africa (35%), the United Kingdom (18%), and Germany (11%). Imports of rhodium were the same as those in 2013 at 11,100 kg; imports of iridium increased by 16% and those of osmium more than tripled to 320 kg. In contrast, imports of ruthenium decreased by 27%. Two countries accounted for 83% of the imports of iridium, osmium, rhodium, and ruthenium in 2014—South Africa (58%) and the United Kingdom (25%) (tables 2, 3).

About 22,500 kg of palladium was exported in 2014, 13% less than that of 2013. Exports of platinum, excluding waste and scrap, increased by 32%, whereas exports of waste and scrap were 30% less than those of 2013. Exports of rhodium decreased by 65% compared with exports in 2013, and combined exports of iridium, osmium, and ruthenium decreased by 32% during the same time period (table 4).

## World Review

In 2014, world mine production of PGMs decreased by 14% to 393,000 kg from 455,000 kg in 2013 (table 5). South Africa accounted for 48% of total PGM mine production in 2014; Russia, 30%; Canada, 7%; Zimbabwe, 7%; the United States, 4%; and other countries, 3%. In 2014, world platinum mine production decreased by 21%. In South Africa, which accounted for 64% of world platinum production, production totaled 94,000 kg of platinum, a 28% decrease from that in 2013, accounting for most of the decrease in global production. Global mine production of palladium in 2014 decreased by 5% to 193,000 kg, with Russia and South Africa accounting for 43% and 30%, respectively, of production; Canada and the United States accounting for 10% and 6%, respectively; and Zimbabwe accounting for 5%. World mine production of other PGMs (iridium, osmium, rhodium, and ruthenium) decreased by 21% in 2014 compared with that of 2013. South Africa, which accounted for 71% of global production, accounted for most of the decrease of other PGMs. Estimated production in Russia, the second leading producer, remained unchanged.

**Canada.**—North American Palladium Ltd. produced 5,420 kg of palladium and 407 kg of platinum from its Lac des Isles Mine in Ontario, increases of 29% and 28%, respectively, compared with production in 2013. The increases were attributed to increased mining and processing rates from the newly developed Offset Zone, and to the processing of low-grade stockpiled material (North American Palladium Ltd., 2015, p. 5–6).

SMC planned to scale back spending on its Marathon PGM project in Ontario, owing to an unacceptable economic rate of return under current PGM prices. Progress on the project (75% owned by SMC and 25% by Mitsubishi Corp.) was halted pending project redirection (Stillwater Mining Co., 2014).

Vale produced 13,800 kg of palladium and 5,660 kg of platinum as byproducts of its nickel operations at Sudbury, Ontario, increases of 26% and 25% for palladium and platinum, respectively, from production in 2013. Glencore plc (formerly Glenore Xstrata plc) (Switzerland) produced PGMs

as byproducts from nickel mining operations at Sudbury and the Raglan Mine in Quebec. In 2014, it produced 2,200 kg of palladium and 1,350 kg of platinum, increases of 4% each compared with 2013 production (CPM Group, 2015, p. 20, 111).

**Russia.**—Norilsk Nickel produced 82,700 kg of palladium and 19,400 kg of platinum in 2014, 3% more for palladium and a slightly less for platinum compared with 2013 production. (OJSC MMC Norilsk Nickel, 2015, p. 52).

**South Africa.**—In 2014, the South African platinum mining industry was subject to the longest workers' strike in South Africa's mining history. About 70,000 workers at the three leading PGM mining companies, Anglo American Platinum Ltd. (Amplats), Impala Platinum Holdings Ltd., and Lonmin plc were on strike from January until June to demand higher wages. According to the mining companies, lost production totaled 33,600 kg of platinum and lost revenue totaled \$2.3 billion. Rampup to full production levels took several months following the end of the strike, adding to the production and revenue losses (Blamey, 2014).

The world's leading PGM producer, Amplats, reported primary equivalent refined platinum production of 54,300 kg in 2014, an 18% decrease compared with that in 2013. Production of equivalent refined platinum from the Tumela Mine was 4,650 kg, 31% less than in 2013; production from the Thembelani Mine was 3,550 kg, 52% less than in 2013; production from the Bathopele Mine was 2,960 kg, 14% less than that of 2013; and production from the Union Mine was 3,330 kg, 37% less than in 2013. In contrast, production at the Mogalakwena open pit mine was not affected by the strike, and increased by 4% to 11,100 kg. Equivalent refined platinum production of 3,730 kg from the Mototolo Mine, a joint venture with Glencore, was slightly less than 2013 production. The Kroondal Mine, operated under a pool-and-share agreement with Aquarius Platinum Ltd., produced 7,840 kg of platinum, 4% less than in 2013. At Modikwa, which was a joint venture of Amplats and African Rainbow Minerals Ltd. (ARM), platinum production decreased by 12% to 3,030 kg. At the Bafokeng-Rasimone Platinum Mine (BRPM), which was a joint venture of Amplats with Royal Bafokeng Platinum Ltd., refined platinum production increased by 5% to 5,800 kg. Amplats expected higher platinum production in 2015, but did not expect to return to production levels of 2013. In response to lower metal prices, Amplats planned to reduce operating costs by divesting some of its higher cost operations, such as the Union Mine and its mines in the Rustenburg area (Anglo American Platinum Ltd., 2015, p. 19, 58–75).

Production at Impala Platinum Holdings Ltd.'s South African mining operations during their reporting year of July 1, 2013, through June 30, 2014, was 11,800 kg of palladium, 20,700 kg of platinum, and 3,000 kg of rhodium, which were decreases of 30%, 27%, and 33%, respectively, compared with 2013 production (Impala Platinum Holdings Ltd., 2015, p. 10).

Lonmin plc produced 11,700 kg of platinum in 2014, a 51% decrease from that in 2013, owing to the workers' strike. Northam Platinum Ltd. produced 3,100 kg of palladium and 5,510 kg of platinum, which were slight and 14% decreases, respectively, compared with 2013. Aquarius Platinum Ltd. produced 1,960 kg of palladium and 6,600 kg of platinum,

which were 9% and 3% less, respectively, than in 2013 (CPM Group, 2015, p. 17, 111).

The planned sale by Aquarius Platinum Ltd. of its shares in platinum holdings in South Africa to a Chinese consortium for \$37 million failed to secure South Africa's regulatory approval and was terminated. The sale would have included the Blue Ridge Mine, idled since 2011, and the Sheba project and would have marked one of only a few ventures by China into the South African platinum mining industry (Thomson Reuters, 2014).

**Zimbabwe.**—In 2014, palladium and platinum production increased by 5% each compared with 2013 production. Amplats' Unki Mine produced 1,900 kg of platinum, 10% less than that in 2013. Production at the Mimososa Mine, a joint venture between Aquarius and Impala, was 2,700 kg of palladium and 3,400 kg of platinum, increases of 9% and 10%, respectively, compared with those of 2013 (Impala Platinum Holdings Ltd., 2015, p. 11). At Zimplats Holdings Ltd.'s (a subsidiary of Impala) Ngezi project, a major underground collapse in July resulted in the suspension of mining at the Bimha Mine. Redevelopment of the mine continued past yearend (CPM Group, 2015, p. 20).

## Outlook

Palladium, platinum, and rhodium are used primarily in catalytic converters in automobiles to decrease harmful emissions; therefore, the performance of the automobile industry will have the greatest impact on future consumption of these PGMs. Global automobile production is expected to increase, particularly in emerging markets, such as China and India, as well as in developed markets in the United States and Europe; therefore, an overall increase in demand for PGMs in catalytic converters is expected. The automobile markets in China and the United States are predominantly gasoline-powered vehicles; therefore, the increase in automobile demand in those markets will likely affect palladium demand in particular. Automobile emissions standards are tightening in China, Europe, and other parts of the world, which will likely lead to increased loadings of PGMs in catalytic converters and increased demand for PGMs. In the electronics industry, palladium demand is expected to increase owing to increased demand for electronic items, such as tablets and other mobile devices, as well as a continued demand for laptop and desktop computers. The demand for platinum in the jewelry industry is expected to increase, especially in China, owing to lower prices. Growth in the use of fuel cells for stationary power generation or in vehicles would affect platinum consumption because platinum is used in fuel cells. Owing to lower prices, rhodium consumption is expected to increase as a result of higher vehicle production in many areas of the world as well as increased consumption by the glass manufacturing industry. Ruthenium demand in the electronics industry is expected to be unchanged, because decreased production of personal computers is expected to be offset by increased applications in data centers. Ruthenium is used largely in computer hard drives. Iridium demand is likely to increase in the electronics industry, in which iridium crucibles are used in the manufacture of light-emitting diode lights.

Production from South Africa is expected to increase in 2015 relative to that of 2014 owing to resumption of mining following the workers' strikes of 2014. However, platinum

production levels remain vulnerable to problems in the South African mining industry, including work stoppages caused by labor disputes and safety issues, and to ongoing restructuring of the platinum mining industry, including closure of unprofitable mines. Supply from Zimbabwe is expected to increase owing to ongoing mine expansions but is subject to political stability. Palladium supply is expected to decrease slightly owing to lower production in Russia. Recycling of platinum and palladium is expected to increase, particularly from automotive catalysts, although the quantity of material available for recycling is very price sensitive, with higher metal prices leading to a greater amount of recycling, and lower metals prices leading to reduced recycling.

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TABLE 1  
SALIENT PLATINUM-GROUP METALS STATISTICS<sup>1</sup>

		2010	2011	2012	2013	2014
United States:						
Mine production:						
Palladium, Pd content: <sup>2</sup>						
Quantity	kilograms	11,600	12,400	12,300	12,600	12,400
Value	thousands	\$199,000	\$295,000	\$257,000	\$295,000	\$324,000
Platinum, Pt content: <sup>2</sup>						
Quantity	kilograms	3,450	3,700	3,670	3,720	3,660
Value	thousands	\$179,000	\$205,000	\$184,000	\$178,000	\$163,000
Refinery production:						
Palladium, Pd content:						
Quantity	kilograms	6,820	17,500	21,000	23,900	23,700
Value	thousands	\$116,000	\$414,000	\$438,000	\$499,000	\$495,000
Platinum, Pt content:						
Quantity	kilograms	5,410	15,500	16,600	19,100	18,900
Value	thousands	\$281,000	\$859,000	\$831,000	\$956,000	\$946,000
Imports for consumption, refined:						
Iridium, Ir content	kilograms	3,530	2,790	1,230	1,720	1,990
Osmium, Os content	do.	76	48	130	77	322
Palladium, Pd content	do.	70,700	98,900	80,100	83,100	92,400
Platinum, includes waste, scrap, and coins, Pt content	do.	152,000	129,000	172,000	116,000	141,000
Rhodium, Rh content	do.	12,800	13,100	12,800	11,100	11,100
Ruthenium, Ru content	do.	14,100	13,300	10,200	15,300	11,100
Exports, refined:						
Iridium, osmium, and ruthenium, gross weight	do.	3,720	1,150	1,640	1,320	901
Palladium, Pd content	do.	38,100	32,000	32,200	25,900	22,500
Platinum, Pt content	do.	16,900	11,300	8,630	11,200	14,800
Rhodium, Rh content	do.	2,320	1,370	1,040	1,220	428
Stocks, National Defense Stockpile, December 31:						
Iridium, Ir content	do.	18	18	18	18	18
Platinum, Pt content	do.	261	261	261	261	261
Price, average:						
Iridium <sup>3</sup>	dollars per troy ounce	642.15	1,035.87	1,066.23	826.45	556.19
Palladium <sup>3</sup>	do.	530.61	738.51	649.27	729.58	809.89
Platinum <sup>3</sup>	do.	1,615.56	1,724.51	1,555.39	1,489.57	1,387.89
Rhodium <sup>3</sup>	do.	2,459.07	2,024.35	1,274.98	1,069.10	1,174.23
Ruthenium <sup>3</sup>	do.	198.45	165.85	112.26	75.63	65.13
Employment		1,350	1,570	1,660	1,770	1,620
World, mine production, PGM content	kilograms	473,000 <sup>r</sup>	491,000 <sup>r</sup>	423,000	455,000 <sup>r</sup>	393,000

<sup>r</sup>Revised. do. Ditto.

<sup>1</sup>Data are rounded to three significant digits, except prices.

<sup>2</sup>Source: Stillwater Mining Co., 2015a, 2014 annual report: Billings, MT, Stillwater Mining Co., p. 51.

<sup>3</sup>Price data are annual averages of daily Engelhard unfabricated quotations published in Platts Metals Daily.

TABLE 2  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM, BY COUNTRY<sup>1</sup>

Country	Grain and nuggets			Sponge			Other unwrought			Other			Waste and scrap			Coins	
	Quantity, Pt content (kilograms)	Value (thousands)		Quantity, Pt content (kilograms)	Value (thousands)		Quantity, Pt content (kilograms)	Value (thousands)		Quantity, Pt content (kilograms)	Value (thousands)		Quantity, Pt content (kilograms)	Value (thousands)		Quantity, Pt content (kilograms)	Value (thousands)
2013	913	\$42,700	\$1,290,000	27,000	\$1,290,000	\$172,000	5,790	\$259,000	4,290	\$172,000	\$937,000	77,200	572	\$29,900			
2014:																	
Australia	--	--	--	--	--	23,500	--	--	498	23,500	41,900	1,100	26	365			
Belgium	--	--	54,200	--	--	43	--	--	1	43	3,840	127	--	--			
Brazil	--	--	--	--	--	18	--	--	(2)	18	22,900	2,360	--	--			
Canada	33	1,290	--	17	859	111,100	252	111,100	252	111,100	103,000	19,200	57	2,540			
Chile	--	--	--	--	--	--	--	--	--	--	16,300	420	--	--			
China	--	--	--	342	16,600	195	4	195	4	195	32,300	35,000	1	12			
Colombia	--	--	--	1,500	54,400	--	--	--	--	--	1,830	86	--	--			
Czech Republic	--	--	--	--	--	3,730	85	3,730	85	3,730	207	4	--	--			
France	--	--	372	24	1,250	3,320	83	3,320	83	3,320	15,500	361	--	--			
Germany	20	368	87,700	1,160	55,500	69,500	1,900	69,500	1,900	69,500	245,000	7,360	22	1,330			
India	2	101	--	(2)	3	5	(2)	5	(2)	5	4,130	90	--	--			
Indonesia	--	--	--	--	--	--	--	--	--	--	1,170	26	--	--			
Ireland	--	--	--	(2)	8	243	12	243	12	243	6,580	149	--	--			
Israel	--	--	--	--	--	15	(2)	15	(2)	15	2,530	70	--	--			
Italy	--	--	148,000	--	--	62	1	62	1	62	103,000	8,630	1	48			
Japan	--	--	10,700	14	683	5,570	165	5,570	165	5,570	144,000	5,300	--	--			
Korea, Republic of	--	--	87,100	--	--	78	--	78	4	78	15,200	422	--	--			
Malaysia	--	--	--	--	--	--	--	--	--	--	3,270	180	--	--			
Mexico	1	36	--	34	1,480	149	4	149	4	149	34,400	1,890	--	--			
Morocco	--	--	--	--	--	--	--	--	--	--	5,930	157	--	--			
Netherlands	--	--	--	--	--	--	--	--	--	--	9,360	636	--	--			
Norway	--	--	53,000	--	--	--	--	--	--	--	441	8	--	--			
Oman	--	--	--	--	--	--	--	--	--	--	2,950	64	--	--			
Philippines	--	--	--	--	--	--	--	--	--	--	1,140	132	--	--			
Poland	--	--	--	--	--	--	--	--	--	--	3,390	78	--	--			
Russia	339	14,600	25,300	765	25,300	20,200	523	20,200	523	20,200	--	--	(2)	5			
Saudi Arabia	--	--	--	--	--	--	--	--	--	--	37,400	957	--	--			
Singapore	255	13,400	6	1,380	78,700	788	16	788	16	788	109,000	2,810	--	--			
South Africa	--	--	621,000	1,110	46,300	8,250	208	8,250	208	8,250	5,560	120	--	--			
Switzerland	15	427	78,800	39	1,620	10,300	258	10,300	258	10,300	6	(2)	100	4,640			
Taiwan	--	--	--	--	--	624	26	624	26	624	23,100	723	--	--			
Thailand	--	--	--	--	--	--	--	--	--	--	27,200	561	--	--			
Turkey	--	--	--	--	--	--	--	--	--	--	5,170	122	--	--			
United Kingdom	21	888	335,000	598	24,500	7,820	227	7,820	227	7,820	49,100	5,250	(2)	7			
Venezuela	--	--	--	--	--	21	1	21	1	21	2,060	63	--	--			
Other	--	--	--	7	332	490	12	490	12	490	11,900	1,060	1	37			

See footnotes at end of table.

TABLE 2—Continued  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM, BY COUNTRY<sup>1</sup>

Country	Grain and nuggets		Sponge		Other unwrought		Other		Waste and scrap		Coins	
	Quantity, Pt content (kilograms)	Value (thousands)										
Total	685	31,100	34,400	1,500,000	6,230	282,000	4,290	166,000	95,600	1,090,000	208	8,990

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 3  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM-GROUP METALS, BY COUNTRY<sup>1</sup>

Country	Unwrought palladium		Palladium, other		Iridium <sup>2</sup>		Osmium <sup>2</sup>		Ruthenium <sup>2</sup>		Rhodium <sup>2</sup>	
	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Ir content (kilograms)	Value (thousands)	Quantity, Os content (kilograms)	Value (thousands)	Quantity, Ru content (kilograms)	Value (thousands)	Quantity, Rh content (kilograms)	Value (thousands)
2013	68,500	\$1,570,000	14,700	\$349,000	1,720	\$43,200	77	\$444	15,300	\$36,200	11,100	\$367,000
2014:												
Austria	--	--	176	4,850	--	--	--	--	--	--	--	--
Belarus	17	424	--	--	--	--	--	--	--	--	--	--
Belgium	853	21,100	206	5,340	--	--	--	--	--	--	440	15,000
Brazil	69	1,930	--	--	--	--	--	--	--	--	30	815
Canada	1,170	9,870	2,740	83,800	--	--	--	--	--	--	--	--
China	--	--	--	--	--	--	--	--	--	--	46	1,900
France	--	--	8	298	--	--	--	--	--	--	--	--
Germany	3,240	87,400	548	14,100	257	5,460	--	--	429	1,930	879	34,400
Hong Kong	44	1,190	--	--	--	--	--	--	--	--	--	--
Italy	19,100	509,000	831	22,000	8	111	--	--	--	--	192	7,700
Japan	1,490	15,800	99	1,670	42	765	--	--	--	--	(3)	17
Korea, Republic of	3,380	84,100	55	1,430	--	--	--	--	--	--	474	17,800
Mexico	15	499	1	16	--	--	--	--	6	37	--	--
Norway	2,210	56,900	202	5,060	--	--	--	--	--	--	75	2,680
Russia	12,800	326,000	4,720	121,000	44	802	--	--	41	126	1,080	37,900
South Africa	18,400	470,000	295	7,510	1,000	16,200	322	1,670	6,790	13,700	6,050	219,000
Switzerland	12,900	340,000	412	10,500	--	--	--	--	--	--	50	1,610
United Kingdom	3,690	95,600	2,780	71,500	634	10,500	--	--	3,830	8,680	1,780	69,200
Other	(3)	17	10	76	1	21	--	--	34	79	1	51
Total	79,300	2,020,000	13,100	350,000	1,990	33,900	322	1,670	11,100	24,600	11,100	408,000

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Unwrought and other forms.

<sup>3</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 4  
U.S. EXPORTS OF PLATINUM-GROUP METALS, BY COUNTRY<sup>1</sup>

Country	Palladium		Platinum		Platinum, waste and scrap		Iridium, osmium, ruthenium		Rhodium	
	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, gross weight (kilograms)	Value (thousands)	Quantity, Rh content (kilograms)	Value (thousands)
2013	25,900	\$452,000	11,200	\$487,000	364,000	\$1,070,000	1,320	\$21,200	1,220	\$46,100
2014:										
Australia	104	2,200	168	6,780	--	--	16	194	(2)	6
Austria	18	223	(2)	6	4	111	--	--	(2)	16
Belarus	69	603	--	--	--	--	--	--	--	--
Belgium	12	237	1	32	7,580	2,900	2	23	--	--
Brazil	543	13,100	66	2,460	--	--	(2)	7	(2)	4
Canada	2,870	60,900	147	6,570	108	729	1	12	1	97
Chile	--	--	250	10,300	--	--	--	--	--	--
China	2,030	47,700	854	38,600	16	662	(2)	8	129	4,760
Colombia	54	908	1	34	--	--	--	--	(2)	3
Costa Rica	47	735	4	83	--	--	(2)	5	--	--
Croatia	--	--	13	599	--	--	--	--	--	--
Czech Republic	18	178	3	52	--	--	--	--	--	--
Denmark	33	626	(2)	18	--	--	--	--	--	--
Dominican Republic	6	22	5	284	--	--	--	--	--	--
Finland	5	105	(2)	19	--	--	--	--	--	--
France	499	4,990	144	4,830	2	47	18	289	--	--
Germany	3,160	64,800	1,290	60,000	29,000	97,600	191	4,310	13	512
Hong Kong	575	9,860	89	3,440	--	--	109	1,980	60	2,750
India	691	18,400	20	647	314	14,400	94	906	38	1,530
Ireland	142	1,350	233	8,990	--	--	--	--	--	--
Israel	1,580	9,020	9	232	--	--	7	29	--	--
Italy	781	22,400	2,290	102,000	84	2,650	--	--	40	1,400
Japan	1,050	22,700	1,510	67,500	188,000	201,000	73	1,290	23	811
Korea, Republic of	1,640	39,900	1,440	64,400	--	--	273	2,080	--	--
Laos	2	80	26	1,200	--	--	--	--	--	--
Lebanon	--	--	3	115	--	--	--	--	--	--
Luxembourg	32	775	54	1,630	--	--	--	--	--	--
Malaysia	7	70	(2)	11	--	--	1	27	--	--
Mexico	235	2,870	369	9,640	17	503	5	130	2	252
Netherlands	31	225	(2)	71	18	9	21	304	(2)	10
New Zealand	41	890	(2)	69	--	--	2	18	--	--
Norway	22	496	(2)	14	--	--	--	--	--	--
Peru	12	223	(2)	3	(2)	4	--	--	--	--
Philippines	2	34	(2)	72	--	--	1	7	--	--
Poland	5	23	(2)	6	--	--	(2)	11	--	--
Saudi Arabia	29	282	1	21	--	--	--	--	--	--
Singapore	45	1,190	3,870	126,000	43	75	29	615	121	4,790
Spain	31	333	(2)	4	--	--	--	--	--	--

See footnotes at end of table.

TABLE 4—Continued  
U.S. EXPORTS OF PLATINUM-GROUP METALS, BY COUNTRY<sup>1</sup>

Country	Palladium			Platinum			Platinum, waste and scrap			Iridium, osmium, ruthenium			Rhodium	
	Quantity, Pd content (kilograms)	Value (thousands)	Pt content (kilograms)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, gross weight (kilograms)	Value (thousands)	Quantity, Rh content (kilograms)	Value (thousands)	
Sweden	20	194	2	2	61	--	--	--	--	--	--	--	--	
Switzerland	146	2,490	828	828	32,300	6,480	111,000	--	--	--	--	--	--	
Taiwan	1,290	17,200	42	42	1,450	--	--	18	212	--	(2)	6	6	
Thailand	104	2,610	34	34	1,490	(2)	8	--	--	--	1	32	32	
Turkey	2	10	14	14	604	--	--	--	--	--	1	17	17	
United Arab Emirates	13	104	8	8	360	4	184	--	--	--	(2)	7	7	
United Kingdom	4,460	108,000	976	976	42,900	22,200	627,000	28	631	--	--	--	--	
Vietnam	3	17	14	14	664	--	--	--	--	--	--	--	--	
Other	29	423	1	1	133	--	--	11	89	--	(2)	9	9	
Total	22,500	460,000	14,800	14,800	596,000	2,540,000	1,060,000	901	13,200	428	17,000	17,000	17,000	

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 5  
PLATINUM-GROUP METALS: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Kilograms)

Country <sup>3</sup>	2010	2011	2012	2013	2014
<b>Palladium:</b>					
Australia <sup>e,4</sup>	650	350	300	320	320
Botswana	3,328	2,115	2,613	1,337	560 <sup>e</sup>
Canada <sup>c</sup>	11,000	17,400	17,300	16,500	20,000
Finland	1,493	1,058	1,100 <sup>e</sup>	1,100 <sup>e</sup>	902
Japan <sup>5</sup>	6,107	7,534	8,052	6,239	6,969
Poland <sup>e,6</sup>	15	15	15	15	15
Russia <sup>e</sup>	84,700 <sup>7</sup>	84,100 <sup>7</sup>	82,000	80,000	83,000
Serbia	22	4	22	20 <sup>e</sup>	20 <sup>e</sup>
South Africa	82,222	82,731	74,738	75,000 <sup>e</sup>	58,410
United States <sup>8</sup>	11,600	12,400	12,300	12,600	12,400
Zimbabwe <sup>e</sup>	7,000	8,241 <sup>7</sup>	7,800	9,600	10,100
<b>Total</b>	<b>208,000</b>	<b>216,000</b>	<b>206,000</b>	<b>203,000</b>	<b>193,000</b>
<b>Platinum:</b>					
Australia <sup>e,4</sup>	130	95	90	90	90
Botswana	560	373	435	218	93
Canada <sup>c</sup>	3,500	8,000	7,500	7,000	8,500
Colombia	997	1,231	1,460	1,836 <sup>r</sup>	1,135
Ethiopia <sup>9</sup>	8	--	--	--	--
Finland	718 <sup>r</sup>	836 <sup>r</sup>	429 <sup>r</sup>	946 <sup>r</sup>	1,060
Japan <sup>5</sup>	1,331	1,765	1,735	1,963	1,724
Poland <sup>e,6</sup>	25	25	25	25	25
Russia <sup>e</sup>	25,700	27,300	26,500	25,500	23,000
Serbia	--	6	3	3	3
South Africa	147,790	148,008	128,590	131,000 <sup>e</sup>	93,991
United States <sup>8</sup>	3,450	3,700	3,670	3,720	3,660
Zimbabwe <sup>e</sup>	8,800	10,826 <sup>7</sup>	10,500	12,400	13,000
<b>Total</b>	<b>193,000</b>	<b>202,000</b>	<b>181,000</b>	<b>185,000<sup>r</sup></b>	<b>146,000</b>
<b>Other platinum-group metals:<sup>c</sup></b>					
Canada	400	800	750	1,000	900
Russia	12,000	12,000	12,000	12,000	12,000
South Africa	57,292 <sup>7</sup>	58,111 <sup>7</sup>	21,010 <sup>7</sup>	52,000	38,000
Zimbabwe	1,820	1,820	2,200	2,700	2,700
<b>Total</b>	<b>71,500</b>	<b>72,700</b>	<b>36,000</b>	<b>67,700</b>	<b>53,600</b>
<b>Grand total</b>	<b>473,000<sup>r</sup></b>	<b>491,000<sup>r</sup></b>	<b>423,000</b>	<b>455,000<sup>r</sup></b>	<b>393,000</b>

<sup>e</sup>Estimated. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>World total, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes data available through March 23, 2016. Platinum-group metal (PGM) production by Germany, Norway, Switzerland, and the United Kingdom is not included because the production is derived wholly from imported metallurgical products and to include it would result in double counting.

<sup>3</sup>In addition to the countries listed, China, Indonesia, and the Philippines are thought to produce PGMs, and several other countries may also do so, but output is not reported quantitatively, and there is no reliable basis for the formulation of estimates of output levels. A part of this output not specifically reported by country is, however, presumably included in this table credited to Japan.

<sup>4</sup>PGM recovered from nickel ore that is processed domestically. PGM in exported nickel ore are extracted in the importing countries, such as Japan, and are thought to be included in the production figures for those countries.

<sup>5</sup>Production derived entirely from imported ores.

<sup>6</sup>Official Polish estimates based on reported platinum- and palladium-bearing final (residual) slimes and then average platinum and palladium content from electrolytic copper refining.

<sup>7</sup>Reported figure.

<sup>8</sup>Byproduct platinum and palladium produced from gold-copper ores was not included.

<sup>9</sup>Data for the Ethiopian calendar year ending July 7 of that stated. Yubdo Mine only. Platinum was also reportedly contained in gold ingots from the Lega Dembi Mine, but information is inadequate to estimate output.