



# 2016/17 SOUTH AFRICA YEARBOOK

## MINERAL RESOURCES

South Africa is a leading producer and supplier of a range of minerals, with over 1 700 mines and quarries across the country.

Mining contributes about 8% directly to South Africa's Gross Domestic Product (GDP) and just under 460 000 direct jobs, with an estimated US\$2,5 trillion to US\$3 trillion non-energy mineral resource base.

The Department of Mineral Resources (DMR) assumes the custodianship of all mineral resources in South Africa on behalf of its citizens.

To this end, the DMR promotes and regulates the minerals and mining sector for transformation, growth and development as well as ensures that all South Africans derive sustainable benefit from the country's mineral wealth.

Various specialised divisions of the DMR and associated institutions are responsible for the administration of the mining legislation and regulations and for promoting the development of the industry. The DMR's strategic goals are to:

- promote and facilitate an increase in mining activity and in value added to mineral resources extracted in South Africa
- implement transformation policies that redress past imbalances through broader participation in the mineral sector
- provide a framework for managing health and safety risks, enforce compliance and promote best practice in the mineral sector
- promote sustainable resource management, contribute to skills development and the creation of sustainable jobs in the mining sector
- contribute to a reduction in the adverse impacts of mining on the environment
- attract, develop and retain appropriate skills and ensure the optimal utilisation of resources
- implement risk-management strategies and promote corporate governance.

Mining is regulated by three branches: the Mineral Policy and Promotion Branch, the Mineral Regulation Branch and the Mine Health and Safety Inspectorate.

### Mineral Policy and Promotion Branch

The Mineral Policy and Promotion Branch was created in April 2005, resulting from the split of the Mineral Development Branch. The strategic plan behind this restructuring was based on the fact that the functions performed by the former Mineral Development Branch could broadly be divided into three main streams: regulation, promotion and policy formulation.

The branch is responsible for formulating mineral-related policies and helps promote the mining and minerals industry of South Africa to make it attractive to investors.

### Mineral Regulation Branch

The Mineral Regulation Branch consists of four chief directorates. Their functions are to:

- administer the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) and other applicable legislation to ensure the granting of prospecting and mining rights in terms of the Act

- promote mineral development including urban renewal, rural development and black economic empowerment
- address past legacies with regard to derelict and ownerless mines and enforce legislation regarding mine rehabilitation by means of regulated environmental management plans
- coordinate and liaise with national, provincial and local government structures for efficient governance.

### Mine Health and Safety Inspectorate

The Mine Health and Safety Inspectorate was established in terms of the Mine Health and Safety Act, 1996 (Act 29 of 1996), as amended, for the purpose of executing the statutory mandate of the DMR to safeguard the health and safety of mine employees and communities affected by mining operations.

The activities of the inspectorate are geared to achieve the following strategic objectives:

- active contribution to sustainable development and growth
- regulation of the minerals sector
- promotion of health and safety in the minerals sector
- efficient and effective service delivery
- management of the culture, systems and people
- ensuring financial stewardship.

The main functions of the Mine Health and Safety Inspectorate are as follows:

- providing policy inputs for the establishment and application of mine safety standards at mining operations and promoting the application thereof
- providing policy inputs towards the establishment and application of mine equipment safety standards at mining operations and promoting their application
- establishing and applying mine health standards at mining operations and promoting these applications
- ensuring an effective support and inspection service.

### Budget and funding

The department was allocated a budget of R1,669 billion for 2016/17. The bulk of this budget was transferred to its entities:

- Council for Geoscience (CGS): R378,6 million
- Council for Mineral Technology and Research (Mintek): R356,4 million
- Mine Health and Safety Council (MHSC): R6,2 million
- South African Diamond and Precious Metals Regulator (SADPMR): R53,2 million
- State Diamond Trader (SDT): R631,3 million.

### Role players

#### Mining Qualifications Authority (MQA)

Government's influence within the mineral industry is not only confined to orderly regulation and the promotion of equal opportunity for all its citizens and investors, but government also participates in mining operations through state-owned companies such as Alexkor, the African Exploration Mining and Finance Corporation (Pty) Ltd and the Industrial Development Corporation.

All stakeholders in the industry need to intensify skills-development efforts to ensure that the mining industry operates in a sustainable and competitive environment.

The future of mining in the country largely depends on the successful implementation of skills development initiatives.

Particular focus is placed on artisans and artisan aid as well as other technical skills. Capacity-building within the department and associated institutions has also been prioritised in respect of identified critical areas of skills shortage; necessary interventions have been introduced, which include learnership programmes and bursary schemes.

The MQA was established as a sector education and training authority. It facilitates the development of appropriate knowledge and skills in the mining, minerals and jewellery sectors to:

- enable the development and transformation of the sector
- contribute to the health, safety and competitiveness of the sector
- improve access to quality education and training for all
- redress past inequalities in education and training.

The MQA is responsible for:

- developing and implementing a sector skills plan
- developing unit standards and qualifications for the sector
- establishing, registering, administering and promoting learnerships and apprenticeships
- maintaining the quality of standards, qualifications and learning
- disbursing grants from the skills-development levy.

### Chamber of Mines

Corporate restructuring of the South African mining industry remains an ongoing exercise. The introduction of the Mining Charter in South Africa was aimed at transforming the mining industry to redress historical imbalances so that the industry is aligned with the changes in the country's overall transformation of its social, political and economic landscape

The transformation of the mining industry has included the consolidation of ownership through minority buy-outs, separation of large diversified companies into two or more specialised companies as well as the purchase of South African mining assets by foreign companies.

The Chamber of Mines of South Africa is a voluntary, private sector employers' organisation founded in 1889, three years after gold was discovered on the Witwatersrand.

It is an association of mining companies and mines operating in the gold, coal, diamond, platinum and other mineral commodity sectors. The organisation acts as the principal advocate of the major policy positions endorsed by mining employers. The organisation represents the formalised views of its membership to various organs and spheres of government, and to other relevant policy-making and opinion-forming entities, both within and outside the country.

### South African Mining Development Association (SAMDA)

SAMDA, which was formed in 2000 as a junior mining initiative by a group of people associated with various South African junior and Black Economic Empowerment mining companies, aims to create an enabling environment for raising finance, developing technical and other skills, practising responsible

environmental management and sustainable development as well as the maintenance of standards of good practice in the junior mining sector.

### Voluntary associations

- The Southern African Institute of Mining and Metallurgy was founded in 1894. This is a professional institute with local and international links aimed at helping members to source news and views about technological developments in the mining, metallurgical and related sectors as well as embracing a professional code of ethics.
- The South African Colliery Managers Association represents eight mining houses and some smaller operators with 43 mine operations in four provinces. Current SACMA membership totals 434 coal mining. The association's operations have an annual turnover of over R35 billion with a labour bill contribution of over R6 billion to the South African workforce comprising 47 000 direct employees.
- The Association of Mine Managers South Africa provides a platform for mining industry professionals to discuss, evaluate and debate mining and minerals policy, technical innovations, safety and health challenges and advancements in mining in South Africa. Current membership stands at 825 in seven categories – candidate (student), junior associate, ordinary, associate, honorary life, honorary associate and retired members.
- Geological Society of South Africa was established in 1895 and is one of the oldest scientific societies in South Africa. It is a society that exists for geologists and earth scientists with an interest in southern Africa and has over 2 500 members and student members.
- The Engineering Council of South Africa is a statutory body established in terms of the Engineering Profession Act, 2000 (Act 46 of 2000). Its primary role is the regulation of the engineering profession in terms of this Act. Its core functions are the accreditation of engineering programmes, registration of persons as professionals in specified categories, and the regulation of the practice of registered persons.
- The South African Council for Natural Scientific Professions is a legislated regulatory body for natural science practitioners in South Africa. The natural sciences encompass a wide range of scientific fields covering basic sciences and many of their applied derivatives.

### South African Diamond and Precious Metals Regulator

The SADPMR regulates the diamond, platinum and gold industries and accelerates beneficiation in the jewellery industry. The SADPMR's objectives are to:

- ensure that precious metal and diamond resources are exploited and developed in the best interests of all South Africans
- promote equitable access to and local beneficiation of precious metals and diamonds
- promote the development of precious metal and diamond enterprises

- advance broad-based socio-economic empowerment
- ensure compliance with the Kimberley Process Certification Scheme (KPCS).

Its functions regarding diamonds include:

- implementing, administering and controlling all matters relating to the purchase, sale, beneficiation, import and export of diamonds
  - establishing diamond exchange and export centres to facilitate the buying, selling, export and import of diamonds.
- While the South African Diamond Board essentially has a regulatory role, the SADPMR has a promotional role as well.

By administering licences and export approvals, the SADPMR ensures that local demand for diamonds and precious metals is catered for, and that there is growth in local beneficiation of diamonds and precious metals.

### Council for Mineral Technology and Research

Mintek helps the minerals industry to operate more effectively by developing and making available the most appropriate and cost-effective mineral recovery and mineral beneficiation technologies.

It is engaged in the full spectrum of minerals research: from the mineralogical examination of ores to the development of processing, extraction and refining technologies, as well as conducting research into the production of added value products and feasibility and economic studies. Much of this work is carried out in close liaison with the local and international minerals and metallurgical industries.

Mintek is involved in research into the use of nanotechnology for medical applications of gold as well as giving effect to the Hydrogen Strategy.

This is intended to create future demand for gold and platinum in keeping with the national objective of achieving 20% global market share of platinum catalysis by 2020.

### Mine Health and Safety Council

The MHSC is a national public entity established in terms of the Mine Health and Safety Act of 1996, as amended.

The entity comprises a tripartite board represented by the State, employer, and labour members under chairpersonship of the Chief Inspector of Mines.

The MHSC is funded by public revenue and is accountable to Parliament. Its main task is to advise the Minister of Mineral Resources on occupational health and safety legislation and research outcomes focused on improving and promoting occupational health and safety in South African mines.

In addition, the council is tasked with:

- overseeing the activities of its committees
- promoting a culture of health and safety in the mining industry
- arranging a summit every two years to review the state of occupational health and safety at mines
- liaising with the MQA and any other statutory bodies about mining health and safety.

With effect from 1 April 2016, the MHSC started doing business only with suppliers who are registered on the Central Supplier Database with National Treasury.

### Council for Geoscience

The CGS undertakes geological mapping and carries out studies pertaining to the identification, nature, extent and genesis of ore deposits and also maintains national databases of the country's geoscientific data and information.

The CGS is also able to provide commercial geoscientific services.

The CGS participates in various Southern African Development Community (SADC) projects aimed at promoting the economic development of the southern African subcontinent.

International cooperative projects that have been carried out, or are in progress, include geological mapping, geochemical and geophysical surveys, and the production of maps in many countries, either on a bilateral basis or collaboratively in the SADC region.

### State Diamond Trader

The SDT's main business is to buy and sell rough diamonds to promote equitable access to and beneficiation of diamond resources. The main aim of the SDT is to address distortions in the diamond industry and correct historical market failures to develop and grow South Africa's diamond cutting and polishing industry.

The SDT is a state-owned entity established in terms of the Diamonds Amendment Act, 2005 (Act 29 of 2005). The company is classified as a Schedule 3b entity in terms of the Public Finance Management Act, 1999 (Act 1 of 1999).

The SDT sells to approved customers through the SDT's application and approval process. The entity is eligible by law and proclamation to purchase up to 10% of the running rights of all diamond-producing mines in South Africa.

### Petroleum Agency South Africa (PASA)

PASA promotes exploration for onshore and offshore oil and gas resources, as well as their optimal development on behalf of Government, as designated in terms of the Mineral and Petroleum Resources Development Act of 2002. The agency regulates exploration and production activities, and acts as the custodian of the national petroleum exploration and production database.

### African Mining Partnership (AMP)

The AMP, whose main function is to drive the New Partnership for Africa's Development mining initiatives, was established during the African Mining Minister's meeting in Cape Town in February 2004. South Africa, as a major role player in this body, has played an important role as the Secretariat, in hosting as well as coordinating the affairs of the AMP. The AMP merged with the African Union Conference of Ministers Responsible for Mineral Resources Development.

### African Diamond Producers Association (ADPA)

ADPA is an association of diamond-producing African countries, 11 of which have full membership while seven only enjoy observer status. The association is chaired on a rotational basis.

The main focus of the ADPA revolves around the implementation of aligned policies and strategies intended to maximise the benefits derived from revenue of diamonds across the African continent. In doing so, the ADPA explores the development of a best practice document that will promote the realisation of harmonised policies across Africa with a goal to increase foreign investment in the diamond sector for the benefit of all member states.

### The Kimberley Process

South Africa is one of the founding members of the Kimberley Process, which brought into existence the KPCS.

The Kimberley Process was established when diamond producing countries convened in Kimberley, South Africa, in May 2000, to discuss ways to stem the trade in "conflict diamonds" and ensure that the diamond trade was not fuelling armed conflicts.

In December 2000, the United Nations General Assembly adopted the landmark Resolution 55/56 of 2000, which supported the establishment of an international certification scheme for rough diamonds.

By November 2002, negotiations between governments, the international diamond industry and civil society organisations resulted in the creation of the KPCS, which was launched in Kimberley, South Africa, in 2003.

As one of the founding members of the KPCS, South Africa played a pivotal role in the establishment of the KPCS as well as the harmonisation of the regulatory framework relating to the sale and export of diamonds.

The KPCS has 54 participants representing 81 countries that counts for 99,8% of the global production of rough diamonds. Its core document (statutes) governs the global production of rough diamonds and stipulates the objectives, definitions, internal controls and, with which most importantly, minimum requirements that each participant must comply. Australia was the 2017 Chairperson of the KPCS.

### Projects and initiatives

With significant resources of gold, uranium, chrome, manganese, Platinum Group Metals (PGM), titanium minerals, vanadium, coal, limestone, vermiculite and zirconium, South African mining real estate remains attractive for development.

South Africa has significant known reserves and resources of mineral commodities, with almost 60 minerals being actively mined and prospects for exploitation of an additional two new minerals over the short to medium term. A large number of these known reserves was discovered using conventional exploration methodologies. For this reason, there is still considerable residual potential for discovery of world-class deposits using modern exploration technology.

This is further supported by existing mining infrastructure, which enables investors to leverage maximum value from their investment while simultaneously contributing to socio-political improvement.

### Shale-gas exploration

The potential of shale-gas exploration and exploitation provides an opportunity for South Africa to begin exploring the production of its own fuel and marks the beginning of the reindustrialisation of the economy.

The proposed regulations on petroleum exploration and exploitation prescribe good international petroleum industry practices and standards, which enhance safe exploration and production of all petroleum and will further ensure that petroleum exploration is conducted in a socially and environmentally balanced manner.

The technical regulations provide for the assessment of the potential impact of the proposed activities on the environment; the protection of freshwater resources and mechanisms for the co-existence of shale gas exploitation and the Square Kilometre Array project.

The South African Government would have a free-carried shareholding of 20% in entities producing shale gas in the Karoo in future.

The security of energy supply, in light of the demand, has galvanised the need for a diverse energy mix.

The DMR would therefore continue to promote, among others, exploration for shale gas. It would put in place the necessary legal framework to ensure that the exploration of resources is undertaken in a responsible manner, to ensure that the environment is protected for future generations.

Working with other government departments and institutions, the DMR will continue to promote mineral value addition, which would strengthen the interface between the industry and the socio-economic development of South Africa.

As part of improving the socio-economic development of mining towns, the department would continue to support the Special Presidential Package in distressed mining towns.

In 2016/17, five applications for mining shale gas were being considered for licensing. Research on shale gas is progressing, following the additional allocation of R108 million for the department's shale gas project in 2014/15.

### Stability in the mining sector

Although growth in the mining sector turned around from a decrease of 1,6% in 2014 to an increase of 3,0% in 2015, global demand for commodities remained weak during 2016, resulting in lower mining export volumes. Despite the weaker exchange rate and a recovery in commodity prices, the mining sector thus saw its share of South Africa's export basket decline marginally.

Stability within the mining industry remains imperative to ensure its sustainable growth and competitiveness. The importance of healthy relations between mining companies, communities and local government cannot be overstated. For mining to be sustainable, mutual respect and cooperation are critical. Right-holders must also engage continuously with the relevant communities, for the duration of their right, to pre-emptively address issues as they arise.

The DMR continues to engage various community structures, where discontent between mining companies and some host

communities – often characterised by violence and destruction to property – has become more pronounced.

While employment of people living close to the mines remains important, South Africa belongs to all who live in it, and opportunities from mining cannot only be limited to those residing nearer mining operations. Mineral resources must be used to benefit the country as a whole.

### Mine health and safety

The purpose of the Promotion of Mine Safety and Health programme is to ensure the safe mining of minerals under healthy working conditions.

In 2016/17, the DME promoted mine health and safety over the medium term by:

- conducting 8 396 inspections and audits, and implementing the occupational health and safety strategy to reduce occupational fatalities by 20% and occupational injuries by 20%
- reducing occupational diseases among mine workers by 10%
- implementing the occupational health and safety improvement strategy and enforcing its guidelines.

The Mineral Regulations and Mine Health and Safety programmes contribute 58,90% of the total budget for employees' compensation.

The higher contribution to compensation of employees is due to the labour-intensive nature of inspections and technical expertise required for the job.

### Skills development

The DMR aimed to contribute to skills development in the mining sector by reviewing and implementing the certificate of competency model, developed with the MQA and universities, as well as to improve healthcare turnaround times on an ongoing basis by:

- ensuring 80% adherence to prescribed timeframes for resolving medical appeals
- ensuring 90% adherence to timeframes for appeals to the Chief inspector of Mines
- ensuring 80% adherence to timeframes for applications in terms of the Mineral and Petroleum Resources Development Act of 2002.

### Illegal mining

Illegal mining is often organised and carried out by organised crime syndicates. Illegal miners, known as *zama zamas*, operate in disused mines and set ambushes and traps for employees, security and rival groups of illegal miners.

Illegal miners risk their lives by using explosives to open cemented shafts at abandoned mines or live underground for extended periods of time, without necessary protective gear, once they have gained access to operational mines. The illegal mining market is a well-managed five-tier system.

The Chamber of Mines has recognised that the only way to deal with the problem is to focus on both the supply and demand side of illegal mining and all five levels of the syndicates need to be addressed, namely:

Mineral sales increased by 17,4% year-on-year in May 2016. The largest positive contributors to the increase were:

- Gold: 44,1%
- PGMs: 20,1%
- Coal: 13,8%
- Manganese ore: 82,6%
- Iron ore: 14,5%

Seasonally adjusted mineral sales at the aforementioned prices increased by 20,6% in May 2016 compared with April 2016. This followed month-on-month changes of 1,2% in April 2016. Mining production had decreased by 2,5% year-on-year by June 2016.

- the underground workers who do the physical mining – many have worked in the mines previously and use chemical substances to refine the products
- the buyers are on the surface around the mines and also organise the level one illegal miners and support them with food, protection and equipment
- the regional bulk buyers are usually entities which in most cases have permits issued in terms of the Precious Metals Act, 2005 (Act 37 of 2005) to trade in precious metals
- those who distribute nationally and sometimes internationally do so through front companies or legitimate exporters
- the top international receivers and distributors are usually international refineries and intermediary companies.

### Integrated licensing

The construct of the Mining Regulatory Framework is fragmented and has been identified as one of the binding constraints to the growth and competitiveness of the South African mining sector. The departments of mineral resources, water affairs and environmental affairs have agreed on the modalities of integrating the timeframes and processes of environmental authorisation and water-use licensing for prospecting and mining operations.

The modalities include the departments implementing the National Environmental Management Act, 1998 (Act 107 of 1998), for the industry to be regulated by a single environmental piece of legislation.

Processes of environmental authorisation will be contained within the same time frames that apply to prospecting and mining authorisations, and the process of approving water use licences will also be finalised within the same time frames.

This represents a significant improvement in service delivery, both in terms of certainty regarding security of tenure when mining or prospecting rights are issued and in terms of improved turnaround times resulting from the processes being finalised in parallel rather than sequentially as was previously the case.

### Job creation and sustainable development

The South African Government is committed to ensuring a conducive environment for investment. The amendment of the principal legislation, the Mineral and Petroleum Resources Development Act of 2002, was expected to be finalised in 2017.

The Mining Charter was expected to be gazetted by mid-March 2017.

## Rehabilitation of mines

The mine rehabilitation programme has had a positive effect on communities where the projects include economic growth owing to sourcing labour and material locally. The programme also results in improved health and well-being of communities. The rehabilitation programme reduces the risk of humans and animals being exposed to asbestos fibres originating from sites where asbestos used to be mined.

Job creation is one of the key requirements of the rehabilitation project. This contributes to some of the priorities of the National Development Plan.

The DMR also develops reports on mine closures as well as derelict and ownerless mines. The strategy for managing and rehabilitating derelict and ownerless mines aims to guide the management of the environmental legacies of mining.

It proposes a prudent course of action for the state to discharge its responsibility regarding constitutional rights as contemplated in Section 24 of the Constitution.

The implementation of the strategy will continue with annual updates, completed by actuarial scientists commissioned by the department, estimating the State's liability for the rehabilitation of derelict or ownerless mines.

The DMR plans to rehabilitate 220 derelict, ownerless and dangerous mine sites by 2019.

## Acid mine drainage (AMD)

By August 2015, harmful effects of AMD on the environment were being successfully mitigated by a drainage plant in Germiston, Gauteng, which contains a comprehensive mixing system. The plant consists of a combination of 53 specialised mixers.

In May 2016, the Department of Water and Sanitation announced that National Treasury would commit R600 million, annually, to the AMD initiative.

This long-term intervention will therefore turn the AMD problem into a long-term sustainable solution by producing fully treated water that will significantly increase water supply to the Vaal River System and defer the need for further costly augmentation beyond Phase 2 of the Lesotho Highlands Water Project for at least 30 years.

## Resources

South Africa's mineral wealth is typically found in the following well-known geological formations and settings:

- the Witwatersrand Basin yields some 93% of South Africa's gold output and contains considerable uranium, silver, pyrite and osmiridium resources
- the Bushveld Complex is known for PGMs (with associated copper, nickel and cobalt mineralisation), chromium and vanadium-bearing titanium-iron ore formations as well as large deposits of industrial minerals, including fluor spar and andalusite

In June 2016, the DMR's Deputy Minister together with the Mining Qualification Authority (MQA), the National Skills Fund and the Namakwa District Municipality launched the Transforming the Youth Through Artisan Skills Youth Development Programme in Springbok, Northern Cape.

The programme aims to provide skills and training to unemployed youth over a three-year period. Some 500 artisan students were registered with the MQA on the same programme.

- the Transvaal Supergroup contains enormous resources of manganese and iron ore
- the Karoo Basin extends through Mpumalanga, KwaZulu-Natal, the Free State as well as Limpopo, hosting considerable bituminous coal and anthracite resources
- the Phalaborwa Igneous Complex hosts extensive deposits of copper, phosphate, titanium, vermiculite, feldspar and zirconium ores
- kimberlite pipes host diamonds that also occur in alluvial, fluvial and marine settings
- heavy mineral sands contain ilmenite, rutile and zircon
- significant deposits of lead-zinc ores associated with copper and silver are found in the Northern Cape near Aggeneys.

## Gold

South Africa dominated global gold production in the 20th century. There are 35 large-scale gold mines operating in South Africa, including the record setting TauTona mine, which extends 3,9 km underground. TauTona means "great lion" in Setswana. South Africa accounts for 11% of the world's gold reserves.

Gold production fell to 143 711 kg in 2015 compared to 151 622 kg mined the previous year. The seasonally adjusted production index decreased by 5,4% in 2015. Although the dollar price of gold decreased by 10,3% in 2015, the depreciation of the local currency saw the rand price of gold rising by 7,4% in 2015 (R474 090 per kg in 2015 compared with R441 246 per kg in 2014).

## Coal

The accelerated demand for coal, accompanied by an increase in international coal prices, has invariably changed the buying patterns and structure of the local coal export industry.

The emergence of the export market for lower-grade coal has presented government with a challenge in that it has constrained the availability of coal that was historically sold to Eskom.

During the winter of 2015, coal production declined by 4,1% compared to 2014's winter. There was a 2,9% fall in national electricity generation and a 2,3% fall in electricity consumed. For the entire 2015, seasonally adjusted coal production fell by 3,3%.

Some other factors affecting the coal sector include:

- rapidly increasing production costs over the past few years
- the impact of declining reserves
- challenges with securing capital for future and expansion projects
- the impact of previous above-inflation increases
- a weak global thermal coal market, meaning slower commodity demand

- declining yields, ageing mines, more difficult geology, poorer quality coal reserves and rising regulatory costs.

## Platinum group metals (PGMs)

Platinum, palladium, rhodium, osmium, ruthenium and iridium occur together in nature alongside nickel and copper. Platinum, palladium and rhodium, the most economically significant of the PGMs, are found in the largest quantities.

The remaining PGMs are produced as co-products. South Africa is the world's leading platinum and rhodium producer, and the second-largest palladium producer after Russia. South Africa's production is sourced entirely from the Bushveld Complex, the largest known PGM-resource in the world.

PGMs were the main contributor to the 3,5% rise in overall mining production. Of the four major minerals, the PGM group was the only one to record a production increase in 2015. The low base created in 2014 by the PGM miners' strike saw PGMs performing strongly year-on-year in the first half of 2015, with production rising by 46,2% for the year as a whole.

## Platinum

South Africa accounts for 96% of known global reserves of the PGMs.

The Merensky Reef, stretching from southern Zimbabwe through to the Rustenburg and Pretoria regions, is the centre of platinum mining in South Africa, playing host to companies such as Rustenburg Platinum Mines and Bafokeng Rasimone Platinum Mines.

Amplats is the industry leader in the mining, marketing, and distribution of platinum. Amplats produces 40% of the world's total PGMs.

Other key platinum mining companies in South Africa include BHP Billiton and Impala Platinum.

Platinum mining in South Africa is growing. The establishment of projects such as the R7,1 billion Twickenham Expansion Project, 100 km south-east of Polokwane, will see the production of 250 000 t/m pure platinum.

The Impala Platinum No. 20 Shaft Project is geared to produce 185 000 ounces of platinum a year on the Bushveld Complex.

Many platinum mines are implementing mechanisation with about 30% of the country's current underground platinum production coming from mechanised mining. Mechanisation is difficult for the gold-mining industry because orebodies are steeper than those of platinum mines.

## Palladium

South Africa is the world's second-largest palladium producer. All of South Africa's production is sourced from the Bushveld Igneous Complex, which hosts the world's largest resource of PGMs.

Palladium and platinum are more abundant than any other PGM.

## Ferrous minerals

South Africa is the largest producer of chromium and vanadium ores and a leading supplier of their alloys. It is also a significant

producer of iron and manganese ores, and a minor producer of ferrosilicon and silicon metal.

Ferrous minerals are produced from some 32 mines and 23 ferroalloys smelters.

### Copper

Palabora, a large copper mine, smelter and refinery complex managed by the Palabora Mining Company at the town of Phalaborwa in Limpopo, is South Africa's only producer of refined copper. Producing about 80 000 t per year, it supplies most of South Africa's copper needs and exports the balance.

Useful byproduct metals and minerals include zirconium chemicals, magnetite and nickel sulphate as well as small quantities of gold, silver and platinum. Palabora's large block cave copper mine and smelter complex employs approximately 2 200 people. Palabora also owns a nearby vermiculite deposit, which is mined and processed for sale worldwide. Vermiculite is a versatile industrial mineral.

### Chrome

South Africa accounts for 74% of chrome reserves globally.

### Manganese

South Africa accounts for 26% of manganese reserves, but exploitation of the mineral has not reflected its development potential.

### Diamonds

South Africa, the site of the biggest diamond discovery, plans to process a greater proportion of its gems locally to keep more profit in the country.

Government wants to cut and refine 70% of the diamonds mined in South Africa by 2023. Currently, only 4% is processed locally.

### Industrial minerals

There are some 680 producers of industrial minerals in South Africa, of which almost half are in the sand and aggregate sector.

There are some 153 producers of clays (brick-making and special), 40 limestone and dolomite, 79 dimension stone, 28 salt and 20 silica producers. Bulk consumption of industrial minerals is realised in the domestic market, as most are low-priced commodities and sold in bulk, making their economic exploitation highly dependent on transport costs and distance to markets.

### Mineral Regulation

The purpose of the Mineral Regulation Programme is to regulate the minerals and mining sector to promote economic development and employment and also ensure transformation and environmental compliance.

There was a 5% increase in the budget allocation for Mineral Regulation.

Expenditure in the Management Mineral Regulation subprogramme is planned to almost double to R40 million. This subprogramme provides overall management of the programme.

Expenditure is planned to increase because of responsibilities transferred from the Department of Environmental Affairs.

The staff complement for the branch was expected to increase to 403 in 2015/16. This is a 35% increase over the staffing levels in 2013/14, and includes the appointment of environmental mineral resource inspectors who will work within the DMR to ensure that the provisions of national environmental legislation are applied across the mining sector.

### Geology

South Africa has a long and complex geological history dating back more than 3 700 billion years. Significant fragments of this geology have been preserved and, along with them, mineral deposits.

The preservation of Archaean geology, dating back more than 2 500 million years, has resulted in the Archaean Witwatersrand Basin, as well as several greenstone belts, being preserved.

### Barberton mountain land

This beautiful and rugged tract of country with some of the oldest rocks on Earth is found south of Nelspruit, Mpumalanga.

The greenstone formations represent the remains of some of the earliest clearly decipherable geological events on the Earth's surface.

Silica-rich layers within the greenstone have revealed traces of a very early life form – minute blue-green algae.

Granites surround the formations and gneisses that are more than 3 000 million years old. Gold, iron ore, magnesite, talc, barite and verdite are mined in the area.



### Witwatersrand

The geology and gold mines of the Witwatersrand (Ridge of White Waters) are world famous.

More than 50 055 t of gold have been produced from seven major goldfields distributed in a crescent-like shape along the 350-km long basin, from Welkom in the Free State in the south-west, to Evander in the east.

The geology of the region can be seen at many outcrops in the suburbs of Johannesburg. The sequence is divided into a lower shale-rich group and an upper sandstone-rich group. The latter contains the important gold-bearing quartz-pebble conglomerates.

### Bushveld Complex and escarpment

The Bushveld Complex extends over an area of 65 000 km<sup>2</sup> and reaches up to 8 km in thickness. It is by far the largest known layered igneous intrusion in the world and contains most of the world's resources of chromium, PMGs and vanadium.

The impressive igneous geology of the Bushveld Complex can best be viewed in Mpumalanga, in the mountainous terrain around the Steelpoort Valley. The imposing Dwars River chromitite layers, platinum-bearing dunite pipes, the discovery site of the platinum-rich Merensky Reef, and extensive magnetite-ilmenite layers and pipes near Magnet Heights and Kennedy's Vale are in this area.

The Great Escarpment of Mpumalanga is one of South Africa's most scenic landscapes. This area features the Bourke's Luck Potholes, which have become a major tourist attraction.

### Drakensberg Escarpment and Golden Gate Highlands National Park

The main ramparts of the Drakensberg range, which reach heights of more than 3 000 m, lie in KwaZulu-Natal and on the Lesotho border. These precipitous mountains are the highest in southern Africa and provide the most dramatic scenery.

They were formed by the partial erosion of a high plateau of basaltic lava, which is more than 1 500 m thick, and covers the Clarens sandstones.

Prior to its erosion, the continental basalt field covered significantly more of the continent.

The uKhahlamba-Drakensberg Park, which covers 243 000 ha, has been declared a world heritage site. More than 40% of all known San cave paintings in southern Africa are found here.

The scenic Golden Gate Highlands National Park in the Free State features spectacular sandstone bluffs and cliffs. The sandstone reflects a sandy desert environment that existed around 200 million years ago. Dinosaur fossils are still found in the area.

### Karoo

Rocks of the Karoo Supergroup cover about two-thirds of South Africa and reach a thickness of several thousand metres. The sedimentary portion of this rock sequence reveals an almost continuous record of deposition and life, from the end



of the Carboniferous into the mid-Jurassic periods, between 300 million and 180 million years ago.

Karoo rocks are internationally renowned for their wealth of continental fossils, and particularly for the fossils of mammal-like reptiles that show the transition from reptiles to early mammals, and for their early dinosaur evolution. During this long period of the Earth's history, southern Africa was a lowland area in the centre of the Gondwana supercontinent.

Initially, the prehistoric Karoo was a place of vast glaciation. It then became a shallow inland sea, before this was replaced by huge rivers, with lush flood plains and swampy deltas, which dried out to form a sandy desert. Finally, vast outpourings of continental basaltic lava accompanied by the break-up of Gondwana occurred.

### Diamond fields

Kimberlite is the primary host-rock of diamonds and was first mined as weathered "yellow ground" from the Kimberley mines, starting in 1871 at Colesberg koppie, now the site of the Big Hole of Kimberley. At increasing depths, less-weathered "blue ground" that continued to yield diamonds was encountered.

The discovery of kimberlite-hosted diamonds was a key event in South Africa's economic and social development, and paved the way for the later development of the Witwatersrand goldfields.

The Orange and Vaal rivers' alluvial diamond fields and the rich West Coast marine diamond deposits all originated by erosion from primary kimberlite pipes.

### Meteorite impact sites

Impacts by large meteoritic projectiles played a major role in shaping the surface of the Earth. The Vredefort Dome is the oldest and largest visible impact structure known on Earth and is a World Heritage Site. It lies some 110 km south-west of Johannesburg, in the vicinity of Parys and Vredefort in the Free State and North West.

About 40 km north of Pretoria is the small bowl-shaped Tswaing meteorite-impact crater. Just one kilometre in diameter, this is one of the best-preserved and accessible impact craters of its kind on Earth. It was created about 220 000 years ago when a meteorite, about 50 m, wide slammed into the Earth, and is one of the few impact craters containing a crater lake.

### Pilanesberg

The Pilanesberg Complex and National Park in North West is a major scientific attraction which includes a number of unique geological sites.

The complex consists of an almost perfectly circular, dissected mountain massif some 25 km in diameter, making it the third-largest alkaline ring complex in the world. The geology reflects the roots of an ancient volcano that erupted some 1,5 billion years ago. The remains of ancient lava flows and volcanic breccias can be seen.

The dominant feature of the complex is the concentric cone sheets formed by resurgent magma that intruded ring fractures created during the collapse of the volcano. There are old mining

sites for fluorite and dimension stone, and a non-diamond-bearing kimberlite pipe in the region.

### Cradle of Humankind

This World Heritage Site extends from the Witwatersrand in the south to the Magaliesberg in the north, and is considered to be of universal value because of the outstanding richness of its fossil hominid cave sites.

The Sterkfontein area near Krugersdorp is the most prolific and accessible fossil hominid site on Earth. It comprises several scientifically important cave locations, including Sterkfontein, Swartkrans, Drimolen, Kromdraai, Gladysvale and Plover's Lake, all of which have produced a wealth of material crucial to palaeoanthropological research.

### Table Mountain and the Cape Peninsula

Table Mountain is South Africa's best known and most spectacular geological feature, comprising a number of major rock formations.

The earliest of these are the deformed slates of the Malmesbury Group, which formed between 560 million and 700 million years ago.

Coarse-grained Cape granite intruded about 540 million years ago. The Table Mountain Group, which started forming about 450 million years ago, consists of basalt, reddish mudstone and sandstone that is well exposed along Chapman's Peak.

Overlying this is the light-coloured sandstone that makes up the higher mountains and major cliff faces of the Cape Peninsula, as far south as Cape Point.

Much younger sandy formations make up the Cape Flats and other low-lying areas adjacent to Table Mountain. The Table Mountain Group continues further inland across False Bay in the strongly deformed Cape Fold Belt.