



SA YEARBOOK 2009/10  
**MINERAL RESOURCES**



South Africa is richly endowed with mineral resources. Mining remains an important contributor to the country's economic growth, with an average of 50% of the country's export earnings being derived from mining, while the sector is also a leading contributor to the country's coffers through taxation.

In 2009, following the appointment of a new administration, the Department of Minerals and Energy was divided into two separate departments: mineral resources and energy.

The Department of Mineral Resources aims to formulate and implement policy to ensure optimum use of the country's mineral resources.

In 2009, the mining sector was under severe strain as a result of the unfavourable economic conditions. At the start of the global financial crisis, conservative projections of anticipated job losses were in excess of 100 000 during the first year of the economic slump.

Government initiated a process to lessen the impact of the global financial crisis on the South African mining industry. To this end, the aggregated commodity prices of minerals produced in the country lost some 40% of its value, while job losses were contained to less than 25 000, representing about 5% of total employment in the industry.

This was a result of the cooperation among all stakeholders in the sector, represented by government, business and labour. This collaborative work was rooted in the departmental-led Mining Industry Growth, Development and Employment Task Team.

In 2009, the team was also tasked with developing recommendations that would ensure optimal development of the mining industry to benefit South Africa once the crisis is over.

The Mineral Policy and Promotion Branch of the Department of Mineral Resources is responsible for formulating and promoting mineral-related policies that will encourage investment in the mining and minerals industry, making South Africa attractive to investors.

The Mine Health and Safety Inspectorate (MHSI) is responsible for implementing mine-health and -safety legislation.

The Mineral Regulation Branch regulates the mining and minerals industry to achieve transformation and contribute to sustainable development.

## Policy and legislation

Mining and minerals policy is based on the principles of the Freedom Charter, according to which the mineral wealth beneath the soil will be transferred to the ownership of the people as a whole.

The Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002), has opened doors for the substantial and meaningful participation of black people in the exploration and exploitation of mineral resources. The MPRDA, 2002 enshrines equal access to mineral resources, irrespective of race, gender and creed.

Since May 2004, an unparalleled number of applications for prospecting, exploration and mining have been received, reaching more than 18 000 and resulting in the development of several new projects. All prospecting/exploration applications are processed within six months, while mining rights are processed within a year.

The South African Diamond Board was established in 1987 in terms of the Diamond Act, 1986 (Act 56 of 1986), to regulate control over the possession, purchase, sale, processing and export of diamonds.

The Diamond Amendment Act, 2005 (Act 30 of 2005), the Diamond Second Amendment Act, 2005 (Act 30 of 2005), and the Precious Metals Act, 2005 (Act 37 of 2005), broaden the legal mandate of the board to also regulate precious metals. Subsequently, the South African Diamond Board was de-listed as a Schedule 3A public entity in March 2007 and replaced by the South African Diamond and Precious Metals Regulator (SADPMR), which was established by Section Three of the Diamonds Act, 1986 (as amended in 2005).

The SADPMR and the State Diamond Trader (SDT) were officially launched in February 2008.

Their establishment signalled a number of significant changes in the regulation of diamonds and precious metals and heralded a new era where the SDT began to sell rough diamonds to those South Africans who were previously excluded. The two entities are a product of the Department of Mineral Resources' commitment towards maximising value addition of South Africa's mineral resources, with particular reference to diamonds and precious metals.

The SDT opened in Johannesburg and is expected to move to Kimberley in the Northern Cape at a later stage.

The Precious Metals Act, 2005 provides for the acquisition of smelting, refining, using and disposing of precious metals, with the emphasis on adding increased value.

The SDT was severely affected by the global economic crisis, with diamond prices losing considerable value.

The challenges facing the SDT are compounded by the standing financial model, which is essentially not developmental, but a classical business model.

The department is assessing the prospect of a new business model for the SDT, which will allow the trader to continue implementing its core mandate of promoting equitable access to and beneficiation of diamond resources, addressing distortions in the diamond industry and correcting historical market failures to develop and grow South Africa's diamond cutting and polishing industry.

The Mineral and Petroleum Resources Development Amendment Act, 2008 (Act 49 of 2008), provides for the amendment of the MPRDA, 2002, so as to make the minister the responsible authority for implementing environmental matters in terms of the National Environmental Management Act, 1998 (Act 107 of 1998), and specific environmental legislation as it relates to prospecting, mining, exploration, production and related activities.

The Geoscience Amendment Bill aims to align the Geoscience Act, 1993 (Act 100 of 1993), with the MPRDA, 2002 and expand the functions of the Council for Geoscience (CGS). The Bill was introduced to Cabinet in January 2008, but was referred back for further consultation with other departments.

The department, in conjunction with other key departments as well as relevant state-owned enterprises, launched the Beneficiation Strategy in March 2009 after approval was granted by the

Cabinet Committee for the strategy to be circulated for broader consultation.

Once comments are incorporated into the strategy, it will be sent to Cabinet for approval as a policy position for the country.

The Beneficiation Strategy provides for a framework within which South Africa can implement an orderly development of the country's mineral value chains to leverage benefit from inherent comparative and competitive advantages.

The strategy is intended to support national programmes such as the National Industrial Policy Framework, consistent with the provisions for a sector-specific strategy and key action plans for downstream mineral beneficiation as well as the development of nuclear-power capacity, for instance, which is intended to diversify the country's energy basket and ensure security of energy supply.

## Mine environmental management

Mine environmental management, which forms an integral part of the management of mineral resources, focuses on:

- the approval and monitoring of the implementation of environmental management plans and mine environmental management programmes
- regular inspections to strengthen enforcement to prevent mining legacies
- identifying and managing "hot spots"
- approval of mine-closure applications and the monitoring of the implementation of these
- rehabilitating abandoned and ownerless mines.

Considering the extent of environmental damage caused by mining in South Africa, the Department of Mineral Resources entered into a three-year agreement with the Council for Scientific and Industrial Research, the CGS and Mintek to find solutions for long-term rehabilitation and environmental management. The Sustainable Development Through Mining Programme was established and resulted in addressing the following:

- a database of derelict and ownerless mines
- a regional mine-closure strategy for the Witwatersrand Water Basin
- a sustainable development strategy for minerals and mining
- mine environmental management guidelines for implementation, monitoring and mine closure
- instruments and tools to assist with evaluating, inspections and decision-making.

The inaugural Mining Technology World Exhibition and Conference took place in July 2009 in Midrand, Johannesburg. The event highlighted the importance of technology in mining and the role it will play in future. Topics covered geostatistics, safety and security in mining, geotechnical services and products, maintenance management, metallurgy and mineralogy, information technology in mining, environmental technology, mine surveying and mapping, and management of mines. Participants represented stakeholders involved in mining technology across the African continent.



The long-term approach is to replicate the concept of regional mine-closure strategies to other areas of cumulative and integrated environmental impacts during 2010 to 2012, such as the coal fields in KwaZulu-Natal and Mpumalanga as well as other mining areas of concern.

### **Mining outcomes of the World Summit on Sustainable Development (WSSD)**

Representatives from nearly 200 countries assembled at the WSSD in Johannesburg in September 2002 to reaffirm their commitment to sustainable development. As a follow-up to the WSSD mining outcomes, the then Department of Minerals and Energy initiated a process in 2005 by developing a strategy to address the WSSD outcomes for minerals and mining.

The department is finalising the strategy to achieve the mining priorities of the Johannesburg Plan of Implementation. The key strategic objectives of the strategy are:

- That the South African mining sector reflects the sustainable development values, principles and aspirations of the country. All stakeholders in the sector must share a sustainable development vision based on a culture of mutual respect.
- That the vision of sustainable development in the sector must be communicated effectively to all stakeholders.
- To recognise that the Sustainable Development Strategy and Policy must transcend both the Government of the day and the requirements of the United Nations Conference on Science and Technology for Development and should be valid and appropriate across all time scales. Furthermore, that community empowerment and environmental and social rights are central and enduring tenets of the sector and that all those operating within the minerals sector earn a social licence to do so.
- That the Sustainable Development Strategy facilitates the transition from finite resource-based industries and economies to sustainable knowledge-based economies and that building and accounting for social and natural capital is implicit.
- That the Sustainable Development Strategy promotes economic diversification in existing and future mining industries and that the minerals sector should take due cognisance of globalisation's influence on sustainable development and the consequences of these (including the implications of trade barriers,

global market forces and international agreements, requirements and conventions).

- That the Sustainable Development Strategy acknowledges the potential and realised contribution of the industry for socio-economic empowerment and that policy creates conditions to ensure the continuation of this contribution.
- That value extraction from South Africa's minerals sector benefits vulnerable groups and value addition from South Africa's mineral resources is maximised locally.
- That government is empowered to facilitate sustainable development outcomes and link to national and international sustainable development strategies and initiatives and that all role players realise the synergies achieved through effective cooperation.
- That the minerals sector moves towards sustainable end states and internalises negative costs and associated consequences, and that the cumulative and life-cycle aspects of the sector are fully aligned with sustainable development principles.
- To align beneficiation strategies with appropriate national development objectives, including poverty alleviation, small-scale mining, environmental management and social upliftment.

### **African Mining Partnership (AMP)**

The AMP was established to champion, among other things, the mining and mineral-related initiatives of the New Partnership for Africa's Development (Nepad).

The Global Mining Dialogue was also established to promote WSSD mining outcomes in the international arena.

The sixth AMP meeting was held in February 2009, during which the objective of becoming an official institutionalised affiliate of the African Union (AU) was achieved. The AMP will be merged with the AU Conference of Ministers Responsible for Mineral Resources Development and will be the only AU ministerial organ responsible for mineral-resources development and management in Africa.

The Department of Mineral Resources, as the Secretariat of the AMP, was mandated to lead the merger process, which is envisaged to take two years. The recognition of the AMP by the AU is a milestone as the partnership had been seeking this ever since its formation.

## **Sustainable development on the African continent**

The Intergovernmental Memorandum of Understanding on the Western Power Corridor Project (Westcor) was signed in October 2004.

This Nepad flagship programme intends to pilot the use of hydroelectric energy of the Inga rapids site in the Democratic Republic of Congo (DRC). It will ensure the security of supply in the Southern African Development Community. The participating utilities are those of Namibia, South Africa, the DRC, Botswana and Angola. A joint-venture company has been formed to initiate studies determining the viability of the project and to build, own and operate the infrastructure.

## **Mining industry**

South Africa produces 10% of the world's gold, and has 40% of the world's known resources. It is estimated that 36 000 tons (t) of undeveloped resources – about one third of the world's unmined gold – still remains. These ores are increasingly difficult to exploit due to the great depths where they are situated and their fairly low-grade quality.

With the implementation of the MPRDA, 2002 and the Mining Charter, there has been an increase in the number of women participating in the mining industry. The most significant transactions approved recently saw the creation of black-owned companies.

Anglo Platinum sold a majority stake in the Lebowa Platinum Mines to Anooraq, the third-largest producer of platinum in South Africa. Furthermore, Anglo Platinum sold its 22% shareholding in Northam to Mvelaphanda Resources, making Northam a black-owned and -controlled mine. Anglo Platinum also sold 50% of its stake in the De Brochen Project to Mvelaphanda, making this project 100% black-controlled.

In relation to coal, Anglo Operations, through Anglo Coal, facilitated the creation of a new coal company Anglo Inyosi Coal, wherein historically disadvantaged South Africans (HDSAs) own 26% of its equity. Kgalagadi Manganese is 80%-owned by an empowerment company.

A number of community projects have been approved, wherein communities are holders of mining rights. Some examples of these are Itere-leng Bakgatia Resources, Marual Platinum and Lesizwe Platinum.

Following the successful conclusion of the protracted land claim by the Richtersveld community, the state-owned mining firm Alexkor is in a period of transition and has entered into a process of restructuring.

## **Black Economic Empowerment (BEE)**

The introduction of the Mining Charter in South Africa was aimed at transforming the mining industry to redress historical imbalances engendered by apartheid so that the industry is consistent with the changes in South Africa's overall transformation of its social, political and economic landscape.

Embedded in the Mining Charter are provisions to assess the extent of progress towards the attainment of its objectives and to review the charter within five years of implementation. In reviewing the charter, community upliftment will be among the key focus areas to ensure that mining development does not continue at the exclusion of communities.

The commitments of the charter are not intended for compliance purposes only. They do not end in 2014, but are meant to permanently transform the industry to be truly reflective of South Africa.

The Codes of Good Practice and the Housing and Living Conditions Standards for the Mineral Industry were gazetted in April 2009.

The Department of Mineral Resources' focus over the last five years has been on the transformation of the minerals and mining industry. The department has driven the process of ensuring black participation in the mining sector as operators, investors and managers. This will continue for as long as the minerals and mining sector remains untransformed.

The department has, as of 2009, conducted inspections on all social and labour projects to ensure that companies deliver on their commitments.

As the department reviewed the charter in 2009 objectively, it assessed progress in all areas of the charter to inform a review process.

## **Mineworkers**

According to the Chamber of Mines, the South African mining sector in 2007:

- Directly employed 495 474 workers, compared with 458 600 in 2006. It was estimated that another 165 000 workers were employed in associated industries that either supplied products to, or used products from the mining industry (the multiplier linkages of the industry). Around five million people are directly dependent for their daily subsistence on mine employees.
- Accounted for 6% of those employed in the non-agricultural formal sector of the economy and 7,5% of the total private sector of non-agricultural employment.

- Paid R50 billion in wages and benefits to employees, which accounted for about 5,9% of the total compensation paid to all employed people in the country. This contributed substantially to domestic demand in the South African economy.

### **Mine health and safety**

The Mine Health and Safety Inspectorate (MHSI) of the Department of Mineral Resources, established in terms of the Mine Health and Safety Act (MHSA), 1996 (Act 29 of 1996), is responsible for protecting the health and safety of mineworkers or people affected by mining activities.

The activities of the MHSI focus on achieving a safer and healthier mining industry for all. The MHSI works closely with industry and worker unions to reduce the incidence of mine accidents, with stakeholders committing themselves to continuously reduce fatalities by at least 20% a year. The inspectorate is also pursuing a strategy to eliminate silicosis and noise-induced hearing loss or occupational deafness by 2013, and to reduce the social costs of diseases and injuries to vulnerable communities in particular.

The levels of death, ill health and injuries at mines remain a serious concern for the Department of Mineral Resources. The industry's stakeholders, had, in 2008, managed to record a 24% improvement in fatalities due to mine accidents when compared to the previous year, 2007, when 220 miners had lost their lives.

In early 2009, the Presidential Audit of Mines was conducted. The auditing programme covered mainly the high-risk mines in the country, which amounted to 355.

Among other things, the audit indicated:

- an overall compliance of 66% with the number of items critical for ensuring that there were effective management systems at mines
- the Mine Health and Safety Council (MHSC) had to develop and implement a programme that would promote a culture of health and safety at mines
- an urgent need to develop a national mine seismic network that will be fully integrated with the CGS' seismic network.

Stakeholders, through the MHSC, developed an implementation plan to address the recommendations contained in the report. By June 2009, some of the recommendations were being implemented to ensure complete eradication of accidents and ill-health in the mining industry.

The department introduced the Mine Health and Safety Amendment Act, 2008 (Act 74 of

2008), which aims to enhance the State's ability to address the mine-health and -safety challenge of high injuries, ill health and deaths.

The amendment introduces more strict sanctions for non-compliance with health and safety standards by individuals and corporate bodies as well as prosecution.

The Act establishes the MHSI as a juristic person. This amendment is significant as it provides a platform upon which the critical question of capacity to effectively enforce health and safety regulatory requirements can be addressed.

The department continues to work with security forces to develop a strategy to combat illegal mining, which is one of the biggest threats to mineworkers' health and safety.

South Africa is committed to combating HIV and AIDS in the mining industry.

The department has developed the Human-Resource Development Plan to address the acute shortage of inspectors. The department intends to create its own skills pool to improve the race and gender profile of inspectors.

Three projects are being implemented to address capacity:

- A bursary scheme with 16 students at universities and technikons who will complete their course in the next four years.
- About 23 learners are undergoing experiential training at the Goldfields Training Academy. Upon successful completion, they will be employed as trainee inspectors in the department.
- The ongoing internal training programme in different engineering and occupational health disciplines.

The Mining Qualifications Authority (MQA) aims to train more than 100 mining inspectors at a cost of R4,2 million in 2010. The department is also developing a tailor-made mine-inspector training programme through the University of the Witwatersrand as a long-term measure to address the department's capacity constraints.

### **Mining Qualifications Authority**

The MQA was established as a sector education and training authority under the leadership of the Department of Labour. The MQA aims to facilitate 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 monitoring the implementation of a sector skills plan
- registering skills-development facilitators at workplaces within the sector
- approving work-skills plans and annual training reports of companies in the sector
- developing unit standards and qualifications
- maintaining the quality of standards, qualifications and learning provision in the sector
- establishing, registering, administering and promoting learnerships
- administering existing apprenticeship systems
- administering and disbursing skills-development levies.

The MQA has introduced several initiatives to address skills shortages that specifically aim to support transformation across the mining and minerals sector. Two strategic documents support BEE in the mining industry. Firstly, the service-level agreement signed with the Department of Labour commits to targets set by the National Skills Development Strategy that are underpinned by equity principles aimed at accelerating Broad-Based BEE and employment equity.

Therefore, of all people trained, 85% should be black, 54% women and 4% people with disabilities.

The second strategic document that supports BEE in the mining industry is the MQA Mining Charter Support Strategy. In support of the Mining Charter, the MQA has introduced the Executive Preparation Programme, the Graduate Development Programme, a bursary scheme (including support for undergraduate practical training), the Universities Employment Equity Project, and support for small-scale miners. The MQA also supports small, medium and micro-enterprises in the sector through grants for training in small-scale mining, mineral beneficiation, jewellery manufacturing and diamond processing.

The human-resource development guidelines provide for enhanced opportunities to be made available to HDSAs within the mining and minerals sector. The guidelines specify that by 2010, 40% of managers controlling the full spectrum of activities should be from historically disadvantaged backgrounds and that women must occupy 10% of all positions.

Consequently, the MQA Executive Preparation Programme was created to aid HDSAs. Its focus is

on developing strategic and in-depth understanding of the mining and minerals sector in some 26 learners per six-month term.

The Graduate Development Programme was introduced for unemployed graduates from universities of technology who had qualifications and skills that were scarce and critical according to the Mineral Sector Skills Plan, but who needed to gain work experience.

In April 2009, the former Department of Minerals and Energy presented certificates to candidates who had completed a programme in mining skills in Nongoma, KwaZulu-Natal.

The programme is aimed at training and equipping illegal miners and ex-mine workers with the necessary basic mining skills, and to take steps to legalise their operations. It also seeks to consolidate the department's intervention on mitigating the current global economic crisis.

#### South Africa's mineral reserves, 2007

Commodity	Unit	Reserves	%	World ranking
Alumino-silicates	Kt	51	n/a	n/a
Antimony	t	200	4,7	4
Chrome ore	Mt	5 500	72,4	1
Coal	Mt	27 981	6,1	8
Copper	Kt	13 000	1,4	14
Fluorspar	Mt	80	16,7	2
Gold	t	36 000	40,1	1
Iron ore	Mt	1 500	0,9	9
Lead	Kt	3 000	2,1	6
Manganese ore	Mt	4 000	80	1
Phosphate rock	Mt	2 500	5	4
Platinum-group metals	Kg	70 000	87,7	1
Silver	t	n/a	n/a	n/a
Titanium minerals	Mt	244	16,9	2
Uranium	Kt	341	7,2	5
Vanadium	Kt	12 000	32	1
Vermiculite	Kt	80 000	40	2
Zinc metal	Kt	15 000	3,3	8
Zirconium	Kt	14 000	19,4	2

Mt=megaton, Kt=kiloton, t=ton, n/a=not available, Kg=kilogram

Source: Department of Mineral Resources

The department realised this initiative with the assistance of the MQA and Mintek. About 200 people from the Nongoma area people have been identified to undergo training.

Other initiatives included:

- a strategic partnership was entered into between the MQA and the Jewellery Council of South Africa in terms of the MQA's strategy to support beneficiation in the mining and minerals sector
- the National Skills Fund funded a special project for an additional 1 000 artisans in the mining and minerals sector
- the small-scale and artisanal mining programme of the MQA was introduced to ensure that potential trainees can be trained.

### Chamber of Mines

The Chamber of Mines was established in 1889, and consists of independent mining-finance corporations, individual mines and mining companies. The members account for more than 85% of South Africa's mineral output.

The Chamber of Mines provides an advisory and service function to its members and to the industry on a cooperative basis. It covers areas such as industrial relations; education and training; security and healthcare; technical, legal and communication services; and the provision of statistical data.

Subsidiary companies provide training, examination administration, visits to operational gold and diamond mines, the monthly newspaper *Mining News*, mine-rescue, environmental management, and centres for human development to the South African mining industry and, in some instances, also to customers outside the mining industry.

Other areas of industry networking include:

- the Employment Bureau of Africa (Teba)
- Teba-Bank, which provides efficient and cost-effective banking services for mineworkers
- Rand Mutual Assurance, which provides compensation benefits for accidental injury or workers' death while on duty
- Rand Refinery Limited, the world's largest gold refinery
- the Nuclear Fuels Corporation
- Colliery Technical Services, which includes the Colliery Training College
- Rescue Drilling Unit
- Collieries Environmental Control Services
- Mintek, which specialises in mineral processing, extractive metallurgy and related areas.

### Small-scale mining in South Africa

The potential of small-scale mining as a tool to reduce poverty and create employment, especially in the rural areas, is recognised by the Department of Mineral Resources.

This led to the formation of the Small-Scale Mining Directorate in 2003/04, which promotes the establishment of small-scale mining businesses across South Africa.

Although alluvial diamond mining as well as inland salt mining also play a significant role in the small-scale mining sector, the bulk of the demand for small-scale mining ventures is associated with industrial commodities, such as slate, sand, clay, sandstone, dolerite and granites for the production of infrastructural development products such as tiles, clay and cement bricks, aggregates and dimension stone for cladding.

This is evidenced from the more than 90% of small-scale mining applications received for these commodities and taken through the process of legalisation, feasibility studies, limited capitalisation, monitoring and auditing.

By November 2008, about 38 small-scale mining projects were fully operational.

National Treasury funds, used in 2008/09 via administrative assistance of the Industrial Development Cooperation to cover some work, such as issuing contracts for capitalisation of projects and rehabilitation, amounted to R24 million.

In 2009/10, it was envisaged that 17 new small-scale mining projects would be added to the operational projects.

In terms of job creation, it is estimated that 35 projects will create some 2 000 jobs and sustain another 8 000 workers. Small-scale mining information sessions are also planned to disseminate information about the assistance afforded to potential small-scale miners.

The small-scale mining sector is faced with many challenges such as lack of access to finance and markets, shortage of skills and inadequate or non-compliance with regulatory requirements.

### Mineral wealth

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

- the Witwatersrand Basin yields some 94% of South Africa's gold output and contains considerable resources of uranium, silver, pyrite and osmiridium
- the Bushveld Complex is known for its platinum-group metals (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 fluorspar and andalusite
- 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.

The bulk of the known mineral resources and reserves were discovered using conventional exploration methods, but the country still has significant potential for additional discoveries of world-class deposits, using modern exploration technologies.

South Africa has the world's largest resources of PGMs (87,7% of world total), manganese (80%), chromium (72,4%), gold (40%) and aluminosilicates. South Africa also accounts for over 40% of the global production of the following mineral commodities: ferrochromium, PGMs and vanadium.

It is also the world's leading producer of chrome ore, vermiculite and aluminosilicates, and is among the top three producers of gold, manganese ore, titanium minerals and fluorspar.

The South African mining industry contributes 50,9% of world ferrochromium exports and 34,4% of aluminosilicates, and is one of the world's largest exporters of PGMs, gold and vanadium, and a significant exporter of manganese ore. Other important export commodities include ferro-manganese and fluorspar.

Although South Africa is probably the largest exporter of vanadium, gold and PGMs, it is not possible to rank it because of the unavailability of export data from other producing countries.

South Africa's total sales of primary minerals increased to R223,9 billion in 2007. The value of exports of primary minerals in 2007 increased to R161,8 billion.

The Directorate: Mineral Economics of the Department of Mineral Resources monitors and analyses the global supply and demand of minerals that affect the South African economy.

## Gold

South Africa's gold production decreased by 7,2% from 272,1 t in 2006 to 252,6 t in 2007, largely as a result of the mining of lower-grade ore, made economic by higher rand gold prices, as well as new safety procedures, which involved the temporary closure of a shaft where a fatal incident had occurred to facilitate an audit with a view to improving safety.

Gold's total sales revenue increased by 1,6% to R38 billion, due to a 19,7% rise in the average Rand price for the year, despite lower sales volumes.

**South Africa's mineral production, 2007**

Commodity	Unit	Re-serves	%	World ranking
Aluminium	Kt	914	2,4	9
Alumino-silicates	Kt	265	59,0	1
Antimony	t	3 354	2,5	7
Chrome ore	Mt	9 683	n/a	n/a
Coal	Mt	247,8	4,5	5
Copper	Kt	110	0,7	16
Fluorspar	Mt	285	6,0	4
Gold	t	253	10,3	2
Iron ore	Mt	41,3	2,5	7
Lead	Kt	42,0	1,2	11
Manganese ore	Mt	5 589	14,2	2
Nickel	Kt	42,0	3,1	9
Phosphate rock	Mt	2 556	1,7	10
Platinum-group metals	Kg	304 031	56,7	1
Silver	t	70	0,3	21
Titanium minerals	Mt	1 181	19,5	2
Uranium	Kt	639	1,6	11
Vanadium	Kt	23,5	40	1
Vermiculite	Kt	200	38,5	1
Zinc metal	Kt	31,4	0,3	25
Zirconium	Kt	405	41,6	2

Mt=megaton, Kt=kiloton, t=ton, n/a=not available, Kg=kilogram  
Source: Department of Mineral Resources

## Silver

South Africa's silver-mine production in 2007, at 69,8 t, was 19,7% lower than the 2006 figure of 86,9 t. Silver was produced as a by-product of the gold, lead-zinc, copper and PGM mines. Local sales value decreased from R11 million to R10,9 million due to the higher price, despite lower sales volumes. The export sales value decreased from R239,6 million to R224,1 million.

## Coal

In 2007, South African mines produced 247,7 million tons (mt) of coal. Of this 182,8 mt were sold locally for R19,7 billion, and 67,7 mt realised R24,4 billion on export markets. South Africa has estimated recoverable coal resources of 31 billion tons.

## Platinum-group metals

South African PGM production dropped by 1,7%, to 304 t in 2007, from 309,3 t in 2006. Production of platinum and palladium decreased by 5,3% to 160,9 t and by 3% to 83,6 t respectively, while the production of rhodium rose by 7,2% to 21,1 t.

PGM export sales revenue increased by 23,1% to R66 billion, due to a higher average rand basket price for 2007, despite lower sales volumes.

## Non-ferrous minerals

This sector comprises a mixture of metals and metal concentrates. Copper, nickel and cobalt production and sales are, for the most part, reported as metals, whereas titanium (actually ilmenite and rutile concentrates), zirconium, zinc, lead and antimony are reported either as tons of concentrate or tons of metal in concentrate.

Of the latter, very little, if any, titanium or antimony concentrate ever reaches the metallic stage, and in the rest of the world, these are regarded as industrial minerals (i.e. non-metallics). In 2007, sales in this sector totalled R19 billion, representing 8,5% of total mineral sales. Local sales made up 40,8% of total non-ferrous mineral sales.

## Ferrous minerals

South Africa is an important source of ferrous minerals, being 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 significant supplier of manganese alloys, ferrosilicon and silicon metal.

International crude and stainless steels manufacturing industries, which consume over 90% of ferrous mineral production, drive the demand of these minerals.

In May 2009, a rare 7,3-carat blue diamond discovered in South Africa, sold for more than \$8,4 million, the highest price ever for a gem of its kind, according to auctioneers, Sotheby's.

Including commission, the successful bidder paid around \$9,5 million.

The gem, which is smaller than a dime, shaped like a cushion and one of only a few blue diamonds ever found, was among the 346 lots auctioned in Geneva, Switzerland.

The blue diamond, cut from a 26,58-carat rough, was discovered in 2008 at Petra Diamonds' historic Cullinan Diamond Mine in South Africa. The Gemological Institute of America graded the stone as fancy vivid blue in colour and internally flawless in clarity, the highest possible grading for a blue diamond.

The recent tightness in raw material supply/demand has pushed ferrous mineral prices to record levels. As a result, revenues generated from mineral sales increased by 40% to R49,8 billion in 2007, when compared to 2006, despite the 4% weakening of the Rand/Dollar exchange rate.

Around R38 billion of sales revenues were derived from exports, which consist of less than 1% of primary minerals, mainly iron ores. When compared to the past two to three decades, the South African ferrous minerals industry has made good progress in mineral beneficiation and has the potential to improve on further downstream beneficiation as security of supply as well as proximity to supply could become priority in future.

## Industrial minerals

This sector comprises a wide variety of generally non-metallic minerals, with local sales accounting for some 88% of total revenue from industrial minerals in 2007. Local sales increased by R900 million from R6,9 billion to R7,8 billion in 2007.

The greatest contributor to the local sales value was sand and aggregate (43%), with limestone and lime (21,8%) being the second-biggest contributor. Fluorspar (28,7%), andalusite (26,4%), vermiculite (18,3%) and granite (14,9%) were significant contributors to the value of exports.

## Processed minerals

Ferro-alloys and aluminium are the greatest revenue earners in this sector, contributing 78% to the R54,76 billion sales in 2007. In rand terms, processed mineral sales were 21% more than in 2006. Exports yielded 76% of the total sales of processed minerals.



## Other minerals

This sector is dominated by diamonds and includes hydrocarbon fuel and uranium oxide. Revenue from these minerals increased by 0,7% over that of 2006, to R15 billion. New investments by companies such as Uranium One and First Uranium have contributed greatly to the recovery of this 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 so much 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. Ten of the more significant geological formations in South Africa are discussed below.

### 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 renowned Barberton Greenstone Belt, the largest of its kind in South Africa, contains remnants of original crust, dated at around 3,5 billion years old.

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, chrysotile asbestos and verdite are mined in the area.

### Witwatersrand

The geology and gold mines of the “Ridge of White Waters” are world famous. Nearly half of all the gold ever mined has come from the extensive Witwatersrand conglomerate reefs that were discovered in 1886, not far from Johannesburg's city centre. The Witwatersrand is the greatest goldfield known to mankind. 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. These “gold reefs” were formed from gravels transported into the basin and reworked 2,75 billion years ago. The gold and uranium originated from a rich source in the hinterland.

### 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, PGMs and vanadium.

This mega-complex was emplaced in a molten state about 2 060 billion years ago into pre-existing sedimentary rocks, through several deep feeder zones.

The impressive igneous geology of the Bushveld Complex is best 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 potholes at Bourke's Luck, the Blyde River Canyon and the dolomite formation in which giant stromatolites bear witness to the 2,5-billion-year-old fossilised remains of vast oxygen-producing algae growth.

### Drakensberg Escarpment and Golden Gate Highlands National Park

The main ramparts of the Drakensberg range, reaching 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 northern area of the Drakensberg 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 gold-fields.

Kimberlite originates as magma from very deep below the surface, and typically occurs as small volcanic pipes and craters at the surface. Included within solidified kimberlites are fragments of deep-seated rocks and minerals, including rare diamonds of various sizes.

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.

One such site is the Vredefort Dome, the oldest and largest visible impact structure known on Earth.

Declared a world heritage site in 2005, it lies some 110 km south-west of Johannesburg, in the vicinity of Parys and Vredefort in the Free State and North West.

This spectacular and complex geological feature, measuring 70 km across, was caused by the impact of a 10 km-wide asteroid some two billion years ago. Only a partial ring of hills remains of the dome, created by the rebound of rock below the asteroid's impact site. The original crater – now eroded – is estimated to have been between 250 km and 300 km in diameter.

The Vredefort structure comprises a core zone of granitic rocks, surrounded by a ring-like collar zone of younger bedded formations. Only the north-western portion of the structure remains visible. The south-eastern half was flooded by sediments of the Karoo Supergroup, which cover the Free State. About 40 km north of Pretoria is a small bowl-shaped meteorite-impact crater, termed Tswaing. 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 of 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, located some 120 km north-west of Johannesburg 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.

A 507-carat white diamond was discovered at the Cullinan Mine outside Pretoria in September 2009.



The diamond was discovered alongside three other special white stones of similar colour and clarity in the same production run. Another very large stone of 168 carats and two other stones of 58,50 and 53,30 carats were found.

At 507 carats (just over 100 grams), the diamond is considered to be among the top-20 largest high-quality rough diamonds ever found worldwide, and ranks alongside other illustrious diamonds recovered at the mine.

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 material.

### **Table Mountain and the Cape Peninsula**

Table Mountain is, arguably, 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 around 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.

## Acknowledgements

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*Digest of South African Energy Statistics – 2006*  
published by the Department of Minerals and  
Energy  
Eskom  
*Mining Weekly*  
*South Africa's Mineral Industry, 2007/08*

[www.cef.org.za](http://www.cef.org.za)  
[www.globaldialogue.info](http://www.globaldialogue.info)  
[www.gov.za](http://www.gov.za)  
[www.hartrao.ac.za](http://www.hartrao.ac.za)  
[www.miningweekly.co.za](http://www.miningweekly.co.za)  
[www.sagoodnews.co.za](http://www.sagoodnews.co.za)  
[www.sabcnews.com](http://www.sabcnews.com)  
[www.sasol.co.za](http://www.sasol.co.za)  
[www.southafrica.info](http://www.southafrica.info)

## Suggested reading

Coetzee, B and Horn, R. 2007. *The Theft of Precious Metals from South African Mines and Refineries*. Tshwane: Institute for Security Studies.

*Deep South Africa: A Celebration of the South African Mining Industry*. 2007. Cape Town: Nelida Publishing.

Duminy, K (comp). 2007. *50 Years on the Diamond Fields: 1870 – 1920*. Kimberley: Africana Library Friends.

Eales, H. 2007. *Riddles in Store: Controversies, Theories and Myths about Southern Africa's Geological Past*. Johannesburg; Witwatersrand: Witwatersrand University Press.

Gray, A. 2007. *The Fence*. Cape Town: Human and Rousseau.

Hodgson, FDI et al. 2007. *Investigation of Water Decant from the Underground Collieries in Mpumalanga, with Special Emphasis on Predictive Tools and Long-Term Water Quality Management*. Gezina: Water Research Commission.

Machens, EW. 2009. *Platinum, Gold and Diamonds: The Adventure of Hans Merensky's Discoveries*. Pretoria: Protea Book House.

Masilo, P and Rautenbach, G. 2008. *Commentary on the Mine Health and Safety Act and Regulations*. Cape Town: Juta.

Meredith, M. 2007. *Diamonds, Gold, and War: The Making of South Africa*. London: Simon and Schuster.

*Rainmakers and Potstirrers*. 2008. Sandton: Miningmx.

*The South African Mining Industry's Sustainability and Transformation Report 2007*. 2008. Marshalltown: Chamber of Mines of South Africa.

Tshitereke, C. 2007. *GEAR and Labour in Post-Apartheid South Africa: A Study of the Gold Mining Industry, 1987 – 2004*. Ann Arbor, Mich: UMI.