ANNUAL REPORT

2018 | 19

A PROSPEROUS AND TRANSFORMED SOCIETY ENABLED BY GEOSCIENCE SOLUTIONS

A proud entity of the Department of Mineral Resources and Energy

Council for Geoscience

Council for Geoscience

The Council for Geoscience (CGS) is one of the National Science Councils of South Africa and is the legal successor of the Geological Survey of South Africa, which was formed in 1912 by the amalgamation of three former surveys, the oldest of which – the Geological Commission of the Cape of Good Hope – was founded in 1895.

The Geoscience Act, Act No 100 of 1993 established the CGS in its present form. Today, the CGS is a modern institution, boasting excellent facilities and expertise and ranking among the best in Africa.

We strive for a diverse workplace by incorporating the contributions of people from a wide variety of backgrounds, promoting an inclusive culture and demonstrating respect for the individual.

We consistently provide prompt and courteous service to both our external and internal stakeholders.

annual report

2018 | 19

*** COVER IMAGE:** Spectacular erosional features of Karoo Dolerite Sills (within the Camdeboo National Park) overlooking Graaff-Reinet"

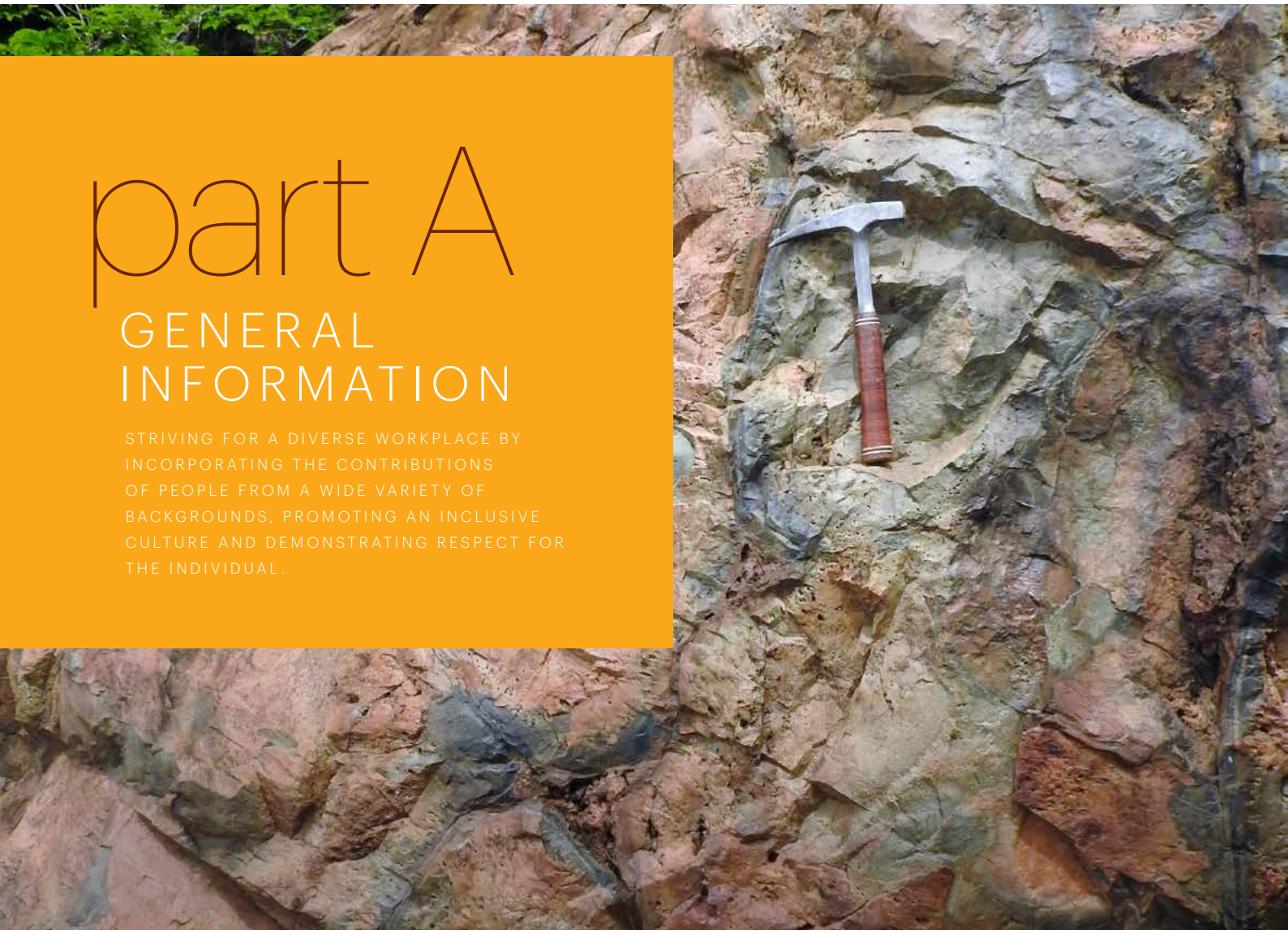
Photo credit: Mr Nick Baglow

TABLE OF contents

ENSURING PROFESSIONAL AND PERSONAL DEVELOPMENT OF OUR STAFF IN A LEARNING ORGANIZATION.

LIST OF TABLES

LIST OF FIGURES



part A

GENERAL INFORMATION

STRIVING FOR A DIVERSE WORKPLACE BY INCORPORATING THE CONTRIBUTIONS OF PEOPLE FROM A WIDE VARIETY OF BACKGROUNDS, PROMOTING AN INCLUSIVE CULTURE AND DEMONSTRATING RESPECT FOR THE INDIVIDUAL.

1. GENERAL INFORMATION ON THE COUNCIL FOR GEOSCIENCE

REGISTERED NAME:	Council for Geoscience
PFMA NATIONAL PUBLIC ENTITY:	Schedule 3A
PHYSICAL ADDRESS:	280 Pretoria Street Silverton, Pretoria South Africa
POSTAL ADDRESS:	Private Bag X112 Pretoria, South Africa 0001
TELEPHONE NUMBER:	+27 (0)12 841 1911
FAX NUMBER:	+27 (0)12 841 1203
E-MAIL ADDRESS:	info@geoscience.org.za
WEBSITE ADDRESS:	www.geoscience.org.za
EXTERNAL AUDITORS:	Auditor-General of South Africa
BANKERS:	Nedbank and ABSA in Silverton, Pretoria
ACTING BOARD SECRETARY:	Ms Nomkhosi Cele

Council for Geoscience

The Geoscience Act, Act No 100 of 1993 as amended, established the Council for Geoscience (CGS) to assume, inter alia, the role of national custodianship of geoscientific information and knowledge.

The CGS has evolved into a modern institution with specialised facilities, assets and expertise. The scientific focus areas of the organisation include geoscience mapping, economic geology, geophysics, marine geoscience, as well as environmental, groundwater and engineering geosciences. The CGS has six regional offices in South Africa, with a head office in Silverton, Pretoria (Figure 1).

WE WILL CONTINUE TO BUILD A STRONG FOUNDATION THAT WILL ENSURE THE PROSPERITY OF THE ORGANISATION IN THE YEARS AHEAD.

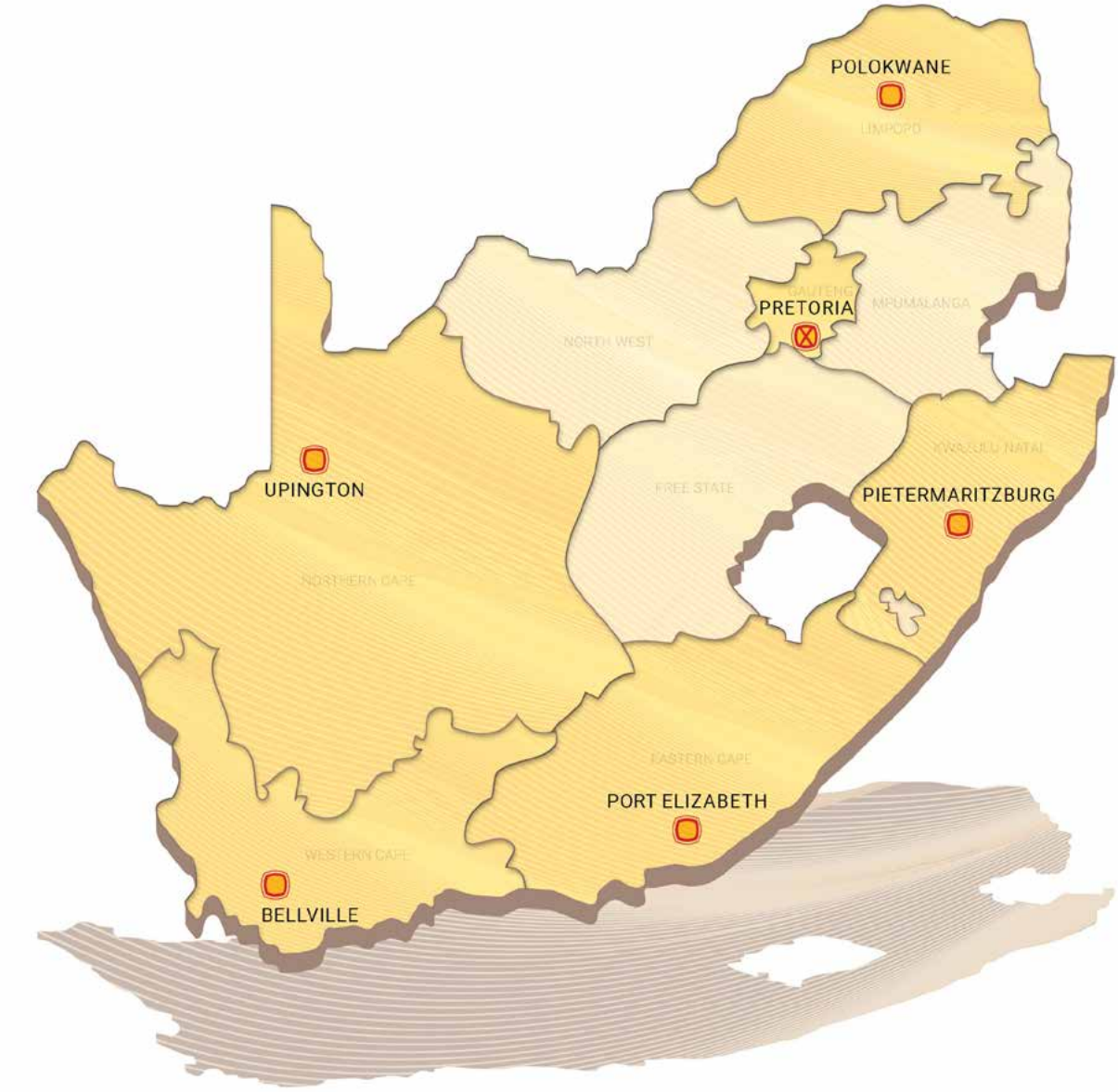


Figure 1: The six regional offices of the CGS in South Africa.

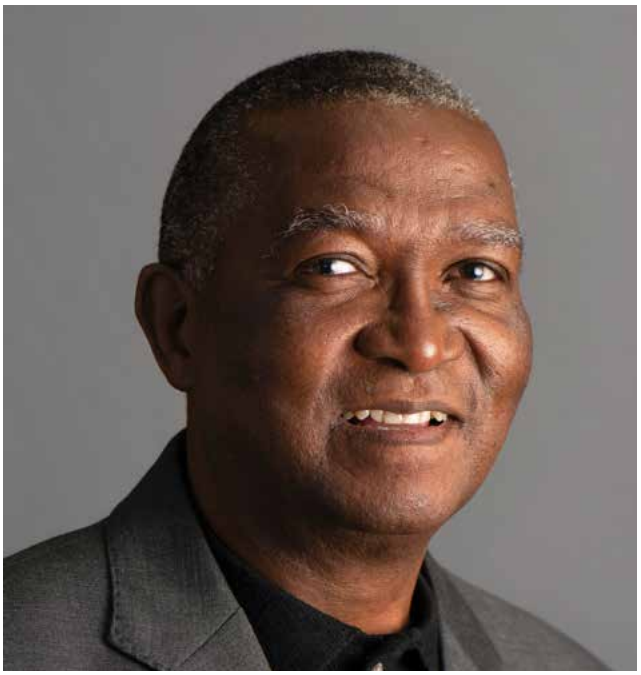
2. ABBREVIATIONS AND ACRONYMS

AMD	Acid Mine Drainage
AMREC	African Minerals and Energy Classification
BBBEE	Broad-Based Black Economic Empowerment
BIF	Banded Iron Formation
BSC	Balanced Scorecard
CEO	Chief Executive Officer
CGS	Council for Geoscience
COGHSTA	Co-operative Governance, Human Settlement and Traditional Affairs
CSIR	Council for Scientific and Industrial Research
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organisation
D&O	Derelict and Ownerless
DMR	Department of Mineral Resources
DST	Department of Science and Technology
ECSA	Engineering Council of South Africa
EE	Employment Equity
EEZ	Exclusive Economic Zone
ERT	Electrical Resistivity Tomography
EU	European Union
GDIP	Geoscience Data and Information Policy
GIS	Geographic Information System
GLCM	Grey Level Co-occurrence Matrix
GRAP	Generally Recognised Accounting Practice
GTP	Geoscience Technical Programme
HIPO	High-potential Employees
ISO	International Organisation for Standardisation
MASW	Multichannel Analysis of Surface Waves
MPRDA	Mineral and Petroleum Resources Development Act
MTEF	Medium Term Expenditure Framework
MTSF	Medium Term Strategic Framework
NDP	National Development Plan
NEMA	National Environmental Management Act
NKP	National Key Point
NRF	National Research Foundation
OAGS	Organisation of African Geological Surveys
OSI	On-Site Inspection
OTR	Overberg Test Range
PADSEM	Projet d'Appui au Développement du Secteur Minier

PFMA	Public Finance Management Act
PGE	Platinum Group Element
PGM	Platinum Group Metal
PLATO	South African Council for Professional and Technical Surveyors
PRECASEM	Projet de Renforcement des Capacités dans le Secteur Minier
PRTC	Personnel, Remuneration and Transformation Board Committee
PyGMI	Python Geophysical Modelling and Interpretation
RS	Remote Sensing
SAA	South African Airways
SACS	South African Committee for Stratigraphy
SAICE	South African Institution of Civil Engineering
SAJG	South African Journal of Geology
SAIMM	Southern African Institute of Mining and Metallurgy
SAMREC	South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves
SAPS	South African Police Service
SHEQ	Safety, Health, Environment and Quality
SMART	Specific, Measurable, Achievable, Realistic and Timely
SPLUMA	Spatial Planning and Land Use Management Act
TIPS	Trade and Industrial Policy Strategies
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFC	United Nations Framework Classification for Resources
XCT	X-ray Computed Tomography

foreword

BY THE CHAIRPERSON OF THE BOARD



'Although the country has a longstanding history of mining, its geological prospects remain unparalleled, especially with application of technology in the context of the fourth industrial revolution and artificial intelligence in geosciences'

DR H MATHE | CHAIRPERSON
BOARD OF THE COUNCIL FOR GEOSCIENCE

It is my humble honour and pleasure to present the Council for Geoscience (CGS) annual report covering the financial year 2018/2019, which coincides with the end of the Government's five-year plan referred to as the Medium-term Strategic Framework (MTSF). In the past five years, the CGS has gone through an unprecedented period of continuous improvement in strategic focus, starting with the 'repositioning strategy' that was partly implemented, followed by an interim phase of 'business unusual' and finally, the current and focused 'integrated and multidisciplinary geoscience mapping' strategy adopted by the current Board at the beginning of its term. The last-mentioned strategy has brought necessary reorientation and realignment of the CGS that places the mandate of the organisation, as inscribed in its founding legislation, at the forefront of performance of the organisation. The adoption of the integrated and multidisciplinary geoscience mapping strategy and its implementation laid the foundation for organisational stability, augmented by the appointment of energised executive management and managers accountable for operational efficacy.

The strategy was implemented in full during 2018/2019. The signals of technical stability have emerged, with the organisation attaining a technical performance of 94% during the year under review. Whereas the overall organisational performance dropped to 69%, compared to 88% for the two years before, the quality of the CGS programme has improved significantly.

Investment in human capital development is bearing fruit. I congratulate team members who obtained their Doctorate and Master's qualifications in the year under review. As a science council, we are steadily boosting the number of postgraduate qualifications in geosciences, who will carry on the legacy of the longstanding knowledge base advanced by our forebears and bequeath it to posterity.

The organisation is also improving its internal governance modalities and I am delighted that it has obtained a clean audit this year, after 16 consecutive years of unqualified audits. My heartfelt congratulations go to my fellow Board members and management for this exceptional

achievement. I implore CGS management to uphold the discipline in governance and entrench it as a culture of doing business. It is imperative that the CGS continues to move forward in the spirit of the National Development Plan (NDP) that seeks to, inter alia, build capable state institutions to optimally deliver on the Government's priorities.

As South Africa ushers in its sixth administration, the mantra that 'geology is the fulcrum for human development' can never be overstated, nor its poignancy ignored. The President of the Republic of South Africa, Mr Cyril Ramaphosa, affirmed that mining remains a sunshine industry. Notwithstanding the loss in the global exploration spend to below 1% over the past two decades, it is our conviction that the investment of R20 billion in geoscience in the country will reignite the appetite for this activity. We have drawn experiences from other nations and learnt that for every US$1 that the state invests in geoscience, it is able to generate US$5 from private sector investment in about five years and a further US$125 over 20 years. South Africa's decision to invest in the geosciences will, indeed, yield desirable results, drive inclusive economic growth, enhance environmental stewardship, and contribute to, among others, food and energy security (including instruments for carbon transition), optimal spatial planning and land use and support for the national water programme.

Although the country has a longstanding history of mining, its geological prospects remain unparalleled, especially with application of technology in the context of the fourth industrial revolution and artificial intelligence in geosciences. The importance of the junior mining industry is further amplified by the need to address a multiplicity of socio-economic challenges that characterise our society. We appreciate the role of geosciences in catalysing this industry and have adopted a 'data policy' with the Board, which will be implemented once the formalities are finalised. This policy is intended to avail geological information to society in a transparent and an orderly manner.

Sustainability is an integral part of the CGS mandate and business at the financial/economic, social, stakeholder and environmental levels. Sustainability is embedded in scientific focus and innovation of the organisation and the Board ensures that all CGS portfolios implement sustainable environmental, health and safety management systems. We are privileged to have a harmonious and diversified workforce that views the CGS as its employer of choice.

To new members of the team, we extend a warm welcome and to those who left us, thank you for your services and enjoy your new endeavours.

Sadly, death claimed three members of the CGS family this year. May the souls of Mr Obed Novhe (senior scientist), Ms Tlou Mashalane (junior scientist) and Mr Jacques Hugo (project administrator) rest in eternal peace. To all members of the CGS team who lost loved ones during the year, I offer my sincere condolences.

In conclusion, I acknowledge the Board and committee members for their consistent and meticulous attention to detail in executing their fiduciary responsibilities. The support they provide to the management team is invaluable. I wish Mr Owen Willcox well in pursuit of greener pastures, after resigning from the Board in January 2019. Mr Willcox was a representative of the Ministry of Finance and provided astute guidance.

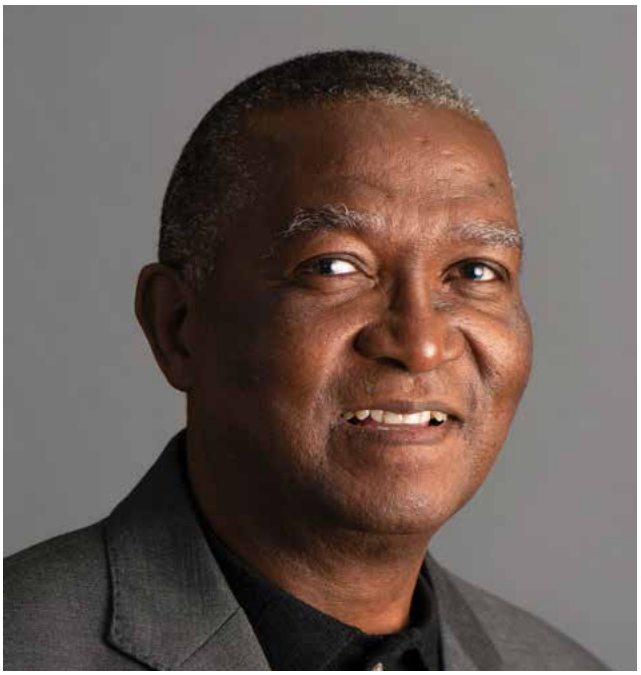
For their support, commitment, oversight and guidance, we owe our gratitude to the Parliament Portfolio Committee on Mineral Resources, the Minister and the officials of the Department of Mineral Resources.

The CGS is steadily building a stable environment capable of delivering on its mandate and creating a permanent legacy for South Africa. I have complete confidence that it will do the country proud.

Dr H Mathe
Chairperson
Board of the Council for Geoscience
31 July 2019

lentswe

LA KETAPELE KA MODULASETULO WA BOTO



NGAKA HUMPHREY MATHE
BOTO YA LEKGOTLA LA JIOSAENSE

Ke tlotla le monyaka o moholo ho nna ho teka tlaleho ya selemo ya Council for Geoscience (CGS) e kenyeletsang selemo sa ditjhelete sa 2018/2019, se thulanang le morero wa dilemo tse hlano wa Mmuso o bitswang Moralo wa Maano a Sehla se Bohareng (Medium-term Strategic Framework (MTSF)). Nakong ya dilemo tse hlano tse fetileng, CGS e fetile nakong ya ntlafatso e tswellang tjhebisisong ya tsa meralo, ho qala ka 'leano la tsitsisobotjha' le kentsweng tshebetsong ka karolo, le latelwang ke mokgahlelo wa 'kgwebo ka tsela e sa tlwaelehang' le qetellong, leano la hajwale le tjhorisitsweng le "le matahantsweng la dimmapa tse ngata la jiosaense' le ananetsweng ke Boto ya hajwale qalong ya sehla. Leano le boletsweng qetellong le tlisitse tlhomello le tlhophiso-botjha tse hlokehang tsa CGS tse behang boikarabello ba mokgatlo, jwalo ka ha o ngotswe molaong wa motheo wa wona, sehlohlolong sa tshebetso ya mokgatlo. Kananelo ya leano le matahantsweng la mafapha a mangata la dimmapa la jiosaense le ho kenngwa tshebetsong ha lona ho tekile moralo bakeng sa botsitso ba mokgatlo, bo matlafaditsweng ke ho thonngwa ha botsamaisi ba phethahatso le baokamedi ba tletseng

'Leha naha e na le nalane ya nako e telele ya merafo, menyetla ya yona e teng ho tsa jioloji ha e na phehisano, haholoholo ha ho sebediswa thekenoloji boemong ba phetohokgolo ya bone ya tsa dindasteri le mahlale a maiketsetso ho tsa jiosaense'

mafolofolo ba ikarabellang bakeng sa tshebetso e atlehileng ya mesebetsi.

Leano lena le kentswe tshebetsong ka botlalo nakong ya 2018/2019. Matshwao a botsitso ba sethekeniki a hlahile, moo mokgatlo o fihletseng tshebetso ya sethekeniki ya 94% nakong ya selemo se tlasa tlhahlobelo. Leha tshebetso e akaretsang ya mokgatlo e theohetse ho 69%, papisong le 88% bakeng sa dilemo tse pedi tse fetileng, boleng ba lenaneo la CGS bo ntlafetse ka tsela e kgolo.

Tjalo ya matsete ntshetsopeleng ya khapitale ya batho e fana ka ditholwana. Ke thoholetsa ditho tsa sehlopha tse fumaneng mangolo a tsona a thuto a Doctoral le Master's selemong se tlasa tlhahlobelo. Jwalo ka lekgotla la tsa saense, re ntse re ntlafatsa palo ya ba nang le mangolo a phahameng a thuto ho tsa jiosaense, e leng bona ba tlang ho tswelletsa letlotlo la nako e telele la motheo wa tsebo o hlahisitsweng ke baholoholo ba rona le ho le fetisetsa melokong e tlang.

Mokgatlo hape o ntlafatsa dibopeho tsa wona tsa tsamaiso ya ka hare mme ke motlotlo hore o fumane oditi e hlwekileng selemong sena, ka mora dilemo tse 16 tse latelanang tsa dioditi tse hlwekileng. Diteboho tse tswang botebong ba pelo ya ka di ya ho bomphato ba ka ba ditho tsa Boto le botsamaisi bakeng sa phihlello ena e kgetholohileng. Ke ipiletsa ho botsamaisi ba CGS ho tswelletsa bohlokolotsi ho tsa tsamaiso le ho bo tebisa hore ebe moetlo wa ho etsa kgwebo. Ho bohlokwa hore CGS e tswele pele ho hatela pele lebitsong la Morero wa Ntshetsopele wa naha (National Development Plan (NDP)) o batlang, hara tse ding, ho aha ditheo tsa naha tse nang le

bokgoni ho fana ka ditshebeletso tsa bohlokwa tsa Mmuso ka tsela e lekaneng.

Ha Afrika Borwa e kena mmusong wa yona wa botshelela, polelo e reng 'jioloji ke kgubu ya ntshetsopele ya setjhaba e bohlokwa ka tsela e ke keng ya hlalosiswa ho feta, mme tokeleho ya yona e ke ke ya iphapanyetswa. Mopresidente wa Riphaboliki ya Afrika Borwa, Mong Cyril Ramaphosa, o tiisitse hore merafo e dula e le indasteri e tswelletsehang. Ho sa natswe tahlehelo e teng tshebedisong ya tjhelete tshibollong ya dirafshwa lefatsheng ho pota e theohetseng ka tlase ho 1% nakong ya dilemo tse mashome mabedi tse fetileng, re dumela hore matsete a R20 bilione ho tsa jiosaense naheng a tla hotetsa botjha takatso tshebetsong ena. Re bone boiphihlelo ho tswa dinaheng tse ding mme ra ithuta hore bakeng sa US$1 e nngwe le e nngwe eo naha e e jalang matsete ho tsa jiosaense, e kgona ho fumana US$5 ho tswa matseteng a sektara ya poraefete nakong e ka bang dilemo tse hlano le US$125 e nngwe nakong ya dilemo tse fetang 20. Qeto ya Afrika Borwa ya ho jala matsete ho tsa jiosaense, bonnete, e tla fana ka diphetho tse labalabelwang, ya qhoba kgodiso ya kgwebo, ya matlafatsa tlhokomelo ya tikoloho, le ho tlatsetsa ho, hara tse ding, tshireletso ya phumano ya dijo (ho kenyeletswa disebediswa bakeng sa phetiso ya khabone), merero ya dibaka le tshebediso ya mobu le tshebetso bakeng sa lenaneo la metsi la naha.

Leha naha e na le nalane ya nako e telele ya merafo, menyetla ya yona e teng ho tsa jioloji ha e na phehisano, haholoholo ha ho sebediswa thekenoloji boemong ba phetohokgolo ya bone ya tsa dindasteri le mahlale a maiketsetso ho tsa jiosaense. Bohlokwa ba indasteri e nyane ya tsa merafo bo hlakisiswa le ho feta ke tlhokeho ya ho rarolla diphephetso tse ngata tsa bophelo ba setjhaba le moruo tse teng setjhabeng sa rona. Re thoholetsa seabo sa jiosaense sa ho beseletsa indasteri ena mme re ananetse 'leano la datha' ho Boto, le tla kenngwa tshebetsong hang ha meralo e phethahaditswe. Leano lena le reretswe ho fana ka tlhahisoleseding ya tsa jioloji setjhabeng ka tsela e nang le ponaletso le botsitso.

Tswelletseho ke karolo ya bohlokwa ya boikarabello ba CGS le kgwebo maemong a tsa ditjhelete /moruo, setjhaba, beng ba seabo le tikoloho. Tswelletseho e tsitsisitswe tjhebisisong ya saense mme boitlhahisetso ba mokgatlo le Boto bo netefatsa hore CGS e kenya tshebetsong tikoloho tse nang le tshwelletseho, disistimi tsa tsamaiso tsa bophelo bo botle le polokeho. Re lehlohonolo ho ba le basebetsi ba utlwanang ba ditsebo tse fapafapaneng ba bonang CGS jwalo ka mohiri wa kgetho.

Ho ditho tse ntjha tsa sehlopha, re nanabetsa kamohelo e mofuthu mme ho batho ba re siileng, re leboha ka ditshebeletso tsa lona mme re le lakaletsa hore le natefelwe mesebetsing ya lona e metjha.

Ka bomadimabe, lefu le nkile ditho tse tharo tsa lelapa la CGS selemong sena. Eka meya ya Mong Obed Novhe, Mof Tlou Mashalane le Mong Jacques Hugo e ka phomola ka kgotso. Ho ditho tsohle tsa sehlopha sa CGS tse lahlehetsweng ke baratuwa ba bona nakong ya selemo sena, ke fana ka matshediso a tswang botebong ba pelo.

Ha ke phethela, ke ananela Boto le ditho tsa dikomiti ka boikitlaetso ba bona bo tsitsitseng mme bo tswileng matsoho mabapi le bohlokolotsi ho phethahatseng boikarabello ba bona ba tsa bodisa ba khampani. Tshehetso eo ba fanang ka yona ho sehlopha sa tsamaiso e molemo ka tsela e kgolo. Ke lakaletsa Mong Willcox mahlohonolo/botle leetong la hae la ho latela makgulo a matala, ka mora ho itokolla Botong ka Pherekgong 2019. Mong Willcox e bile moemedi wa Lefapha la tsa Ditjhelete mme o fane ka tataiso e tiileng.

Bakeng sa tshehetso ya bona, boikitlaetso, bodisa le tataiso, re motlotlo ho Komiti ya Potefolio ya Mehlodi ya Diminerale ya Palamente, Letona le baofisiri ba Lefapha la Mehlodi ya Diminerale.

CGS e aha butlebutle tikoloho e tsitsitseng e nang le tswelletseho e nang le bokgoni ba ho phethahatsa boikarabello ba yona le ho theha letlotlo la dinako tsohle bakeng sa Afrika Borwa. Ke na le boitshepo bo phethahetseng ba hore e tla re fa naha e motlotlo.

Ngaka H Mathe
Modulasetulo
Boto ya Lekgotla la Jiosaense
Letsatsi: 31 Phupu 2019

overview

BY THE CHIEF EXECUTIVE OFFICER (CEO)

'Geoscience is the fulcrum of human development'

MR MOSA MABUZA | CEO
BOARD OF THE COUNCIL FOR GEOSCIENCE

The newly implemented strategy, which focuses on the integrated and multidisciplinary geoscience mapping programme, is demonstrating admirably how geology or geosciences contributes broadly to human development and society. Geosciences programmes at the CGS are aligned with our founding legislation, the Geoscience Act, as amended, and are not limited to minerals development but are a contribution to, inter alia, infrastructure development, agriculture and food security, medical geology, energy security, groundwater, engineering geology and geohazards identification for pre-emptive disaster management.

The CGS will continue executing its geoscience programme to provide innovative geoscience solutions to support the NDP and other Government plans that address economic growth, poverty, inequality, job creation, education, clean water, affordable and clean energy, and safer communities. Mining will remain the sunrise industry, and geoscience information will remain a mainstay in the development of the nation. Investment in geosciences will open gates for acquisition of new geological information, which will aid in exploration, production and beneficiation.

During the year, the CGS closed its analytical services as a result of concerns about compromised air quality. This negatively impacted the implementation of the laboratory ISO accreditation activities and the organisation-wide implementation of ISO, which created dissatisfaction among customers and clients. In response, CGS management has taken precautions to ensure the integrity of the organisation's analytical facility, and to safeguard the health and safety of employees. Internal and external investigations are nearing completion to identify the root cause of the problem.

Highlights during the year under review included the drafting of the Geoscience Data and Information Policy (GDIP), which has been approved by the Board. The modalities for implementation of the GDIP are subject of finalisation and this applies to the management of geoscience data and information held by the CGS and

addresses its access, security, ownership, classification and release, including confidential data and information handled on behalf of clients and stakeholders. The policy will enable South Africa to, inter alia, attract investment in exploration programmes.

The CGS was declared a national key point (NKP) by the Minister of Police, Mr Bheki Cele, after careful consideration of its role in the Republic. The South African Police Service (SAPS), as the Government security regulator, performed the inauguration and handed over the NKP certificate in line with the NKP Act 102 of 1980.

During the year under review, the CGS Geoscience Technical Programme (GTP) made considerable progress in reviewing the role of the organisation in addressing the country's socio-economic challenges. Under the Geoscience for Minerals and Energy Programme, the CGS continued with geoscience investigations to develop a geo-environmental baseline in the southern Karoo to enable informed decision-making and strengthen the regulatory framework for possible shale gas development. In 2017/18, approximately 33 million litres of water per month were made available to the drought-stricken Beaufort West area through multidisciplinary research undertaken by the CGS. To this day, the municipality of Beaufort West continues to pump water sustainably from CGS boreholes. In June 2018, subsequent to the drilling of shallow observation wells, the CGS drilled two additional deeper monitoring holes to depths of 517m and 1 402m, respectively. The 517m borehole intersected significant volumes of good groundwater, while the 1 402m borehole was found to be mostly dry. The additional reserves of groundwater discovered through this exercise are readily available to supplement the current groundwater supply for the Beaufort West community, should this be necessary. The carbonaceous shales of the Tierberg Formation of the Ecca Group were intersected at a depth of 919m. Plans are afoot to start drilling of a 3 500m ultra-deep vertical stratigraphic research borehole in 2019/20. Other minerals and energy projects included new discoveries in the continuation of the shear zone in the Limpopo Greenstone Belt (known as the Giyani Greenstone Belt). This has major implications in the possible extension of gold mineralisation in the region. The CGS will continue with investigations to better understand the Greenstone Belt.

For the first time in its history, the CGS produced a seamless onshore and offshore geological map for the Cape South Coast, which shows the extension of the geology from Cape Agulhas to Plettenberg Bay and from the Langeberg Mountains to 130m below mean sea level. The map will assist in enhancing economic growth through research on the coast and continental shelf of South Africa and will boost the blue economy.

As the global population continues to rise, demand for renewable and cost-effective energy also rises. Current global economies rely mainly on fossil fuels, which contribute to the greenhouse emissions that will impact on climate change. During the year, the CGS focused on characterisation and understanding of the subsurface characteristics of five identified regions of South Africa that show anomalously high geothermal gradients and significant heat flow, which may support the development of low-enthalpy geothermal systems.

We published 26 peer-reviewed articles this financial year, some of which reported new discoveries in the Springbok Flats Basin, which is marked as one of the future energy basins of South Africa, with uranium and coal resources identified and potential for coal gas exploration. The discoveries highlighted the importance of palynology, sedimentology and coal petrology, which resolved problems of stratigraphic units (i.e. correlation of economically significant coal units) and reconstruction of palaeoenvironments of the poorly understood Springbok Flats Basin.

Economic growth of any nation relies on land and infrastructure development. Under the Geoscience for Infrastructure and Land Use Programme, the CGS continues to collaborate with the Northern Cape Department of Cooperative Governance, Human Settlements and Traditional Affairs (CoGHSTA) in special programmes such as Mining Town Revitalisation and Land Restitution. The CGS advises CoGHSTA on allowable development (i.e. the type and size of house and stands) on especially dolomitic land, and on risk-management precautions. Whilst South Africa remains a water-scarce country, the CGS, through its mandate, continues to focus on geoscience research work in mapping of groundwater aquifers. During the year under review, groundwater projects centred on the Kuruman-Ditshilabeleng-Kathu area. The CGS continued with the

overview

BY THE CHIEF EXECUTIVE OFFICER (CEO)

mine water management programme to investigate the impact and mitigation scenarios related to water and the environment in mining. During the year, an extensive study was completed on environmental impact of marine and coastal mining, which will contribute to the development of a regulatory framework. The CGS also assisted the state by evaluating, quantifying and closing derelict and ownerless (D&O) mines in South Africa.

In addition, three innovation projects were completed, including the development of open source 3D software, PyGMI (Python Geophysical Modelling and Interpretation), to create high-resolution 3D geoscience models to interpret, process and analyse seismic and drillhole data. The second project focused on synthesis of nano-sized mineral materials from readily available bushveld mine tailings to be applied in the preparation of plant nano-fertilisers for drought stress management (i.e. nano-minerals for food security) and of nano-additives for rapid geopolymer strength development. The last project focused on the development of a software program, using fuzzy expert systems, to enable rapid and accurate classification of boreholes drilled in dolomitic land, using input parameters (e.g. voids, air loss, material loss, depth-to-water table, depth to bedrock, layer thickness, layer material type and wetness information) typically contained in borehole logs.

The CGS continued implementation of its Geoscience Diplomacy Programme, undertaking a transfrontier geological mapping programme in Namibia, Malawi, Cameroon and Burkina Faso. These projects promote the generation of fundamental geological data necessary to support economic development, and training and development of local geologists and students.

Also, as secretariat of the Organisation of the African Geological Surveys (OAGS), the CGS continues to play a leadership role in improving African partnerships and collaboration.

We hosted our third annual conference on 11 and 12 February 2019. National and international scientists gathered to discuss the CGS's 'integrated and multidisciplinary geoscience mapping programme 2018–2021' under the conference theme, 'Merging maps for an emerging future'. The multidisciplinary mapping programme stems directly from the CGS's mandate and addresses the goals of the NDP. Eleven local and international speakers delivered presentations on the subthemes of geoscience for minerals and energy, geoscience for infrastructure and land use, geoscience for health, groundwater and the environment, geoscience innovation and geoscience diplomacy. The conference set out to provide stakeholders with insight into the nationally funded CGS research projects and to show, via the invited speakers, new areas of enterprise that its scientists could pursue. Some 81 abstracts were received and published in an abstract volume. A highlight of the conference was the honouring of Prof Maarten de Wit for his significant contribution to South Africa's geology and the inspiration he has been to students and those he has led to postgraduate degrees. Also noteworthy was the official launch of the new digital 1:1 000 000-scale geological map of South Africa. Two awards were presented: one for 'best poster presentation', the other for the 'best young scientist presentation'. Two post-conference workshops were held at the CGS head office, entitled 'Passive treatment systems — the good, the bad and the complicated' and 'Global landmarks in the South African stratigraphic record'. These workshops were well attended, opening up ideas for new exciting research, avenues for collaboration between the CGS and academia, and mapping and research areas for the CGS to target.

I am delighted to congratulate the following colleagues who obtained PhD and MSc qualifications:

- Dr MT Atanasova – PhD: Materials Science
- Dr J Cole – PhD: Geophysics
- Dr P Cole – PhD: Geophysics
- Dr TG Dhansay – PhD: Geology
- Dr N Hicks – PhD: Geology
- Dr E Sakala – PhD: Geohydrology
- Ms MG Dube – MSc: Environmental Sciences
- Mr R Lusunzi – MSc: Mining and Environmental Geology
- Ms NP Magwaza – MSc: Chemistry
- Mr S Ndumo – MSc: Applied Geology
- Mr FW Van Zyl – MSc: Geology
- Mr BS Zulu – MSc: Geophysics
- Mr I Saunders – MTech: Geology

In December 2018, we hosted the CGS Excellence Awards to acknowledge and appreciate colleagues who attained excellence in geoscience work. We congratulate all nominees and winners. The special category of the CEO's award for excellence, which is named after Mr Elijah Nkosi, was awarded to Mrs Corlien Cloete, Dr Doug Cole, Mr Schalk Strauss, Mr Johannes Radebe and Mr John Mokoatedi, and the ever-exceptional drilling team that consists of Mr Jimmy Matjeng, Mr Daniel Makgate, Mr Joel Masha, Mr Andries Somo, Mr Daniel Mokonyama and Mr Obed Novhe. Mr Novhe received the award posthumously.

Investment in people remains critical and we commit an average of 2% of our liveable payroll to training and development. At the end of the financial year, we had invested in 52 fulltime bursars, seven at PhD level, and 30 MSc, 13 BSc Honours and two BSc students. We also invested in part-time bursaries for our colleagues at the CGS, benefitting 102 part-time bursars, 20 of whom are PhDs and 40 at MSc level. We also provided opportunities for employment training through our internship programme. In 2018/2019, 26 interns were assisted with various qualifications.

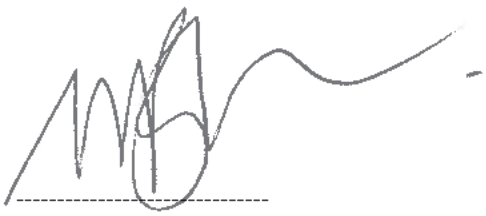
Every year has its high and low moments. In the year under review, we bade farewell to many true stalwarts of geosciences, as they entered retirement. We celebrate the sterling contribution of these colleagues who served the organisation well:

- Mr BJ Mxatule – 25 years as an Administrative Officer: Logistics in Geological Resources
- Mr MW Diketane – 40 years as a General Clerk in Corporate Services
- Mr B Mpofana – 25 years as a General Clerk in Geological Resources
- Mr PSH Phushela – 25 years as an Asset Control Officer in Finance
- Mrs TN Swart – 30 years as an Administrative Officer in Corporate Services, and
- Dr GS de Kock – 40 years as a Specialist Scientist in Geological Resources.

My deepest condolences go to colleagues who lost family members and friends during the year. The sadness of loss hit the CGS family particularly strongly with the untimely deaths of Miss TB Mashalane, a Junior Scientist in the Water and Environment Unit, Mr NO Novhe, a Senior Scientist in the Water and Environment Unit and Mr JLM Hugo, a Project Administrator in the Finance Management Unit. To all those who are convalescing at present, we look forward to welcoming you back.

As I end this year's overview, I share my conviction that we have built a solid foundation on which to create a stronger and more delivery-focused CGS. This we could have achieved only because we recognise that we are proverbially standing on the shoulders of giants in the form of all our forebears. Let us seize this moment and continue crafting a formidable legacy for generations ahead of us.

My special thanks go to the Board members of the CGS, under the judicious leadership of the chairperson, Dr Humphrey Mathe, for their patience, meticulous evaluation of our work, support and guidance throughout the year.



Mr M Mabuza
Chief Executive Officer
Council for Geoscience
31 July 2019

tlhakisetso YA MOOFISIRI YA KA SEHLOOHONG WA PHETHAHATSO

MR MOSA MABUZA | MOOFISIRI YA KA SEHLOOHONG WA PHETHAHATSO LEKGOTLA LA JIOSANSE

Leano le sa tswa kenngwa tshebetsong, le tsepamisang maikutlo hodima lenaneo le matahantsweng la mafapha a mangata la dimmapa tsa jiosaense, le bontsha ka tsela e bohehang ka moo ditlatsetso tsa jioloji kapa jiosaense di tlatsetsang ka pharallo ho ntshetsopele ya setjhaba. Mananeo a jiosaense a CGS a matahantswe le molao wa motheo, Molao wa Geoscience, le dihlopmathiso tsa wona, mme ha a felle feela mabapi le ntshetsopele ya diminerale empa ke tlatsetso ho, hara tse ding, ntshetsopele ya disebediswa, temo le tshireletseho ya phumano ya dijo, jioloji ya tsa bongaka, tshireletseho ya eneji, metsi a ka tlasa lefatshe, jioloji ya boenjineri le tsebahatso ya dikotsi tsa jioloji bakeng sa thibelo ya dikoduwa e sa le pele.

CGS e tla tswela pele ho phethahatsa lenaneo la yona la jiosaense ho fana ka ditharollo tse nang le boitlhahisetso ho tshehetsa NDP le merero e meng ya Mmuso e shebanang le kgolo , bofuma, tlhokeho ya tekano, ho thehwa ha mesebetsi, thuto, metsi a hlwekileng, eneji ya theko e kgonehang le e hlwekileng, le setjhaba se

'Jiosaense ke kgubu ya ntshetsopele ya setjhaba'

bolokehileng. Merafo e tla dula e le indasteri e nang le bokamoso, mme tlhahisoleseding ya jiosaense e tla dula e le tshia ntshetsopeleng ya naha. Matsete ho tsa jiosaense a tla bula ditsela bakeng sa phumano ya tlhahisoleseding e ntjha ya tsa jioloji, e tlang ho thusa tshibollo, tlhahiso le ntlafatso ya dirafshwa.

Nakong ya selemo, CGS e kwetse ditshebeletso tsa yona tsa manollo ka lebaka la dingongoreho tse mabapi le boleng ba moya bo tlase. Sena se amme ka tsela e mpe ho kenngwa tshebetsong ha ditshebetso tsa phano ya kananelo tsa laboratori tsa ISO le ho kenngwa tshebetsong ha mokgatlong ka bophara ha ISO, ho thehileng ho se kgotsofale hara bareki le ditlelaente. E le karabelo ho sena, botsamaisi ba CGS bo nkile mehato ya ho netefatsa hore seriti sa setsi sa manollo sa mokgatlo se a sireletswa, le ho boloka bophelo bo botle le polokeho ya basebetsi. Diphuputso tsa ka hare le tsa kantle di atametse ho phethelwa ho tsebahatsa sesosa sa bothata bona.

Dintlhakgolo nakong ya selemo se tlasa tlhahlobelo di kenyeleditse ho ralwa ha Leano la Jiosaense le Datha le Tlhahisoleseding (Geoscience Data and Information Policy (GDIP)), tse ananetsweng ke Boto. Mekgwa ya phethahatso ya GDIP e tlasa phethelo mme sena se sebetsa bakeng sa tsamaiso ya datha ya jiosaense le tlhahisoleseding e tshwerweng ke CGS mme e sebetsana le phihlello ya yona, tshireletso, thuo, tlhophiso le tokollo, ho kenyeletswa datha ya sephiring le tlhahisoleseding e tshwerweng lebitsong la ditlelaente le boraseabo. Leano le tla kgonahatsa hore Afrika Borwa, hara tse ding, e hohele matsete mananeong a tshibollo.

CGS e phatlaladitswe jwalo ka sebaka sa bohlokwa sa naha (national key point (NKP)) ke Letona la Sepolesa, Mong Bheki Cele, ka mora tekodiso e hlokolotsi ya seabo sa yona kahare ho Riphaboliki ya Afrika Borwa. Ba Ditshebeletso tsa Sepolesa tsa Afrika Borwa (South African Police Service (SAPS)), jwalo ka balaodi ba tshireletso ba Mmuso, ba entse tlhomamiso le nehelano ya setifikeiti sa NKP ho latela Molao wa NKP 102 wa 1980.

Nakong ya selemo se tlasa tlhahlobelo, CGS Geoscience Technical Programme (GTP) e entse kgatelopele e kgolwanyane ho lekoleng seabo sa ho rarolla diphephetso tsa naha tsa setjhaba le tsa moruo. Tlasa Lenaneo la Jiosaense bakeng sa Diminerale le Eneji, CGS e tswetse pele ka diphuputso tsa jiosaense ho hlahisa motheo wa tikoloho wa jioloji Karoo e ka borwa ho kgonahatsa ketso ya diqeto e nang le tlhahisoleseding le ho matlafatsa moralo wa melao bakeng sa ntlafatso ya gase ya shale. Ka 2017/18, dilitara tse ka bang 33 milione tsa metsi ka kgwedi di fanwe tikolohong e otlilweng ke komello ya Beaufort West ka thuso ya dipatlisiso tsa mafapha a mangata tse entsweng ke CGS. Ho fihla letsatsing lena, masepala wa Beaufort West o tswela pele ho pompa metsi ka tsela e nang le tswelletseho ho tswa didibeng tse ahilweng. Ka Phupjane 2018, ka mora ho borwa ha didiba tse sa tebang tsa temoho, CGS e borile didiba tse pedi tse tebileng haholwanyane botebong ba 517m le 1 402m, bobedi. Sediba sa 517m se kopane le metsi a mangata a matle, ha sediba sa botebo ba 1 402m se fumanwe boholo se omme. Dipolokelo tsa tlatsetso tsa metsi a ka tlasa lefatshe tse fumanweng ka tshebediso ena di fumaneha ka tsela e fumanehang ha bonolo ho tlatsetsa phepelo ya hajwale ya metsi a ka tlasa lefatshe bakeng sa setjhaba sa Beaufort West, haeba sena se ka hlokeha. Di-shale tse nang le khabone tsa Tierberg Formation tsa Ecca Group di fumanwe botebong ba 919m. Merero e hatetse pele ya ho qala ho bora sediba sa dipatlisiso sa botebo bo fetisisang ba 3 500m bo tsepameng se parolang mekgahlelo e mengata ka 2019/20. Diminerale tse ding le diprojeke tsa eneji di kenyeleditse ditshibollo tse ntjha ntshetsopeleng ya zounu ya 'shear' mane Limpopo Greenstone Belt (e tsejwang ka hore ke Giyani Greenstone Belt). Sena se na le diphello tse kgolo katolosong ya diminerale tsa kgauta tikolohong ena. CGS e tla tswela pele ka diphuputso bakeng sa ho utlwisisa hantle le ho feta Greenstone Belt.

Lekgetlo la pele nalaneng ya yona, CGS e hlahisitse mmapa wa jioloji o hlokang mathata wa lewatleng le naheng bakeng sa Cape South Coast, o bontshang katoloso ya jioloji ho tloha Cape Agulhas ho fihla Plettenberg Bay le ho tloha Dithabeng tsa Langeberg ho fihla botebong ba 130m ka tlase ho lewatle. Mmapa o tla thusa ho matlafatsa kgolo ya moruo ka dipatlisiso tse etswang lebopong la lewatle le ho shelefo ya kontinente ya Afrika Borwa mme o tla thusa moruong wa lewatle.

Ha setjhaba sa lefatshe ka kakaretso se ntse se tswela pele ho eketseha, tlhokeho bakeng sa eneji e ntjhafatswang le e batlang ditjeo e a eketseha. Meruo ya hajwale e itshetlehile haholo dibesong tsa fosaele, tse tlatsetsang dikgaseng tsa tshilafatso tsa 'greenhouse' tse tla ama phetoho ya tlelaemete. Nakong ya selemo, CGS e tsepamisitse maikutlo le kutlwisiso ya dintlha tsa ditikoloho tse hlano tse tsebahaditsweng tsa Afrika Borwa tse bontshang dikeradiente tse bokowa tsa phallo ya motjheso, tse ka tshehetsang tlhahiso ya disistimi tsa jiothemale tsa 'enthalpy' e tlase.

Re phatlaladitse dingolwa tse 26 tsa bomphato selemong sena sa ditjhelete, tseo tse ding tsa tsona di tlalehileng ditshibollo tse ntjha ho Springbok Flats Basin, e nkuwang e le e nngwe ya diphula tsa matla tsa kamoso Afrika Borwa, moo mehlodi ya yuraniamo le mashala e fumanweng le bokgoni ba ho ka rafa kgase ya mashala. Ditshibollo tsena di hlakisitse bohlokwa ba palynology, sedimentology le coal petrology, tse rarolotseng mathata a diyuniti tsa stratigraphy (k.h.r. matahanyo ya diyuniti tsa mashala tse nang le bohlokwa bo boholwanyane ba tsa moruo) le kaho botjha ya ditikoloho tsa boholoholo (palaeoenvironments) tsa Springbok Flats Basin e sa utlwisisweng ka tsela e ntle.

Kgolo ya moruo ya naha efe kapa efe e itshetlehile hodima ntshetsopele ya inforastraktjha ya mobu. Tlasa Lenaneo la Jiosaense bakeng sa Inforastraktjha le Tshebediso ya Mobu, CGS e tswela pele ho sebedisana le Northern Cape Department of Cooperative Governance, Human Settlement and Traditional Affairs (CoGHSTA) mananeong a kgethehileng jwalo ka Tlhabollo-Botjha ya Ditoropo tsa Merafong le Puseletso ya Mobu. CGS e eletsa CoGHSTA mabapi le ntshetsopele e dumeletsweng (k.h.r. mofuta le saese ya matlo le ditsha) mobung o nang le dolomaete, le ho nkeng mehato ya tlhokomelo bakeng sa taolo ya menyetla ya kotsi. Ha Afrika Borwa e sa ntse e le naha e haellwang ke metsi, CGS, ho latela boikarabello ba yona, e tswela pele ho tsepamisa maikutlo hodima mosebetsi wa dipatlisiso tsa jiosaense ho raleng dimmapa tsa mehlodi ya metsi e ka tlasa lefatshe. Nakong ya selemo se tlasa tlhahlobelo, diprojeke tsa metsi a ka tlasa lefatshe di tsitsisitswe tikolohong ya Kuruman-Ditshilabeleng-Kathu. CGS e tswetse pele ka lenaneo la taolo ya metsi la merafo ho fuputsa maemo a diphello le pebofatso a amanang le metsi le tikoloho merafong. Nakong ya selemo, phuputso e pharaletseng e phethilwe mabapi le kameho ya tikoloho

tlhakisetso

YA MOOFISIRI YA KA SEHLOOHONG WA PHETHAHATSO

ya merafo ya lewatleng le mabopong a lewatle, e tlang ho tlatsetsa ntshetsopeleng ya moralo wa taolo. CGS hape e thusitse naha ka ho lekanya, ho fumana palo le ho kwala merafo e nyahladitsweng mme e se nang beng (D&O) Afrika Borwa.

Hodima mona, diprojeke tse tharo tsa boitlhahisetso di phethilwe, tse kenyeletsang ho hlahiswa ha open source 3D software, PyGMI (Python Geophysical Modelling and Interpretation), ho theha dimmotlolo tsa jiosaense tsa 'high-resolution 3D' tse tolokang, tse sebetsang le ho manolla datha ya tshisinyeho ya lefatshe le ho etjwa ha didiba. Projeke ya bobedi e tsepamisitse maikutlo hodima matahanyo ya dimatheriale tsa diminerale tsa saese ya 'nano' hara masalla a fumanehang dihlatheng a tla sebediswa ho etsweng ha manyolo a polanteng a thekenoloji ya 'nano' bakeng sa taolo ya kgatello e bakwang ke komello (k..h.r. diminerale tsa 'nano' bakeng sa tshireletseho ya phumaneho ya dijo) le dieketswa tsa thekenoloji ya 'nano' bakeng sa matlafatso ya kapele ya matla a geopolymer. Projeke ya ho qetela e tsepamisitse maikutlo hodima ho hlahiswa ha lenaneo la software, ho sebediswa disistimi tsa botsebi tse sa hlakang, ho dumella tlhophiso ya kapele le e nepahetseng ya didiba tse borilweng mobung wa dolomaete, ka ho sebedisa dipharamitha tsa tlatsetso (j.k. maphao, tahlehelo ya moya, tahlehelo ya matheriale, botebo ba ho fihla theiboleng ya metsi, botebo ba letlapa, morumo wa mokato, mofuta wa matheriale ya mokato le tlhahisoleseding ya mongobo) eo ka tlwaelo e leng teng matotong a didiba tse borilweng.

CGS e tswelleditse ho kenngwa tshebetsong ha Lenaneo la yona la Diplomasi ya Jiosaense (Geoscience Diplomacy Programme), moo e phethahatsang mmapa wa jioloji o parolang madiboho dinaheng tsa Namibia, Malawi, Cameroon le Burkina Faso. Diprojeke tsena di kgothaletsa tlhahiso ya datha ya motheo ya jioloji e hlokehang ho tshehetsa ntshetsopele ya moruo, le thupello le ntshetsopele ya dijiolojiste le baithuti.

Hape, jwalo ka bongodi ba Organisation of the African Geological Surveys (OAGS), CGS e tswela pele ho bapala seabo sa boetapele ho ntlafatseng dilekane le tshebeletsano dinaheng tsa Afrika.

Re tshwere seboka sa rona sa boraro sa selemo le selemo ka la 11 le la 12 Hlakola 2019. Borasaense ba naheng le ba matjhaba ba bokane ho tshohla lenaneo la mafapha a mangata a matahantsweng la dimmapa tsa jiosaense la CGS la 2018–2021' tlasa leano la seboka la, 'ho matahanya dimmapa bakeng sa bokamoso bo hlahang'. Lenaneo la mafapha a mangata la dimmapa le hlaha ka kotlololoho boikarabellong ba CGS mme le tobana le dipakane tsa NDP. Ditlalehelo tse leshome le motso o mong tsa lehae le tsa matjhaba hodima meralwana ya jiosaense bakeng sa bophelo bo botle, metsi a ka tlasa lefatshe le tikoloho, diplomasi ya boitlhahisetso le jiosaense. Seboka se qadile ho fa boraseabo tjhebo e mabapi le diprojeke tsa patlisiso boemong ba naha tse tsheheditsweng ka ditjhelete ke CGS le ho bontsha, ka dibui tse menngweng, dibaka tse ntjha tsa kgwebo tseo borasaense ba yona ba ka di salang morao. Diqotso tse 81 di amohetswe le ho phatlalatswa bukeng ya diqotso. Ntlhakgolo ya seboka e bile ho tlotla Prof Maarten de Wit bakeng sa tlatsetso ya hae e kgolo ho jioloji ya Afrika Borwa le tsela eo ka yona a neng a kgothatsa baithuti le batho bao a ba eteletseng pele dithutong tsa bona tse phahameng. Se seng se lokelang ho lemohuwa e bile ho thakgolwa ha mmapa o motjha wa semmuso wa ditjithale wa sekala sa 1:1 000 000 wa jioloji Afrika Borwa. Dikgau tse pedi di fanwe: e le nngwe bakeng sa 'ho tekwa ha phoustara e hlakileng ka ho fetisisa', e nngwe ke ya 'tlhakisetso e hlwahlwa ka ho fetisisa ya rasaense wa motjha'. Diwekshopo tse pedi tsa ka mora seboka di tshwretswe ntlokgolo ya CGS, tse bitswang 'Passive treatment systems — the good, the bad and the complicated' le 'Global landmarks in the South African stratigraphic record'. Diwekshopo tsena di kenetswe ke batho ba bangata, ho bulela mehopolo bakeng sa patlisiso e ntjha e thabisang, metjha bakeng sa tshebeletsano dipakeng tsa CGS le barupelli ditsing tsa thuto, le ho rala dikarolo tsa dimmapa bakeng sa hore CGS e lokela ho toba eng.

Ke thabile ho thoholetsa bomphato ba latelang ba fumaneng mangolo a PhD le MSc:

- Ngaka MT Atanasova – PhD: Saense ya Dimatheriale
- Ngaka J Cole – PhD: Jiofisikse
- Ngaka P Cole – PhD: Jiofisikse
- Ngaka TG Dhansay – PhD: Jioloji
- Ngaka N Hicks – PhD: Jioloji
- Ngaka E Sakala – PhD: Jiohaedroloji
- Mof MG Dube – MSc: Disaense tsa Tikoloho

- Mong R Lusunzi – MSc: Jioloji ya Merafo le Tikoloho
- Mof NP Magwaza – MSc: Khemistri
- Mong S Ndumo – MSc: Jiolofi ya Tshebediso
- Mong FW Van Zyl – MSc: Jioloji
- Mong BS Zulu – MSc: Jiofisikse
- Mong I Saunders – MTech: Jioloji

Ka Tshitwe 2018, re tshwere Dikgau tsa Tshebetso e tswileng Matsoho tsa CGS, re ananela le ho thoholetsa bomphato ba fihletseng tshebetso e tswileng matsoho mosebetsing wa jiosaense. Re thoholetsa bathonngwa bohle le bahlodi. Kgau ya mokgahlelo o kgethehileng ya Moofisiri wa Phethahatso wa Sehlooho bakeng sa tshebetso e tswileng matsoho, e reheletsweng ka Mong Elijah Nkosi, e abetswe Mof Corlien Cloete, Ngaka Doug Cole, Mong Schalk Strauss, Mong Johannes Radebe le Mong John Mokoatedi, sehlopha se kgethehileng sa ho bora se bopilweng ka Mong Jimmy Matjeng, Mong Daniel Makgate, Mong Joel Masha, Mong Andries Somo, Mong Daniel Mokonyama, Mofumahadi Tlou Mashalane le Mong Obed Novhe. Mong Novhe ba fuwe kgau ena ka mora lefu la bona.

Tjalo ya matsete bathong e dutse e le taba ya bohlokwa mme re tsetela palohare ya 2% ya tjhelete ya rona eo re e lefang bakeng sa thupello le ntshetsopele. Qetellong ya selemo sa ditjhelete, re ne re jetse matsete dibasaring tse 52 tsa nako e feletseng, boemong ba PhD, le tsa baithuti tse 30 tsa MSc, tse 13 tsa BSc Honours le tse 2 tsa BSc. Re se ntse re jetse matsete dibasaring tsa karolo ya nako bakeng sa bomphato ba rona ho CGS, tse tswetsweng molemo baithuti ba 102 ba karolo ya nako, bao ba 20 ba bona e leng ba mangolo a boemong ba PhD le ba 40 ba mangolo a MSc. Hape re fane ka menyetla bakeng sa thupello ya kahare ho kgiro ka lenaneo la rona la thupello ya makolwane a ithutelang mosebetsing. Ka 2018/2019, makolwane a ithutelang mosebetsing a 26 a thusitswe mangolong a thuto a fapafapaneng.

Selemo se seng le se seng se na le dinako tsa sona tsa mathata le tsa bonolo. Selemong se tlasa tlhahlobelo, re feleheditse dikgalala tse ngata tsa nnete tsa dijiosaense, ha di ne di beha meja fatshe. Re keteka tlatsetso e tswileng matsoho ya bomphato ba sebeleditseng mokgatlo ona hantle:

- Mong BJ Mxatule – dilemo tse 25 jwalo ka Moofisiri wa Tsamaiso: Dilojistiki le Dirisoseng tsa Jioloji
- Mong MW Diketane – dilemo tse 40 jwalo ka Tlelereke e Akaretsang Ditshebeletsong tsa Khoporeite
- Mong B Mpofana – dilemo tse 25 jwalo ka Tlelereke e Akaretsang Dirisoseng tsa Jioloji
- Mong PSH Phushela – dilemo tse 25 jwalo ka moofisiri wa Taolo ya Matlotlo Lefapheng la tsa Ditjhelete
- Mof TN Swart – dilemo tse 30 jwalo ka Moofisiri wa Tsamaiso Ditshebeletsong tsa Khoporeite, le
- Ngaka GS de Kock – dilemo tse 40 jwalo ka Rasaense ya Kgethehileng wa Dirisose tsa Jioloji.

Matshediso a tswang botebong ba pelo a ya ho bomphato ba lahlehetsweng ke ditho tsa lelapa le metswalle selemong sena. Bohloko ba ho lahlehelwa bo thefutse lelapa la CGS ka tsela e kgolo ka mafu a sa lebellwang a Mof Miss TB Mashalane, Mmasaense e Monyane Yuniting ya Metsi le Tikoloho, Mong NO Novhe, Rasaense e Moholo Yuniting ya Metsi le Tikoloho le Mong JLM Hugo, Motsamaisi wa Projeke Yuniting ya Botsamaisi ba tsa Ditjhelete. Ho bohle ba ntseng ba hlaphohelwa hajwale, re tla thabela ho le bona le kgutlile.

Ha ke phethela tekodiso ena ya selemo, ke arolelana tumelo ya ka ya hore re ahile motheo o matla oo hodima wona re tla theha CGS e matla mme e tsepamisitseng maikutlo phanong ya tshebetso. Sena e ka nna yaba re se fihletse feela hobane re ananela hore re jerwe ke mahetla a dinatla tseo e leng baholoholo ba rona. Ha re nkeng monyetla ona mme re tswele pele ho rala leano le matla bakeng sa meloko e ka pele ho rona.

Teboho ya ka e kgethehileng e ya ho ditho tsa Boto ya CGS, tlasa boetapele bo nang le toka ba modulasetulo, Ngaka Humphrey Mathe, bakeng sa mamello ya bona, tekodiso e hlokolotsi ya mosebetsi wa rona, tshehetso le tataiso nakong ya selemo sohle.

Mong M Mabuza
Moofisiri ya ka Sehloohong wa Phethahatso
Lekgotla la Jiosanse
Letsatsi: 31 Phupu 2019

5. STATEMENT OF RESPONSIBILITY FOR PERFORMANCE INFORMATION

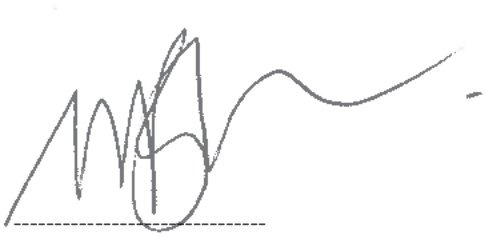
Statement of responsibility for performance information for the year ended 31 March 2019

The Chief Executive Officer (CEO) is responsible for the preparation of the performance information of the CGS and the judgments made in this information.

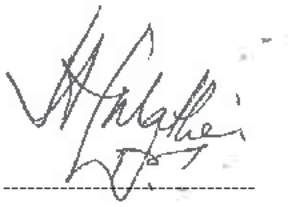
Moreover, it is the responsibility of the CEO to establish and implement a system of internal controls designed to provide reasonable assurance of the integrity and reliability of performance information.

In our opinion, the performance information fairly reflects the actual achievements against planned objectives, indicators and targets of the strategic and annual performance plan of the CGS for the financial year ended 31 March 2019.

The performance information of the CGS for the year ended 31 March 2019 has been examined by the external auditors and their report is presented on pages 30 to 32. The performance information was also approved by the Board of the CGS.



Mr M Mabuza
Chief Executive Officer
Council for Geoscience
31 July 2019



Dr H Mathe
Chairperson
Board of the Council for Geoscience
31 July 2019

6. STRATEGIC OVERVIEW

The core mandate of the CGS is inscribed in its founding prescripts. The vision, mission and core values of the organisation aptly find their expression, as outlined in Geoscience Act No 100 of 1993, as amended, as follows:

6.1. Vision

A prosperous and transformed society enabled by geoscience solutions.

6.2. Mission

The mission of the CGS is to contribute to a prosperous South Africa by:

6.2.1 Providing integrated, systematic and thematic geoscience maps and conducting research on the onshore and offshore geology of South Africa, as mandated, to:

- Facilitate mineral, energy and agricultural development;
- Contribute to the assessment and sustainable management of mineral, geohydrological and geo-environmental resources;
- Contribute to the mapping and characterisation of geo-engineering and geohazards; and
- Support infrastructure development planning.

6.2.2 Acting as a national advisory authority on geo-environmental pollution and geohazards.

6.2.3 Providing an information repository and delivery platform that facilitates actionable decisions and the accessibility of pertinent information by relevant stakeholders.

6.2.4 Discharging the mandate in a manner that supports transformation and national developmental imperatives.

6.3. Core Values

- Innovation: Solving problems through novel ideas that create value for the stakeholders of the CGS;
- Diversity: Promoting an inclusive culture that respects the contributions of the diverse people of the CGS;
- Excellence: Striving for exceptional quality in all that the CGS does;
- Accountability: Setting SMART targets with personal ownership and commitment to the achievement of the desired outcomes;
- Learning: Creating a learning organisation through continuous personnel development; and
- Service: Providing efficient and effective services to all, consistently.

6.4. Strategic outcome-oriented goals

The CGS has adopted a strategy to encourage sustainability of the organisation in a changing state of polity, the economy, society, as well as the scientific and technological landscape. The strategic objectives and their related initiatives, which are illustrated below (Figure 2), are intended to shift the strategic orientation of the CGS to maintain an impactful delivery of the core mandate.

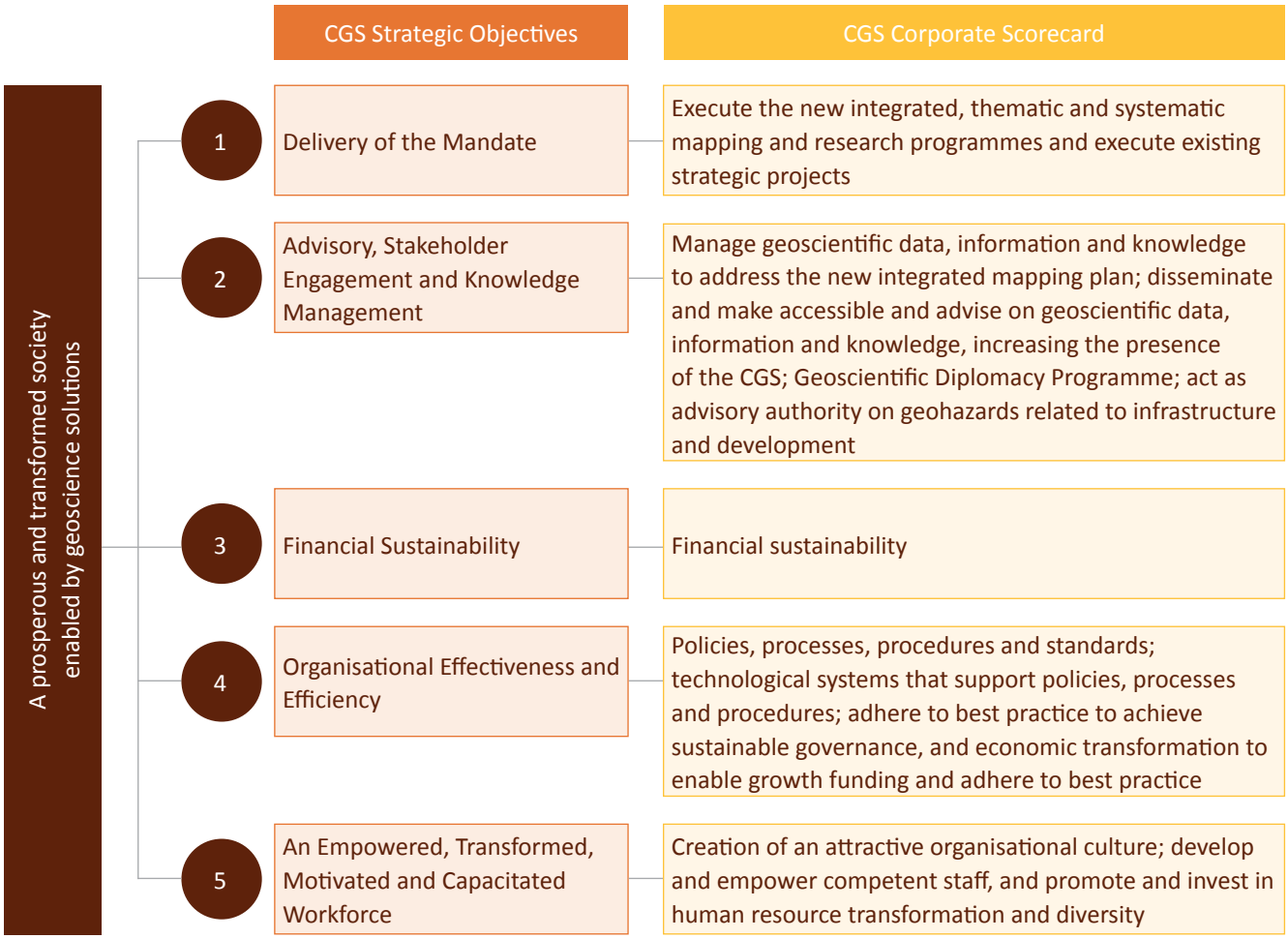


Figure 2: CGS strategic outcomes linked to strategic objectives and initiatives.

7. LEGISLATIVE AND OTHER GUIDING POLICIES

The Public Finance Management Act (PFMA) (Act No 1 of 1999) lists the CGS as a Schedule 3A Public Entity.

Geoscience Amendment Act No 16 of 2010 markedly stretched the mandate of the CGS with the respective sections 4(c), 4(eA), 4(f), 5(b) and 8 introducing the new role of the CGS to receive geoscience information from prospecting and mining rightholders and in the review and evaluation of geotechnical reports, the maintenance of certain national geoscientific facilities and the appointment of a Geotechnical Appeal Committee. These provisions were omitted in the proclamation that pronounced the promulgation of the Amendment Act effective from 1 July 2012 due to the paucity of resources to implement the expanded mandate. The CGS has since reorientated to ready itself for the staggered implementation of these provisions. This constitutes organic growth in pursuit of maximum execution of its mandate by the end of the current Medium Term Expenditure Framework (MTEF) cycle.

The mandate of the CGS, as defined in the Geoscience Act as amended, is summarised as follows:

Geological research and knowledge management: The CGS investigates a wide range of surface and subsurface,

onshore and offshore geosciences. These include geology, geochemistry, geophysics, engineering geology, economic geology, geohazards and geohydrology. The CGS is also mandated to promote the development of mineral and upstream energy resources in the country. The organisation performs these duties mainly through government funds and, to a lesser extent, through collaborations with private and public institutions, including institutions of higher education. The CGS is responsible for the following, among others:

- The national custodianship of all geoscientific information and its dissemination to stakeholders, and
- The review of all geotechnical reports and counsel on infrastructure development in the country.

Management of several national geoscience facilities: These include the National Borehole-Core Repository, the National Geoscience Heritage Collections (Geoscience Museum), the National Geoscience Library and the National Seismograph Network.

Advisory service: Based on research findings obtained through its various functions, the CGS is mandated to advise its primary stakeholder, the Minister of Mineral Resources, as stated in Geoscience Act No 100, on issues relating to mineral resources. The CGS also renders national advisory services for local, provincial, national and international authorities on geohazards and geo-environment-related issues.

Training and development: The CGS invests substantively in the training, development and competency of its staff through training and bursaries. It also cooperates with institutions of higher learning to promote research, training and the development of scientists in geoscience.

7.1. Other guiding policies

Given the urgent need to address national imperatives, the CGS ensures that its business model and all its activities address the following strategic national outcomes in alignment with the National Development Plan (NDP) Vision 2030:

- Decent employment through inclusive economic growth: Increase the benefits of mineral resources to the country by delivering geoscience information and services to increase the rail, water and energy infrastructure;
- A skilled and capable workforce to support an inclusive growth path: Build capacity in scientific, administrative and managerial/leadership skills, and in the development of products, systems and services;
- An efficient, competitive and responsive economic infrastructure network: Geoscience information and services input into infrastructure development contribute to South Africa's economic development of coal, gas, electricity and water resources;
- Vibrant, equitable and sustainable rural communities with food security for all: Assistance by the CGS in the development of South Africa and its people through improved infrastructure development, mining and geotourism;
- Environmental assets and natural resources that are well protected and continually enhanced: Conducting research regarding acid mine drainage (AMD), climate change and carbon capture and storage technologies, and
- An efficient, effective and development-oriented public service and an empowered, fair and inclusive citizenship: Development of the regulatory systems of the CGS in line with legislative requirements and the national mandates that address gender equity and employment equity (EE).

Along with the NDP, the strategy of the CGS aligns with the outcome-oriented goals of the Department of Mineral Resources (DMR) as listed below:

- Increased investment in the minerals, mining and upstream petroleum sectors;
- Efficient, effective and development-oriented state institutions;
- Transformed minerals sector;
- Equitable and sustainable benefits from mineral resources, and
- Improved health and safety conditions.

The CGS derives its strategic underpinning from the government's Medium-term Strategic Framework (MTSF) for 2014 to 2019, the Stakeholders' Declaration on Strategy for the Sustainable Growth and Meaningful Transformation of South Africa's Mining Industry of the DMR, and the Ten-year Innovation Plan of the Department of Science and Technology (DST).

8. ORGANISATIONAL STRUCTURE

The organogram describes the reporting structure of the CGS (Figure 3) that was developed to support its efficient, effective and robust functioning and the composition of its Board of Directors and executive management. The executive management team of the CGS consists of the Chief Executive Officer, who is an accounting officer for the CGS and reports to the accounting authority (the CGS Board, see section 8.2). The CEO is supported by an executive team which oversees four portfolios, namely Geological Resources, Applied Geosciences, Finance and Corporate Services. Information on each member of the executive management team is provided in section 8.1 below.

Figure 3: The organisational structure of the CGS.

Executive

MANAGEMENT TEAM OF THE CGS

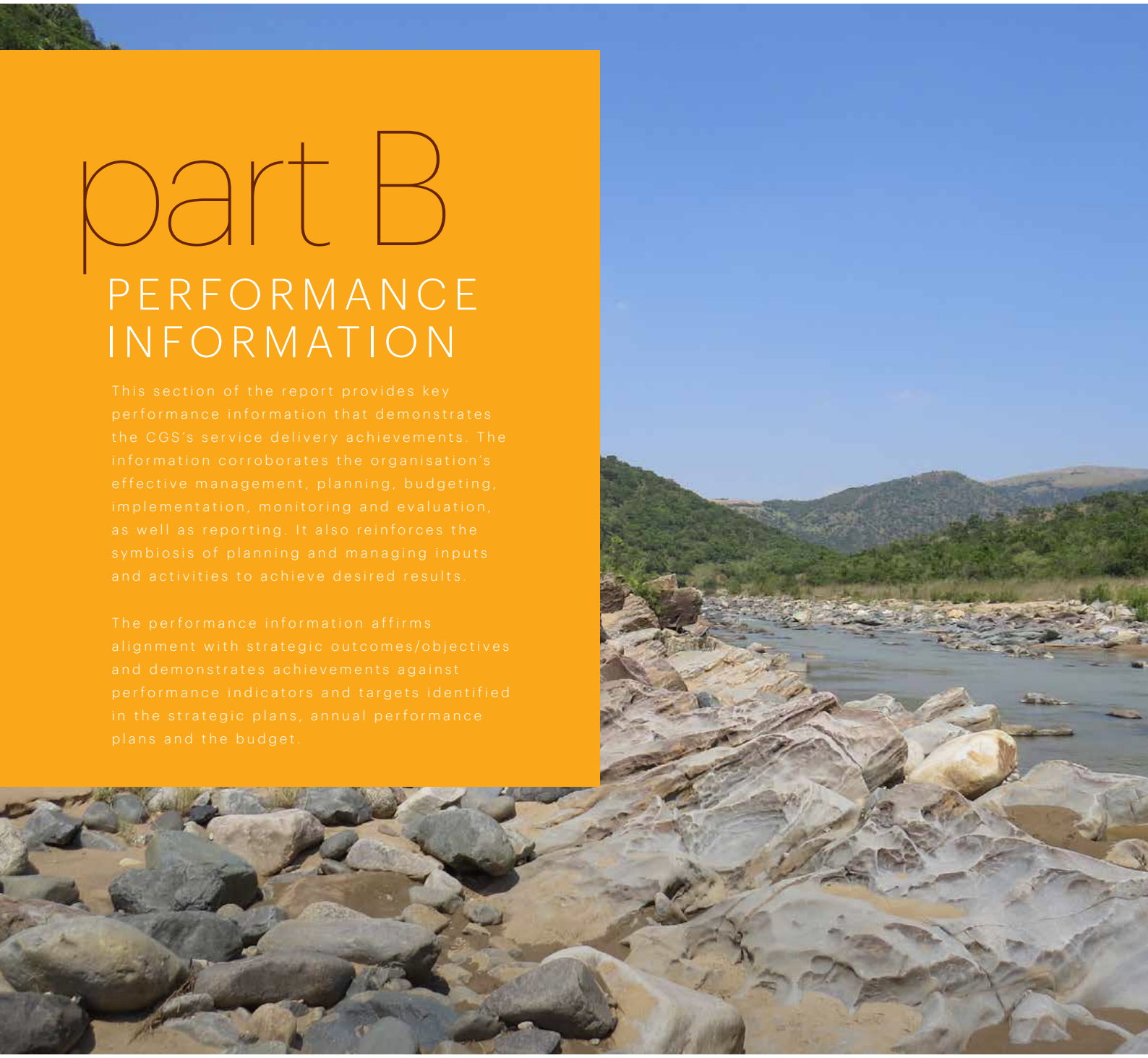
CHIEF EXECUTIVE OFFICER:
Mr Mosa Mabuza

EXECUTIVE MANAGER GEOLOGICAL RESOURCES: Ms Refilwe Shelembe

EXECUTIVE MANAGER APPLIED GEOSCIENCE: Dr David Khoza

CHIEF FINANCIAL OFFICER: Mr Leonard Matsepe

EXECUTIVE MANAGER CORPORATE SERVICES: Dr Jonty Tshipa



part B

PERFORMANCE INFORMATION

This section of the report provides key performance information that demonstrates the CGS's service delivery achievements. The information corroborates the organisation's effective management, planning, budgeting, implementation, monitoring and evaluation, as well as reporting. It also reinforces the symbiosis of planning and managing inputs and activities to achieve desired results.

The performance information affirms alignment with strategic outcomes/objectives and demonstrates achievements against performance indicators and targets identified in the strategic plans, annual performance plans and the budget.

1. AUDITOR-GENERAL'S REPORT: PREDETERMINED OBJECTIVES

The Auditor-General performed the necessary audit procedures on the performance information to provide reasonable assurance in the form of an audit conclusion. The audit conclusion on the performance against predetermined objectives is included in the report to management, with material findings being reported under the Predetermined Objectives heading in the Report on Other Legal and Regulatory Requirements section of the Auditor-General's report.

The Report of the Auditor-General, published as Part E: Financial Information, is contained from pages 96 to 100.

2. OVERVIEW OF THE PERFORMANCE OF THE COUNCIL FOR GEOSCIENCE

2.1. Service delivery environment

The CGS is mandated to collect, compile, interpret and disseminate geoscience information and knowledge for South Africa in accordance with Geoscience Act No 100 of 1993, as amended in 2010. The CGS business model allows for both statutory and collaborative activities, and these are implemented through the statutory integrated and multidisciplinary geoscience mapping programme of the CGS, which addresses the developmental imperatives of South Africa in NDP Vision 2030.

The CGS applies the following scientific disciplines in the integrated and multidisciplinary mapping programme. This programme is implemented through the five themes of the Geoscience Technical Programme (see Section 4: Operational Highlights).

- **Geoscience mapping:**
  Geoscience mapping at various scales is a core discipline at the CGS. In the year under review, the CGS began its detailed mapping programme at a scale of 1:50 000, not only to improve the coverage of published geoscientific maps, but to update existing maps with recent geoscientific knowledge and interpretations. In the 2018/2019 financial year, the CGS produced 45 geological maps at a scale of 1:50 000. In addition, the 2019 edition of the 1:1 million-scale geological map was completed and published.

- **Minerals and energy:**
  South Africa's exploration in green fields has significantly reduced, hence much of the exploration, albeit limited, has been largely in brown fields. The paucity of geoscience information has further compounded matters, decreasing exploration spend and diluting the investment attractiveness of South Africa. Because of the projected exponential increase on the mineral and energy demand in line with the doubling of the world population in the next 20 years, the exigent demands on economy growth are mounting. Alleviation of these pressures requires implementation strategies that include generation of geoscience information by mineralisation systems mapping and research through the execution of projects such as in the Griqualand West and Giyani areas. The CGS is responding to the National energy security programme by conducting research on sources of renewable energy such as geothermal energy and alternative energy minerals. The CGS continues to conduct the Karoo Deep Drilling Project for the development of a geo-environmental baseline for potential shale gas exploration and exploitation.

- **Environment and water:**
  The DMR mandated the CGS to execute the 'Management of state contingent liabilities with respect to derelict and ownerless mines in South Africa' (or derelict and ownerless) and 'Mine environment and water management' (or mine water) projects. The two projects were composed of two main pillars: Research (e.g. air quality monitoring, mineral assessments for future mining, passive treatment, coexistence of mining and biodiversity) and construction (construction of canals and closure of shafts). Through these projects, the CGS advises government through the DMR on the contingent environmental liabilities of derelict and ownerless mines in the country, as well as on the management of mine water ingress and residue control in the Witwatersrand goldfields and coal mines of the eastern Highveld. A major product of the Mine Water Project is an online portal, which will assist in highlighting potential impacts on the environment and proposing mitigation measures, where necessary.

- **Engineering geoscience and physical geohazards:**
  The CGS provides advice, reviews and evaluates geotechnical reports in dolomitic terrains, on geohazards such as landslides, subsidence and seismicity that may affect infrastructure development and pose risks to lives and property. The CGS has explored the applications of artificial intelligence as a predictive capability for subsidence mapping.

The CGS also engages in collaborative projects typically characterised as follows:

- **Agency projects:** Sourced essentially from other government departments/institutions and public entities;

- **International projects:** Sourced mainly through international tenders, and have advanced the country's regional integration policy and the Geoscience Diplomacy Programme of the CGS, and
- **Private sector:** Collaboration with private sector establishments.

The CGS successfully manages a number of national geoscience facilities, including:

- The national seismograph network and infrasound observatory, which monitor earthquakes and other sonic disturbances;
- The national borehole core repository, which provides a comprehensive collection of valuable geological materials;
- The national geoscience museum, which provides information and preserves rare, scientifically valuable and geological heritage samples;
- The national geoscience library and bookshop, which provide geological publications and maps to the public, and
- The national geoscience analytical facility, which is available for the analysis of geological samples and industrial raw materials.

2.2. Organisational environment

During the past year, the CGS focused on filling vacant positions at executive management and senior management levels across the organisation to strengthen organisational stability. The CGS strategy focuses on an integrated and multidisciplinary geoscience mapping programme and its activities. It aims to enhance the map coverage of South Africa's land surface in greater geological, geophysical, geochemical and geotechnical detail, to produce a new generation of more detailed maps as a basis to advise the state and various stakeholders, including the public. Marine geoscience mapping also features prominently in Operation Phakisa.

Following the unsuccessful implementation of the repositioning strategy introduced at the beginning of the current MTSF cycle, an interim intervention was introduced, known as the 'Business Unusual strategy', which yielded positive results such as revenue generation and reduction of the rollover of funds allocated to MTEF projects.

The Geoscience Technical Programme audit, conducted by independent members of the academic community and industry experts, yielded an aggregated performance of 94% at an average quality score of 3.8 out of 5.

The prevailing organisational environment has assisted the CGS to deliver its mandate in a manner that impacts positively on societal developmental needs.

2.3. Key policy developments and legislative changes

No key policy developments have occurred to the Geoscience Amendment Act 16 of 2010 since it took effect on 1 July 2012. The Amendment Act includes a more comprehensive description of the services rendered by the CGS.

The Minerals and Petroleum Resources Development Amendment Act (MPRDA) of 2008 explicitly outlines the role of the CGS in geological information generated through exploration activities in South Africa. With the new strategic approach, the CGS is aligning its activities with the latest developments in the MPRDA amendments, National Environmental Management Act and the Spatial Planning and Land Use Management Act.

3. CGS PERFORMANCE INFORMATION

In accordance with CGS strategy, the balanced scorecard (BSC) has been adopted to provide an account of the overall performance of the organisation. The BSC essentially measures the performance of the organisation at corporate business unit and individual level. There are five strategic objectives that cover the customer, internal business process, learning and growth and financial perspectives (Figure 4).

Figure 4: Summarised strategic objectives of the CGS and link to the corporate scorecard.

This performance account details the service delivery environment of the organisation, the broad disciplines in which service delivery is provided, and the range of clients and stakeholders served. The objectives, activities and progress of programmes and projects of the organisation are outlined.

To evaluate the corporate performance of the CGS, the organisation has developed performance indicators, which, together with the performance targets for 2018/2019, are summarised in the accompanying table on pages 30 to 32 (Table 1).

3.1. Corporate scorecard for 2018/2019

Table 1: Corporate scorecard for 2018/2019

Stakeholder/Market Perspective	EXECUTE THE NEW INTEGRATED, THEMATIC AND SYSTEMATIC MAPPING AND RESEARCH PROGRAMME AND EXECUTE EXISTING STRATEGIC PROJECTS				
Strategic objective 1	Delivery of the Mandate				
Indicators	Actual 2017/2018	Target 2018/2019	Actual 2018/2019	Variance	Comment on variance in excess of 10%
Digital maps produced	New measure	45	49	+4	Target achieved. Following the closure of the analytical services facility (D-Block), human resources were reallocated to focus on the geoscience mapping programme.
Geoscientific information audited	New measure	50%	50%	0	Target achieved.
Annual Statutory Programme (Completion)	70%	100%	94%	-6%	Target not achieved. The score reflects cumulative quarterly calculation based on independent GTP reviews. The Performance index is calculated as the mean % completion multiplied by mean quality/5. The result illuminates an unprecedented achievement compared to 70% in the preceding year.
Innovation projects completed	2	3	3	0	Target achieved.
Completion: Karoo Deep Drilling	39%	100%	100%	0	Target achieved.
Completion: D&O Mines	70%	100%	100%	0	Target achieved.
Completion: Mine Water Management	69%	100%	100%	0	Target achieved.

Strategic objective 2	ADVISORY, STAKEHOLDER ENGAGEMENT AND KNOWLEDGE MANAGEMENT				
Indicators	Actual 2017/2018	Target 2018/2019	Actual 2018/2019	Variance	Comment on variance in excess of 10%
Completed integrated digital migration	New measure	40%	40.7%	+0.7%	Target achieved.
Publications produced: Peer-reviewed articles	47	20	26	+6	Target achieved. The CGS's collaborative efforts led to an increased publications output.
Publications produced: Scientific abstracts Bulletins Memoirs Map explanations Media publications	70	105	155	+50	Target achieved. The CGS conference presented a platform for the development of young geoscientists.

Strategic objective 2	ADVISORY, STAKEHOLDER ENGAGEMENT AND KNOWLEDGE MANAGEMENT				
Indicators	Actual 2017/2018	Target 2018/2019	Actual 2018/2019	Variance	Comment on variance in excess of 10%
Number of agreements implemented between the CGS and its stakeholders	5	12	13	+1	Target achieved.
Marketing and promotional initiatives	New measure	30	35	+5	Target achieved. The CGS responded to increased invitations to showcase its work.
Stakeholder satisfaction level	69.6%	86%	64.9%	-21.1%	Target not achieved. There are two major incidents that negatively affected the performance of the CGS, i.e. the protracted closure of the analytical services facility as well as the imposition of the moratorium on the release of geoscience information and data.
Geohazard assessment reports compiled within prescribed timeframes	New measure	100%	100%	0	Target achieved.

Learning and Growth Perspective	CREATION OF AN ATTRACTIVE ORGANISATIONAL CULTURE, DEVELOP AND EMPOWER COMPETENT STAFF AND PROMOTE AND INVEST IN HUMAN RESOURCE TRANSFORMATION AND DIVERSITY				
Strategic objective 3	An Empowered, Transformed, Motivated and Capacitated Workforce				
Indicators	Actual 2017/2018	Target 2018/2019	Actual 2018/2019	Variance	Comment on variance in excess of 10%
Level of staff satisfaction	69.6%	75%	65%	-10%	Target not achieved. The results reflect, inter alia, prevailing uncertainties in the future of some organisational programmes. However, a staff satisfaction of 65% pegs the organisation in the category of "Top Company" in line with the international benchmark range of 65% to 85%.
Net staff turnover rate	0.24%	5%	5.47%	+0.47%	Target not achieved as a result of voluntary and involuntary terminations late in the year.
Training expenditure (Ratio of training expenditure to leviable amount of payroll)	2.55%	2%	1.46%	-0.54%	Target not achieved. However, the performance exceeds the prescribed 1% in the Skills Development Levy Act.
Staff with disability	0.71%	1.25%	1.59%	+0.34%	Target achieved. This is a result of disability awareness campaigns conducted.
EE statistics (Ratio Male:Female)	50:50	53:47	49:51	4%	Target achieved. An increased focus on gender parity interventions.

Systems Perspective	POLICIES, PROCESSES, PROCEDURES AND STANDARDS, TECHNOLOGICAL SYSTEMS THAT SUPPORT POLICIES, PROCESSES AND PROCEDURES, ADHERE TO BEST PRACTICE TO ACHIEVE SUSTAINABLE GOVERNANCE, ECONOMIC TRANSFORMATION TO ENABLE GROWTH FUNDING AND ADHERE TO BEST PRACTICE				
Strategic objective 4	Organisational Effectiveness and Efficiency				
Indicators	Actual 2017/2018	Target 2018/2019	Actual 2018/2019	Variance	Comment on variance in excess of 10%
Implementation of the planned activities for the year for Laboratory ISO 17025 accreditation	New measure	100%	45%	-55%	Target not achieved. The CGS's analytical services facility was suspended due to health and safety considerations. As a result, the quality management system could not be implemented. The target for the year was therefore not achieved.
Organisational wide implementation of the planned activities for the year in terms of ISO 9001 certification	New measure	100%	83%	-17%	Target not achieved. The CGS's analytical services facility was suspended due to health and safety considerations. As a result, the quality management system could not be implemented. The target for the year was therefore not achieved.
Integrated ICT systems implemented as per business requirements	New measure	60%	60%	0	Target achieved.
Audit qualifications	0	0	0	0	Target achieved.
Value spent on preferential procurement as a proportion of total spend on procurement	72.25%	76%	67.46%	-8.54%	Target not achieved. A number of high-value contracts for specialised services with entities that are still not transformed had a disproportionate impact on the overall performance of the measure.

Financial Perspective	FINANCIAL SUSTAINABILITY				
Strategic objective 5	Financial Sustainability				
Indicators	Actual 2017/2018	Target 2018/2019	Actual 2018/2019	Variance	Comment on variance in excess of 10%
Government grant	R359.5m	R393.9m	R426.6m	+R32.7m	Target achieved. More work was done on executing the integrated and multidisciplinary geoscience mapping programme.
Revenue from collaborative activities/ partnerships	R52.6m	R24.2m	R30m	+R5.8m	Target achieved. More commercial work was done than anticipated.

4. OPERATIONAL HIGHLIGHTS

4.1. Introduction to the Geoscience Technical Programme

The Geoscience Technical Programme (GTP) of the CGS refers to its statutory, commercial and strategic (MTEF) projects and supports NDP Vision 2030. The 2018/2019 GTP marks a significant shift from previous technical programmes at the CGS in that it has been streamlined into a smaller number of projects that largely cover integrated projects that take cognisance of the interconnectivity of various CGS disciplines. Special focus was placed on, among others, Griqualand West in Northern Cape, the Mine Environment and Water Management Programme, the Management of Derelict and Ownerless Mines Programme and the Karoo Deep Drilling Environmental Baseline Programme (see Figure 5).

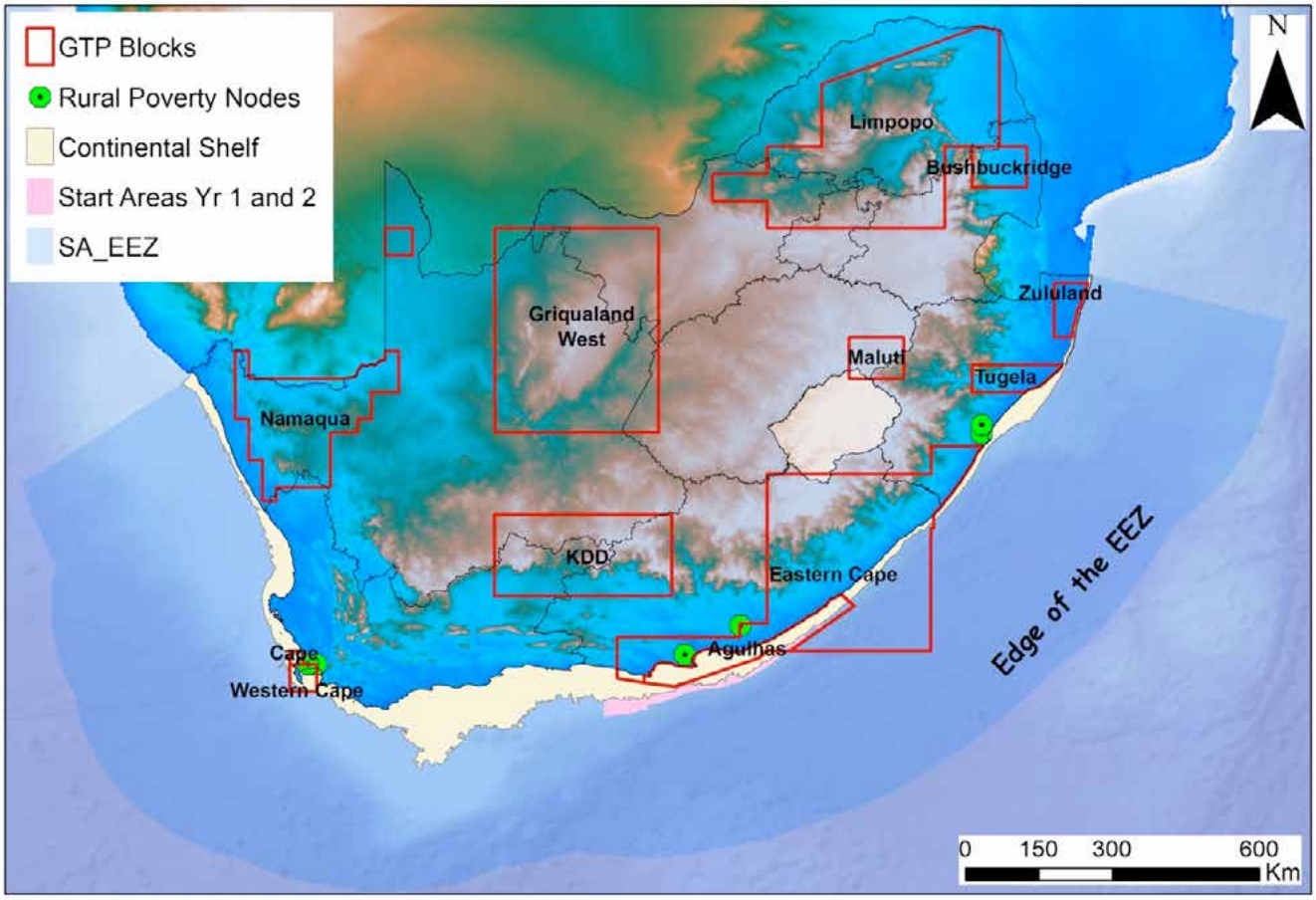


Figure 5: Focus areas for the GTP.

The GTP model or matrix addresses five core themes, which are:

a) Geoscience for mineral and energy resources;
b) Geoscience for infrastructure and land use;
c) Geoscience for health, groundwater and the environment;
d) Geoscience innovation, and
e) Geoscience diplomacy.

Progress and highlights of the GTP during 2018/2019 are discussed in the sections to follow, but a major achievement was the compilation and the launch of the 1:1 million-scale geological map of South Africa (including the kingdoms of Lesotho and Swaziland).

4.1.1. LAUNCH OF THE 1:1 MILLION-SCALE GEOLOGICAL MAP OF SOUTH AFRICA

The CGS published the previous edition of the 1:1 million-scale geological map of South Africa and the kingdoms of Lesotho and Swaziland 19 years ago. The new, fully digital 1:1 million-scale geological map (see Figure 6) and an associated legend, which was produced collaboratively by the CGS and external experts, was launched at the CGS Annual Conference on 11 February 2019. The map was compiled using the latest seamless 1:250 000 datasets (72 map sheets) and a topographic dataset reflecting recent changes to names of locations, particularly the names of towns and villages. The legend was completely revised using the latest stratigraphic information and updated nomenclature. The map is available to the public in a PDF format and can be accessed online free of charge (http://geoscience.org.za).

The main updates include the subdivision of the Transvaal Supergroup in the Griqualand West Basin, subdivision of the Adelaide Subgroup, renaming of Archaean plutons and reclassification of Archaean mafic rocks, recompilation of maps of the Kingdom of Eswatini (Swaziland) and of Lesotho, revision of Precambrian chronostratigraphic nomenclature, inclusion of new geochronological data, revision and classification of Cenozoic rocks, as well as modification of the colours and layout.

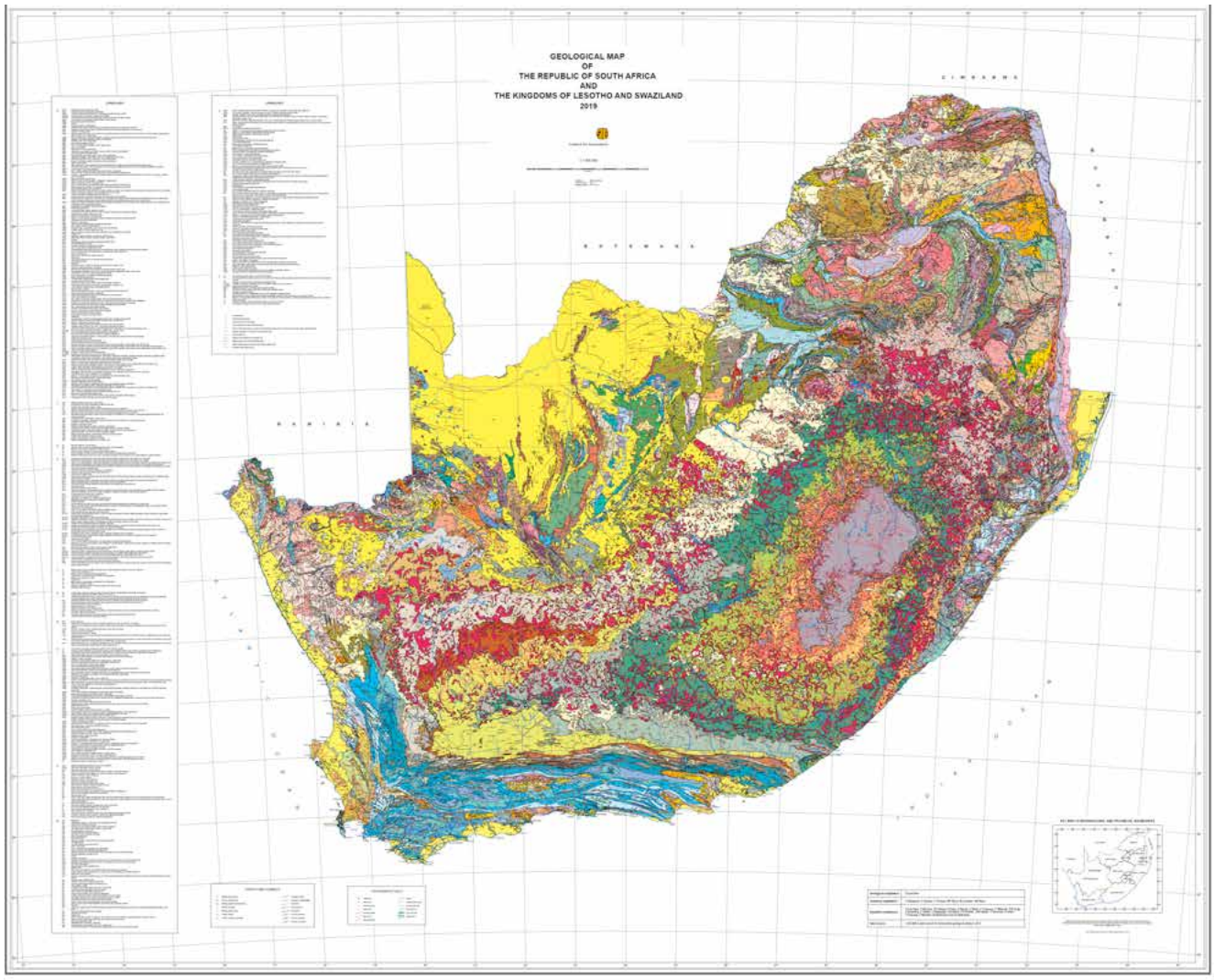


Figure 6: Graphical representation of the new 1:1 million-scale geological map of South Africa.

"Solutions emanating from geosciences mapping not only enhance the prosperity and sustainability of South Africa's resources, but protect the safety of citizens"

4.1.2. GEOSCIENCE FOR MINERAL AND ENERGY RESOURCES

South Africa is endowed with rich and diverse minerals that give it a significant advantage over other nations in the production of resource commodities. Consequently, the minerals and energy sectors are major contributors to South Africa's growth and development plan. Sound policies for these resources are, therefore, essential and these are built on an understanding of available resources. Under the 'Geoscience for mineral and energy resources' theme, the CGS collects, analyses and processes high-quality geological, geochemical, geophysical and mineral data, which will lower the risks of and increase confidence in exploration and mining, particularly in areas that remain underexplored.

In 2018/2019, the CGS undertook 10 such projects, including the Karoo Deep Drilling, Makhonjwa, Geothermal Energy, Griqualand West, Central KwaZulu-Natal, Limpopo Greenstone Belt and Marine Geoscience projects.

4.1.2.1. Karoo Deep Drilling and Geo-environmental Baseline Programme

This five-year programme aims to develop a geo-environmental baseline in the southern Karoo for informed decision-making and strengthening of the regulatory framework for possible shale gas development. The multidisciplinary research of the CGS made it possible to provide about 33 million litres of water a month to the drought-stricken town of Beaufort West. To this day, the Municipality of Beaufort West is pumping sustainably from the CGS borehole at 6 l/s, as advised by CGS hydrogeologists. Subsequent to the drilling of shallow observation wells, the CGS has drilled two deeper monitoring holes of 517m and 1 402m depths respectively (Figure 7). The 517m borehole intersected significant volumes of consumable and usable groundwater, while the 1 402m borehole is mostly dry. The carbonaceous shales of the Tierberg Formation of the Ecca Group were intersected at a depth of 919m. The CGS will start drilling a ~3 500m ultradeep, vertical, stratigraphic research borehole in 2019/2020.

Figure 7: Drilling operation at the 1 402m-deep borehole, RO1-BW, in Beaufort West.

4.1.2.2. Griqualand West Multidisciplinary Mapping Project

The Griqualand West project epitomises the multidisciplinary strategy of the CGS at a larger scale, where almost half of the technical capacity has been assigned (Figure 8). The key objectives of the project include characterising mineral deposits such as diamond, iron, manganese and tiger's eye and their systems, as well as the geological setting of the Griqualand West basin and its surrounding geology, supporting land use, agricultural and environmental studies through geoscientific characterisation, and supporting safe infrastructure development and economic growth through geological, hydrogeological and geotechnical mapping.

In supporting CGS capacity building, more modern techniques and skills are used to build a pool of skilled scientists with informed decisions and insight for future developments and optimal use of land. The Griqualand West area is underlain by interbedded, low-grade, metamorphosed and deformed sediments, chemical sediments and volcanic rocks deposited and extruded in palaeo-environments ranging from terrestrial to shallow and deep water. Due to unique karstic weathering and structural deformation of the chemical sediments, including the dolomite and banded iron formations (BIF), some of the world's largest economically important deposits of Fe and Mn are concentrated in the area. During 2018/2019, mapping was completed of 15 1:50 000-scale geological maps, two 1:100 000-scale hydrogeological maps, three 1:50 000-scale geotechnical maps and regional geophysical surveys. These datasets are being integrated and the preliminary results are providing significant insights into applied solutions for infrastructural development and understanding hydrothermal mineralising systems.

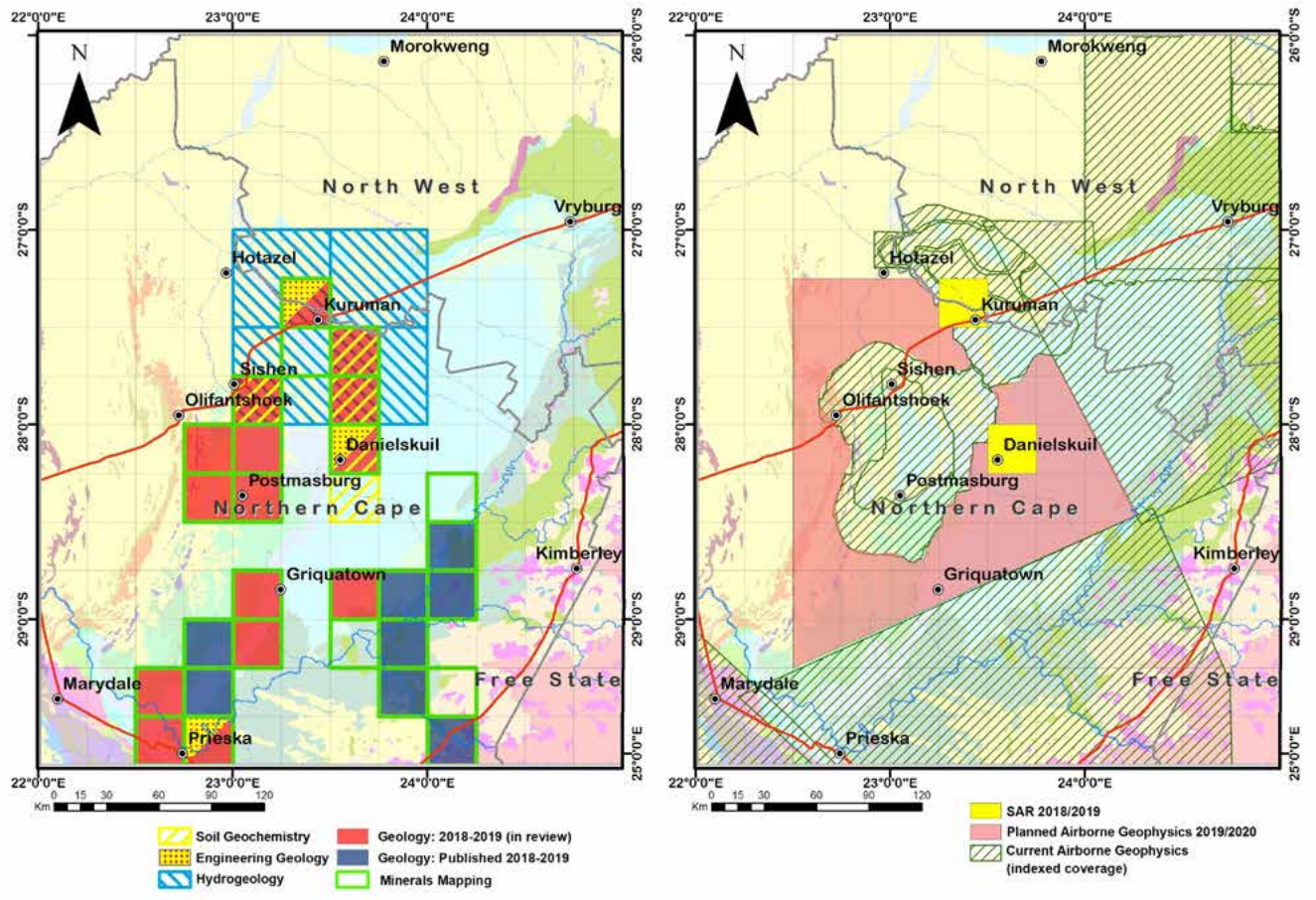


Figure 8: Index map of the Griqualand West project area illustrating the integrated multidisciplinary approach to mapping .

1 The map on the left emphasises the correlation of the 2018/2019 GTP field mapping among the different scientific disciplines at the CGS, while the map on the right highlights the regional geophysics coverage and specialised interferometry work. Remote sensing interpretations were undertaken for the whole mapped area and ground geophysical site-specific investigations as directed by the mapping.

4.1.2.3. Marine Geoscience Programme

South Africa's offshore area is larger than the onshore region and will at least double if the extended shelf claim is ratified by the United Nations. High-quality baseline datasets are required to master resources sustainably on the continental shelf and adjacent seabed area. Fundamental to management and planning are baseline regional bathymetric and substrate data. The Marine Geoscience Programme, therefore, aims to create an integrated map of South Africa, which spans seamlessly from the onshore area to the outermost edge of the offshore territory (see Figure 9). In 2018/2019, the CGS produced, for the first time, an onshore-offshore geological map along Mossel Bay that is key to unlocking the mineral and energy potential of the region.

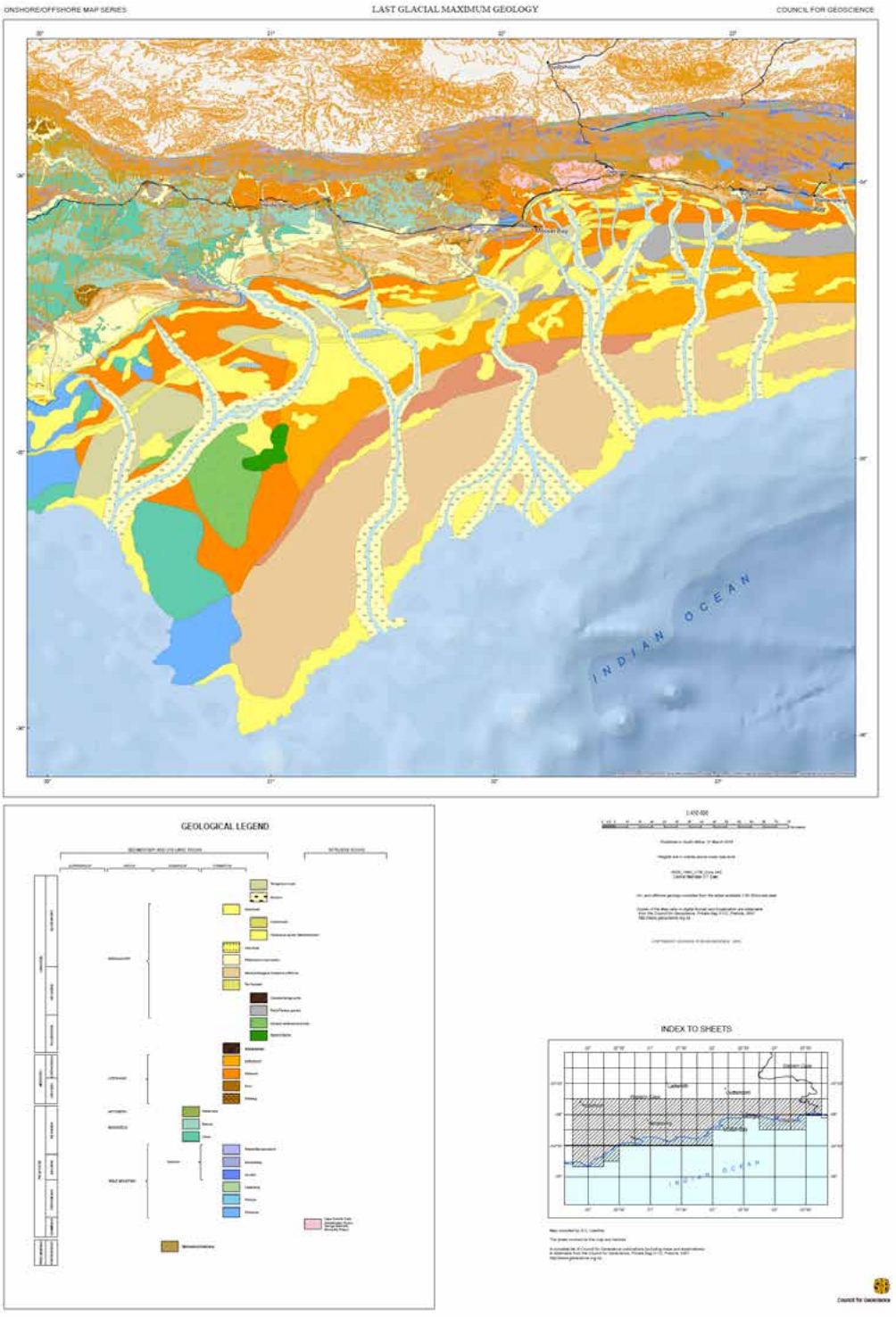


Figure 9: Geological map of the Last Glacial Maximum for the Cape South Coast.

Marine geoscience mapping will cover the entire exclusive economic zone (EEZ), using a suite of vessels and marine geophysical methods (i.e. multibeam bathymetry, side-scan sonar, marine magnetics, medium-penetration sub-bottom profiling and gravity).

"The CGS's first onshore-offshore geological map along Mossel Bay is key to unlocking the Blue economy of South Africa"

4.1.2.4. Geothermal energy potential of South Africa

Rapid technological advances have made low-enthalpy geothermal energy one of the fastest growing global renewable energy resources. The CGS has identified five regions in South Africa that show anomalously high geothermal gradients and significant heat flow, which may be suitable for the development of low-enthalpy geothermal systems. During 2018/2019, the CGS launched a project to better characterise and understand the subsurface parameters of these anomalous regions. This included hydrochemical and isotopic modelling of geothermal waters, with characterisation of regional and local tectonic controls. In addition, more precise geothermometry was undertaken, which has shown a direct correlation between estimated reservoir temperatures and those observed on the surface (see Figure 10). Furthermore, the initial results of the isotopic modelling have identified apparent underlying tectonic controls on the depth-temperature-flow and physical properties of geothermal waters in the various anomalous regions. Additional work will include radiogenic carbon age dating and 3D magnetotelluric investigations, which will further assist in characterising the depths and volumes of potential geothermal reservoirs.

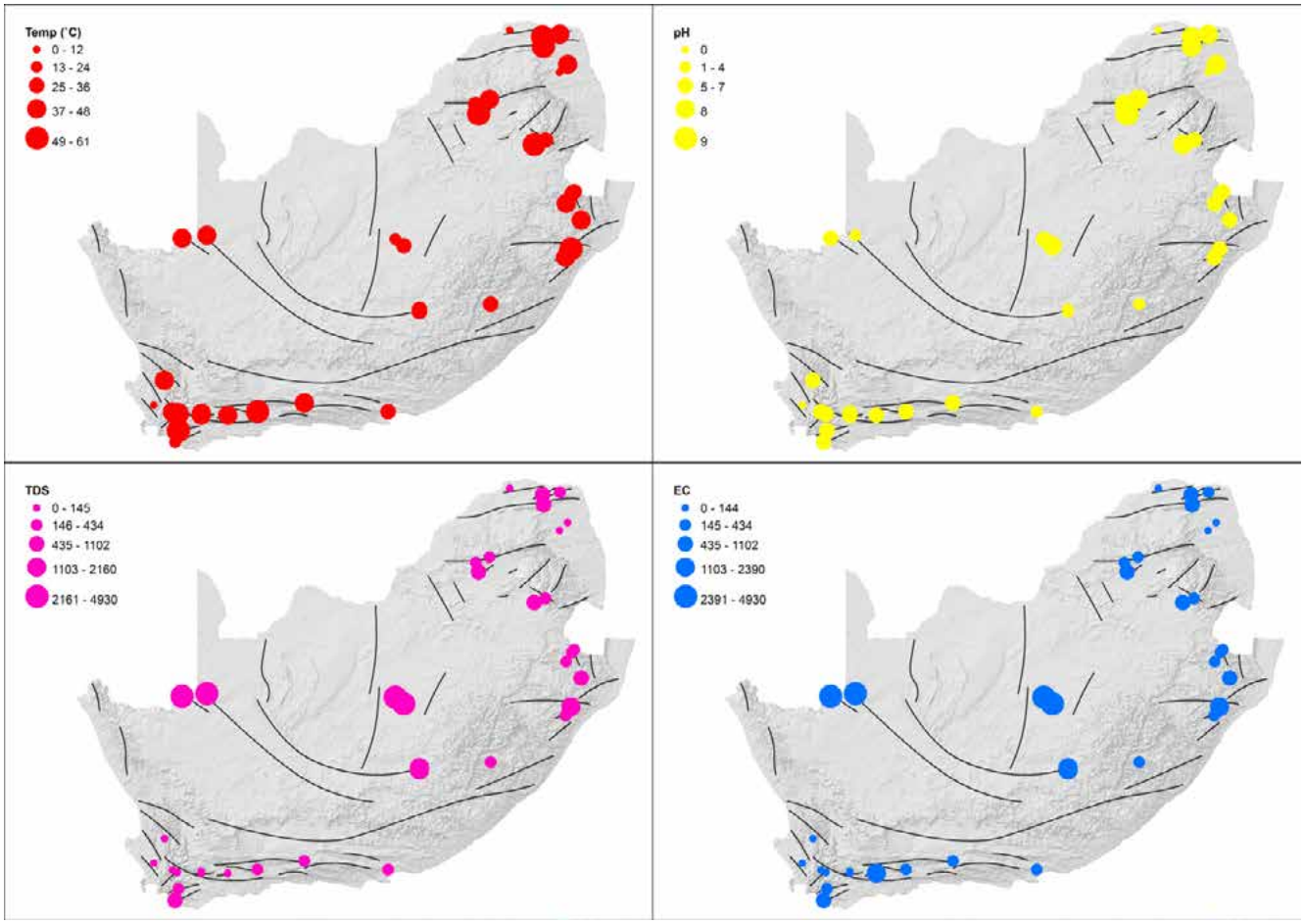


Figure 10: Overview of physical properties measured at various hot spring locations in regions showing anomalously high geothermal gradients.

4.1.2.5. Limpopo Greenstone Belt Project

The Limpopo Greenstone Belt Project is a multidisciplinary mapping project focusing on geoscientific research across the greenstone belts and surrounding rocks in Limpopo, namely Giyani Greenstone Belt (GGB), Murchison Greenstone Belt (MGB), Rhenosterkoppies Greenstone Belt (RGB) and Pietersburg Greenstone Belt (PGB). The belts host the earliest rocks formed on earth and provide a window into the earliest evolutionary history of the earth's crust more than 3.1 billion years ago. Most of the greenstone belts are strongly deformed, eliminating original footprints of the pre-existing rock formations, thereby resulting in limited understanding of the greenstone belts. The main objective of the project is an understanding of the orogenic gold mineralisation system through comprehensive geoscience mapping (geological mapping, and soil geochemical and geophysical investigations), which may assist in supporting economic growth in the historically underdeveloped area.

Project activities include detailed geological mapping at a scale of 1:50 000, investigation of the mineral potential, geochemical mapping and geophysical investigations, and environmental impacts of historical mining. The study area is situated along the boundary between the Kaapvaal Craton and the Southern Marginal Zone of the Limpopo Metamorphic Belt and consists largely of highly deformed ultramafic rocks intruded by Archaean-Palaeoproterozoic granitoids. In 2018/2019, six 1:50 000 geological maps integrated with regional soil geochemistry and magnetotelluric geophysical surveys were completed. Additional highlights included the delineation of an extension of the Schiel Alkaline Complex and a newly observed granite body, which has been proposed as the Mninginisi Granite. In addition, well-preserved pillow lavas were located along the Klein Letaba River (Figure 11), which confirms extrusion of lava in the presence of large bodies of water (i.e. a marine/ocean environment) on the earth's surface. This not only provides scientific evidence for the geological setting of the early environment of the Giyani Greenstone Belt, but proves its potential to be conserved as a geoheritage site to attract tourists and for the benefit of research to the geoscience community and South Africa.

Figure 11: (a) Giyani Greenstone Belt pillow lavas displaying a tubular shape and distinctive chilled margins; (b) Sheared tabular pillows with distinctive chilled margins.

4.1.2.6. Central KwaZulu-Natal Geoscience Mapping Project

This multidisciplinary project involves geological mapping, mineral potential mapping and the evaluation of previously acquired airborne geophysics and other data covering the 2830DB Qudeni 1:50 000-scale map sheet for 2018/2019. The central KwaZulu-Natal region is a key area for geological studies as it is the only region in South Africa of continuous exposure to the contact between the Archaean Kaapvaal Craton and the Proterozoic Namaqua-Natal Metamorphic Province. The CGS undertook geological mapping and characterisation of the mineral occurrences around the Qudeni region of northern KwaZulu-Natal. The geology of the Qudeni region is defined by rocks ranging from Palaeoarchaean to recent, with multiple lithologies of various ages hosting mineral occurrences of various commodities and mineralising styles. Previous regional geochemical sampling and geophysical acquisition in the region have indicated possible areas of low-grade, subeconomic mineralisation associated with ultramafic complexes in Natal Metamorphic Province, but the key geophysical data factor is the link between geological structures on the surface that have previously been overlooked due to intense weathering and thick vegetation cover.

A key feature of the project is the geological mapping of lithologies of the Pongola Supergroup in the Nkandla region in northern KwaZulu-Natal, which have, until now, been undifferentiated on existing geological maps. Detailed field mapping by the CGS in 2018/2019 has allowed for reinterpretation of the successions through the use of well-defined marker horizons that aid correlations between tectonic blocks. Detailed field mapping undertaken during this project has confirmed a correlation between the individual inliers of Pongola Supergroup lithologies, and has reinterpreted the stratigraphy in line with currently accepted nomenclature. The project revealed a major discovery in the identification of previously unrecognised Mozaan Group lithologies (Figure 12).

The project area has a long history of mineral exploration and mining activities, with gold the main mineral mined and explored around the turn of the 20th century. Subeconomic occurrences of vein-hosted gold, copper and lead are present in shear zones related to Namaqua-Natal Metamorphic Province to the south of the mapping area. In the Pongola Supergroup, lithologies such as auriferous and uraniferous conglomerates of the Mozaan Group have long been acknowledged as having genetic similarities with the placer reef systems of the Witwatersrand Supergroup. Auriferous/uraniferous conglomerate horizons in the Nkandla region have been correlated with the gold-bearing placer conglomerates of the Dominion Group in the Witwatersrand Basin. The identification of an exceptionally low-grade, gold-bearing conglomerate placer reef package in the Central Syncline, stratigraphically higher than the basal Denny Dalton reef systems, suggests a likely correlation with the basal reefs of the Central Rand Group in the Witwatersrand. This will be further investigated in 2019/2020.

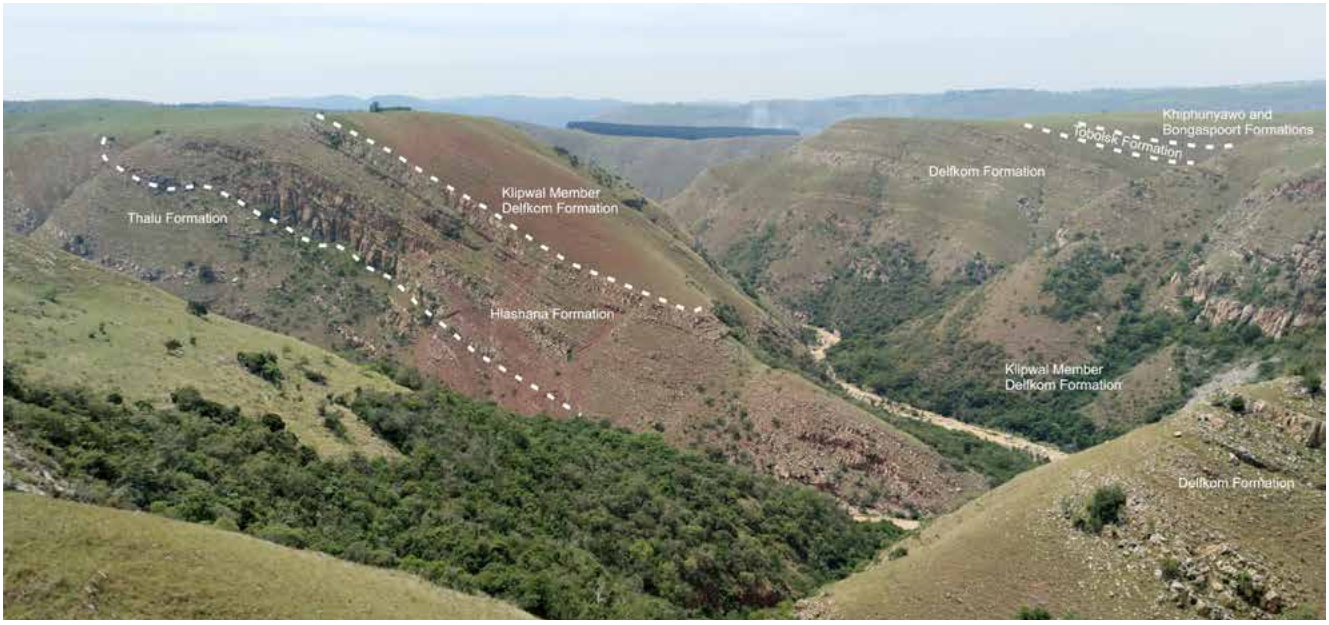


Figure 12: Previously undifferentiated Mozaan Group lithologies exposed in the Nsuze River gorge.

4.1.2.7. Richtersveld Geoscience Mapping Project

The Richtersveld Geoscience Mapping Project aims to characterise the tectonostratigraphic evolution of the Namaqualand Belt to expand understanding of geological controls on hydrothermal mineralisation in the region to assist in ensuring sustainable mineral development in this Northern Cape area. During 2018/2019, focus was on the Onseepkans and south of Springbok. The mapping region east of Onseepkans extends across three lithotectonic domains of the Mesoproterozoic Namaqua-Natal Metamorphic Province. The Palaeoproterozoic amphibolite facies of the Pella domain forms the southwest corner of the mapping area and tectonically above this area, to the north and northeast, stands the granulite facies Mesoproterozoic Kakamas domain. The contact zone between the Pella and Kakamas domains is marked by the amphibolite facies Lower Fish River/Onseepkans Thrust Zone, which is bound at the base by the Onseepkans Thrust, forms the contact with the Pella domain and is capped by the Kêrelbad Thrust. The latter is the contact with the Kakamas domain. South of Springbok, the area is underlain by high-grade Proterozoic gneisses and metamorphosed igneous rocks of the Bushmanland Subprovince of the Namaqua Sector in the Namaqua-Natal Metamorphic Province. The basement has been subdivided into 15 distinct units and partitioned into their appropriate lithostratigraphic hierarchical groupings, based on new field observations and literature subdivisions. The basement rocks were intruded by Cretaceous mafic-ultramafic bodies and overlain by extensive Quaternary deposits. Six geological maps were completed for review, while nine geological maps were reviewed and completed for publication. In addition, new bulk rock geochemistry and geochronology were undertaken, which will be finalised and interpreted in 2019/2020.

"The work of CGS enhances the management of the effects of natural disasters and seeks to impact positively on the economy, property and infrastructure developments"

4.1.3. GEOSCIENCE FOR INFRASTRUCTURE AND LAND USE

South Africa's natural hazards include high risk of subsidence in dolomitic terrains, and earthquakes and floods, all of which may have a significant impact on the economy, property and key infrastructure developments. The CGS strengthens the nation's ability to manage the impact of natural hazards by collecting geoscience information and building early warning systems that can reduce hazard impact. Project highlights supporting infrastructure and land use planning are detailed below.

4.1.3.1. Geotechnical investigations for low-cost housing developments in Northern Cape

The CGS continued its collaboration with the Northern Cape Department of Cooperative Governance, Human Settlement and Traditional Affairs (CoGHSTA) on special programmes such as mining town revitalisation and land restitution. The CGS advises CoGHSTA on allowable development (i.e. type and size of houses and stands) on especially dolomitic land, as well as on measures to manage risks. Specific geotechnical site investigations on dolomite include the identification and quantification of subsidence and sinkhole formation that might affect land development.

In 2018/2019, the CGS and CoGHSTA collaborated on the following projects:

1. Engineering geological investigations into the dolomite land status of Skeyfontein in Postmasburg (Tsantsabane Local Municipality).
2. Dolomite stability and near-surface geotechnical investigations for Wrenchville in Kuruman (Ga-Segonyana Local Municipality).
3. Near-surface geotechnical investigations for Skeyfontein.
4. Preliminary investigations to confirm the dolomitic land status of Heuningvlei village in the Joe Morolong Local Municipality.

Ongoing projects include dolomite stability and near-surface geotechnical investigations at seven sites in the Joe Morolong Local Municipality and an asbestos survey for Magobing.

4.1.3.2. Eastern Cape Mapping Project

This project has two main objectives – the completion of 12 detailed 1:50 000-scale geological maps in areas earmarked for development and growth, and five strategically located projects that will aid infrastructure development, environmental management and the identification, evaluation and exploration of key mineral deposits in the province. Tasks include geoscientific investigations along the Wild Coast (between Kei River Mouth and Port Edward), Cape St Francis, Mthatha, Port Shepstone and Makhanda (erstwhile Grahamstown). Initial field investigations have revealed that past and present improper agriculture practices, inappropriate land use, and haphazard settlement and infrastructure expansion have contributed largely to accelerated erosion in a landscape already exhibiting predisposing environmental conditions. In addition, significant soil erosion and land degradation have developed into major geohazards, posing both onsite and offsite threats in many pristine areas along the Wild Coast of the Eastern Cape. The project also investigated how this accelerated erosion is leading to increased development of geohazards. Kaolin resources were identified and characterised as potential building material to meet the demands of the growing Eastern Cape socio-economy. Figure 13 is a compilation of the old 'Red Desert' erosion features south of the Kwanyana River that are associated with deep donga incision, yardangs, manganese occurrences and sedimentation of adjacent wetlands.

Figure 13: 'Red Desert' erosion features south of the Kwanyana River.

4.1.3.3. Maluti a Phofong Geoscience Mapping Project

In line with its commitment to fundamental geoscience mapping to support local development, the CGS has undertaken mapping in Maluti a Phofong, Free State (Figure 14). Two geological maps, one each in Phuthaditjabha and Tshiame were produced in 2018/2019. This involved collecting, reviewing and updating existing geological data in preparation for more intense investigations into land use, infrastructure and local economic development. Field work allowed for stratigraphic revision to reflect basin-wide terminology and included, from the base upwards, the Balfour Formation of the Adelaide Subgroup (consisting of the middle Schoondraai and upper Harrismith members), the Katberg and Burgersdorp formations of the Tarkastad Subgroup, both of the Beaufort Group, and the Stormberg Group (basal Molteno, middle Elliot and upper Clarens formations) and the Drakensberg Group. Subdivision was revised of the Elliot Formation, which separates the Elliot into more argillaceous sequences sandwiched between a sandstone-rich informally recognised member. Quaternary deposits such as the Masotcheni Formation and its allomorphic members have been added to the map, as have other Quaternary deposits and geomorphological features. Tasks for 2019/2020 will include tracing potential diamondiferous alluvial deposits and investigating sedimentary-hosted uranium deposits.

Figure 14: The eastern end of the Maluti Mountain range towers over the map area.

4.1.4. GEOSCIENCE FOR HEALTH, GROUNDWATER AND THE ENVIRONMENT

The South African mining industry is a relatively mature sector that has boosted the economy, but, to some degree, has left legacy challenges in need of urgent attention. Furthermore, the social and economic wellbeing of communities is related directly to the health of the environment in which they live, produce their food and work. The focus of mining worldwide is shifting towards exploration and exploitation, with great emphasis on environmental stewardship. South Africa as a water-scarce country, faces significant challenges in availability and provision of water and a limited understanding of water resources. The development of communities, agriculture, and mineral and energy resources depends on availability and knowledge of water resources. CGS-generated hydrological and environment geoscience information improve this knowledge, while the characterisation of local and regional aquifer systems guides sustainable use of ground and surface water resources.

During the year under review, the CGS undertook three such projects, focused mainly on the management of state contingent liabilities for legacy mines and the Mine Environment and Water Management Programme.

4.1.4.1. Management of state contingent liabilities for derelict and ownerless mines in South Africa

The CGS assists the state by evaluating, quantifying and closing derelict and ownerless mines in South Africa. The project involved management and maintenance of a national derelict and ownerless mine database and

assessment of opportunities for future mining and other development at selected sites, with special focus on coal sites in KwaZulu-Natal (Malcom Colliery) and Mpumalanga (Protea Colliery) respectively. The analytical results indicated that future use of the coals, while still feasible, would require more advanced technologies and emissions-abatement strategies to comply with environmental legislation. The integrated rehabilitation monitoring programme in the project encapsulated specialist studies in dust and air quality, post-rehabilitation and water quality monitoring to quantify and provide baseline asbestos load data in different environmental samples around vulnerable residential areas near asbestos mine dumps in Northern Cape. Some 20 abandoned mines were closed using a generic concrete plug to seal vertical and inclined mine openings. A detailed desktop study was completed for mapping of shallow undermined areas in Gopane, North West. Furthermore, the project developed a draft national mine closure strategy information document, which was completed in March 2019.

4.1.4.2. Mine Environment and Water Management Programme

The Mine Environment and Water Management Programme investigates the impact and mitigation scenarios for water and the environment in the mining industry. During 2018/2019, an extensive study was completed of the environmental impact of marine and coastal mining that will contribute to the development of the regulatory framework. The study outcomes were presented to and workshopped with different stakeholders, with a final document to be published by the DMR. The project developed an online portal, which packages field data into useful products such as groundwater risk maps. The tool will also assist regulatory bodies to make informed decisions on applications from companies applying for mining/prospecting rights by highlighting potential impacts and proposing mitigation measures and specialist studies where necessary.

Since 2010, the Interministerial Committee (IMC) report on mine water management and acid mine drainage has been the backbone of mine water management in South Africa. In this financial year, the CGS reviewed progress made on the report's interventions and recommendations and identified knowledge gaps. The review found that the implications of small-scale mining activities on strategies to curtail ingress have been underestimated. The CGS conducted a pilot risk assessment in the Van Ryn area (Benoni, Gauteng) and proposed recommendations for maximising small-scale mining activities (Figure 15).

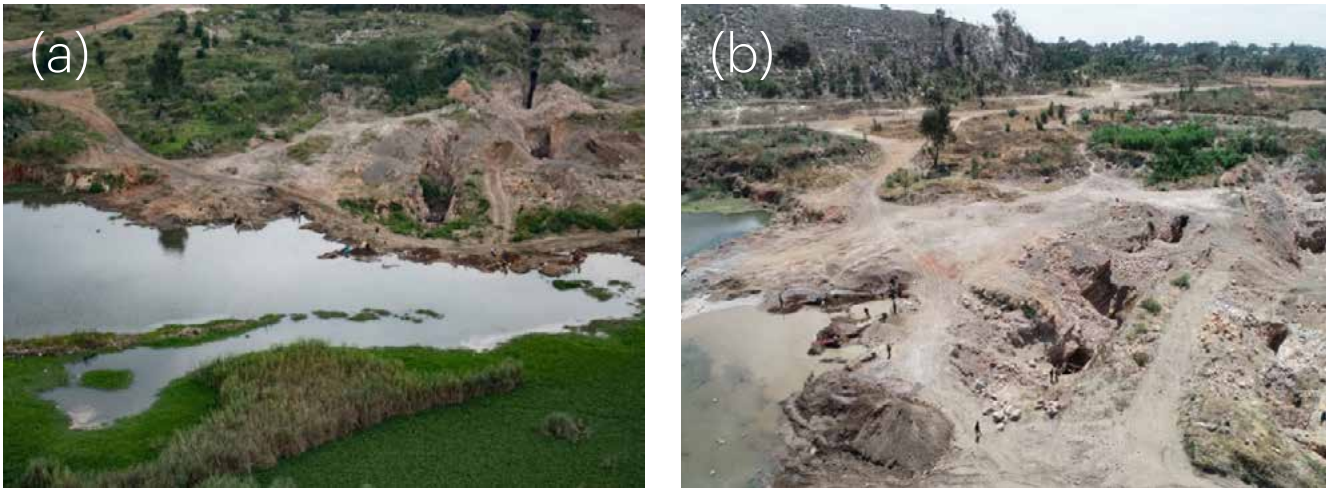


Figure 15: (a) Small-scale mining activities close to Orient Shaft ; (b) Exposed stopes at Van Ryn, adjacent to a pond caused by the breach in the Van Ryn Canal.

The project also involves the development of low-cost geopolymers from mine residues and coal fly ash as alternative liner materials for mine dumps. The geotechnical properties of the pre-prototype geopolymers have achieved compressive and flexural strengths of up to 50MPa and 16MPa, which are promising for application as liner material in industrial applications.

"The Mine Environment and Water Management Programme focuses on measures of coexistence between mining and the environment"

4.1.4.3. Zululand Basin geoscience mapping

The CGS planned the publication of 20 1:50 000-scale maps covering the Maputaland coastal plain east of the Lebombo Mountain foothills, from St Lucia estuary to the Mozambique border. Available field sheets covering the Maputaland coastal plain region in northern KwaZulu-Natal were selected – based on detailed aerial photographs and field mapping – as the basis for these maps, since they represent the revised lithostratigraphy of the Maputaland Group. Parts of nine 1:50 000 sheets comprising the coastal zone of the iSimangaliso Wetland Park were completed during 2017/2018, followed by seven 1:50 000 sheets in 2018/2019. In addition, a South African Committee for Stratigraphy catalogue description of the Maputaland Group was published in the South African Journal of Geology. Early in the financial year, airborne geophysical investigations were undertaken, resulting in the compilation of aeromagnetic and radiometric map coverages for the Maputaland region. The data are currently being assessed and modelled to identify the geophysical signatures of the mapped geological units. Field mapping was undertaken to verify the geological boundaries and refine the mapped geological units. To complete the map coverage, the Jurassic Lebombo Group, which contains ammonite fossils (Figure 16), and Early Cretaceous Bumbeni Complex mapping was revised and the Cretaceous Zululand Group boundaries were included to complete the map sheet coverage.

Figure 16: Ammonite fossil in Early Cretaceous marine deposits on the Lebombo Mountain footslopes.

4.1.5. GEOSCIENCE INNOVATION

Geoscience innovation is key to addressing modern-day social and economic issues sustainably. Data collected over more than century need to be reprocessed using modern techniques to extract value. The CGS is implementing innovative artificial intelligence tools in modelling groundwater vulnerability and charactering subsidence from sinkholes. New geoscience modelling software is being developed that is open source and allows for integration of multiple geoscience data layers. Below are details of some CGS innovation projects.

4.1.5.1. Use of Bushveld mine tailings for the synthesis of nano-sized materials

This project seeks to synthesise nano-sized mineral materials from readily available Bushveld mine tailings. Targeted applications include preparation of plant nano-fertilisers for drought stress management (i.e. nano-minerals for food security), preparation of nano-additives for rapid geopolymer strength development. The latter links directly with the mine residue and geopolymer task in the Mine Environment and Water Management Programme, which seeks to develop cost-effective geopolymer-based liners to replace prohibitively expensive layers currently used in liner systems that are crucial in preventing the release of acid mine drainage into valuable natural water resources.

The synthesis of magnetic nanoparticles (nano-magnetite Fe3O4 and nano-maghemite γ-Fe2O3) from iron-rich tailings was partly successful and will be investigated further. An assessment of elemental extraction efficiencies from tailings using a low-temperature sulfate process was investigated, but thermochemical treatment was found to be more effective in extracting valuable components from tailings.

4.1.5.2. Python Geophysical Modelling and Interpretation Project

Python Geophysical Modelling and Interpretation (PyGMI) develops open-source software to create high-resolution 3D models (Figure 17). It incorporates various interpretation tools, including processing capability for seismic data, and has been designed for ease of use, with minimum training required. PyGMI implementation has revolutionised geophysical modelling at the CGS and it is expected to contribute positively to 3D modelling in the geological sciences. Thus, the software will be freely available to local and international organisations, especially small companies and academic institutions with limited budgets for equipment.

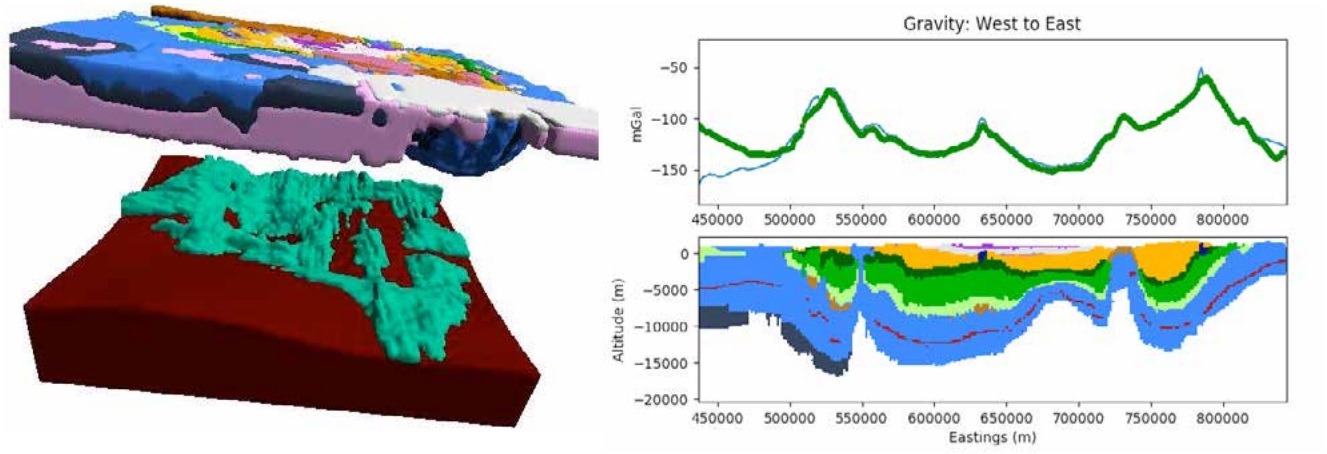


Figure 17: An example of a model created with PyGMI.

4.1.5.3. Application of artificial intelligence in geoscience

a. Development of an automation system for hazard classification of boreholes drilled in dolomitic land

Sinkholes are a geological hazard that manifest as depressions on the ground surface, often due to the dissolution or collapse of surface sediments into bedrock cavities. Sinkholes are very common in karstic terrains (a geological environment dominated by rocks such as limestone, dolomite and gypsum, which can be dissolved by slightly acidic groundwater) and occur in various sizes, shapes or depths. To characterise the risk of sinkhole formation prior to infrastructure development, boreholes are normally drilled and logged. Borehole data are then interpreted to classify the likelihood of sinkhole formation.

The CGS established a project to develop an automatic classification platform with a user-friendly graphic user interface. It focused on development of software, using fuzzy expert systems, to enable rapid and accurate classification of boreholes drilled in dolomitic land, using input parameters typically contained in borehole logs, such as voids, air loss, material loss, depth to water table, depth to bedrock, layer thickness, layer material type and wetness information. When the software was tested against data from several thousand boreholes that were correctly classified over the year, it compared very favourably with the human expert classifications. Thus, the automated system can reduce bias associated with borehole classification, while speeding up classification. This research approach could be applicable to dolomitic terrains elsewhere in the world.

b. Regional groundwater potential mapping using fuzzy inference system

In a water-scarce country such as South Africa, groundwater is a valuable natural resource for communities, agriculture and industries. In recent years, the Geographic Information System (GIS) and remote sensing have become successful tools for groundwater exploration, at low cost and with rapid coverage of large areas. The CGS methodology incorporated nine different data sources (aquifer types, topographic slope, lineament density, drainage density, land use/land cover, distance to lineaments, distance to streams, potential recharge and soil clay content) in a fuzzy inference system that used inhouse-developed software to create a regional groundwater potential map for northern Free State (Figure 18). The method proved very effective, minimising time, labour and costs required to identify areas with high groundwater potential and should aid local authorities in land-use planning, and groundwater resources management.

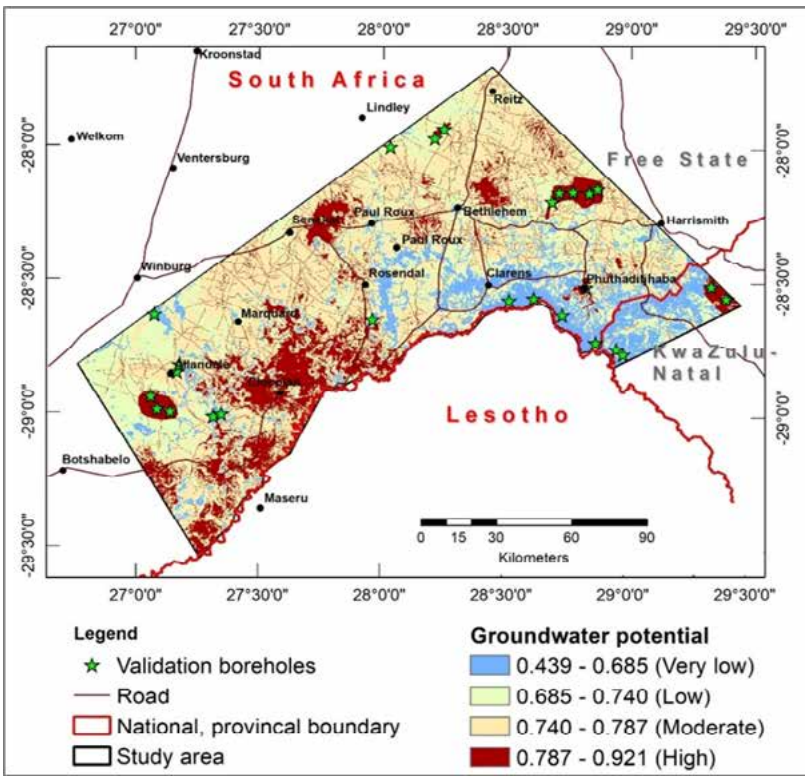


Figure 18: Regional groundwater potential map for northern Free State.

4.1.6. GEOSCIENCE DIPLOMACY

The CGS continues to develop its Geoscience Diplomacy Programme as part of the thematic approach to its GTP. This theme supports broader international geoscientific developmental goals and requirements, particularly of African communities. Transboundary geological mapping has been undertaken in Namibia and Malawi to generate fundamental geological data to support economic development, and to train and develop local geologists and students. Another CGS project supporting training and development involves oversight of geological mapping for and development of geological surveys in Cameroon and Burkina Faso. As secretariat of the Organisation of African Geological Surveys (OAGS), the CGS continues to play a leadership role in improving African partnerships and collaboration. The South African seismic network, administered by the CGS, makes an important contribution to the preparatory commission for the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO), which facilitates global cooperation in monitoring nuclear weapon testing. CGS geoscience diplomacy projects will continue into 2019/2020, in Malawi, through extended research in Namibia and engagement with CGS-equivalent organisations.

4.1.6.1. CTBTO project

The CGS participated in the CTBTO advanced course of the onsite inspection (OSI) third training cycle (3TC) for surrogate inspectors, which took place from 7 to 20 October 2018, and the ground and airborne visual observation course from 22 to 27 October 2018. The courses, held at the Denel Overberg Test Range, Arniston, Western Cape, both addressed competencies required of OSI surrogate inspector trainees (Figure 19) and were the first of a number of courses in the advanced block of the 3TC programme, which will continue into 2019/2020.

The advanced course drew 73 participants from 41 CTBTO member states, 14 of which are African regional states. The CGS pledged two staff members and a helicopter to the course as an indication of its commitment to the CTBTO and its values.

The observation course, attended by 16 trainees, covered topics related to overflights during an onsite inspection. Both courses were resounding successes and earned CTBTO approval.

Figure 19: Participants in the CTBTO course.

4.1.6.2. Geological mapping and integrated training and capacity building in modern geological mapping and research for the Directorate Geological Survey Namibia and the CGS

For several years, the CGS has led a regional-scale mapping and capacity building project in southern Namibia under contract for and in collaboration with the Directorate Geological Survey Namibia. The programme, which has produced new, fully digital 1:50 000-scale geological maps covering almost 28 0000km^2 of rugged and remote mountain desert along the lower Orange River border with South Africa, contributes to the larger objective of 1:50 000-scale detailed geological map coverage for the entire country by 2030, in line with NDP Vision 2030, the Millennium Development Goals and the Harambe Prosperity Plan of the Government of Namibia.

Furthermore, the programme will enhance research skills and capacity in geological mapping at Geological Survey Namibia. The Karas and Kunene regions are priority areas for new and revision mapping based on geology and economy. Mapping in southern Namibia was last carried out in the late-1960s to mid-1970s at a scale of 1:100 000 and, given its potential for the discovery of new mineral deposits: the region was due for more detailed 1:50 000-scale geological mapping and research. While modern maps and geological understanding are crucial to developing mineralisation models, the maps and reports also provide base geological information to search for water, support infrastructure development (solar-powered farms, pipelines, roads and bridges) and for geotourism activities. Figure 20 shows the faulting in the Boom River, with significant downthrow of the Nama Group, Ai-Ais-Richtersveld Transfrontier Park, Lower Orange River region.

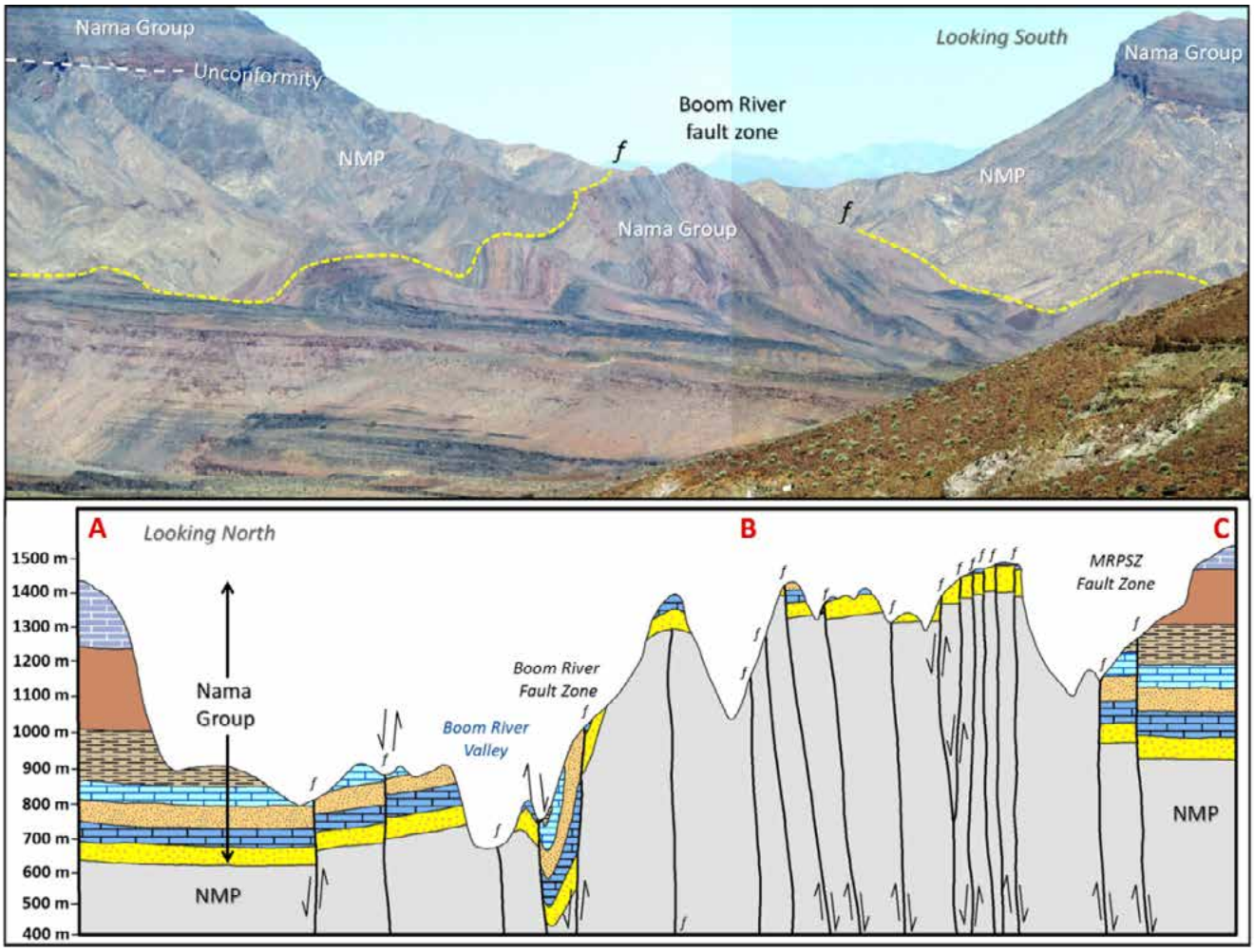


Figure 20: Faulting in the Boom River, with significant downthrow of the Nama Group, Ai-Ais-Richtersveld Transfrontier Park, Lower Orange River region.

4.1.6.3. Geological and geochemical mapping supervision in Burkina Faso

The CGS assisted the Ministry of Mines and Energy of Burkina Faso with a mapping exercise to develop and promote that country's mineral resources industry. The World Bank-funded five-year Projet d'Appui au Développement du Secteur Minier includes geological mapping at 1:200 000 scale of 13 sheets, which will provide complete coverage of the country; compilation of a 1:1 000 000-scale geological map of the country (Figure 21); an airborne geophysical survey of the northern part of the country, where known mineral resources occur; steam sediment geochemical mapping of the southwestern part of the country; and restructuring of the database and GIS infrastructure. The CGS's tasks included supervision of the terms of reference and evaluation of the technical offer of the consultants, monitoring of activities, approval of deliverables, and writing of evaluation reports, a promotional brochure and the final report.

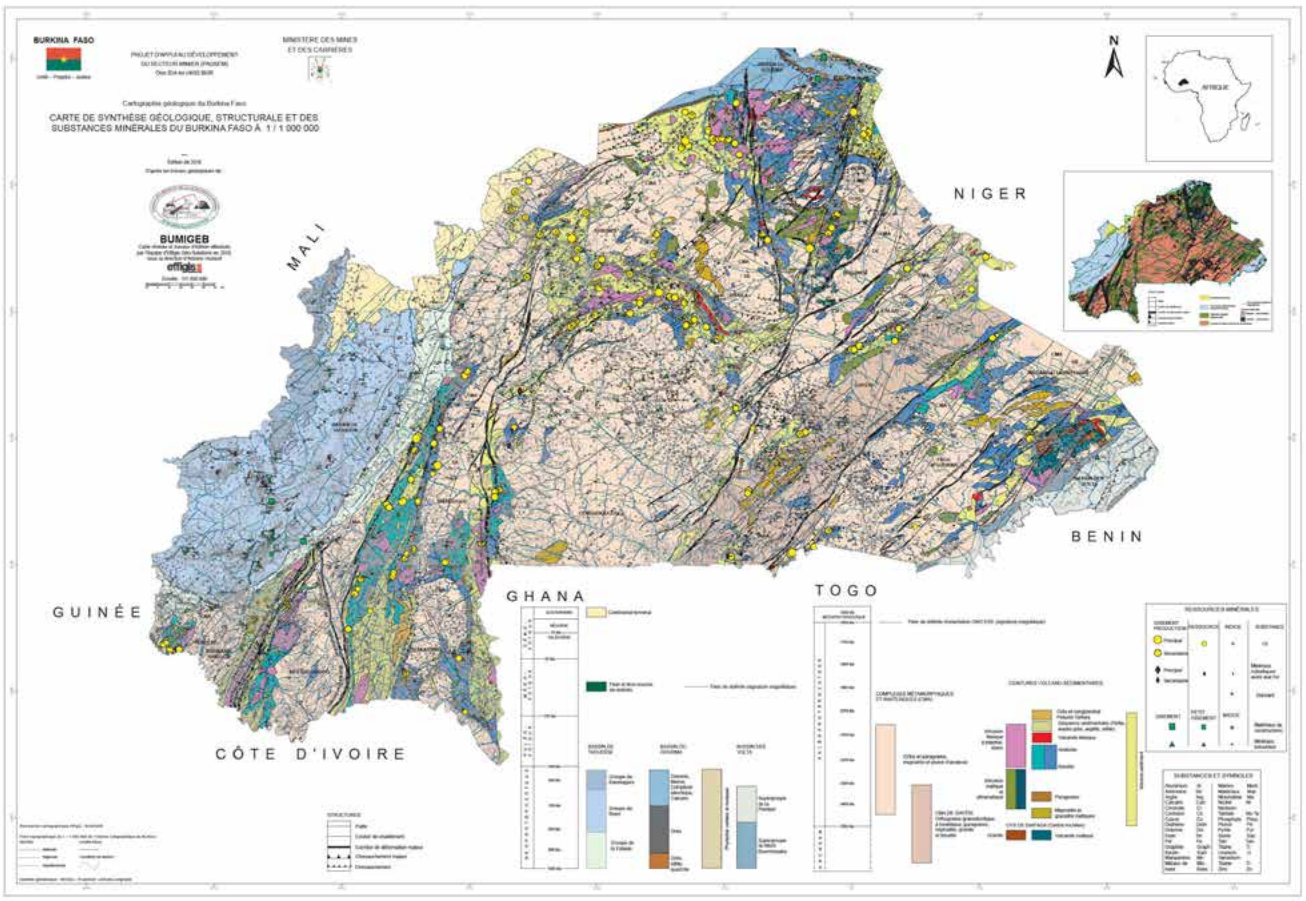


Figure 21: New 1:1 000 000-scale geological map of Burkina Faso.

4.1.6.4. Cameroon geological and geochemical mapping supervision

The World Bank is funding Projet de Renforcement des Capacités dans le Secteur Minier, a four-year project of the Ministry of Mine, Industry and Technological Development of Cameroon to promote the mineral resources of the country. The project includes geological mapping at 1:200 000 scale of 13.5 sheets (Ndikiniméki, Bafia, Nanga-Eboko, Bertoua, Bafoussam (1/2), Linté, Yoko, Deng-Deng, Banyo, Tibati, Bagodo, Tignere, N'Gaoundéré and Tchamba) to complete the coverage of the country. Two phases will see the production of eight maps in the south and five maps in the north of the country. In addition, stream sediment geochemical mapping will take place over the geological mapping area and the database and GIS infrastructure will be restructured. Mineral-potential regions in the study area will be mapped (Figure 22).

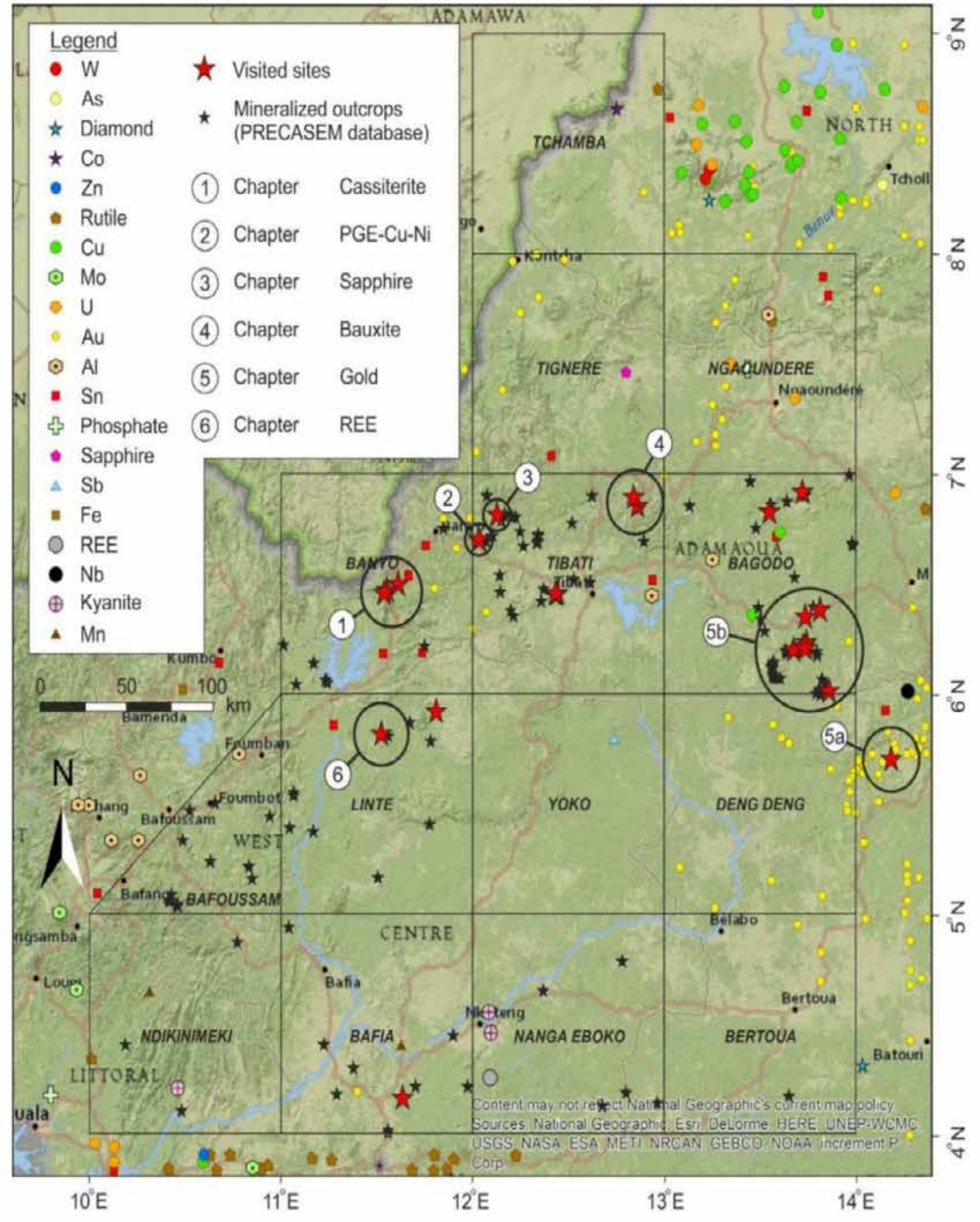


Figure 22: Mineral-potential regions identified in Cameroon.

4.1.6.5. OAGS

OAGS was established on 2 February 2007 to address and promote African geoscience matters, provide technical advice to the continent's decision-makers and establish a platform for member interaction. OAGS's mandate is to foster and sustain geoscience programmes and excellence on the African continent, leading to socio-economic development, poverty alleviation, sustainable land use, hazard mitigation and environmental protection.

Figure 23: OAGS held its 11th annual general meeting in Dakar, Senegal.

During the year under review, OAGS continued implementing the following programmes (Figure 23):

a) African Minerals and Energy Classification

African Minerals and Energy Classification (AMREC) is an African Union-led continental system based on the United National Framework Classification for Resources (UNFC) for sustainable management of the minerals and energy value chain in Africa. The African Union-AMREC Working Group, of which OAGS is a member, was established to spearhead the development of UNFC-AMREC and to complete it within a specified period.

b) Fourth UN Environmental Assembly, Nairobi, Kenya, 5 to 15 March 2019

The African Union Commission invited CGS CEO, Mosa Mabuza, to present at this meeting of historical significance as part of the OAGS delegation. The session examined the development and implementation of UNFC-AMREC and how it supports concepts that promote innovative solutions to transform environmental challenges into opportunities.

c) PanAfGeo training

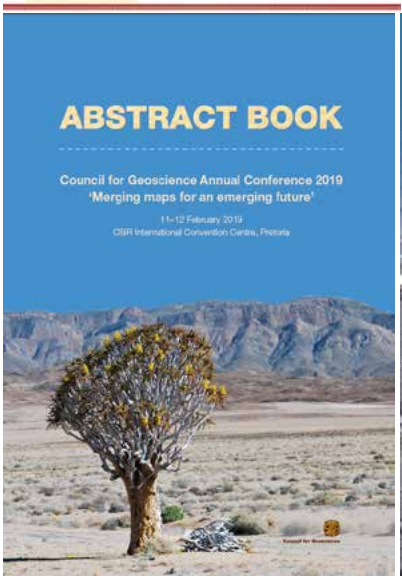
PanAfGeo (geoscientific knowledge and skills in African Geological Surveys) is a Pan-African geoscientific project that supports the training of geoscientific staff from African Geological Surveys. PanAfGeo is funded by the European Union and administered through the EuroGeoSurvey Secretariat in partnership with OAGS. The OAGS Secretariat administers reports and feedback questionnaires from African Geological Surveys trainees. This training programme comprises mineral resources assessment, geoscientific mapping, geoscientific information management/database management, handling of spatial data and GIS, geoheritage, geohazards, environmental management of mines, and artisanal and small-scale mining.

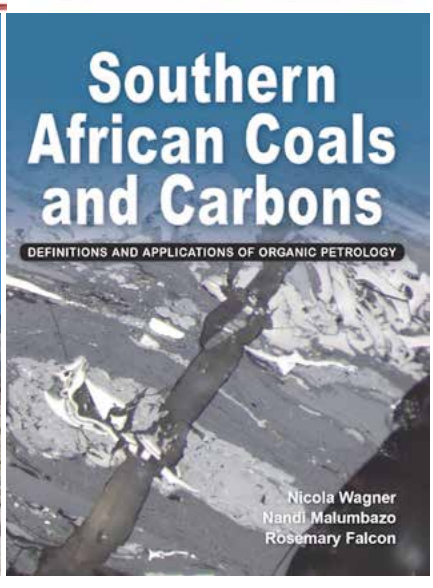
5. DISSEMINATION OF INFORMATION

The CGS disseminates the results of its research to its stakeholders in publication series including memoirs, bulletins, explanations, annual reports, newsletters, conference proceedings and maps, and these are presented in sections 5.1 to 5.3. The organisation's refocus on its mandate and its focus on acquiring new-multidisciplinary data have resulted in new external collaborations and partnerships and development of additional publications.

5.1. Publications

1. GEOclips Volume 53. June 2018, 8pp
2. GEOclips Volume 54. September 2018, 12pp
3. GEOclips Volume 55. December 2018, 12pp
4. GEOclips Volume 56. March 2019, 16pp
5. Wagner, **N., Malumbazo**, N. and Falcon, R., 2018. Southern African Coals and Carbon: Definitions and Applications of Organic Petrology. Struik Nature, ISBN 978 1 77584 543 0
6. Council for Geoscience Annual Conference 2019 Abstract Book, 131pp





5.2. Peer-reviewed articles

(CGS staff are indicated in bold)

1. Barbolini, N., **Nxumalo, V.**, Wagner, N., Kramers, J., Vorster, C., Cairncross, B. and Bamford, M.K., 2019. Palynostratigraphic correlation of the Springbok Flats coalfield to other coal-bearing successions in the Karoo basins of southern Africa. South African Journal of Geology, https://doi.org/10.25131/sajg.122.0001
2. **Botha, G.A.**, Porat, N., Haldorsen, S., Duller, G.A.T., Taylor, R. and Roberts, H.M., 2018. Beach ridge sets reflect the late Holocene evolution of the St Lucia estuarine lake system, South Africa. Geomorphology, 318, 112–127.
3. **Brandt, M.B.C.**, 2019. Performance of the South African National Seismograph Network from October 2012 to February 2017: Spatially varying magnitude completeness. South African Journal of Geology, 122.1, https://doi.org/10.25131/sajg.122.0004
4. **Brassnavy, M., Midzi, V., Mulabisana, T.F., Zulu, B., Pule, T., Myendeki, S.** and **Rathod, G.W.**, 2018. Seismotectonics of South Africa. Journal of African Earth Sciences, doi: 10.1016/j.jafrearsci.2018.08.012
5. Carr, A.S., Bateman, M.D., **Cawthra, H.C.** and Sealy, J., 2019. First evidence for onshore marine isotope stage 3 aeolianite formation on the southern Cape coastline of South Africa. Marine Geology, 407, 1–15, https://doi.org/10.1016/j.margeo.2018.10.003
6. Craddock, J.P., Ojakangas, R.W., Malone, D.H., Konstantinou, A., Mory, A., Bauer, W., **Thomas, R.J.**, Affinati, S.C., Pauls, K., Zimmerman, U. and **Botha, G.**, 2019. Detrital zircon provenance of Permo-Carboniferous glacial diamictites across Gondwana. Earth-Science Reviews, https://doi.org/10.1016/j.earscirev.2019.01.014
7. Farrant, A.R., Mounteney, I., Burton, A., **Thomas, J.R.**, Roberts, N.M.W. and Knox, W.O.R., 2018. Gone with the wind: Dune provenance and sediment recycling in the northern Rub' al-Khali, United Arab Emirates, Arabia. Journal of the Geological Society of London, Jgs2017-044, 10.1144/jgs2017-044
8. Gastaldo, R.A., **Neveling, J.**, Geissman, J.W. and Kamo, S.L., 2018. A lithostratigraphic and magnetostratigraphic framework in a geochronologic context for a purported Permian-Triassic boundary section at Old (West) Lootsberg Pass, Karoo Basin, South Africa. GSA Bulletin, 130(9–10), 1411–1438, doi: https://doi.org/10.1130/B31881.1
9. Grantham, G.H., Eglington, B.M., **Macey, P.H.**, Ingram, B.A., Rademeyer, M., Keidan, H. and Manhica, V., 2018. The chemistry of Karoo-age andesitic lavas along the northern Mozambique coast, southern Africa and possible implications for Gondwana breakup. South African Journal of Geology, https://doi.org/10.25131/sajg.121.0026
10. Hahn, A., Miller, C., Andò, S., Bouimetarhan, I., **Cawthra H.C.**, Green, A., Radeff, G., Schefuß, E. and Zabel, M., 2018. The Provenance of Terrigenous Components in Marine Sediments along the East Coast of Southern Africa. Geochemistry, Geophysics, Geosystems, 19(7), 1946–1962, https://doi.org/10.1029/2017GC007228
11. Helm, C.W., Benoit, J., Mayor, A., **Cawthra, H.C.**, Penn-Clarke, C.R. and, Rust, R., 2019. Interest in geological and palaeontological curiosities by southern African non-western societies: A review and perspectives for future study. Proceedings of the Geologists' Association, https://doi.org/10.1016/j.pgeola.2019.01.001
12. Helm, C.W., **Cawthra, H.C.**, De Vynck, J.C., Lockley, M.G., McCrea, R.T. and Venter, J., 2019. The Pleistocene fauna of the Cape south coast revealed through ichnology at two localities. South African Journal of Science, 115(1/2), https://doi.org/10.17159/sajs.2019/5135
13. **Kgaswane, E.M., Rathod, G.W.**, and **Saunders, I.**, 2018. Tectonic history of the Kaapvaal craton: Constraints from rheological modelling. Journal of Geophysical Research: Solid Earth, 123, https://doi.org/10.1029/2018JB015631
14. **Kwata, M.G., Moja, S.J.** and Chadi, A., 2018. A physico-chemical study of dust samples from derelict and ownerless asbestos mine dumps in Mpumalanga Province, Republic of South Africa. WIT Transactions on Ecology and the Environment, 230, 331–342.
15. **Macey, P.H., Abrahams, Y.** and **Miller, J.A.**, 2018. Lithostratigraphy of the Mesoproterozoic Stolzenfels Enderbite (Komsberg Suite), South Africa and Namibia. South African Journal of Geology, 121.2, doi: 10.25131/sajg.121.0016
16. **MacHutchon, M.R.** and Van den Bossche, P., 2018. The marine geology of the one-nautical-mile, exclusive zone around Robben Island, South Africa. South African Journal of Geology, 121.2, 141–156, https://doi.org/10.25131/sajg.121.0005
17. **Mashalane, T.B., Moja, S., Novhe, O., Kwata, M.G.** and **Masindi, K.**, 2018. A study of the trapped dust and dustfall samples from human settlements near rehabilitated and non-rehabilitated abandoned asbestos mine dumps in the Northern Cape Province, South Africa. WIT Transactions on Ecology and the Environment, 230, 355–366.
18. Masindi, V., **Madzivire, G.** and Tekere, M., 2018. Reclamation of water and the synthesis of gypsum and limestone from acid mine drainage treatment process using a combination of pre-treated magnesite nanosheets, lime and CO_2 bubbling. Water Resource and Industry, 20, 1–14.

19. Melosh, B.L., Rowe, C.D., Gerbi, C., Smit, L., Groenewald, C., Lambert, C.W. and **Macey, P.H.**, 2018. Seismic cycle feedbacks in a mid-crustal shear zone. Journal of Structural Geology, 112, 95–111.
20. Mendonidis, P. and **Thomas, R.J.**, 2018. A review of the geochronology of the Margate Terrane reveals a history of diachronous terrane docking and arc accretion across the Mesoproterozoic Natal belt, southeastern Africa. Journal of African Earth Sciences, 150, 532–545, ISSN1464343X, https://doi.org/10.1016/j.jafrearsci.2018.07.021
21. **Midzi, V., Saunders, I., Manzunzu, B.**, Kwadiba, T., Jele, V., Marimira, K., **Mulabisana, T.**, Ntibinyane, O., **Pule, T., Rathod, G.W.**, Sitali, M., **Tabane, L.**, Van Aswegen, G. and Zulu, B.S., 2018. The 03 April 2017 Botswana M6.5 earthquake: Preliminary results. Journal of African Earth Sciences, 143, 187–194.
22. **Mngadi, S.**, Moodley, R. and Jonnalagadda, S.B., 2019. Elemental composition and nutritional value of the edible fruits of Transvaal red milkwood (Mimusops zeyheri) and impact of soil quality. Environmental Monitoring and Assessment, 191: 135, https://doi.org/10.1007/s10661-019-7280-z
23. **Mulabisana, T., Midzi, V.** and **Manzunzu, B.**, 2018. Local site effects during the Orkney earthquake of 5 August 2014. Pure and Applied Geophysics, 176(1), 147–164, doi: 10.1007/s00024-018-1959-x
24. Nyabese, P., Gwavava, O. and **Sekiba, M.**, 2018. Using Electrical Resistivity Tomography (ERT) to delineate subsurface structures at Siloam hot spring in the Soutpansberg Basin, South Africa. Journal of Geography and Geology, 10(4), doi: 10.5539/jgg.v10n4p19
25. **Thomas, R.J.**, Jacobs, J., Mruma, A., Elburg, M., Kamihanda, G., Kankila, A., Masanja, A. and Saidi, H., 2018. New U-Pb-Hf zircon isotope data for the Paleoproterozoic Ubendian belt in the Chimala area, SW Tanzania. Geoscience Frontiers, 1–15, https://doi.org/10.1016/j.gsf.2018.05.010
26. Viljoen, J.H.A. and **Cawthra, H.C.**, 2019. Lithostratigraphy of the Buffelskloof Formation (Uitenhage Group), South Africa. South African Journal of Geology, 97–104, https://doi.org/10.25131/sajg.122.0009

5.3. Scientific abstracts

(CGS staff are indicated in bold)

1. **Baglow, N., Mthembi, P., Munyangane, P., Thomas, A., Nxantsiya, Z., Mankayi, N., Makonto, O., Nemaxwi, P.** and **Matshivha, M.** Dolomites in the Kuruman-Daniëlskuil area: a multiple perspectives viewpoint. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 104.
2. **Billay, A.Y.** The Platinum Group Elements (PGE) potential of the Main Zone, Northern Limb, Rustenburg Layered Suite. Geocongress, University of Johannesburg, 18–20 July 2018.
3. **Bosch, P.** and **Hatton, C.** Evidence for early life in South African geology depicted on South African postal stamps. Geocongress, University of Johannesburg, 18–20 July 2018.
4. **Bosch, P.J.A.** The Gamagara Formation, Olifantshoek Supergroup, a case of identity theft of an important formation that preserved the Mn-Fe ore or the Maremane Dome in the Northern Cape? Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 63.
5. **Botha, G.** and **Singh, R.**, 2019. Quaternary stratigraphy: Don't lose sight of the big picture. SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
6. **Brandt, M.B.C.** The South African National Seismograph Network: magnitude of completeness and mine-related event statistics. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 113.
7. Castleman, B.A., **Doucet, F.J.** and Van der Merwe, E.M. Production of Mg- and Fe-containing compounds during the valorisation of diamond mine slimes via thermochemical treatment. 7th International Conference on Engineering for Waste and Biomass Valorisation (WasteEng2018), Prague, Czech Republic, 2–5 July 2018.
8. **Cawthra, H.C.** 'Imagine a landscape': how geological mapping of the seafloor can help to inform past and future projections of global change. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 110.
9. **Cawthra, H.C.** Investment by the Council for Geoscience in marine geoscience and how we aim to produce the 'real' map of South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 56.
10. **Cawthra, H.C.**, Anderson, R.J., De Vynck, J., Fisher, E.C., Jacobs, Z., Jerardino, A., Kyriacou, K. and Marean, C.W. Migration of Pleistocene shorelines across the Palaeo-Agulhas Plain and the influence of intertidal resources on human subsistence. SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
11. **Cawthra, H.C.**, Cowling, R.M., Marean, C.W. and Andò, S. The geological and edaphic nature of the Palaeo-Agulhas Plain: evidence from the continental shelf. SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
12. **Chauke, R.**, Nex, P. and Hunt, J.P. Metallogeny of Boschoek Base Metal (Cu-Pb-Zn): with reference to Stravoren fragment polymetallic mineralisation. Geocongress, University of Johannesburg, 18–20 July 2018.

13. **Chevallier, L.** Geological mapping supervision in Burkina Faso and Cameroon. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 28.
14. **Chiliza, S.G.** and Hingston, E.D.C. A petrographic and geotechnical study of the sandstone of the Fundudzi Formation, Lake Fundudzi, South Africa. In: Shakoor, A. and Cato, K. (eds), IAEG/AEG Annual Meeting Proceedings, San Francisco, California, 2018 — Volume 6. Springer, Cham, doi: https://doi.org/10.1007/978-3-319-93142-5_21
15. **Chirenje, E., Sebothoma, S., Sekiba, M., Nxantsiya, Z., Sethobya, R.M.** and **Netsianda, A.** Quality management and optimising the value of a reconnaissance geophysical survey: case study from Duynefontein marine terrace mapping. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 107.
16. **Chiya, L.**, Lehnhardt, L. and Robb, L. Geochemical investigations of hydrothermally altered portions of the Schrikkloof Formation, Rooiberg Group, Modimolle, South Africa: Mass Balance Approach. Geocongress, University of Johannesburg, 18–20 July 2018.
17. **Claassen, D.** and De Wit, M. The occurrence and development of onland palaeovalleys buried beneath Cenozoic cover between Oyster Bay and Cape St Francis, Eastern Cape, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
18. **Claassen, D.** and **Myendeki, S.** Land degradation and its potential risk to infrastructure in the Mthatha area, Eastern Cape, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 108.
19. **Claassen, D.** Lithostratigraphy of the Riverton Formation, Northern Cape Province, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
20. **Coetzee, H.** Meeting Dr Mellor: Using a Century of Spatial Geoscience Information in the Witwatersrand to address Environmental Legacies. Geocongress, University of Johannesburg, 18–20 July 2018.
21. **Coetzee, H.** Reconstructing historical mine water management practices for a portion of the East Rand Goldfield, South Africa, using long-term map and image time series. In: Wolkersdorfer, C., Burgess, J. and Tremblay, G.A. (eds), 11th ICARD/IMWA/MWD Conference: Risk to Opportunity. IMWA/ICARD/MWD, Pretoria, 10–14 September 2018.
22. **Cole, D.** Geoheritage initiatives in the Western Cape Province, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
23. **Cole, D.** New insights into the stratigraphy of the lower Ecca Group using recent data from the deep borehole logs in the central and southern parts of the Main Karoo Basin. Geocongress, University of Johannesburg, 18–20 July 2018.
24. **Cole, D.** Review of shale gas potential of the Whitehill Formation in the Main Karoo Basin, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 53.
25. **Cole, J.** and **Cole, P.** Geological remote sensing — a comparison between multispectral and hyperspectral remote sensing data. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 68.
26. **Cole, P., Coetzee, H.** and **Cole, J.** The use of change detection in remote sensing relating to the geosciences. Council for Geoscience Annual Conference 2019, 11–12 February 2019, p. 91.
27. Cowling, R., Grobler, A., **Cawthra, H.C.** and Potts, A.J. The ghosts of habitat past: why are Cape Holocene dunes so rich in species and endemics? SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
28. Davids, S., Scharenberg, M., Lang, A., **Hicks, N.**, Smith, V., Heinrichs, M., Moody, M., Sullivan, C., Kamrajh, N., Maupa, T., Beck, B., Walker, J., Burchwell, A. and Gupta, N. How legacy data can open new potential for carbon capture and storage in South Africa. 14th International Conference on Greenhouse Gas Technologies, Melbourne, Australia, 21–25 October 2018.
29. **Dhansay, T., Makubalo, S.** and **De Kock, G.** Gold kinematics — tracing mineralisation pathways in the Sabie-Pilgrim's Rest goldfield. Council for Geoscience Annual Conference 2019, 11–12 February 2019, p. 78.
30. **Dhansay, T., Moabi, N., Hicks, N.** and **Baglow, N.** The Council for Geoscience field school — evolving geoscience education in evolving landscapes. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 27.
31. **Dhansay, T., Musekiwa, C., Ntholi, T., Chevallier, L., Cole, D.** and De Wit, M. South Africa's geothermal energy hotspots inferred from subsurface temperature and geology. Geocongress, University of Johannesburg, 18–20 July 2018.
32. **Dhansay, T.**, Navabpour, P., De Wit, M. and Ustaszewski, K. Assessing the reactivation potential of pre-existing fractures in the southern Karoo, South Africa: evaluating the potential for sustainable exploration across its Critical Zone. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 55.
33. **Dhansay, T., Safi, M., Motlakeng, T.** and **Ngamlana, S.** The hunt for energy in the deep: the geothermal energy potential of South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 77.
34. Diop, S., Tessema, A., Sethobya, R.M., Hobo, M. and Chirenje, E. A multidisciplinary investigation approach into the causes of sinkhole and subsidence: case study in South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 101.

35. **Doggart, S.W., Buick, I., Macey, P., Lana, C., Frei, D.** and **Lambert, C.W.** Coupled in situ Sm-Nd isotope geochemistry and U-Pb isotope geochronology of monazite from pegmatites of the Orange River belt. Clues to their emplacement within the polymetamorphic Namaqua-Natal Metamorphic Belt. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 51.
36. **Doucet, F.J.** and **Nyale, S.** Geopolymer composites as potential alternative liner material for mine residues. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 90.
37. **Dube, M.** and **Sakala, E.** GIS-based regional groundwater potential mapping of the area between Harrismith and Botshabelo, Free State Province of South Africa. 6th ChinAfrica Water Forum Conference, Sharm El Sheik, Egypt, 23–25 July 2018.
38. **Dube, M.** and **Sakala, E.** Regional groundwater potential mapping using fuzzy inference systems in the area between Harrismith and Botshabelo, Free State Province of South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 95.
39. **Dudumashe, N., Buthelezi, M.** and **Sakala, E.** Application of remote sensing for monitoring forest vegetation health: case study of the Highflats forest in the KwaZulu-Natal Province of South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 97.
40. Esteban, I., Bamford, M.K., Miller, C., Neumann, F.H., Schefuss, E., Zabel, M., Pageter, J., **Cawthra, H.C.** and Fisher, E.C. A multi-proxy approach for coupling past climate and environments to plant-foraging hunter-gatherer behaviours from MIS 3 to the early Holocene in coastal Pondoland. SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
41. Fisher, E.C., **Cawthra, H.C.**, Esteban, I., Jacobs, Z., Jerardino, A., Miller, C., Neumann, F.H., Oertle, A., Pargeter, J., Saktura, R., Schefuss, E. and Szabo, K. The influence of coastal and marine geology on human occupation in Pondoland (South African Wild Coast) since the Late Pleistocene. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 127.
42. Fisher, E.C., **Cawthra, H.C.**, Esteban, I., Jacobs, Z., Jerardino, A., Miller, C., Neumann, F.H., Oertle, A., Pargeter, J., Saktura, R., Schefuss, E. and Szabo, K. Coastal occupation and foraging during the Late Pleistocene and early Holocene at Waterfall Bluff, eastern Pondoland, South Africa. SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
43. **Groenewald, C.A.**, Kisters, A.F.M., **Macey, P.H.** and Lambert C.W. The architecture and kinematics of the deep crustal, transcurrent Pofadder Shear Zone, with emphasis on the termination of a continental-scale ductile shear zone, Namaqua Metamorphic Province, South Africa and Namibia. Council for Geoscience Annual Conference 2019, 11–12 February 2019, p. 48.
44. Gupta, N., Moody, M., Sullivan, C., **Hicks, N.**, Davids, S., Heinrichs, M., Kamrajh, N. and Beck, B. Development of the first CO_2 storage pilot test for CCS capacity building in South Africa — The Phase I Experience. 14th International Conference on Greenhouse Gas Technologies, Melbourne, Australia, 21–25 October 2018.
45. **Hatton, C.** and **Mandende, H.** Caught in the act — incipient chromitite layers in the southeastern Bushveld Complex. Geocongress, University of Johannesburg, 18–20 July 2018.
46. **Hatton, C.** Cratonic uplift as a driver of biological evolution in southern Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 112.
47. **Hatton, C.** Drainage evolution in southern Africa on a Karoo Supergroup substrate. Geocongress, University of Johannesburg, 18–20 July 2018.
48. **Hatton, C.**, Hunt, J., **Mandende, H.** and Schweiter, J. Ancient mafic crust in the source of the Bushveld magmas. Geocongress, University of Johannesburg, 18–20 July 2018.
49. **Havenga, M.** Supervised versus unsupervised classification of radiometric data, Zululand, KwaZulu-Natal. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 76.
50. **Hicks, N.** and **Ncume, M.** Newly identified stratigraphy of the Nsuze Group in the Nkandla subbasin, northern KwaZulu-Natal: applications towards a revised lithostratigraphic framework and unified nomenclature. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 67.
51. **Hicks, N.** The South African Pilot CO_2 Storage Project: Geological modelling of a potential onshore CO_2 storage aquifer. Geocongress, University of Johannesburg, 18–20 July 2018.
52. **Hlatshwayo, S.M., Netshitungulwana, R., Strauss, S., Elsenbroek, J.H., Ralushai, A.E., Mukosi, N.C., Bensid, M.L., Nxumalo, V.** and **Ntikang, T.** Regional geochemical mapping of the 2918 Pofadder 1:250 000-scale sheet: a geochemical atlas. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 49.
53. **Hobo, M., Cole, P., Sakala, E.** and **Cole, J.** A decision-support tool to promote the coexistence of mining and biodiversity. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 98.

54. **Hunt, J.** Statistical treatment of soil data towards population determinations for cluster analysis of Bushveld Granites, Geocongress, University of Johannesburg, 18–20 July 2018.
55. **Kenan, A.** Surficial uranium potential near Keimoes, Northern Cape Province, Geocongress, University of Johannesburg, 18–20 July 2018.
56. **Kwata, M.G., Moja, S.J., Masindi, K., Mtyelwa, O.** and **Malatji, M.** Asbestos fibre and mineral counts from filtered dust collected in human settlements in the vicinity to former asbestos mine dumps in Mpumalanga Province, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 96.
57. **Lehong, K., Pieterse, L.** and **Kenan, A.** Copper inventory within the Namaqualand District in the Northern Cape, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
58. **Lin, H.** Groundwater modelling in Ngabu area, Malawi. Geocongress, University of Johannesburg, 18–20 July 2018.
59. **Lombard, D.** and **Diop, S.** Geotechnical laboratory testing of aggregates, Eastern Cape Province, South Africa — a case study. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 130.
60. Long, C., De Wit, M. and **Coetzee, H.** Hydrochemical characterisation of mine drainage discharging into the UNESCO Fossil Hominid Site of South Africa. In: Wolkersdorfer, C., Burgess, J. and Tremblay, G.A. (eds), 11th ICARD/IMWA/MWD Conference: Risk to Opportunity. IMWA/ICARD/MWD, Pretoria, 10–14 September 2018.
61. **Macey, P.H.** and Slingsby, P. A hiking and geology map of the Fish River Canyon. Geocongress, University of Johannesburg, 18–20 July 2018.
62. **Macey, P.H., Abrahams, Y.** and Miller, J.A. Lithostratigraphy of the Mesoproterozoic Stolzenfels Enderbite (Komsberg Suite), South Africa and Namibia. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 66.
63. **Macey, P.H.**, Bailie, R., Miller, J.A., **Thomas, R.J., De Beer, C.**, Frei, P. and Le Roux, P. Implications of the distribution, age and origins of the granites of the Mesoproterozoic Spektakel Suite for the timing of the Namaqua Orogeny in the Bushmanland Subprovince of the Namaqua-Natal Metamorphic Province, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
64. **MacHutchon, M.R., De Beer, C.H., Van Zyl, F.W., Salzmann, L.** and **Cawthra, H.C.** Structural insights into the western branch of the Saldania Belt through the marine geology of Table Bay, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 74.
65. **Madzivire, G.**, Maleka, R.M., Tekere, M. and Petrik, L.F. Acid mine drainage treatment technology developed in the context of a circular economy. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 43.
66. **Makubalo, S., Kenan, A.** and Diamond, R. Carnotite solubility index in the Namaqualand region, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
67. **Makubalo, S.S., Kenan, A.O.** and Diamond, R. Carnotite solubility index in Namaqualand, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 65.
68. **Manzunzu, B., Midzi, V.**, Durrheim, R.J. and **Mulabisana, T.F.** Uncertainties associated with the earthquake catalogue used in seismic hazard assessment for Johannesburg. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 111.
69. **Mashalane, T.B., Novhe, O.N., Coetzee, H.** and Wolkersdorfer, C. Metal removal from mine water using integrated passive treatment system at Witkrantz discharge point in the Ermelo Coal Fields, Mpumalanga. In: Wolkersdorfer, C., Burgess, J. and Tremblay, G.A. (eds), 11th ICARD/IMWA/MWD Conference: Risk to Opportunity. IMWA/ICARD/MWD, Pretoria, 10–14 September 2018.
70. Mashamba, L., Kramers, J. and **Coetzee, H.** Geochemical behaviour and seasonal variations of the acid mine drainage pollutant sources at a section of the Brugspruit Catchment, Emalahleni, South Africa. Geocongress 2018, University of Johannesburg, 18–20 July 2018.
71. **Mashiane, N.**, Elburg, M., **Billay, A.** and **Mutele, L.** Phosphate-REE related mineralisation in the Upper Zone of the Rustenburg Layered Suite. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 82.
72. **Mashiane, N.**, Elburg, M., **Billay, A.** and **Mutele, L.** Potential for metals on the Critical Zone of the Rustenburg Layered Suite. Geocongress, University of Johannesburg, 18–20 July 2018.
73. **Mello, T., Madzivire, G., Ligavha-Mbelengwa, L., Kgari, T.** and **Coetzee, H.** Water source apportionment for ingress point identification using emerging organic contaminants as environmental tracers. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 89.
74. Mfikili, A., Bornman, T. and **Cawthra, H.C.** Paleo-tsunami deposits — how much do we know along the South African coast? SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
75. **Midzi, V., Pule, T., Manzunzu, B., Mulabisana, T.F.** and **Zulu, B.S.** Determination of velocity models for use by the CGS cluster networks in earthquake locations. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 109.

76. **Midzi, V., Pule, T., Mulabisana, T., Zulu, B.** and **Manzunzu, B.** The 03 April 2017 Botswana M6.5 earthquake: The identification of possible ground truth events from a reassessed database of major southern African earthquakes of magnitude ML ≥ 5.0. 36th General Assembly of the European Seismological Commission, Valletta, Malta, 2–7 September 2018.
77. **Midzi, V., Saunders, I., Manzunzu, B., Kwadiba, T., Jele, V., Marimira, K., Mulabisana, T., Ntibinyane, O., Pule, T., Rathod, G.W., Sitali, M., Tabane, L., Van Aswegen, G.** and **Zulu, B.S.** Investigation of the 2017 Botswana M6.5 earthquake and its aftershocks. 2nd General Assembly of the African Seismological Commission, Al Hoceima, Morocco, 23–27 April 2018.
78. **Moabi, N.** and **Maré, L.** The geochemistry and palaeomagnetism of the Espungabera Formation lavas in Mozambique and Straumsnutane Formation lavas in Dronning Maud Land, eastern Antarctica: a geological correlation by geochemistry and rock magnetism. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 45.
79. **Mohamed, S., Doucet, F.J.** and Van der Merwe, E.M. Applications of thermogravimetric analysis in the investigation of mineral transformations during thermochemical treatment of mineral wastes. Analytika 2018 Conference, Mookgophong, 22–25 July 2018.
80. Mohamed, S., Van der Merwe, E.M., Petrik, L. and **Doucet F.J.** Recovery of iron from platinum group metal (PGM) tailings and synthesis of iron-based nanomaterials. 7th International Conference on Engineering for Waste and Biomass Valorisation (WasteEng2018), Prague, Czech Republic, 2–5 July 2018.
81. **Mosavel, H.** Investigating the shale gas potential of the Prince Albert Formation in the southern part of the Main Karoo Basin. Geocongress, University of Johannesburg, 18–20 July 2018.
82. **Mosavel, H., Cole, D.** and **Nxokwana, N.** Results of a hydrological investigation as part of the Karoo Deep Drilling Project in Beaufort West. Geocongress, University of Johannesburg, 18–20 July 2018.
83. **Motlakeng, T., Coetzee, H.**, Van Tonder, D. and **Novhe, O.** Optimal strategy of sampling mine residue and waste rock with reference to critical raw materials of South African tin mines. Geocongress, University of Johannesburg, 18–20 July 2018.
84. **Mthembi, P.** The sedimentation and depositional environments of the Ghaap Plateau in the Daniëlskuil and surrounding areas. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 62.
85. **Mukosi, N.C., Radzuma, T., Doggart, S., Mothetha, M., Mathebula, J., Mogowe, K., Ngobeni, D., Bensid, M., Netshitungulwana, R.** and **Hlatshwayo, S.** Multidisciplinary mapping of the Giyani greenstone belt and its remnants. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 79.
86. **Mulabisana, T.** and **Midzi, V.** Local site effects study based on the Orkney earthquake of 5 August 2014. 2nd General Assembly of the African Seismological Commission, Al Hoceima, Morocco, 23–27 April 2018.
87. **Munyangane, P.** The problem of dolomite identification: quick field techniques for the determination of calcareous rocks. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 83.
88. **Musekiwa, C., De Beer, C.H., Noruka, S.** and **Thomas, C.** The 2018 edition of the 1:1 million-scale geological map of South Africa, Lesotho and Swaziland: A collaborative effort in a digital environment. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 25.
89. **Musekiwa, C., Macey, P.H., Smith, H., Lambert, C.W.** and **Denner, G.** The application of multispectral satellite image remote sensing data for geological mapping in the Namaqua and Gariep Belts of South Africa and Namibia. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 60.
90. **Mutele, L., Setladi, C.** and **Kenan, A.** Geochemistry and petrography of lithium and fluorine rich rocks from Salpeterkop Carbonatite Complex, Sutherland, Northern Cape, South Africa: A potential Li-F mineralisation. Geocongress, University of Johannesburg, 18–20 July 2018.
91. **Myendeki, S.** Use of earthquake locations to identify seismogenic structures in the Witwatersrand Basin, South Africa. 2nd General Assembly of the African Seismological Commission, Al Hoceima, Morocco, 23–27 April 2018.
92. **Myendeki, S., Midzi, V.** and **Saunders, I.** Use of earthquake locations to identify seismogenic structures in the Witwatersrand Basin, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 129.
93. **Ncume, M., Hicks, N.** and Hoyer, L. Revisiting the geology and geochemistry of the Bumbeni Complex. The last phase of volcanic activity in the Karoo Igneous Province. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 44.
94. Neumann, F.H., Miller, C., Hahn, A., Schefuss, E., Zabel, M., Dupont, L., Finch, J., **Cawthra, H.C.** and Green, A. Late Quaternary vegetation dynamics observed in a marine core from Maputo Bay, Mozambique. SASQUA 22nd Conference, Mossel Bay, 28 January–1 February 2019.
95. **Ngobeni, D.D.** Mapping deeply buried Whitehill Formation using broadband magnetotellurics near Beaufort West. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 58.

96. **Ngubelanga, S.** Development on dolomitic land in South Africa: a special reference to the legislative framework and technical requirements. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 105.
97. **Ngubelanga, S.** Regulating development on dolomite: Application of SANS 1936. Dolomite Seminar, University of Pretoria, 4–6 June 2018.
98. Nkosi, Z., Altermann, W., **Doucet, F.J.** and Poellmann, H. Preferential precipitation of magnesite over calcite during mineral carbonation of platinum tailings: A possible consequence of the inhibition effect induced by the Mg cation activity in solution. 27th Colloquium of African Geology and 17th Conference of the Geological Society of Africa, Aveiro, Portugal, 21–28 July 2018.
99. Nkosi, Z., Nhlabathi, T., Gumede, A., Altermann, W. and **Doucet, F.J.** Appending mineral carbonation to mine waste management and/or retreatment processes. Geocongress, University of Johannesburg, 18–20 July 2018.
100. **Novhe, N.O., Yibas, B.** and **Coetzee, H.** Geochemistry and mineralogy of precipitates formed during passive treatment of acid mine drainage in the Ermelo Coal Field, South Africa. In: Wolkersdorfer, C., Burgess, J. and Tremblay, G.A. (eds), 11th ICARD/IMWA/MWD Conference: Risk to Opportunity. IMWA/ICARD/MWD, Pretoria, 10–14 September 2018.
101. **Nxantsiya, Z.** and **Chirenje, E.** Geophysical imaging of the central Karoo Basin near Beaufort West using magnetic, gravity and borehole data. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 94.
102. **Nxumalo, V., Netshitungulwana, R., Lehong, K.** and **Setladi, C.** Geochemistry and mineralogy of U-Mo mineralisation in the Molteno Formation, Karoo Basin, Rosendal, South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 72.
103. **Nxumalo, V.**, Vorster, C., Kramers, J. and Cairncross, B. Preliminary detrital zircon age data from the Karoo Supergroup of the Springbok Flats Basin, South Africa: An extensive provenance study. Geocongress, University of Johannesburg, 18–20 July 2018.
104. **Nyale, S., Vadapalli, V., Madzivire, G.** and **Ndumo, S.** Geopolymer grout for sealing mine cracks in underground mines in South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
105. **Penn-Clarke, C.R.** A multiproxy approach to understanding the rise and fall of the Malvinokaffric Realm in South Africa: palaeontology, ichnology, biostratigraphy and sequence stratigraphy of the Bokkeveld Group. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 40.
106. **Penn-Clarke, C.R.** Palaeoenvironmental change and allocyclicity at high (60–90°) southern latitudes during the Early–Middle Devonian of South Africa. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 39.
107. **Penn-Clarke, C.R.**, Browning, C., Deacon, J., Van der Westhuizen, J., Du Plessis, R. and Nieuwoudt, J. The Cederberg Exploration Centre: 500 million years, under one roof! Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 29.
108. **Penn-Clarke, C.R.**, Vorster, C. and Dixon, R. Palaeogeography, geochronology and tectonic setting of the Clanwilliam subbasin during the Early-Middle Devonian: the search for detrital and volcanogenic zircons in unconventional sinks. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 41.
109. **Pillay, T., Cawthra, H.C.** and Lombard, A.T. Characterising marine benthic habitats on the South African continental shelf using geophysical tools. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 36.
110. **Pule, T.** Vulnerability/damage curves for major cities in South Africa. 2nd General Assembly of the African Seismological Commission, Al Hoceima, Morocco, 23–27 April 2018.
111. **Pule, T., Midzi, V., Manzunzu, B., Zulu, B., Mulabisana, T., Rathod, G.** and **Mphahlele, K.** The macroseismic survey of the M4.6, 2017 Stilfontein Earthquake. 16th European Conference on Earthquake Engineering, Greece, 18–21 June 2018.
112. **Pule, T., Midzi, V., Manzunzu, B., Zulu, B., Mulabisana, T., Rathod, G.** and **Mphahlele, K.** The macroseismic survey of the M4.6, 2017 Stilfontein earthquake. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 115.
113. **Rudzani, L.** Geochemical and mineralogical characterisation of gold mine tailings for the potential of acid mine drainage in the Sabie-Pilgrim's Rest goldfields, South Africa. Council for Geoscience Annual Conference 2019, 11–12 February 2019, p. 88.
114. **Safi, M., Dhansay, T., Motlakeng, T., Ngamlana, S., Maja, F.** and **Ngubana, M.** In hot waters. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 84.
115. **Sakala, E.** and Fourie, F. Artificial intelligence as an emerging technology for the extraction of valuable information from geoscientific datasets. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 35.
116. **Sakala, E.** and **Saeze, H.** Application of Artificial Intelligence in Hydrogeology: A possible problem-solving tool for water-related issues — case studies from South Africa and Malawi. AAPG ICE2018 International Conference and Convention, Cape Town, 4–7 November 2018.

117. **Sakala, E.**, Fourie, F., **Dube, M., Saeze, H.** and **Cole, P.** Development of a software platform for regional groundwater potential mapping using artificial intelligence. 6th ChinAfrica Water Forum Conference, Sharm El Sheik, Egypt, 23–25 July 2018.
118. **Sethobya, R.M.** and **Diop, S.** Multidisciplinary geophysical approach for sinkhole and subsidence mapping, West Rand area. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 125.
119. S**ingh, R., Ncume, M., Botha, G.** and Kemp, J. Wind erosion: lessons to be learnt from the past. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 131.
120. **Smith, H.P., Macey, P.H.**, Miller, J.A., Angombe, M., Lambert, C.W. and Rowe, C. Thrusting across frontiers, the evolution of the Lower Fish River-Onseepkans Thrust Zone. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 80.
121. **Thomas, A.** Mapping of subsidence possibly due to the development of sinkholes in the Pretoria and Johannesburg areas using radar interferometry. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 102.
122. **Thomas, A.** Mapping of surface deformation (subsidence) in the Daniëlskuil and Kuruman areas using ENVI SARscape software. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 122.
123. **Thomas, A.** Mapping of surface deformation associated with the 6.5 magnitude Botswana earthquake of 3 April 2017 using radar interferometry. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 116.
124. **Thomas, A.** Radar interferometry for mapping surface deformation associated with the magnitude 5.2 Stilfontein earthquake of 3 April 2017. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 119.
125. **Thomas, A.** Usefulness of Sentinel-2 satellite data in geoscientific studies: a case study of the Limpopo greenstone belts (Giyani area). Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 70.
126. **Thomas, R.J.** Reflections on 40 years' progress in African geoscience. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 24.
127. Van der Merwe, E.M., **Doucet, F.J.**, Castleman, B. and **Mohamed, S**. Thermogravimetric investigations of thermochemically-treated solid mine residues in the context of waste beneficiation. ESTAC12 — 12th European Symposium on Thermal Analysis and Calorimetry, Brasov, Romania, 27–30 August 2018.
128. **Voigt, M.**, Miller, J., Bbosa, L., Govender, R.A., Bradshaw, D., Mainza, A. and Becker, M. Developing a 3D mineral texture quantification method of drill core for geometallurgy. GEO-11, The South African Institute for Mining and Metallurgy (SAIMM), Cape Town, 6–8 August 2018.
129. **Voigt, M.**, Miller, J., Bhosa, L., Govender, R.A., Bradshaw, D., Mainza, A. and Becker, M. Development of a three-dimensional mineral texture quantification method of drill core and its application in the geosciences and minerals engineering through a multidisciplinary approach. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 37.
130. **Voigt, M.**, Miller, J., Mainza, A. and Becker, M. The robustness of the GLCM and XCT method for the quantification of 3D mineral texture. International Process Mineralogy '18, Cape Town, 19–21 November 2018.
131. Wiles, E., Loureiro, C. and **Cawthra, H.C.** Short-term migration of shoreline position within a stable embayment: small changes with large impact. Coastal Hazards in Africa, Tetouan, Morocco, 4–5 October 2018.
132. **Yibas, B.** Management of mine water and AMD challenges using river water catchment area and geo-environmental provinces approach, South Africa. Geocongress, University of Johannesburg, 18–20 July 2018.
133. **Yibas, B.** The geodynamic evolution of the Precambrian of Southern Ethiopia and its implications on gold mineralisation. Geocongress, University of Johannesburg, 18–20 July 2018.
134. **Yibas, B.** The ophiolites of Ethiopia and their implication on the assembly of Gondwana. Geocongress, University of Johannesburg, 18–20 July 2018.
135. **Zulu, B.S.** Assessment of temporal variation and spatial variation of recurrence parameters in the gold mining regions of South Africa. 2nd General Assembly of the African Seismological Commission, Al Hoceima, Morocco, 23–27 April 2018.
136. **Zulu, B.S., Manzunzu, B., Mulabisana, T.F., Pule, T.G., Semelane, L.L., Zulu, T.P., Khumalo, K.S.** and **Midzi, V.** Multichannel analysis of surface waves (MASW) for KwaZulu-Natal major cities. Council for Geoscience Annual Conference 2019, Pretoria, 11–12 February 2019, p. 126.

part C
GOVERNANCE

Corporate governance at the CGS embodies systems, structures and processes by which the entity is directed, controlled and held to account. It is applied through the precepts of its enabling act, Geoscience Act, Act No 100 of 1993, as amended, the Public Finance Management Act (PFMA) (Act No 1 of 1999, as amended), National Treasury Regulations, the Protocol on Corporate Governance in the Public Sector, the King IV Code and policies of the organisation. This part of the report details the organisation's governance systems, structures and processes.

- The Board and its committees — the composition of the Board and committees, Board induction, Board remuneration and conduct, role and responsibilities of the Board;
- Compliance with laws and regulations — the status of CGS compliance with legislative prescripts;
- Internal control and risk management —the risk management framework implemented, and the effectiveness of the internal controls in the organisation;
- Fraud and corruption — measures to detect and combat fraudulent activities;
- Internal audit —activities of the internal audit function;
- Quality assurance — status of quality assurance, and
- Health, safety and environment issues — compliance with safety, health, environment and quality (SHEQ) standards.

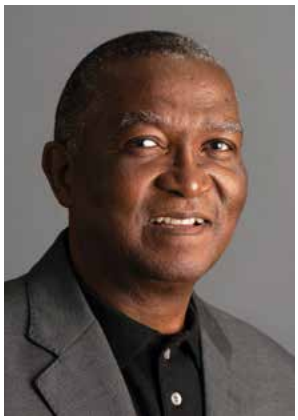
1. EXECUTIVE AUTHORITY

The Minister of Mineral Resources (the Minister), through the CGS Board, is accountable for the control, management and performance management of the CGS. Accordingly, the organisation submits reports quarterly and annually in terms of National Treasury Regulations (26.1) to the DMR on 31 January, 30 April, 31 July and 31 October.

2. BOARD OF THE COUNCIL FOR GEOSCIENCE

2.1. Board composition and duties

The Minister appointed the CGS Board with effect from 1 March 2017, in terms of Section 4 of the Geoscience Act (Act No 100 of 1993, as amended). The Board is composed of twelve non-executive members, four alternate members and one executive member, the CEO. The Chairperson of the Board is an independent non-executive member and the roles and duties of the Chairperson and the CEO are clearly outlined. Mr O Willcox, formerly deployed by the Minister of Finance to the Board, terminated his services on 31 January 2019.



CHAIRPERSON OF THE BOARD: Dr Humphrey Mathe

Skills and experience:
Dr Mathe was appointed Board Chairperson on 1 March 2017. He is an exploration geologist with a BSc in Geology and Chemistry, BSc Honours in Geology and an MSc and a PhD in Exploration Geology. He has vast experience and knowledge acquired over many years and has held CEO positions in both the private and public sectors.

Current external appointments:
He serves as Chief Executive Officer for Tranter Holdings, member of the Board and director for a number of organisations, including Howden Africa Holdings and Westcoal Holdings Limited. He is Chairperson of Scinta South Africa.

CHIEF EXECUTIVE OFFICER: Mr Mosa Mabuza

Skills and experience:
Mr Mabuza is a geologist with a BSc Honours in Geology and a Postgraduate Diploma in Business Administration. He was appointed a Board member on 1 March 2017 and the CEO of the CGS on 1 July 2017. Mr Mabuza served, inter alia, at De Beers as an explorationist, laboratory geologist and senior business analyst, at DMR as Chief Director of Mineral Promotion, at Anglo American Platinum as Head of Government Relations and at DMR as Deputy Director-General for Mineral Policy and Promotion.

Current external appointments:
He serves as a member of the Wits University Council and has vast experience in strategic leadership, exploration, policy formulation and human resources.

Board member: Mr Beeuwen Gerryts

Skills and experience:
Mr Gerryts is a mechanical engineer and has also completed an MSc Eng Management degree (technology and innovation management) at the University of Pretoria. He was appointed Board member on 1 March 2017. He is serving at DST as a Chief Director for Technology Localisation, Beneficiation and Advanced Manufacturing. He has extensive experience in research and innovation management, ICT and product system specifications, policy development, and publications in R&D and industrial development.

Current external appointments:
He is currently serving on the CGS Board and is Chairperson of the Technical Committee. He also served on the board of the Centurion Aerospace Village (CAV) between 20 Oct 2015 and 20 March 2019.

Board member: Mr Kabelo Koloi

Skills and experience:
Mr Koloi was appointed a Board member on 1 March 2017. He is a member of the Institute of Professional Engineering Technologists. He has a B-Tech in Electrical Engineering and a Diploma in Business Management. He is a chemical engineer at Infracon.

Current external appointments:
He is a member of the Board of the CGS.

Board member: Dr Jeffrey Mahachi

Skills and experience:
Dr Mahachi was appointed a Board member on 1 March 2017. He is a registered professional structural engineer with a PhD, MSc and Master's in Information Technology and BSc in Civil Engineering. He has worked as a technical executive with the National Home Builders Registration Council and as a research engineer with the CSIR. He is currently Head of Civil Engineering and Built Environment School at the University of Johannesburg.

Current external appointments:
He has served as a Board member for a number of institutions, including Agrèment South Africa and the Engineering Council of South Africa and is a fellow of the South African Institution of Civil Engineering.

Board member: Dr Monde Mayekiso

Skills and experience:
Dr Mayekiso is a Board member with a PhD in Marine Estuarine Environmental Science, an MSc in Ichthyology and Fisheries Science, a BSc Honours in Zoology, and a Certificate in Financial Management. He has worked as Deputy Director General of Ocean and Coast Branch of the Department of Environment Affairs. He has also served as Programme Manager for Coast at the CSIR and on the advisory panels for the National Research Foundation (NRF) Institutional Research Development Programme and as a Board member of the South African Biodiversity Institute. He currently represents South Africa on international bodies such as the Intergovernmental Oceanographic Commission (IOC) and the Convention on the Conservation of Antarctic Marine Living Resources (CCALMR). He has served as Chair of both IOC Sub-commission for Africa and CCALMR. He has been published in local and international journals.

Current external appointments:
He serves on the Advisory Panel of the NRF Institutional Research Development programme at the University of KwaZulu-Natal and a board member for the South African Biodiversity Institute. He is a member of a number of committees, including South African Fisheries and the IOC Sub-commission for Africa. He has published a number of international and local papers and publications.

Board member: Ms Rosalind Mdubeki

Skills and experience:
Ms Mdubeki was appointed a Board member on 1 March 2017. She has a BSc in Surveying, a National Diploma in Surveying and a Certificate in Project Management. She has worked for Eskom as a survey technician and engineer in training and currently serves as a Surveyor General: Bloemfontein (responsible for Free State and the Northern Cape provinces) in the Department of Rural Development and Land Reform.

Current external appointments:
She is a member of the Board and Chairperson of the Personnel, Remuneration and Transformation Committee of the CGS. She is a member of the Free State Townships Board and a Council member of SAGC.

Board member: Mr Kagiso Menoe

Skills and experience:
Mr Menoe holds a BSc in Chemical Engineering and several management qualifications. He was appointed a Board member on 1 March 2017. He has worked for the Department of Mineral Resources as a director for beneficiation economics, for the State Diamond Trader as a Quality Assurance Inspector, and for De Beers as an optimisation engineer, ore processing engineer and senior plant metallurgist.

Current external appointments:
He is currently a Board member at the CGS and of the State Diamond Trader.

Board member: Ms Deborah Mochothli

Skills and experience:
Ms Mochothli was appointed a Board member on 1 March 2019 and has a Master's in Environment and Society, a B-Tech in Environmental Health, a BA Honours in Public Administration and a BA in Social Science. She has worked with the Department of Water Affairs as Chief Director for Regulations and Water Use, for South African National Parks as Manager: Environmental Audits and for Mafikeng District as Chief Environmental Health Officer.

Current external appointments:
She is a Board member of the CGS, and a member of Women for the Environment and of the North West Interdepartmental Committee.

Board member: Mr Xolisa Mvinjelwa

Skills and experience:
Mr Mvinjelwa has a BSc in Chemistry, Master's in Business Administration and Diploma in Production Management. He was appointed a Board member on 1 March 2017. He has worked as a technical assistant at Vereeniging Refractories, for Rhino Minerals as an assistant marketing manager and later, marketing analyst and director for special projects at SAMREC.

Current external appointments:
He is a Board member of the CGS and serves as Chairman of the SAMREC Provident Fund and Chairman of the ECCA Mineral Pension Fund. He was appointed as the Head of Human Resources, Strategy and Corporate Services at Imerys South Africa. He is currently the Executive Director of Ethics and Transformation at Imerys South Africa. He is also the Chairman of Coastal Fuels, a junior coal mining company. He is also the Chairperson of the Port St Johns Development Agency, and an Executive Director and Board member, and Chairperson of the Stakeholder Relations Management Steering Committee of Imerys South Africa.

Board member: Dr Kgosientso Ramokgopa

Skills and experience:
Dr Ramokgopa was appointed a Board member on 1 March 2017. He holds a PhD in Public Affairs, a Master's in Public Administration, Master's of Business Leadership and BSc in Civil Engineering.
He has served as a Mayor for City of Tshwane and as CEO for Metropolitan Trading Company and for Johannesburg Market.

Current external appointments:
He serves as Deputy Chairperson for the Board of Trade and Investment in Limpopo and led the South African Student Congress. He was a Ward Councillor and Chairperson of the ANC in Tshwane.

Board member: Mr Owen Willcox

Skills and experience:
Mr Willcox was appointed a Board member on 1 March 2017 and resigned on 29 January 2019. He has a Master's of Commerce in Economics and BA Honours in Economics and Industrial Psychology.

He has served at National Treasury as a senior economist, Director for International Finance and Regional Economic Policy, Chief Director of Economics, Director for Forecasting and Trade Programme Manager for TIPS, among others.

Current external appointments:
He is President of the Rhodes University Wine Cultural Society. He has published a number of publications.

Alternate Board member: Ms Pontso Tsotetsi

Skills and experience:
Ms Tsotetsi was appointed an alternate Board member to Ms R Mdubeki on 1 March 2017. She has a BSc in Land Surveying, a Diploma in Land Surveying and a certificate in Advanced Management Development Programme.

Current external appointments:
She has served as a survey technician at the Surveyor-General in Pietermaritzburg, professional land surveyor at the Surveyor-General in Bloemfontein and a deputy surveyor-general at the Surveyor-General in Pretoria.

Alternate Board member: Mr Paul Nel

Skills and experience:
Mr Nel was appointed an alternate member to Ms D Mochothli on 1 March 2017. He has a BCompt Honours and is a chartered accountant and information systems auditor.

He has served as Chief Director at the Department of Water Affairs, Managing Director for Integrated Business Control South Africa, Chief Financial Officer for several banking institutions and an audit manager for Deloitte & Touche.

Current external appointments:
Mr Nel is an alternate Board member of the CGS.

Alternate Board member: Mr Ishaam Abader

Skills and Experience:

Mr Abader was appointed an alternate Board member to Dr Mayekiso on 1 March 2017. He has a Master's Degree in Business Administration (MBA), a law degree (BProc) and a Bachelor of Arts (BA) with law as a major.

Mr Abader was a senior state attorney and later a legal director in the Gauteng Department of Agriculture and Rural Development (GDARD), and has also served as the Chief Director: Legal Services in the Department of Environmental Affairs. He has held various portfolios as a deputy director general in the Department of Environmental Affairs: DDG: Corporate Affairs; DDG: Environmental Quality and Protection and, currently, DDG: Legal, Authorisations, Compliance and Enforcement. Mr Abader has also served on the Weather Services Board, the Geoscience Board as well as on the Board of the National Nuclear Regulator.

Current external appointments:

He is a Board member of the CGS, the chair of a charitable trust and a member of the Law Society, South Africa, where he is registered on the roll of non-practicing attorneys.

The Board upholds and embraces the fiduciary duties outlined in Section 50 of the PFMA (Act No 1 of 1999, as amended) which requires, among others, that Board members:

2.1.1 Exercise the duty of utmost care to ensure reasonable protection of the assets and records of the organisation;
2.1.2 Act with fidelity, honesty, integrity and in the best interest of the CGS in managing the financial affairs of the CGS;
2.1.3 Not act in a way that is inconsistent with responsibilities assigned to Board members;
2.1.4 Not use their position and/or privileges or confidential information they obtained as members of the Board for personal gain or to improperly benefit another person, and
2.1.5 Disclose and declare any direct or indirect interests that the member or spouse or close family may have that would be a potential conflict of interest.

The Board has implemented annual declarations of interest and a declaration of interest at committees of the Board and Board meetings to ensure that Board members disclose real or perceived conflicts in any matter before the Accounting Authority. Board members must withdraw from proceedings when the matter is considered unless the Board decides otherwise.

Subject to the provisions of the Geoscience Act, read together with the PFMA, the Board is accountable for the performance of the CGS. The Board shall exercise control and manage the affairs of the CGS, set the strategic direction of the organisation, and approve the vision, mission, strategic objectives and policies of the organisation.

In addition, the Board monitors compliance with policies and performance with scientific, administrative and financial objectives. The Board is solely responsible for ensuring that the CGS has and maintains effective, efficient and transparent systems of financial management, risk management, internal audit, and fair, equitable, competitive and cost-effective procurement.

The Board has the authority to lead, control and manage the business of the CGS, and has adopted a comprehensive delegation of authority framework in accordance with Section 56 of the PFMA ((Act No 1 of 1999, as amended), which delegates the day-to-day management of the affairs of the CGS to the CEO. The delegation of authority policy does not in any way divest the Board of its responsibility and accountability for the organisation.

2.2. Board Charter and Board responsibilities

The Board Charter, which is reviewed annually, provides for the following:

a) Leadership role of the Board, judgment and strategic direction;
b) Board composition;
c) Accountability, fiduciary duties and responsibilities;

d) Code of conduct for the Board;
e) Constitution and appointment of committees;
f) Governance and meeting procedures;
g) Management of conflict of interest;
h) Responsibility for the adoption of strategic plans and the monitoring of operational performance and management;
i) Determination and approval of policies;
j) Risk management, and
k) Board selection, orientation and evaluation.

2.3. Board induction and orientation

The CGS has a Board induction programme.

2.4. Training of new Board members

A director development programme ensures that Board members are adequately and continually trained and have the necessary knowledge of and development on best practices and principles of corporate governance. Through quarterly reports and policies, Board members are kept abreast of CGS governance structures, strategic projects and organisational performance to enable them to fulfil their duties and responsibilities.

2.5. Board meetings

The Board had five meetings in 2018/2019. The accompanying tables detail the attendance of meetings by each Board member during the year.

Table 2: Board meetings

Board members	25 April 2018	28 May 2018	25 July 2018	24 October 2018	29 January 2019	Number of meetings attended
Dr H Mathe (Chairperson)	Present	Present	Present	Present	Present	5
Mr M Mabuza (CEO)	Present	Present	Present	Present	Present	5
Dr M Mayekiso	Apology	Present	Apology	Apology	Apology	1
Mr I Abader*	Apology	Apology	Apology	Present	Apology	1
Ms D Mochothli	Present	Present	Apology	Apology	Apology	2
Mr P Nel*	Apology	Apology	Present	Present	Present	3
Ms R Mdubeki	Present	Apology	Present	Apology	Present	3
Ms P Tsotetsi*	Apology	Apology	Present	Apology	Present	2
Dr J Mahachi	Apology	Present	Present	Present	Present	4
Mr X Mvinjelwa	Present	Present	Present	Present	Apology	4
Mr K Koloi	Present	Present	Apology	Apology	Present	3
Mr O Willcox	Present	Apology	Present	Apology	Present	3
Dr K Ramokgopa	Present	Present	Present	Present	Present	5
Mr B Gerryts	Present	Present	Present	Present	Present	5
Mr A Moatshe*	Apology	Apology	Apology	Present	Apology	1
Mr K Menoe	Apology	Present	Present	Apology	Apology	2

* Alternate members

2.6. Board remuneration

The remuneration of Board members is determined by the Minister of the DMR, as disclosed in note 12 of the notes to the financial statements.

2.7. Committees of the Board

In terms of Section 15 of the Geoscience Act (Act No 100 of 1993, as amended), the Board may establish a committee that shall, subject to the direction of the Board, perform such functions of the Board as determined from time to time. Furthermore, Section 56 of the PFMA (Act No 1 of 1999, as amended) provides that some Board responsibilities may be delegated to Board committees and the management of the CGS without divesting the Board of its roles and responsibilities. The Board committees are, therefore, required to make recommendations to the entire Board before strategic decisions are implemented by management.

Mandated by Section 15 of the Geoscience Act (Act No 100 of 1993, as amended), Section 56 of the PFMA (Act No 1 of 1999, as amended) and the recommendations of the King Code, the Board has constituted and delegated some of its functions to the following four Board committees:

2.7.1. Audit and Risk Committee

The Audit and Risk Committee was established in terms of Section 77 of the PFMA (Act No 1 of 1999, as amended) and National Treasury Regulation 27. The Audit and Risk Committee discharges its responsibilities in terms of the Audit and Risk Committee Charter, which sets out its committee composition, roles and responsibilities. The Audit and Risk Committee continually monitors the quality and reliability of CGS financial information used by the Board, financial statements issued by the CGS and various functions in the organisation. The Audit and Risk Committee ensures that emerging risks are timeously identified and that appropriate and effective control measures are put in place to mitigate these risks.

The composition and meeting attendance of the Audit and Risk Committee from 1 April 2018 to 31 March 2019 are reflected in the table below.

Table 3: Audit and Risk Committee meetings

Committee members	2018/2019						Meetings attended
	12 April	23 May	12 July	11 October	16 January	25 January#	
Mr SM Xulu (Chairperson)	Present	Present	Present	Present	Present	Present	6
Mr P Nel	Apology	Apology	Present	Present	Apology	Apology	2
Ms I Singo**	Present	Apology	Present	Present	**	**	3
Ms D Morabe	-	-	-	-	Present	Present	2
Mr O Willcox	Present	Present	Apology	Apology	Present	Present	4
Ms KR Mthimunye	Present	Present	Apology	Present	Present	Present	5
Dr K Ramokgopa	Present	Present	Present	Present	Present	Apology	5

**Resigned, - Before appointment, #Joint meeting of the Finance Committee and Audit and Risk Committee

2.7.1.1. Audit and Risk Committee Report

The Audit and Risk Committee reports that it has complied with its responsibilities arising from Section 77 of the PFMA and National Treasury Regulation 27.1. The committee also reports that it has adopted the Audit and Risk Committee Charter as its appropriate terms of reference, has regulated its affairs in compliance with this charter and has discharged all its responsibilities contained therein.

In executing its duties, the committee has performed, inter alia, the following functions:

1. Evaluation of internal controls

The committee has directed, monitored and evaluated the activities of the Internal Audit function. Through the Internal Audit function, the committee constantly monitored the effectiveness of the internal controls and assessed whether the Internal Audit function fulfilled its roles. During 2018/2019, the internal controls were reported to have significantly improved, and compliance with prescribed policies as well as procedures was reported to be satisfactory. However, there is a room for improvement in:

a) Procurement;
b) Financial management;
c) Human resources management;
d) Performance management;
e) Information technology infrastructure-related control measures, and
f) Fraud prevention and corruption-related control measures.

The committee is confident to report that corrective measures were implemented towards resolving all findings relating to internal controls weaknesses. The committee further reports that during the year under review a number of weaknesses in performance management and information technology were identified, and management has assured the committee that appropriate corrective measures will be implemented in 2018/2019.

2. Evaluation of the annual report

The committee has:

a) Reviewed the CGS's report on corporate performance information;
b) Reviewed the CGS accounting policies and practices;
c) Reviewed the adequacy and usefulness of the financial information provided to the Auditor-General;
d) Evaluated, reviewed and discussed with the Auditor-General the audited Annual Financial Statements included in the annual report;
e) Reviewed the Auditor-General's management report and the Auditor's report, and
f) Based on the information provided to the committee, considered and concluded that the Annual Financial Statements comply with the requirements of the PFMA, National Treasury Regulations and South African Standards of Generally Recognised Accounting Practices (SA Standards of GRAP).

3. Risk management

The committee reports that during the year under review it approved the Risk Management Framework, Strategic Risk Register and Fraud Prevention Plan, which were subsequently communicated to employees and incorporated in the culture of the CGS. The committee reviewed:

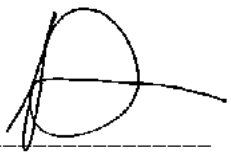
a) The organisation's risk appetite and tolerance levels;
b) The significant financial risk exposures and directed management to monitor and develop mitigation strategies for such exposures, including reputational, operational, fraud, strategic, information technology and communications systems, as well as disaster recovery and business continuity risk, and
c) Requested management to prioritise the development of the annual risk management plan for the annual risk management scope of work and compliance activities.

4. Evaluation of financial statements

The committee reviewed and discussed with the Auditor-General the financial statements of the CGS for the year ended 31 March 2019. The committee also reviewed the management letter of the Auditor-General and management responses thereto. The committee is of the opinion that the financial statements are compliant, in all material respects, with the requirements of the PFMA (Act No 1 of 1999, as amended) and the SA Standards of GRAP.

5. Auditor's report

The committee has reviewed the prior year audit findings implementation plan and hereby reports that a significant number of findings have been resolved. The committee will ensure that management resolves all audit findings that are still in progress. The committee concurs and accepts the conclusions of the Auditor-General on the financial statements and is of the opinion that the audited Annual Financial Statements should be accepted and read together with the report of the Auditor-General.



Mr SM Xulu
Chairperson
Audit and Risk Committee
31 July 2019

2.7.2. Finance Committee responsibilities and composition

The Finance Committee of the CGS is mandated to consider and recommend for the Board's approval the following matters:

- Significant financial activities;
- Liquidity and financial condition of the CGS;
- Write-off of bad debts;
- Material variances in the approved annual and/or revised budgets in accordance with the Materiality and Significance Framework Plan;
- Proposed capital and operating budget for capital expenditures;
- Financial statements for the annual report;
- All policies that have financial implications, and
- Corporate performance information management against the approved budget.

The Finance Committee consists of six non-executive members as detailed in the table below, together with the meeting attendance from 1 April 2018 to 31 March 2019.

Table 4: Finance Committee meetings

Committee members	2018/2019					Meetings attended
	12 April	12 July	11 October	16 January	25 January#	
Ms KR Mthimunye (Chairperson)	Present	Present	Present	Present	Present	5
Mr P Nel	Apology	Present	Present	Apology	Apology	2
Ms I Singo	Present	Present	Present	*	*	3
Ms D Morabe	-	-	-	Present	Present	2/2
Dr J Mahachi	Present	Present	Apology	Present	Present	4
Mr K Koloi	Present	Apology	Present	Apology	Apology	2
Mr M Mabuza	-	-	Present	Present	Apology	2/3
Mr O Willcox	Present	Present	Present	Present	Present	5

*Resigned, -Before appointment, #Joint meeting of the Finance Committee and Audit and Risk Committee

2.7.3. Technical Committee

The Technical Committee of the CGS is mandated to consider and recommend for the Board's approval the annual scientific and strategic technical programme of the organisation, evaluate the scientific and technical output and oversee the annual technical audit.

The composition and meeting attendance of the Technical Committee from 1 April 2018 to 31 March 2019 are reflected in the table below.

Table 5: Technical Committee meetings

Committee members	2018/2019				Meetings attended
	11 April	11 July	12 October	17 January	
Mr B Gerryts (Chairperson)	Present	Present	Apology	Present	3
Mr X Mvinjelwa	Present	Present	Apology	Apology	2
Dr M Mayekiso	Apology	Present	Apology	Apology	1
Dr J Mahachi	Present	Present	Present	Present	4
Mr K Menoe	Apology	Present	Present	Present	3
Ms P Tsotetsi	Present	Present	Present	Apology	3
Mr D Sibiya	Apology	Apology	Present	Present	2
Mr M Mabuza	-	-	Present	Present	2

-Before appointment

2.7.4. Personnel, Remuneration and Transformation Committee

The Personnel, Remuneration and Transformation Committee is mandated to consider and recommend for the Board's approval the human resources strategies and policies of the CGS. It also considers and recommends for the Board's approval the organisational remuneration model, remuneration for executive management and annual salary increases, and evaluates and makes recommendations on the payment of performance bonuses. The committee also considers organisational performance reports on labour-related matters, employment equity, and employee training and development matters.

The composition and meeting attendance of the Personnel, Remuneration and Transformation Committee from 1 April 2018 to 31 March 2019 are reflected in the table below.

Table 6: Personnel, Remuneration and Transformation Committee meetings

Committee members	2018/2019				Meetings attended
	19 April	11 July	11 October	15 January	
Ms R Mdubeki (Chairperson)	Present	Present	Present	Present	4
Dr K Ramokgopa	Present	Present	Apology	Present	3
Mr K Menoe	Apology	Present	Present	Present	3
Mr A Moatshe*	Apology	Apology	Apology	Apology	0
Mr I Abader	Apology	Present	Apology	Apology	1
Mr X Mvinjelwa	Present	Present	Present	Apology	3
Mr D Sibiya	Present	Apology	Present	Apology	2
Mr M Mabuza	-	-	Present	Present	2

*Alternate member, - Before appointment

3. RISK MANAGEMENT

The CGS Board is responsible for entrenching risk management governance through effective leadership. Management accounts to the Board for the integration of risk management into CGS daily operations and for the implementation and monitoring of the risk management process. The Audit and Risk Committee is an independent committee responsible for overseeing risk exposure related to governance and risk management within the CGS. The CGS develops the strategic risk register annually based on the organisational strategy, which is monitored quarterly and which provides assurance to the Board that the CGS is adequately managing identified risks.

The organisational governance risk management structure of the CGS is presented in the figure below.

Figure 24: Organisational governance risk management structure of the CGS.

4. INTERNAL CONTROL

Management is responsible for designing, implementing and continually reviewing internal controls to provide assurance on the effectiveness and efficiency of operations and on the reliability of financial reporting, and for safeguarding and maintaining accountability for the assets of the organisation. These controls are monitored throughout the CGS by management and employees, with the necessary segregation of duties. The internal audit performs independent reviews on the effectiveness of these controls as part of its annual internal audit plan, and the audit reports are presented to the Audit and Risk Committee.

5. INTERNAL AUDIT

The internal audit function was established in terms of the PFMA and conducts risk-based audits aligned to the Standards for the Professional Practice of Internal Auditing. A formal internal audit charter was reviewed and approved by the Audit and Risk Committee.

An annual internal audit plan was approved by the Audit and Risk Committee, and internal audit reports were presented to the Audit and Risk Committee quarterly. Follow-up audits were conducted on prior-year findings. The internal audit also performed ad-hoc tasks requested by management.

6. COMPLIANCE WITH LAWS AND REGULATIONS

The CGS complies with National Treasury Regulations through the PFMA compliance calendar, which is continually monitored and updated. Compliance with laws and regulations is monitored through the activities of the Audit and Risk Committee.

7. FRAUD AND CORRUPTION

The CGS has a legal responsibility in terms of the PFMA (Act No 1 of 1999, as amended) to take appropriate steps to prevent unauthorised, irregular, fruitless and wasteful expenditure and losses resulting from criminal conduct. An anti-fraud prevention policy is in place, as well as a whistleblowing facility that is administered by Deloitte. Reports are issued monthly, and fraudulent conduct is investigated by the internal auditors and reported to the Audit and Risk Committee.

8. MINIMISING CONFLICT OF INTEREST

All suppliers of goods and services to the CGS are required to complete standardised National Treasury documentation (SBD4 Declaration of Interest). In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons employed by the CGS, or to persons connected with or related to them, it is required that the bidder or his or her authorised representative declare his or her position to the evaluation/adjudication authority.

In addition, staff members of the CGS involved in the Bid Evaluation and Adjudication Committee are required to complete declaration and non-disclosure forms at each meeting.

9. CODE OF CONDUCT

All staff members of the CGS abide by the Code of Ethics and Conduct. The CGS is committed to ethical and fair business dealings and promotes a corporate culture that is non-sectarian, and is socially and environmentally responsible. It does so by subscribing to the following values and principles:

- Fairness and integrity in all business dealings, including the ethical handling of actual or apparent conflicts of interest between personal and professional relationships;
- Respect for the human rights and dignity of all employees;
- Acceptance of diverse cultural, religious, race, gender and sexual orientations;
- Honesty, transparency and accountability, and
- Adherence to sound standards of corporate governance and applicable laws.

In terms of the Code of Ethics and Conduct, all persons serving on behalf of the CGS are required to uphold the highest standard of business ethics and integrity. Furthermore, all staff, contractors, consultants and others acting on behalf of the organisation are required to accurately and honestly represent the organisation and to refrain from engaging in any activity or scheme intended to defraud anyone of

money, property or services. The reputation and integrity of the CGS are central to its ability to operate as an effective state-owned organisation.

10. COMPANY SECRETARY

The Company Secretary provides advisory services to the Board and notifies Board members of regulatory changes and new developments in corporate governance. Furthermore, the Company Secretary provides the Board and the Board committees with guidance on how their responsibilities should be discharged in the best interests of the organisation. The Company Secretary facilitates and attends Board and Board committee meetings, and takes custody of the related policy documents.

11. QUALITY ASSURANCE

Services delivered by the CGS are rendered in the context of a quality management system which ensures that creation, delivery and monitoring of services are in line with national and international quality standards. Quality management in the CGS ensures that stakeholders receive excellent services at all times.

Following the previous financial year's organisation-wide ISO 9001:2015 quality awareness training, the development of quality documents has begun. This includes the review of the SHEQ policy statement, the writing of procedures (including scientific procedures) and the initiation of schedules for monitoring and measuring resources. Plans are afoot to attain ISO 9001 certification by the end of 2022/2023.

The CGS laboratory remains a high-priority facility in testing a variety of samples to ensure excellent and accurate service to clients and stakeholders. Activities undertaken during the year towards ISO 17025 accreditation include test method plans, validation and reporting (pH, electrical conductivity, alkalinity, major and minor oxides, trace elements, carbon, nitrogen, hydrogen and calorific values), ISO 17025:2017 transition training for 19 key laboratory personnel, review of quality management system documents and the rollout of a quality control programme. The organisation is on track to attain full accreditation by the end of 2020/2021.

12. HEALTH, SAFETY AND ENVIRONMENT

The executive management of the CGS is obliged, in terms of the Occupational Health and Safety Act, to provide a safe workplace without risk to human life, while staff members have a duty to work and behave in compliance with the safety directives of the organisation. CGS safety, health and environment policies enable the organisation to drive compliance with occupational health, safety and environmental legislation.

Occupational health and safety performance is monitored through various indicators (indoor air quality and ventilation, hazardous biological agents, water quality monitoring, hazardous chemical substances) to ensure continual compliance with applicable legislation. Employee medical surveillance was conducted for CGS employees, followed by an extensive medical assessment for CGS laboratory personnel.

The Audit and Risk Committee and the CGS Board monitor the occupational health and safety performance of the organisation quarterly.

Fifty-four CGS employees received firefighting training during this financial year.

Project safety activities conducted on CGS scientific projects during the financial year included occupational health and safety risk identification workshops with CGS employees, health, safety and environmental inspections on the Karoo Deep Drilling Project in Beaufort West and risk assessment on CGS employees exposed to asbestos workings in the Griqualand West area.

13. MARKETING, COMMUNICATION AND STAKEHOLDER ENGAGEMENT PROGRAMME

Building the CGS brand

During 2018/2019, the CGS coordinated brand awareness activities to illuminate the work of the organisation among all stakeholders. This involved events, campaigns, participation in conferences, media relations, and establishing and maintaining strategic collaborations and partnerships.

Brand-building highlights included:

- The integrated multidisciplinary mapping programme was profiled in Mining Weekly in an article titled: 'Government's R20 billion exploration boost lauded, but needs to be done'.
- A Mining Weekly article on a CGS ground stability study in areas affected by illegal mining.
- Engineering News article on the CGS's intention to finalise its data policy and another on the DMR being hopeful about the prospects of shale gas in the Karoo.
- Advertorial in the February 2019 edition of SAA's flagship publication Sawubona profiling the CGS's integrated mapping programme.
- Five media adverts in various trade and mainstream media.
- Regular real-time newsfeeds that have continued to grow the follower bases on the CGS social media accounts on Facebook, Twitter and Linkedin.

Media interviews

- The CGS received the following media coverage: eNCA prime time broadcast on the CGS's ground stability study in Johannesburg (CEO).
- Interview by Radio 702's Bongani Bingwa on the risks emanating from illegal mining activities close to fuel and gas pipes, and on infrastructure (CEO).
- Interview at Mining Indaba 2019 by SAfm's Bongi Gwala, highlighting the role and work of the CGS (CEO).
- Interview by Power FM's Ayabonga Cawe on South Africa's mineral potential (CEO).
- BBC documentary on gold mining in South Africa (CEO).
- Interview on eNCA on the causes of powerful earthquakes such as in the Indonesian island of Lombok (Dr Eldridge Kgaswane).
- Interview on Thobela FM as part of a feature on women in science (Ponani Mthembu).

In addition, the CGS responded to many ad-hoc print and online media enquiries about earthquakes.

Campaigns and events

Key campaigns and events for the year included:

- Brand awareness campaign at Cape Town International Airport, gateway to a number of key international conferences in February. Numerous billboards were flighted in the departure section of the airport profiling the mandate and services of the CGS.
- Corporate and social media marketing videos for different platforms and audiences encapsulating the work of the organisation.
- Social media campaign in January and February 2019 publicising the annual CGS conference, and one throughout August profiling women in different roles at the CGS.
- A celebration of Heritage Day, with CGS staff wearing traditional clothing and sharing traditional dishes.
- Prestigious awards ceremony on 7 December 2018 at Monte de Dios in Pretoria to recognise and show appreciation to scientists and staff who excelled.

Career and educational expos

The CGS participated in the following career expos:

- Learners Focus Week hosted by the DMR from 1 to 5 July 2018 at Nelson Mandela University, Port Elizabeth. The expo targeted mathematics and science learners from all nine provinces.
- Wits University School of Geoscience (RocSoc) career day on 21 July 2019.
- National Science Week at University of Mpumalanga's Mbombela campus on 28 July 2018, which exposed more than 2 000 learners to careers in science, engineering and technology.
- Mining Careers Expo at Kensington High School, Cape Town, on 2 February 2019.

Corporate social initiatives

Corporate social activities included:

- Celebration at CGS offices countrywide of Nelson Mandela Day on 18 July 2018, which reinforced the organisation's commitment to being of service to the underprivileged.
- Donation of 60 copies of geological maps and their

explanations, valued at R141 000, to Wits University's Geoscience School. These maps will assist in the training and development of candidate geoscientists (undergraduate and postgraduate) who may soon be able to contribute, directly or indirectly, to the CGS mapping programme.

- Donation of R11 000 worth of maps to Stellenbosch University to assist undergraduate and postgraduate students in geoscience-related studies. The CGS plans to roll out this assistance to other institutions of higher learning.

The CGS participated in the annual Learners Focus Week at Nelson Mandela University, Port Elizabeth from 2 to 4 July 2018 through an exhibition and presentations to mathematics and science learners from all provinces on career options in the organisation. Leslee Salzmann and Kholisile Nzolo educated learners on the role and services of the CGS, and also explained the different rock types on display at the exhibition stand. The students were particularly enthralled by the marine geology display.

The CGS joined the world in commemorating Nelson Mandela Day on 18 July 2018 with the theme 'Action against poverty' and served its 67 minutes through various activities at its offices that demonstrated its commitment to improving the quality of life of the underprivileged. Pictured here are CGS employees donating painting, gardening and school material to Itumeleng Day Centre in Atteridgeville.

The CGS participated in the Mining Indaba from 3 to 6 February 2019 at Cape Town International Convention Centre. During the conference, Minister of Mineral Resources Gwede Mantashe spent time at the CGS stand interacting with CGS representatives.

part D

HUMAN RESOURCES MANAGEMENT

This section presents key focus areas of the Human Resources department for the year under review, including training and transformation initiatives.

It also includes:

- Performance measurement systems to assess performance;
- Management of employee wellness to ensure the health and wellbeing of staff;
- Key human resources activities for the year;
- Human capital challenges;
- Human resources goals, and
- Human resources statistics.

The CGS regards its staff members as a crucial resource pivotal to the delivery of its strategic objectives. To this end, the Human Resources department is a strategic partner in the organisation whose role is to ensure that the CGS attracts and retains the required resources and expertise to carry out its legislative mandate and strategic objectives.

1. OVERVIEW OF HUMAN RESOURCES MATTERS

SYNOPSIS

At the end of 2018/2019, the organisation had 439 staff, 60% of whom make up the science cohort, with 40% in support functions.

The organisation invested R1.65 million during the year in training to ensure that competitiveness of its greatest asset – its employees.

As competition for human capital intensifies, CGS tracks the sources of its talent and talent lost. During the year, 43% of applications for managerial scientific positions came from the private sector, an indication that the organisation may be competing with the private sector for talent. Of concern was that some candidates interviewed were already earning more than CGS core line executives.

It is encouraging that executive management is at 100% occupancy against the approved staff establishment. According to the Auditor-General, a vacancy rate of zero at executive level is a significant achievement, which has a bearing on the implementation of the Annual Performance Plan.

CHALLENGES

CGS's expertise is relatively young. Loss of skills from experienced staff retiring is a challenge in funding for training requirements, but also an opportunity to put in place robust succession measures to 'grow our own timber' and bridge the gap.

PERFORMANCE AGAINST PREDETERMINED OBJECTIVES

In line with the strategic objective of the 2018/2019 Annual Performance Plan, Human Resources is tasked with ensuring that the organisation has a workforce that is empowered, transformed, motivated and capacitated. To this end, Human Resources, with the guidance of the Personnel, Remuneration and Transformation Board Committee, was responsible for the following targets of the balanced scorecard:

1. Target – Attain a staff satisfaction score of at least 65%

A score of 65% was achieved, which, although below target, is still within the range of 65% to 85%, which pegs the organisation in the 'top company' category based on Pure Survey benchmark data. The survey is used to gauge satisfaction and engagement, which should ideally translate into low turnover. The 65% score was expected as management used the findings of the previous year's survey to improve 'hygiene factors' such as policies, performance management, communication and succession planning. The CEO continues to communicate with staff quarterly, taking them through the year-to-date performance, shortcomings and challenges. These staff meetings are appreciated by staff and ensure information symmetry.

2. Target – Net staff turnover rate of less than 5%

Staff turnover rate for the year was marginally above target at 5.47%, which can be attributed to the high levels of satisfaction and engagement reflected in the survey. There is empirical support for a nexus between high satisfaction levels and turnover rates.

3. Target – At least 1.25% of the workforce should be people living with disability

The CGS continued to strive for fair representation of people with disabilities and achieved 1.59% for the year, a significant increase from the previous year as a result of an awareness campaign that encouraged disability disclosures. More employees are now seeing the need to disclose to allow the organisation to provide an enabling and accommodating environment.

4. Target – Attain a gender representation of less than 52% for male and at least 48% for female

Gender representation at the end of the financial year was almost at parity of 49:51 (Male:Female) due to focused recruitment. Management is working hard to ensure the same parity at strategic positions. Notably, 51% of CGS science staff are females.

5. Target – Attain a training expenditure of 2% of the leviable payroll

In line with the core value of creating a learning organisation, the organisation spent 1.46% of the leviable payroll on both short- and long-term training, 65% of which was allocated to scientific training. The short-term training is aimed at immediate impact and aligned to personal development plans. Long-term training (bursaries) is informed by future business exigencies.

Generally, CGS has a young workforce, with 50% of the current staff complement between 24 and 38 years as shown in Figure 25 below. The picture differs in the core business, where millennials constitute 58% of the science cohort.

The organisation categorises its workforce in terms of generation mix. This approach identifies workforce profile and trends such as tenure, and turnover per generation. For instance, there is empirical evidence that Millennials are 'flight risks' as they do not stay in the organisation for long. Figure 26 suggests that the average stay for Millennials in the organisation is 3.2 years, whilst the tenures for Generation Y and Baby Boomers are 8.3 years and 31.8 years, respectively.

In the satisfaction survey, staff highlighted a lack of vertical mobility or career progression. In response, management has developed a career-pathing policy and succession measures to ensure focused training and exposure to prepare deserving employees to compete when positions become available. It is anticipated that this will promote longer tenure among Millennials.

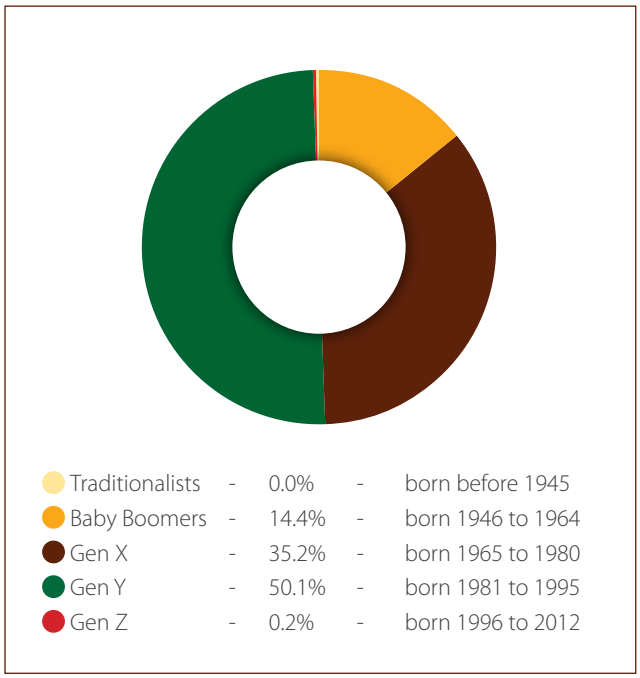


Figure 25: Workforce generation mix.

2019 Workforce turnover by generation and average years of service

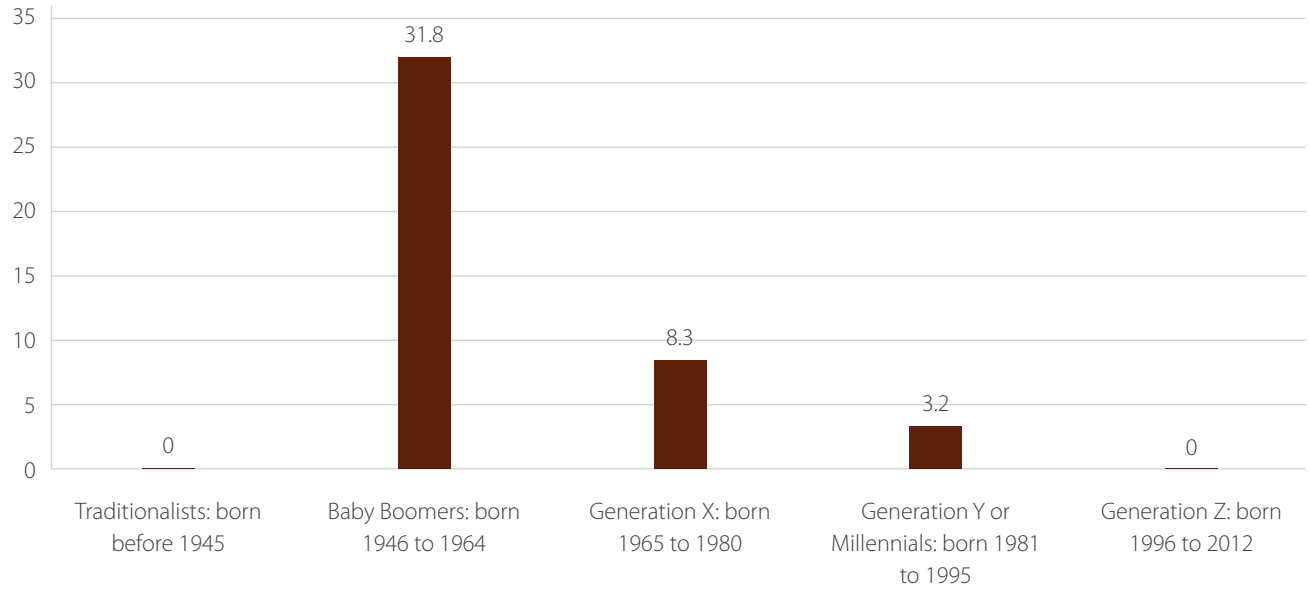


Figure 26: Years of service per generation mix.

INCLUSIVE AND DIVERSE WORKING ENVIRONMENT

Enhancing diversity and inclusion to reflect the demographics of the country remains essential and forms part of CGS's strategic priorities. The graph below depicts a modest increase of female representation over the past six years. In 2014, the organisation had only 40% female representation, whilst in the reporting period, 51% of the workforce were female.

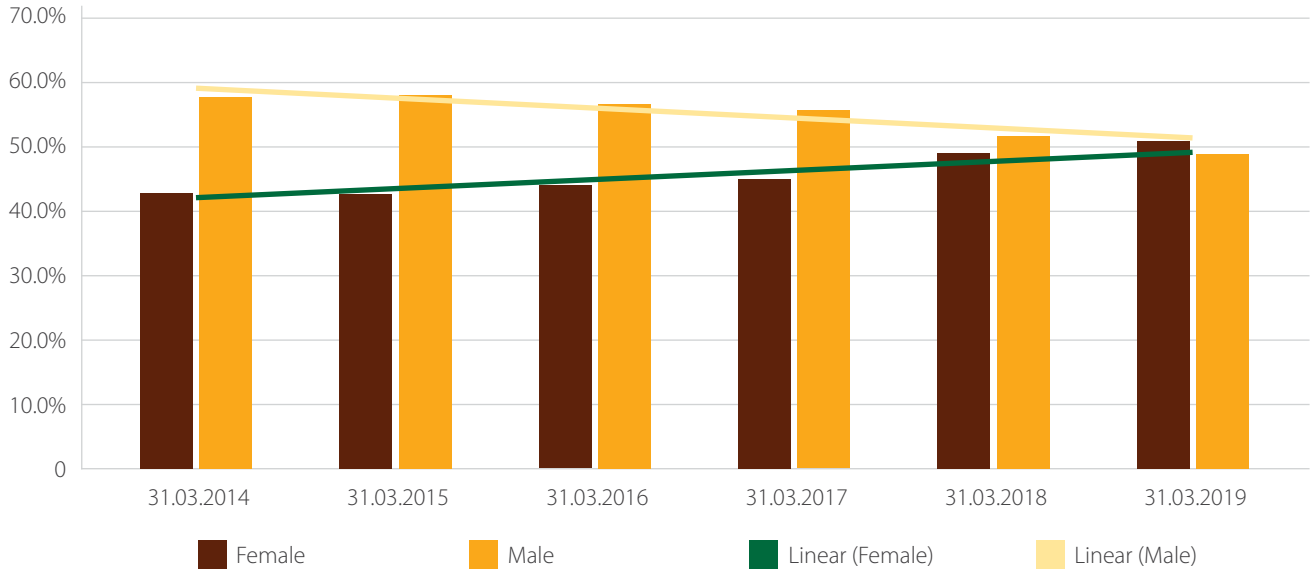


Figure 27: Gender diversity.

The percentage representation of staff living with disability was currently 1.59% at 31 March 2019, attributable to an awareness campaign that encouraged disclosure.

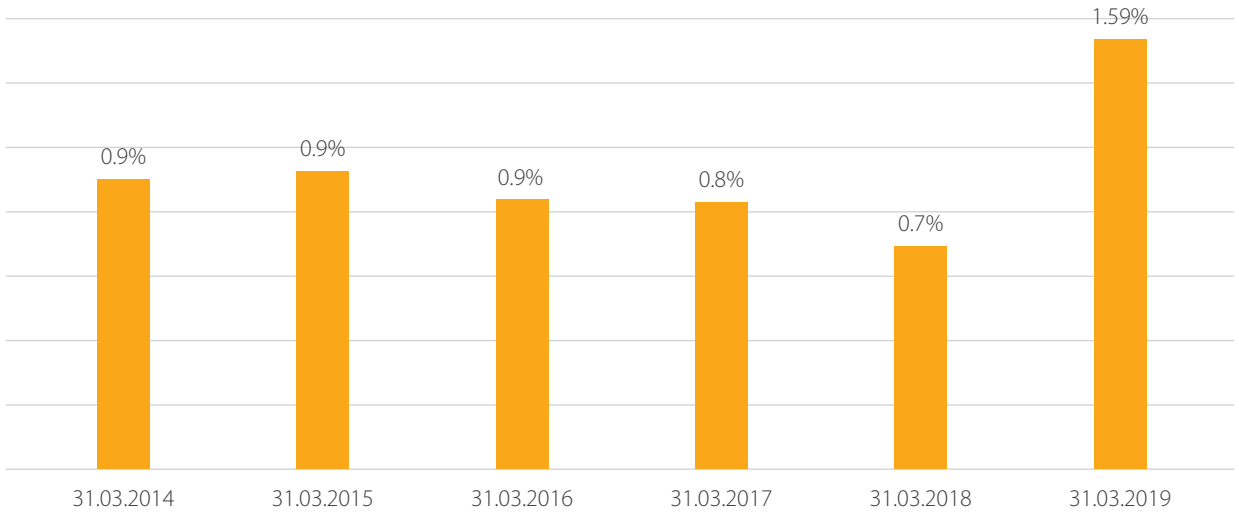


Figure 28: Percentage representation of people living with disabilities.

SCIENTIFIC EDUCATION QUALIFICATION PROFILE

At 31 March 2019, 36% of science staff had Master's and Doctoral-level qualifications. The following graph shows the educational level for the core business.

2019 Scientific workforce educational level

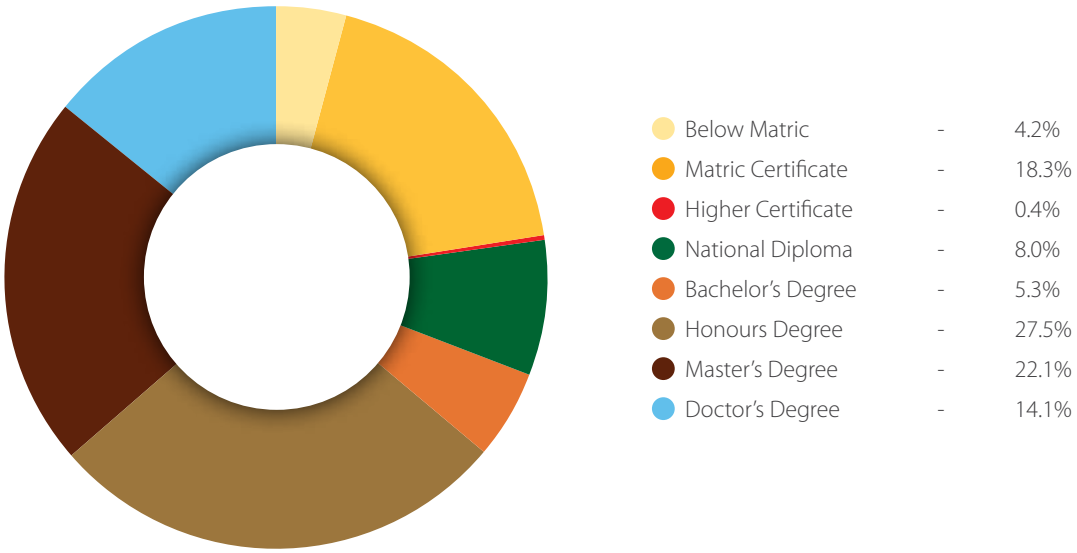


Figure 29: Scientific workforce education level.

Tables 7 and 8 below provide the status of employment equity performance against targets for male and female.

Table 7: Employment equity: Male

Levels	MALE								Foreign nationals
	African		Coloured		Indian		White		
	Current	Target	Current	Target	Current	Target	Current	Target	
Top management	5	3	0	1	0	0	0	0	0
Senior management	6	6	1	1	0	0	1	1	0
Professional qualified	46	45	1	2	3	3	35	33	14
Skilled	66	68	2	3	0	0	5	6	0
Semiskilled	12	12	2	2	0	0	1	2	0
Unskilled	23	6	0	0	0	0	0	0	0
Total	158	140	6	9	3	3	42	42	14

Table 8: Employment equity: Female

Levels	FEMALE								Foreign nationals
	African		Coloured		Indian		White		
	Current	Target	Current	Target	Current	Target	Current	Target	
Top management	1	2	0	0	0	0	0	0	0
Senior management	3	5	0	1	0	1	2	2	0
Professional qualified	57	53	2	3	6	7	18	16	2
Skilled	20	21	0	0	1	3	8	9	0
Semiskilled	37	33	4	7	0	0	9	11	0
Unskilled	45	4	1	0	0	0	0	0	0
Total	163	118	7	11	7	11	37	38	2

Even though progress has been significant in aligning the CGS workforce to the EE plan, the organisation falls marginally short in terms of coloured and Indian representations. Focused recruitment will continue to ensure that the CGS workforce reflects the demographics of the country.

REASONS FOR STAFF LEAVING

The graph below outlines staff attrition trends for the period under review. More than 50% of employment terminations were resignations. Of 12 resignations, 58% were Millennials who stayed with the organisation for an average of 3.2 years. Given the growing number of dismissals, there is a need in the next year for employee relations interventions. Tragically, death claimed 14.3% of the workforce.

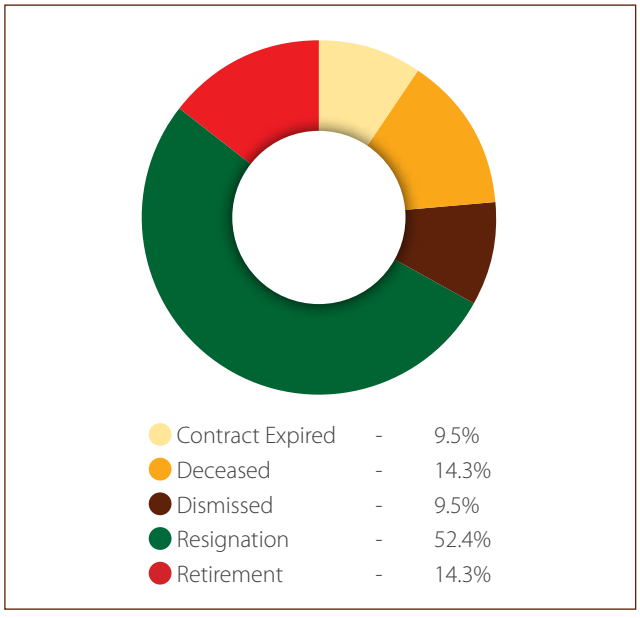


Figure 30: Exits for the period.

EMPLOYEE WELLNESS PROGRAMME

Psychosocial and financial wellness support is available to employees through the employee assistance programme, telephonically or face-to-face and on- or off-site. Employees are encouraged to take advantage of this programme.

The wellness of staff is crucial to CGS human capital interventions. The service provider has indicated that the utilisation rate of CGS is above the benchmark both in corporate and in government – an indication that employees are using the service. Human Resources will continue to monitor usage and common cases to provide timely interventions.

RECOGNITION PROGRAMMES

CGS recognises internal role models who embody its values and believes that celebrating successes together motivates and rewards. The CGS Employee Excellence Awards are the vehicle to honour achievements that contribute to realisation of the organisation's strategic goals and sustainability. The 2018/2019 ceremony was held in December 2018.

The CGS boasts loyal and dedicated employees focused on educating, training and providing services to the younger generation. Employees who completed 30, 20, 15 and 10 years' service were recognised at a long-service awards event in December 2018.

DISCIPLINARY PROCESSES

Seventeen cases of employee misconduct were reported in the period under review. Actions taken to mitigate the risk of recurrence include training on types of misconduct. Below is the summary of cases during 2017/2018 and 2018/2019.

Table 9: Summary of cases during 2017/2018 and 2018/2019

Incident	Description	No of incidents recorded: 2017/2018	No of incidents recorded: 2018/2019
Misuse/abuse of leave	Employees disregard CGS leave management policy	7	0
Insubordination	Resistance to or defiance of authority; disobedience; refusal or failure to obey reasonable and lawful instructions, bringing the employer's name into disrepute, and rebellious behaviour resulting in a work stoppage or part stoppage	5	2
Dereliction of duty	Intentional or unintentional failure and/or omission by an employee to do his/her duty	2	3
Theft/fraud	Removal of personal property to deprive the rightful owner of it and/or misrepresentation of facts with malicious intent to steal or misinform	0	6
Adherence to Supply Chain Management (SCM) Policy	Violation of and/or failure to comply with SCM Policy and procedures	0	3
Team cohesion	A process where people with different skills and abilities work together and complement each other to achieve a set common goal	1	3

Misconduct trend analysis

The graph below indicates the misconduct trends for 2017/2018 compared to those for 2018/19:

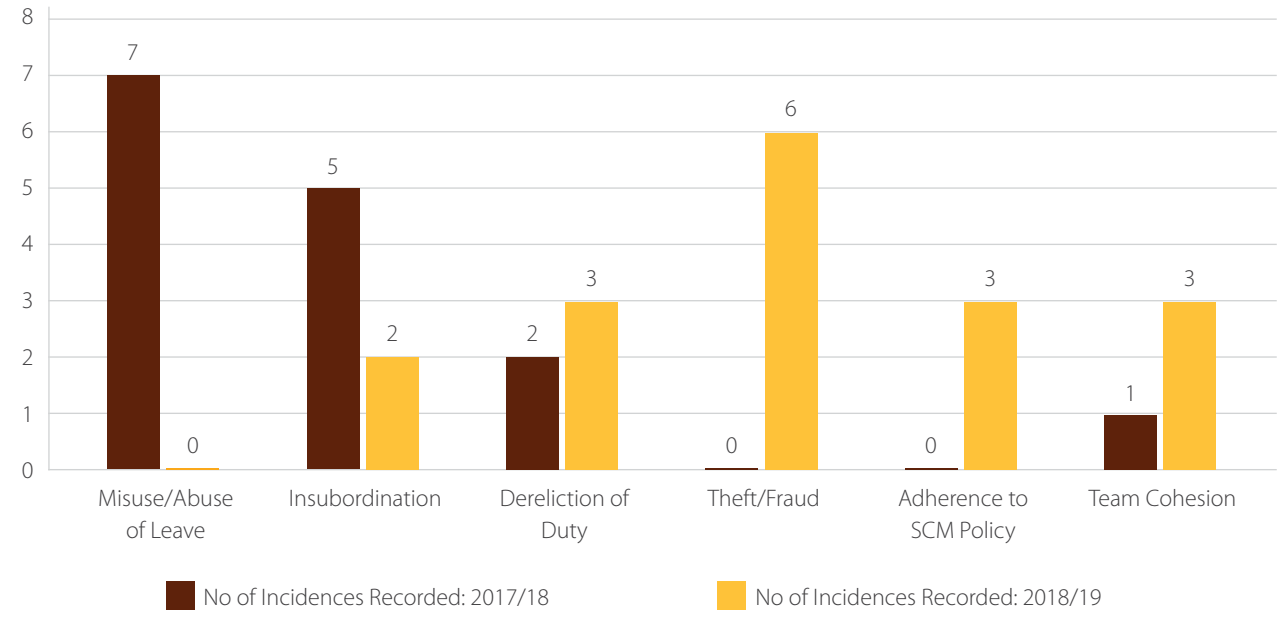


Figure 31: Misconduct trends for 2017/2018 and 2018/2019.

Employee relations interventions

Interventions to reduce numbers of misconduct cases included:

Completed interventions	Planned interventions
- Employee relation training for managers/supervisors - Business ethics training for all staff that addressed ethical behaviour in the workplace - Manager workshop on Performance Management Policy - Team cohesion training in Cape Town and Port Elizabeth	- Rollout of employee relation training to all staff in 2019/2020 - Workshop for all staff on human resources policies - Frequent and meaningful engagement at the bargaining forum, with specific focus on misconduct management - Ongoing induction for new employees to incorporate employee relations - Workshop crucial policies, including subsistence and travel, SCM and vehicle/transport - Diversity and inclusivity - Training of managers on legal liabilities - Training of managers on etiquette and protocol

TALENT MANAGEMENT AND DEVELOPMENT

Talent management is a strategic business priority. The organisation's ability to attract and retain key talent is measured through its recruitment success rate and employee retention rate. The CGS aims to attract and retain key talent through attractive career opportunities, market-related remuneration and an inclusive and enabling culture with zero tolerance for discriminatory behaviour. The success of the talent management interventions is reflected in the year's low staff turnover.

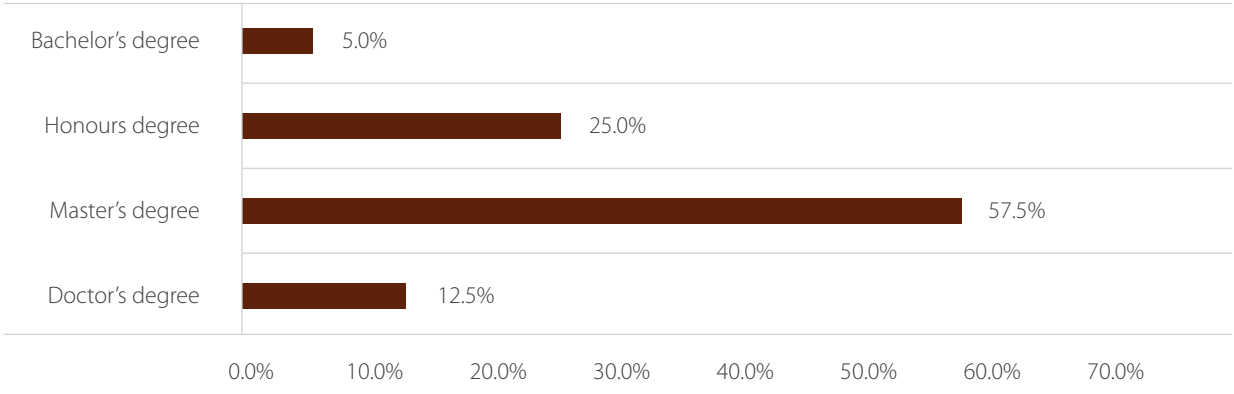
GROWING OUR OWN TIMBER

The CGS aims to ensure an effective talent pipeline with the development of high-potential individuals. During the year under review, the organisation exposed a number of high-performing employees to managerial acting positions.

SKILLS DEVELOPMENT AND TRAINING

Skills development as a means of improving performance and organisational effectiveness is an important component of human capital. The CGS offers a wide range of developmental opportunities, enabling employees to obtain the skills, competencies and experience necessary to contribute to the attainment of individual, team and organisational goals in an increasingly diverse and demanding context. Employee training is the responsibility of both the organisation and of management and individual employees. Leadership commitment is required for all employees to have equal access to training and development opportunities, and to improve their skills and competences. Fulltime bursaries at the end of the financial year are detailed below. Management has started planning to absorb, where possible, graduated bursars.

Bursaries: Full-time (% distribution by level of study)



Education assistance is also available for part-time studies.

Short-term courses are linked to employees' personal development plans and are immediate in impact. During the year under review, the following short-term courses were undertaken by staff:

HUMAN CAPITAL INVESTMENT

Below are previous bursars who assumed different roles this year:

Refilwe Shelembe – Executive Manager: Geological Resources
Favourite quotes: 'Whether you think you can or you think you can't, you're right.' – Henry Ford;
'Together we can!' – Refilwe Shelembe

Refilwe has served the CGS, her employer of choice, uninterrupted for 13 years. A CGS bursar in 2004, when she was registered for a Master's degree with the University of the Witwatersrand, she completed her MSc degree in geology under the supervision of Prof Grant Cawthorn, then platinum industry professor on the Merensky Unit at Lonplats Mines. In May 2006, she joined the CGS as a junior field geologist and she is the first black female geologist to complete and publish 1:50 000 scale geological maps (2526 BB Mabeskraal and 2526BD Mabaalstad) at the CGS. She also worked as task/sheet leader on Keimos Geological Mapping, Alluvial Gravel Mapping and 3D Geological Mapping.

In 2012, she was promoted to senior scientist. She has worked on the World Bank project for geological mapping in Ghana, and in the Central African Republic and Nigeria. She managed the Strategic New Nuclear Reserves Project and was part of the seismic source characterisation integration and evaluation team for the probabilistic seismic hazard assessment of the Thyspunt area, SSHAC level 3, both Eskom projects.

Other roles included mapping representative at the CGS Young Science Forum, chairperson of the Young Geoscientist Network, member of the Library Committee and of the Job Grading Committee, assistant project manager for the CGS's Nuclear Geo-Hazards Group, technical assistant in the Office of the CEO, and acting manager for the Geoscience Mapping unit (geological mapping) and acting executive manager for the Geological Resources Portfolio.

She was appointed executive manager in June 2018.

Shane Doggart - Junior Scientist
Favourite quote: 'Where must we go, we who wander this wasteland, in search of our better selves?' The First History of Man (fictional book in the Mad Max universe).

Junior Scientist Shane Doggart's journey with the CGS began in January 2012, when he was an undergrad at Stellenbosch University. He completed three weeks of vacation work at CGS Bellville, organising map cabinets and the library. Once he learnt of the CGS bursary, his career began to take shape. The bursary enabled him to move on to honours in 2013, with a project in the South-Central Zone of the Damara Belt in Namibia. This involved a ground radiometric survey and lithological mapping to understand the uranium mineralisation associated with the numerous axial-planar granitic dykes that swarm the supracrustals of the Hollands Dome, one of the most spectacular Skarn deposits in the world.

Shane completed an internship with the CGS from 2014 to 2016, during which he participated in applying remote sensing techniques to ASTER and LANDSAT image coverage in Northern Cape and Western Cape to delineate and highlight mineral deposits. He was also exposed to mapping of the Namaqua-Natal Metamorphic Complex (NNMC), and investigating the geology of metamorphic terranes and mobile belts, which included working amid the spectacular scenery of Ai-Ais, Grunau and the lower reaches of the Fish River.

Other highlights included a posting to the Keimoes MTEF project, participation in the drafting of the Friesdale 1:50 000 geological map and achievement of the highest mark for mapwork at the CGS Field School in the Richtersveld.

An MSc project at his alma mater followed, which involved the geochronology and isotope geochemistry of the Orange River Pegmatite Belt and culminated in Shane's graduation in 2019.

Although it was back to full-time study after the internship, the graduate's involvement with the CGS continued, with work in the largely unmapped Huns Mountains and in the Fish River Canyon as part of the team that produced the region's first official hiking map.

His big CGS break came in March 2018, when he was offered a permanent position in Polokwane, attached to the Limpopo Greenstone Belt Project and part of the team mapping the Giyani Greenstone Belt and surrounding granitic terrane.

Shane is currently in Upington, participating in an NNMP mapping project and planning his PhD, which will probably continue the work undertaken in his MSc in the Orange River Pegmatite Belt, work that he hopes will bring great value to the CGS and the country.

Sibongiseni Musawakhe Hlatshwayo – Economic Geology and Geochemistry Manager

Favourite quote: 'If you can't fly, then run. If you can't run, then walk. If you can't walk, then crawl, but by all means, keep moving.' (Martin Luther King Jr).

In 2004, Sibongiseni Hlatshwayo enrolled for a BSc in Applied Geology at University of Western Cape, which he completed in 2006. The CGS awarded him a bursary in 2007 to enrol to facilitate his honours degree University of Pretoria. Again, Sibongiseni did not disappoint and, in 2008, he was appointed a CGS junior scientist in the geochemistry unit. A rewarding journey followed, during which the young geochemist gained valuable experience as both a team member and project leader for geochemical mapping projects such as Tugela and Namaqualand. In 2012, Sibongiseni took unpaid leave to complete an MSc in exploration geology and on his return to the CGS, he continued to learn and grow until he was judged ready for the responsibilities of manager of the Economic Geology and Geochemistry Unit, a position he assumed in 2018. 'Challenge', 'interesting' and 'an opportunity' are among the words he uses to describe his new role. It is certainly a far cry from his early life in the village of Bergville in Emangwaneni, where a future involving management never crossed his mind for a moment. He credits the CGS and mentors such as Schalk Strauss for his success and for giving him a foundation from which the only direction is up.

Fortress Netili

Fortress Netili walked into the CGS in 2004, a proud bursar with an MSc in Hydrogeology certificate under his arm. Over the next decade, he gradually rose through the ranks, from hydrogeologist to project manager and later a manager of the Water Geoscience Unit. He took a three-year break from the organisation in 2014 to further his career and tackle some of the most pressing issues of water security and environmental degradation across different sectors, in consulting capacity, with the government and at non-profit organisations locally and in the SADC region.

He returned to the organisation in February 2019, bringing his newfound knowledge to the role of manager of the Water and Environment Unit. In this capacity, he provides strong and effective leadership to the staff of the business unit, and develops and provides to stakeholders and clients groundwater and related environmental services that will ensure sustainability and growth in water and environmental geoscience for the CGS.

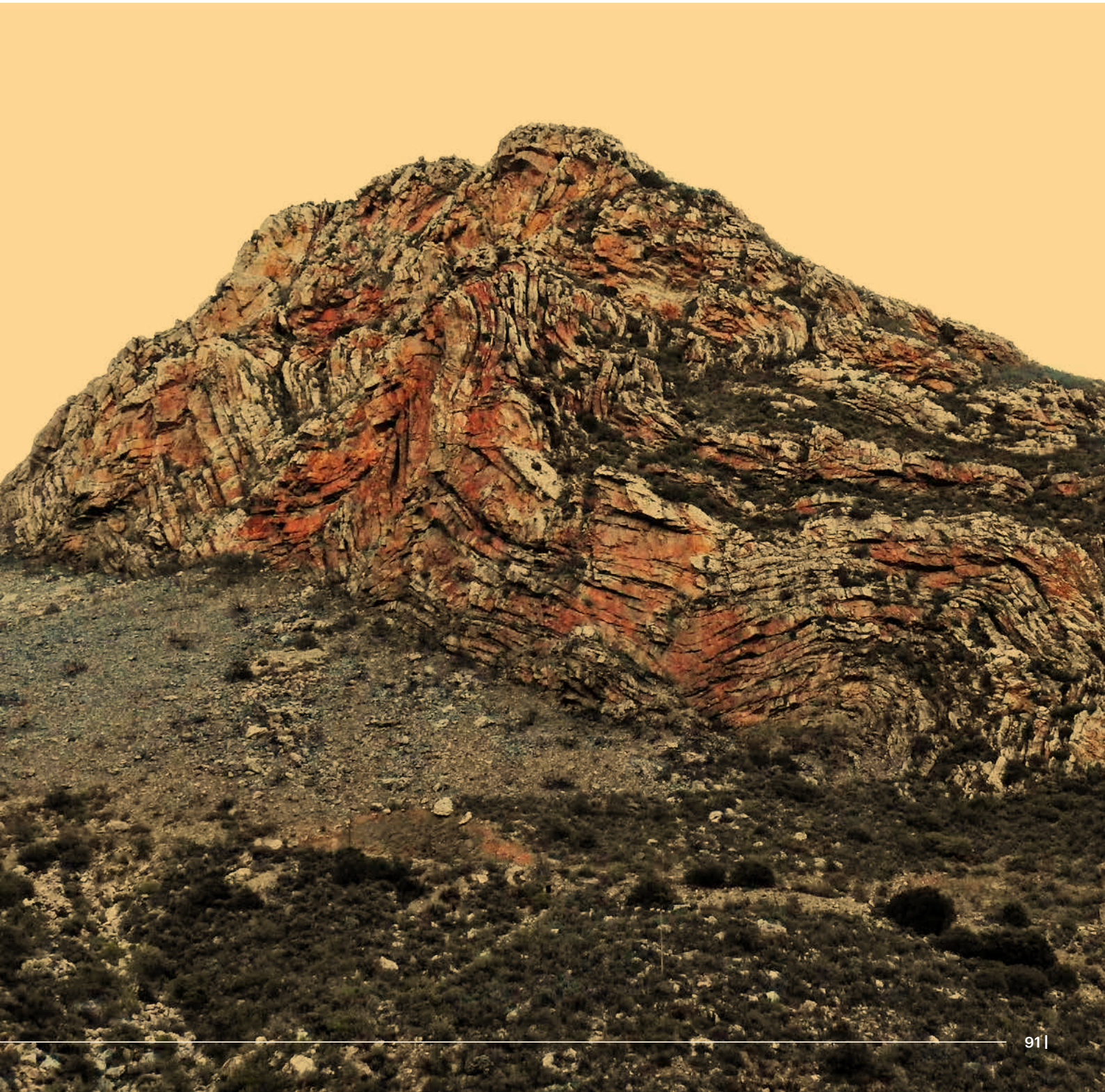
Fortress has bolstered his academic credentials over the years with a BSc (Honours) in Earth Sciences and a Postgraduate Diploma in Business Administration. He is currently registered for a PhD in Groundwater Governance. He is a member of International Association of Hydrogeologists, member of the Groundwater Division of the Geological Society of South Africa, an Associate Member of the Water Institute of South Africa and a Registered Professional Scientist (Pri Sci Nat) with the South African Council for Professional Natural Scientists.

He maintains a keen interest in and commitment to continued professional development in decision-making, environmental sustainability and all aspects of integrated environmental planning, policy, management and assessment.

EMPLOYEE ENGAGEMENT WITH THE CEO

The CGS favours open communication at all levels, as employee engagement boosts staff morale, productivity and sense of belonging. During 2018/2019, the CEO hosted four ordinary staff meetings, which discussed the following topics:

- The organisation's year-to-date performance;
- Strategic interventions following the mid-term review;
- Board-approved policies;
- The impact of the February 2019 budget vote speech and budget cuts;
- Ethical behaviour, and
- The 2017/2018 staff satisfaction survey.



part E

FINANCIAL INFORMATION

This part of the report provides insight into the financial wellness of the organisation. It covers the following aspects:

- The statement of responsibility for the Annual Financial Statements of the year ended 31 March 2019, signed by the CEO, Mr M Mabuza and the Chairperson of the Board, Dr H Mathe;
- The report of the CEO, which includes the general financial review and matters related to the proposed activities, retention of surplus, supply chain management, audit report and plans for the future;
- Report of the Auditor-General to Parliament on the CGS. This report gives an opinion regarding the fairness of the Annual Financial Statements in presenting the organisation's financial position, financial performance, cash flow in accordance with SA Standards of GRAP and requirements of the PFMA in all material aspects. It reports on performance on legal and regulatory compliance, internal control and related matters, and
- The Annual Financial Statements, comprising the Statement of Financial Position, Statement of Financial Performance, Statement of Changes in Net Assets, Cash Flow Statement and Notes to the Financial Statements.

1. STATEMENT OF RESPONSIBILITY

Statement of responsibility for the Annual Financial Statements for the year ended 31 March 2019

The Board is responsible for the preparation of the Annual Financial Statements of the CGS and the judgments made in this information.

It is the responsibility of the Accounting Authority to establish and implement a system of internal controls designed to provide reasonable assurance of the integrity and reliability of the Annual Financial Statements.

In our opinion, the financial statements fairly reflect the operations of the CGS for the financial year ended 31 March 2019.

The external auditors are engaged to express an independent opinion on the Annual Financial Statements of the CGS.

The Annual Financial Statements of the CGS for the year ended 31 March 2019 have been audited by the external auditors, and their report is presented on pages 96 to 100.

The Annual Financial Statements of the CGS set out on pages 101 to 130 have been approved.

Mr M Mabuza
Chief Executive Officer
Council for Geoscience
31 July 2019

Dr H Mathe
Chairperson of the Board
Council for Geoscience
31 July 2019

report BY THE CHIEF FINANCIAL OFFICER (CFO)

MR LEONARD MATSEPE | CHIEF FINANCIAL OFFICER

'Financial sustainability of geosciences will deliver the integrated and multidisciplinary geoscience mapping programme, which in turn contribute in the rejuvenation of investment in the mining sector'

Background

The Council for Geoscience is listed as a Schedule 3A Public Entity in terms of the Public Finance Management Act, Act No 1 of 1999. The objectives underlying the establishment of the CGS are to develop and publish world-class geoscience knowledge products and to render geoscience-related services to the South African public and industry.

Financial position

The CGS maintains a strong balance sheet position, which has grown from R570.6 million in 2018 to R667 million in 2019. The current assets equate to 1.4 times current liabilities.

Capital expenditure

During the year, the CGS invested R28.7 million (2017/18: R31.8 million) in plant, equipment and intangible assets. Of this capital expenditure, R19.2 million (2017/18: R22.5 million) was for equipment. Continued investment in scientific infrastructure and equipment remains a priority to ensure that world-class facilities and equipment are acquired and maintained.

Cash flow management

Cash and cash equivalents decreased from R264.6 million in 2018 to R253.6 million in 2019, resulting in a net cash outflow of R11 million.

Going concern

The CGS's Annual Financial Statements have been prepared on the going-concern basis. Executive management has performed a formal review of the CGS's ability to continue as a going concern in the foreseeable future and based on this review, considers that the presentation of the financial statements on this basis is appropriate.

Events after the reporting date

No facts nor circumstances of a material nature arose between the financial year-end and the date of this report.

New proposed activities

The Geoscience Amendment Act (Act No 16 of 2010) mandates the CGS to, among others, be the custodian and curator of all geotechnical information in South Africa. The CGS is also the national mandatory authority for geohazards related to infrastructure development. Thus, the Act empowers the CGS to be the custodian of all geotechnical data with the purpose of advising government, state institutions, private organisations and the public on the complete geotechnical risk profile of the country.

Request for the retention of surplus

In terms of Section 53(3) of the PFMA of 1999, the CGS has to obtain approval from National Treasury to retain surpluses. Approval was obtained for the use of accumulated surpluses for the maintenance of and investment in scientific equipment and infrastructure, and the implementation of the repositioning strategy. A new request will be made for the year under review.

Supply chain management

The Supply Chain Management Unit is operational under the division of the Chief Financial Officer. This business unit provides an appropriate procurement and provisioning system, which is fair, equitable, transparent, competitive and cost-effective, and is established in accordance with Section 54 of the PFMA of 1999 (as amended by Act No 29 of 1999). In terms of the BBBEE, Section 13G(1) of the B-BBEE Act, the CGS complied with Management control and Enterprise Supplier Development.

Audit report matters

The CGS obtained an unqualified audit opinion from the Auditor-General for the year ended 31 March 2019. Several issues were raised but were resolved during the current financial year.

Plans for future additional financial challenges

The CGS has reviewed its strategy and structure to optimise the delivery of its mandate. The new strategy includes an integrated and multidisciplinary geoscience mapping programme, which aims to refocus the organisation on its statutory mandate, as well as to rejuvenate investment in the mining sector. Funding of R386 million has been allocated for the 2019/20 and 2020/21 financial years. There is a need to secure continued funding to sustain this programme.

3. REPORT OF THE AUDITOR-GENERAL TO PARLIAMENT ON COUNCIL FOR GEOSCIENCE

Report on the audit of the financial statements

Opinion

1. I have audited the financial statements of the Council for Geoscience set out on pages 101 to 130, which comprise the statement of financial position as at 31 March 2019, the statement of financial performance, statement of changes in net assets, and cash flow statement for the year then ended, as well as the notes to the financial statements, including a summary of significant accounting policies.

2. In my opinion, the financial statements present fairly, in all material respects, the financial position of the Council for Geoscience as at 31 March 2019, and its financial performance and cash flows for the year then ended in accordance with the Standards of General Recognised Accounting Practice (Standards of GRAP) and the requirements of the Public Finance Management Act of South Africa, 1999 (Act No.1 of 1999) (PFMA).

Basis for opinion

3. I conducted my audit in accordance with the International Standards on Auditing (ISAs). My responsibilities under those standards are further described in the auditor-general's responsibilities for the audit of the financial statements section of this auditor's report.

4. I am independent of the public entity in accordance with sections 290 and 291 of the International Ethics Standards Board for Accountants' *Code of ethics for professional accountants* (IESBA code), parts 1 and 3 of the International Ethics Standards Board for Accountants' *International code of ethics for professional accountants (including International Independence Standards)* and the ethical requirements that are relevant to my audit in South Africa. I have fulfilled my other ethical responsibilities in accordance with these requirements and the IESBA codes.

5. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Responsibilities of accounting authority for the financial statements

6. The accounting authority is responsible for the preparation and fair presentation of the financial statements in accordance with Standards of GRAP and the requirements of the PFMA, and for such internal control as the accounting authority determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

7. In preparing the financial statements, the accounting authority is responsible for assessing the Council for Geoscience's ability to continue as a going concern, disclosing, as applicable, matters relating to going concern and using the going concern basis of accounting unless the appropriate governance structure either intends to liquidate the public entity or to cease operations, or has no realistic alternative but to do so.

Auditor-general's responsibilities for the audit of the financial statements

8. My objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion.

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the ISAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

9. A further description of my responsibilities for the audit of the financial statements is included in the annexure to this auditor's report.

Report on the audit of the annual performance report

Introduction and scope

10. In accordance with the Public Audit Act of South Africa, 2004 (Act No. 25 of 2004) (PAA) and the general notice issued in terms thereof, I have a responsibility to report material findings on the reported performance information against predetermined objectives for selected objectives presented in the annual performance report. I performed procedures to identify findings but not to gather evidence to express assurance.

11. My procedures address the reported performance information, which must be based on the approved performance planning documents of the public entity. I have not evaluated the completeness and appropriateness of the performance indicators included in the planning documents. My procedures also did not extend to any disclosures or assertions relating to planned performance strategies and information in respect of future periods that may be included as part of the reported performance information. Accordingly, my findings do not extend to these matters.

12. I evaluated the usefulness and reliability of the reported performance information in accordance with the criteria developed from the performance management and reporting framework, as defined in the general notice, for the following selected objectives presented in the annual performance report of the public entity for the year ended 31 March 2019:

Objectives	Pages in the annual performance report
Objective 1 – delivery of the mandate	30
Objective 2 – advisory, stakeholder engagement and knowledge management	30 - 31

13. I performed procedures to determine whether the reported performance information was properly presented and whether performance was consistent with the approved performance planning documents. I performed further procedures to determine whether the indicators and related targets were measurable and relevant, and assessed the reliability of the reported performance information to determine whether it was valid, accurate and complete.

14. I did not raise any material findings on the usefulness and reliability of the reported performance information for these objectives:

- Objective 1 – delivery of the mandate
- Objective 2 – advisory, stakeholder engagement and knowledge management

Other matters

15. I draw attention to the matter below.

Achievement of planned targets

16. Refer to the annual performance report on pages 30 to 32 for information on the achievement of planned targets for the year and explanations provided for the under-/overachievement of a number of targets.

Report on the audit of compliance with legislation

Introduction and scope

17. In accordance with the PAA and the general notice issued in terms thereof, I have a responsibility to report material findings on the compliance of the public entity with specific matters in key legislation. I performed procedures to identify findings but not to gather evidence to express assurance.

18. I did not raise material findings on compliance with the specific matters in key legislation set out in the general notice issued in terms of the PAA.

Other information

19. The accounting authority is responsible for the other information. The other information comprises the information included in the annual report. The other information does not include the financial statements, the auditor's report and those selected objectives presented in the annual performance report that have been specifically reported in this auditor's report.

20. My opinion on the financial statements and findings on the reported performance information and compliance with legislation do not cover the other information and I do not express an audit opinion or any form of assurance conclusion thereon.

21. In connection with my audit, my responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements and the selected objectives presented in the annual performance report, or my knowledge obtained in the audit, or otherwise appears to be materially misstated.

22. If based on the work I have performed, I conclude that there is a material misstatement in this other information, I am required to report that fact. I have nothing to report in this regard.

Internal control deficiencies

23. I considered internal control relevant to my audit of the financial statements, reported performance information and compliance with applicable legislation; however, my objective was not to express any form of assurance on it. I did not identify any significant deficiencies in internal control.

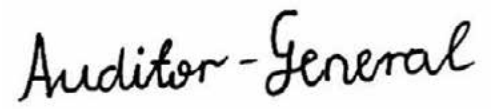
Other reports

24. I draw attention to the following engagements conducted by various parties that had, or could have, an impact on the matters reported in the public entity's financial statements, reported performance information, compliance with applicable legislation and other related matters. These reports did not form part of my opinion on the financial statements or my findings on the reported performance information or compliance with legislation.

25. An independent consultant investigated an allegation of possible misappropriation of the public entity's assets at the request of the public entity, which covered the period 1 April 2017 to 30 April 2018. The investigation report was issued in October 2018 and resulted in further enquiries into the implicated employees. These proceedings were in progress at the date of this audit report.

26. An independent consultant investigated an allegation of irregular procurement of assets at the request of the public entity, which covered purchases made in 2016. The investigation report was issued in May 2019 and resulted in further enquiries into the implicated employees. These proceedings were in progress at the date of this audit report.

27. An independent consultant investigated an allegation of irregular expenditure relating to non-compliance with legislation and allegations of fraud at the request of the public entity, which covered the period 13 June 2017 to 18 January 2018. In May 2019, the investigation was concluded and disciplinary processes were instituted.



Pretoria
31 July 2019

AUDITOR-GENERAL
SOUTH AFRICA

Auditing to build public confidence

4. Annexure – Auditor-general's responsibility for the audit

1. As part of an audit in accordance with the ISAs, I exercise professional judgement and maintain professional scepticism throughout my audit of the financial statements, and the procedures performed on reported performance information for selected objectives and on the public entity's compliance with respect to the selected subject matters.

Financial statements

2. In addition to my responsibility for the audit of the financial statements as described in this auditor's report, I also:

- identify and assess the risks of material misstatement of the financial statements whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control
- obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the public entity's internal control
- evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the accounting authority
- conclude on the appropriateness of the accounting authority's use of the going concern basis of accounting in the preparation of the financial statements. I also conclude, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Council for Geoscience's ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements about the material uncertainty or, if such disclosures are inadequate, to modify the opinion on the financial statements. My conclusions are based on the information available to me at the date of this auditor's report. However, future events or conditions may cause a public entity to cease continuing as a going concern
- evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation

Communication with those charged with governance

3. I communicate with the accounting authority regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

4. I also confirm to the accounting authority that I have complied with relevant ethical requirements regarding independence, and communicate all relationships and other matters that may reasonably be thought to have a bearing on my independence and, where applicable, related safeguards.

5. ANNUAL FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 MARCH 2019

STATEMENT OF FINANCIAL POSITION

Annual Financial Statements for the Year Ended 31 March 2019

	Notes	2019 R'000	2018 (Restated) R'000
Assets			
Non-current assets			
		279 167	284 596
Property and equipment	3	260 049	264 290
Intangible assets	4	1 556	2 744
Heritage assets	26	17 562	17 562
Current assets		387 884	286 067
Inventories	5	5	5
Trade and other receivables	7	134 297	21 456
Cash and cash equivalents	8	253 582	264 606
Total assets		667 051	570 663
Net assets and liabilities			
Accumulated surplus		388 660	389 746
Non-current liabilities			
Post-employment benefit liabilities	6	7 661	8 035
Current liabilities		270 730	172 882
Trade and other payables	9	24 257	32 213
Deferred income	10	221 360	119 405
Accruals	11	25 113	21 264
Total net assets and liabilities		667 051	570 663

STATEMENT OF FINANCIAL PERFORMANCE

Annual Financial Statements for the Year Ended 31 March 2019

	Notes	2019 R'000	2018 (Restated) R'000
Revenue	12	456 036	414 112
Cost of commercial projects	12	(20 775)	(25 265)
Cost of statutory projects	12	(158 043)	(188 364)
Gross surplus		277 218	200 483
Other operating income	12	6 638	4 458
Administrative expenses		(299 592)	(249 664)
Other operating expenses	12	(6 455)	(1 581)
Interest received	13	21 132	24 425
(Loss) from operations		(1 058)	(21 879)
Finance cost	14	(28)	(31)
Net (loss) for the year		(1 086)	(21 910)

STATEMENT OF CHANGES IN NET ASSETS

Annual Financial Statements for the Year Ended 31 March 2019

	Notes	Accumulated surplus R'000	Total R'000
Balance at 31 March 2018		384 417	384 417
Correction of prior period error	24,1	5 329	5 329
Balance at 31 March 2018		389 746	389 746
Net (loss) for the period		(1 086)	(1 086)
Balance at 31 March 2019		388 660	388 660

CASH FLOW STATEMENT

Annual Financial Statements for the Year Ended 31 March 2019

	Notes	2019 R'000	2018 (Restated) R'000
Cash inflow from operating activities		17 097	(21 365)
Cash receipts from customers		342 862	412 903
Cash paid to suppliers and employees		(346 869)	(458 662)
Cash generated from operations	15	(4 007)	(45 759)
Interest received	13	21 132	24 425
Finance cost	14	(28)	(31)
Cash outflow from investing activities		(28 121)	(31 393)
Acquisition of:			
Property and equipment	16,1	(28 542)	(31 540)
Intangible assets	16,2	(132)	(279)
Proceeds from sale of asset	12	339	296
Insurance proceeds for property and equipment	3,1	214	130
Net (decrease) in cash and cash equivalents		(11 024)	(52 758)
Cash and cash equivalents at beginning of period	8	264 606	317 364
Cash and cash equivalents at end of period	8	253 582	264 606

ACCOUNTING POLICIES

1 Accounting policies

1.1 Basis of preparation

Statement of compliance

1. The financial statements have been prepared in accordance with the Standards of Generally Recognised Accounting Practices (GRAP) including any interpretations, guidelines and directives issued by the Accounting Standards Board.

   The financial statements have been prepared on a historic cost basis and accounting policies are consistent with prior years.

   These annual financial statements have been prepared on a going concern basis, i.e. the assumption that the Council for Geoscience will continue to operate as a going concern for at least the next twelve months.

2. The cash flow statement has been prepared in accordance with the direct method.

3. Specific information has been presented separately on the statement of financial position such as:
   (a) receivables from non-exchange transactions, including taxes and transfers;
   (b) taxes and transfers payable;
   (c) trade and other payables from non-exchange transactions.

The budget reporting standard does not apply to the Council for Geoscience as our budget is tabled as part of the Department of Mineral Resources budget.

1.2 Revenue recognition

Revenue comprises the revenue from non-exchange transactions recognised as income in the current year, contract income and sales of publications.

The Council for Geoscience measures revenue at the fair value of the consideration received or receivable. Revenue is recognised only when it is probable that the economic benefits associated with a transaction will flow to the Council for Geoscience, and the amount of revenue and associated costs incurred or to be incurred, can be measured reliably.

1.2.1 Revenue from non-exchange transactions

The Council for Geoscience receives grants in the form of a baseline allocation from the Department of Mineral Resources.

Revenue from non-exchange transactions is recorded as deferred income when it is received. It is then recognised as income proportionate to the costs incurred.

1.2.2 Revenue from exchange transactions

Revenue from exchange transactions comprises sales and contract revenue as follows:

Sales revenue
Sales revenue represents the invoiced value of goods and services supplied by the Council for Geoscience. This revenue is recognised when the revenue recognition criteria are met.

Contract revenue
Revenue from contracts is recognised by means of progress payments over the duration of the contracts. Revenue from contracts in progress is recognised when the revenue criteria are met. When the outcome of a contract can be estimated reliably, revenue is recognised by referring to the stage of completion of the contract outcome.

1.3 Interest received

Interest is recognised on a time proportionate basis with reference to the principal amount receivable and the effective interest rate applicable.

1.4 Property and equipment

Property and equipment are tangible non-current assets that are held for use in the production or supply of goods or services, or for administrative purposes, and are expected to be used during more than one period.

The cost of an item of property and equipment is recognised as an asset when:
- it is probable that future economic benefits associated with the item will flow to the Council for Geoscience; and
- the cost of the item can be measured reliably.

Land and buildings were valued at initial recognition and subsequently only the building is depreciated on a straight-line method.

Costs include costs incurred initially to acquire or construct an item of property and equipment and costs incurred subsequently to add to, replace part of, or service it. If the cost of a replacement part is recognised in the carrying amount of an item of property and equipment, the carrying amount of the replaced part is derecognised.

Property and equipment are carried at cost less accumulated depreciation and any impairment losses.

Day to day expenses incurred on property and equipment are expensed directly to surplus or deficit for the period.

Where an asset is acquired at no cost , or at a nominal cost, its cost is its fair value as at date of acquisition.

Major maintenance that meets the recognition criteria of an asset is capitalised.

Depreciation is provided on all property and equipment other than freehold land, to write down the cost, less residual value, by equal instalments over their average useful lives, as follows:

Land	Not depreciable
Buildings	30 years
Motor vehicles	5 to 8 years
Equipment	5 to 7 years
Aircraft & Helicopter - Body	15 years
Aircraft & Helicopter - Components	Useful hours per Civil Aviation Authority
Boat	10 years
Office furniture	20 years
Computer equipment	6 years
Specialised equipment	15 years

The depreciation charges for each period are recognised in the statement of financial performance, unless it is included in the carrying amount of another asset.

The average useful lives and residual values are reviewed on an annual basis and changes are reflected as change in accounting estimates on a prospective basis.

1.5 Intangible assets

An intangible asset is recognised when:
- it is probable that the expected future economic benefits that are attributable to the asset will flow to the entity; and
- the cost of the asset can be measured reliably.

Capitalised computer software is carried at cost less accumulated amortisation and less accumulated impairment losses. Computer software is tested annually for impairment or changes in estimated future benefits. Amortisation is provided to write down the intangible assets to their residual value, on a straight-line basis, being two to five years.

Research and development
Expenditure on research activities is recognised as an expense in the period in which it is incurred.

An internally generated intangible asset arising from research and development is recognised as part of intangible assets only if all of the following conditions are met:
- an asset is created that can be identified;
- it is probable that the asset created will generate future economic benefits;
- the development cost of the asset can be measured reliably.

Where no internally generated intangible asset can be recognised, development expenditure is recognised as an expense in the period in which it is incurred. Internally generated assets are amortised on a straight-line basis over their useful lives.

1.6 Heritage assets

Heritage assets are assets held for their cultural, environmental or historical significance. Heritage assets are initially recognised at deemed cost which has been determined, due to the nature of heritage assets, by specialist valuators. Heritage assets are reflected at deemed cost and are not depreciated. At each reporting date Heritage assets are assessed for indications of impairment. If any such indication exists, an estimate of the recoverable amount or the recoverable service amount of the heritage assets will be determined and tested against the carrying amount.

1.7 Inventories

The Council for Geoscience is a custodian of scientific information that produces publications in the form of books, maps and map explanations etc. These publications are distributed to the public for free or at a nominal charge.

Inventories are initially measured at deemed costs (fair value).

1.8 Translation of foreign currencies

Foreign currency transactions
A foreign currency transaction is recorded, on initial recognition in Rands, by applying to the foreign currency amount the spot exchange rate between the Rand and the foreign currency at the date of the transaction.

At each balance sheet date:
- foreign currency monetary items are translated using the closing rate.

Exchange differences arising on the settlement of monetary items or on translating monetary items at rates different from those at which they were translated on initial recognition during the period or in previous annual financial statements are recognised in the statement of financial performance in the period in which they arise.

Cash flows arising from transactions in a foreign currency are recorded in Rands by applying to the foreign currency amount the exchange rate between the Rand and the foreign currency at the date of the cash flow.

1.9 Deferred income

Deferred Income is accounted for in the statement of financial position. The related revenue is recognised on an accrual basis in the statement of financial performance in the period in which it satisfies the revenue recognition criteria.

1.10 Retirement benefit costs

Short-term employee benefits
The cost of short-term employee benefits (those payable within twelve months after the service is rendered, such as bonuses, paid vacation leave and sick leave) is recognised in the period in which the service is rendered and is not discounted.

The expected cost of compensated absences is recognised as an expense as the employees render services that increase their entitlement or, in the case of non-accumulating absences, when the absence occurs.

Defined contribution and defined benefit plans
The Council for Geoscience operates both a defined contribution pension and provident fund and a defined benefit plan in respect of post-retirement medical-aid contributions. For the defined benefit plan, the defined benefit obligation and the related current service cost, is determined by using the projected unit credit method. The defined benefit plan is subject to an annual actuarial valuation. The qualifying plan asset of this scheme is held and administered by Momentum Group Limited.

The actuarial gains or losses are further limited to the extent that the net cumulative unrecognised actuarial gains or losses (before recognition of that actuarial gain or loss) exceed the unrecognised part of the transactional liability. Payments to defined contribution retirement benefit plans are charged to the statement of financial performance in the year to which they relate.

1.11 Provisions and contingent liabilities

Provisions are recognised when:

- the entity has a present obligation as a result of a past event;
- it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation; and
- a reliable estimate can be made of the obligation.

The amount of a provision is the present value of the expenditure expected to be required to settle the obligation.

Commitments

The Council for Geoscience classifies commitments as contracted future transactions that are non-cancellable or only cancellable at significant cost , and that will normally result in the outflow of cash.

This excludes steady routine transactions such as salary commitments relating to employment contracts or social security benefits.

A distinction is made between operational and capital commitments;

Disclosure is made of the aggregate amount of operational and capital expenditure contracted for at the reporting date, to the extent that the amount has not been recorded in the financial statements.

If a commitment is for a period longer than a year, it is stated in the note to the commitments.

Disclosure of expenditure that has been approved, but that has not yet been contracted for, is made.

1.12 Financial instruments

Initial recognition

The entity classifies financial instruments, or their component parts, on initial recognition as a financial asset, a financial liability or an equity instrument in accordance with the substance of the contractual arrangement.

Financial assets and liabilities are recognised on the entity's statement of financial position when the Council for Geoscience becomes party to the contractual provisions of the instrument.

Financial assets and liabilities are recognised initially at fair value.

Derecognition of financial instruments

The entity derecognises a financial asset only when the contractual rights to the cash flows from the asset expire, or it transfers the financial asset and substantially all the risks and rewards of ownership of the asset to another entity.

The entity derecognises financial liabilities when the entity's obligations are discharged, cancelled or they expire.

Impairment of loans and receivables
Financial assets are assessed for indicators of impairment at each balance sheet date. Financial assets are impaired where there is objective evidence that, as a result of one or more events that occurred after the initial recognition of the financial asset, the estimated future cash flows of the investment have been impacted.

The carrying amount of trade receivables is reduced through the use of an allowance account (bad debt provision).When a trade receivable is considered uncollectible, it is written off against the allowance account. Subsequent recoveries of amounts previously written off are credited against the allowance account. Changes in the carrying amount of the allowance account are recognised in surplus or deficit.

Fair values of trade and other payables are determined at a price charged at transaction date and impaired when indicators of impairment are present. At period end there were no differences between the book value and the fair values of trade and other payables.

Fair value of trade and other receivables
Fair values of trade and other receivables are determined at a price charged at transaction date and impaired when indicators of impairment are present. At period end there were no differences between the book value and the fair values of trade and other receivables because of the short-term maturity.

Financial assets carried at amortised cost
Loans and receivables are measured at amortised cost less any impairment losses recognised to reflect irrecoverable amounts. Impairment is determined on a specific basis, whereby each asset is individually evaluated for impairment indicators. Write-offs of these assets are expensed in surplus or deficit.

Cash and cash equivalents
Cash and cash equivalents are short-term, highly liquid investments that are readily convertible to known amounts of cash. Cash and cash equivalents are measured at fair value.

Financial liabilities carried at amortised cost
Trade and other payables are initially measured at fair value and are subsequently measured at amortised cost.

1.13 Operating leases

Leases of assets under which all the risks and rewards of ownership are effectively retained by the lessor are classified as operating leases. Lease payments under an operating lease are recognised as an expense on a straight-line basis over the lease term.

Any contingent rents are expensed in the period they are incurred.

1.14 Impairment

The Council for Geoscience identifies cash generating assets as assets that are managed with the objective of generating a commercial return, and non -cash generating assets as assets that do not generate market related cash flows from that asset .

The entity assesses at each balance sheet date whether there is any indication that an asset may be impaired. If there is any indication that an asset may be impaired, the recoverable amount is estimated for the individual asset. The recoverable amount of an asset is the higher of fair value less assumed costs to sell and its value in use.

If the recoverable amount of an asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. That reduction is an impairment loss recognised immediately in surplus or deficit.

At each reporting date the entity assesses impairment losses recognised in prior years for continued existence or decreases. If such indication exists, the recoverable amounts of those assets are estimated. The increase in the carrying amount of an asset attributable to a reversal of an impairment loss does not exceed the carrying amount that would have been determined had no impairment loss been recognised for the asset in prior periods. A reversal of an impairment loss of assets carried at cost less accumulated depreciation or amortisation is recognised immediately in surplus or deficit.

1.15 Critical accounting estimates and judgements

Provision for bad debts
Past experience indicates a reduced prospect of collecting debtors over the age of four months. Debtor balances are regularly assessed by management and provided for in line with the policy.

Provisions
Provisions were raised and management determined an estimate based on the information available and in line with the policy.

Property and equipment
Management has made certain estimations with regard to the determination of estimated useful lives and residual values of items of property and equipment.

Leases
Management has applied its judgement to classify all lease agreements that the entity is party to as operating leases, as they do not transfer substantially all risks and ownership to the entity. Furthermore, as the operating lease in respect of premises is only for a relatively short period of time, management has made a judgement that it would not be meaningful to classify the lease into separate components for the land and for the buildings for the Polokwane office current lease, and the agreement will be classified in its entirety as an operating lease.

1.16 Sources of estimation uncertainty

There are no key assumptions concerning the future and other key sources of estimation uncertainty at the balance sheet date that could have a significant risk of causing material adjustment to the carrying amounts of assets and liabilities within the next financial year.

1.17 Irregular expenditure

Irregular expenditure is recorded in the notes to the financial statements when confirmed. The amount recorded is equal to the value of the irregular expenditure incurred, unless it is impractical to determine, in which case reasons therefore must be provided in the notes.Irregular expenditure receivables are measured at the amount that is expected to be recovered and are de-recognised when settled or written-off as irrecoverable

2 New standards and interpretations

2.1 Standards and interpretations issued, but not yet effective

The Council for Geoscience has not applied the following standards and interpretations, which have been approved but are not yet effective for accounting periods 2018/2019:

GRAP statement	Description	Impact	Effective date
GRAP 20	Related Party Disclosure	None	01 April 2019
GRAP 32	Service Concession Arrangements: Grantor	None	No effective date
GRAP 34	Separate Financial Statements	None	No effective date
GRAP 35	Consolidated Financial Statements	None	No effective date
GRAP 36	Investments in Associates and Joint Ventures	None	No effective date
GRAP 37	Joint Arrangements	None	No effective date
GRAP 38	Disclosure of Interests in Other Entities	None	No effective date
GRAP 108	Statutory Receivables	None	01 April 2019
GRAP 109	Accounting by Principals and Agents	None	01 April 2019
GRAP 110	Living and Non-living Resources	None	01 April 2019
IGRAP 1	Applying the probability test on initial recognition revenue (amendments)	None	01 April 2020
IGRAP 17	Service concession arrangements where a grantor controls a significant residual interest in an asset	None	01 April 2019

3 Property and equipment

2019	Land	Buildings and Fixtures	*Equipment	Office furniture	Aircraft and Boat	Motor vehicles	Computer equipment	Total
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Gross carrying amount	18 231	189 610	154 354	14 162	22 348	33 763	20 653	453 121
Accumulated depreciation at the beginning of the period	(1 960)	(59 933)	(81 838)	(8 557)	(10 184)	(12 937)	(13 422)	(188 831)
Opening net carrying amount at 31 March 2018	**16 271**	**129 677**	**72 516**	**5 605**	**12 164**	**20 826**	**7 231**	**264 290**
Movements during the period:								
Work in progress (refer to note 3.3)	-	2 131	2	-	-	-	-	2 133
Acquisitions	-	3 341	19 245	234	-	1 956	1 633	26 409
Reversal of impairment	-	631	-					631
Disposals	-	-	(475)	(233)	-	(3 952)	(638)	(5 423)
Disposals - Cost	0,00	-	(7 602)	(1 081)	-	(6 456)	(1 735)	(16 874)
Disposals - Depreciation	0,00	-	7 127	849	-	2 379	1 097	11 452
Depreciation	0,00	(6 032)	(15 830)	(674)	(102)	(3 137)	(2 218)	(27 993)
Closing net carrying amount at 31 March 2019	**16 271**	**129 748**	**75 458**	**4 932**	**12 062**	**15 569**	**6 009**	**260 049**
Gross carrying amount	18 231	195 082	165 999	13 315	22 348	29 264	20 551	464 790
Accumulated depreciation/impairment	(1 960)	(65 334)	(90 541)	(8 383)	(10 286)	(13 695)	(14 542)	(204 741)

Property and equipment (continued)

2018	Land R'000	Buildings and Fixtures R'000	*Equipment R'000	Office furniture R'000	Aircraft and Boat R'000	Motor vehicles R'000	Computer equipment R'000	Total R'000
Gross carrying amount	18 231	184 274	138 955	13 519	24 425	30 652	20 364	430 420
Accumulated depreciation at the beginning of the period	(1 960)	(54 726)	(75 316)	(8 156)	(11 035)	(11 014)	(12 671)	(174 878)
Opening net carrying amount at 31 March 2017	**16 271**	**129 548**	**63 639**	**5 363**	**13 390**	**19 638**	**7 693**	**255 542**
Movements during the period:								-
Work in progress (refer to note 3.3)	-	5 336	(2 600)	-	-	-	-	2 736
Acquisitions	-	-	22 463	993	-	3 865	1 483	28 804
Disposals	-	-	(393)	(96)	(104)	(312)	(298)	(1 203)
Disposals - Cost	-	-	(4 464)	(350)	(2 077)	(754)	(1 194)	(8 839)
Disposals - Depreciation	-	-	4 071	254	1 973	442	896	7 636
Depreciation	-	(5 207)	(10 593)	(655)	(1 122)	(2 365)	(1 647)	(21 589)
Closing net carrying amount at 31 March 2018	**16 271**	**129 677**	**72 516**	**5 605**	**12 164**	**20 826**	**7 231**	**264 290**
Gross carrying amount	18 231	189 610	154 354	14 162	22 348	33 763	20 653	453 121
Accumulated depreciation/impairment	(1 960)	(59 933)	(81 838)	(8 557)	(10 184)	(12 937)	(13 422)	(188 831)

* Equipment in the tables above include the following categories of equipment: Specialised Equipment, Audio & Visual and Technical Equipment

The transfer of the following land and buildings as stipulated under section 26 of the Geoscience Act (Act No. 100 of 1993) has not yet been completed.

Location	Fair value at date of transfer R'000
474 Carl Street, Town Lands 351JR, Pretoria West	R2 800
280 Pretoria Street, Silverton, Pretoria	R94 000

The value of these properties has been included in the carrying amount of land and buildings as at 31 March 2019 and was determined by an independent valuator.

Details regarding land and buildings are kept at the Council for Geoscience head office and will be supplied upon written request.

Property and equipment (continued)

	2019 R'000	2018 R'000
3.1 Compensation from third parties for property and equipment lost		
Proceeds from insurance	214	130

3.2 Property and equipment in the process of being constructed

Cumulative expenditure recognised in the carrying value of property and equipment being developed/ constructed

	Buildings and Fixtures R'000	*Equipment R'000	Aircraft and Boat R'000	Total R'000
Gross carrying amount	24 012	(370)	983	24 625
Opening net carrying amount at 31 March 2018	24 012	(370)	983	24 625
Movement	2 131	2	-	2 133
Closing net carrying amount at 31 March 2019	26 143	(368)	983	26 758

Property and equipment in the process of being constructed with delays

Included in the work in progress for buildings and fixtures is a carrying amount of R24,724m in respect of a ventilation system in the Silverton building that has been delayed.

	Buildings and Fixtures R'000
Gross carrying amount	24 724
Opening net carrying amount at 31 March 2018	24 724
Movement	-
Closing net carrying amount at 31 March 2019	24 724

3.3 Property and equipment continued

Repairs and maintenance expenditure incurred for the year to repair and maintain property and equipment

Repairs and Maintenance

	2019 R'000	2018 R'000
Land and Buildings	4 933	5 100
Office Equipment and Furniture	5	690
Technical and Scientific Equipment	1 224	2 781
Specialised Equipment	58	51
Computer Equipment	150	80
Aircraft	366	1 208
	6 737	9 910

	2019 R'000	2018 R'000

4 Intangible assets

Computer software		
Gross carrying amount	9 733	9 971
Accumulated amortisation	(6 990)	(6 438)
Opening net carrying amount at 31 March 2018	2 744	3 533
Movements during the period:		
Acquisitions	132	279
Disposals	-	(108)
Disposals - Cost	-	(517)
Disposals - Amortisation	-	409
Amortisation	(1 320)	(961)
Closing net carrying amount at 31 March 2019	1 556	2 744
Gross carrying amount	9 865	9 733
Accumulated amortisation	(8 309)	(6 990)

5 Inventories

Publication inventories	5	5

6 Retirement benefit

6.1 Post-retirement medical-aid fund (PRM)

The Council for Geoscience has made provision for the medical-aid fund covering all its qualifying employees. All eligible employees are members of the defined benefit scheme. To improve management of this defined benefit scheme the Council for Geoscience established a qualifying plan asset in October 2010 which is held and administered by Momentum Group Limited and evaluated annually as at 31 March.

The amount recognised in the statement of financial performance is determined as follows:

Current service costs	73	95
Interest charge	2 020	1 899
Expected return on planned assets	(1 441)	(1 285)
Actuarial (gain)/loss recognised	(1 026)	(724)
	(374)	(15)

The amount included in the statement of financial position arising from Council for Geoscience obligation in respect of PRM is as follows:

	2019	2018	2017	2016	2015
Present value of fund obligations	24 215	25 565	23 084	22 931	21 863
Fair value of planned assets	(16 554)	(17 530)	(15 034)	(15 059)	(14 851)
Liability recognised in statement of financial position	7 661	8 035	8 050	7 872	7 012

Movement in net liability during the period is as follows:	2019 Liability	2019 Planned asset	2019 Net	2018 Liability	2018 Planned asset	2018 Net
Liability at beginning of period	25 565	-	25 565	23 084	-	23 084
Value of planned assets at beginning of period	-	(17 530)	(17 530)	-	(15 034)	(15 034)
	25 565	(17 530)	8 035	23 084	(15 034)	8 050
Interest charge/expected return of planned asset	2 020	(1 441)	579	1 899	(1 285)	614
Current service costs	73	-	73	95	-	95
Benefits paid	(1 742)	1 742	-	(1 701)	1 701	-
Actuarial (gain)/loss	(1 702)	676	(1 026)	2 188	(2 912)	(724)
Closing balance	24 214	(16 553)	7 661	25 565	(17 530)	8 035

Contributions expected to be paid
Top up payments are expected to be made during the 2020 financial year

Expected rate of return on assets	8,96%
Assumptions	
Discount rates	8,96%
Basis of discount rates: JSE zero coupon bond yield after the market closed on 31 March 2019	
Return on assets	8,22%
Expected salary increases	7,00%
Health care cost inflation rate	6,48%

Sensitivity analysis-on accrued liability (R Millions) for the year ending 31 March 2019

Assumption	Change	In service	Continuation	Total	Change
Central assumptions	-	3,950	20,265	24,215	-
Health care inflation	1%	4,526	21,816	26,342	9%
	-1%	3,475	18,880	22,355	-8%
Discount rate	1%	3,481	18,879	22,360	-8%
	-1%	4,527	21,844	26,371	9%
Post retirement mortality	-1 year	4,063	21,118	25,181	4%
Average retirement date	-1 year	4,051	20,265	24,316	0%
Continuation of membership at retirement	-10%	3,563	20,265	23,828	-2%

The table above indicates, for example that if medical inflation is 1% greater then the long-term assumptions made, the liability will be 9% higher than that shown.

Sensitivity analysis for current service and interest cost (R Millions) for the year ending 31 March 2019

Assumption	Change	Current service	Interest cost	Total	Change
Central assumptions	-	72 600	2 020 200	2 092 800	-
Health care inflation	1%	87 500	2 216 100	2 303 600	10%
	-1%	60 800	1 849 900	1 910 700	-9%
Discount rate	1%	61 400	2 074 000	2 135 400	2%
	-1%	86 800	1 950 400	2 037 200	-3%
Post retirement mortality	-1 year	74 800	2 109 700	2 184 500	4%
Average retirement date	-1 year	47 800	2 029 900	2 077 700	-1%
Continuation of membership at retirement	-10%	65 600	1 992 500	2 058 100	-2%

The table above indicates, for example, that if medical inflation is 1% greater then the long-term assumptions made, the liability will be 10% higher than that shown.

6.2 Pension and provident fund benefits

The Council for Geoscience and its employees contribute to a defined contribution plan. The assets of the scheme are held separately from the Council for Geoscience in funds under the control of trustees. The total cost charged to income of R13,755m (2018: R11,580m) represents equal contributions of 7.5% by the employer and employee.

	2019 R'000	2018 R'000
7 Trade and other receivables for exchange revenue		
Trade receivables	1 977	3 492
Contract customers	127 574	12 651
Other receivables	6 922	5 331
	136 473	21 474
Less - Provision for bad debts	(2 175)	(18)
	134 297	21 456
Provision for bad debts		
Opening balance	18	662
Movement	2 157	(644)
Closing balance	2 175	18
Analysis of Impairment		
Long overdue debtors considered impaired	2 175	18
	2 175	18

There is no difference between the fair value of trade and other receivables and their book value.

		2019 R'000	2018 R'000
8	**Cash and cash equivalents**		
	Cash and cash equivalents at the end of the period are represented by the following balances:		
	Cash at bank	17 333	19 944
	Call accounts	236 249	244 662
	Cash and cash equivalents at the end of the period are represented by the following balances:	253 582	264 606
	There is no difference between the fair value of cash and cash equivalents and their book value.		
9	**Trade and other payables**		
	Trade payables	9 621	15 545
	Other payables	14 636	16 668
		24 257	32 213
	There is no difference between the fair value of trade payables and their book value.		
10	**Deferred income**		
	Exchange revenue		
10.1	**Deferred income arising as a result of an agreement entered into with the Department of Science and Technology to develop an intellectual property management office. (Geoscience Act par 5(1)(g))**		
	Carrying amount at the beginning of period	3 879	1 421
	Amounts received	-	3 103
	Amounts used during the period	(615)	(645)
	Carrying amount at the end of period	3 264	3 879
10.2	**Deferred income arising as a result of an agreement with the Orgarnisation of African Geological Surveys.**		
	Carrying amount at the beginning of period	48	48
	Carrying amount at the end of period	48	48
10.3	**Deferred income arising as a result of an agreement with the Department of Science and Technology for the environmentally friendly and efficient methods for the extraction of Rare Earth Elements.**		
	Carrying amount at the beginning of period	182	1 004
	Amounts used during the period	-	(822)
	Carrying amount at the end of period	182	182
10.4	**Deferred income arising as a result of an agreement with the Department of Science and Technology in terms of the Earth Observation and Geohazards Assessment.**		
	Carrying amount at the beginning of period	2 922	2 922
	Amounts used during the period	(2 922)	-
	Carrying amount at the end of period	-	2 922

		2019 R'000	2018 R'000
	Deferred income (continued)		
10.5	**Deferred income arising as a result of an agreement with the Department of Science and Technology to study the Witwatersrand Central Basin mine water apportionment.**		
	Carrying amount at the beginning of period	-	35
	Amounts used during the period	-	(35)
	Carrying amount at the end of period	-	-
10.6	**Deferred income arising as a result of an agreement entered into with the National Research Foundation.**		
	Carrying amount at the beginning of period	110	321
	Amounts used during the period	-	(211)
	Carrying amount at the end of period	110	110
10.7	**Deferred income arising as a result of an agreement entered into with the Department of Mineral Resources to develop and implement various measures to mitigate the effect of mining-induced contamination.**		
	Carrying amount at the beginning of period	112 264	107 369
	Amounts received	206 648	189 788
	Amounts used during the period	(101 157)	(184 893)
	Carrying amount at the end of period	217 755	112 264
	Total deferred income	221 360	119 405
11	**Accruals**		
	Accruals for leave pay		
	Carrying amount at the beginning of period	16 060	13 584
	Provision current period	4 061	3 379
	Amounts used during the current period	(1 138)	(903)
	Carrying amount at the end of period	18 983	16 060

The leave pay provision relates to the estimated liabilities as a result of leave days due to employees.

	Accruals for 13th cheque		
	Carrying amount at the beginning of period	5 204	4 582
	Provision current period	926	622
	Carrying amount at the end of period	6 130	5 204

The 13th cheque accrual relates to the structuring of the employee costs to company and is paid out on employees' birthdays.

	Total accruals	25 113	21 264

	2019 R'000	2018 R'000
12 Surplus/deficit from operations		
Operating surplus/deficit is arrived at after taking the following items into account:		
Revenue		
Non-exchange revenue		
Total grant received	405 983	366 988
Project related revenue	(206 648)	(189 788)
	199 335	177 200
Exchange revenue		
Department of Mineral Resources project related revenue	227 288	184 893
Contracting revenue	25 812	47 458
Publication revenue	3 601	4 561
	256 701	236 912
	456 036	414 112
Cost of contracts*		
Direct cost	10 755	11 865
Personnel expenditure	10 020	13 400
	20 775	25 265
Cost of statutory projects*		
Direct cost	59 825	101 522
Personnel expenditure	98 217	86 842
	158 043	188 364
Other operating income		
Foreign currency gains	1 744	119
Proceeds from sale of asset	339	296
Recovery of asset losses	214	130
Sundry income	4 341	3 913
	6 638	4 458
Administrative expenses include -		
Audit fees	5 586	5 898
- Current period	2 756	2 235
- Internal audit	2 830	3 597
- Fee for other services	-	66

Surplus/deficit from operations (continued)	2019 R'000	2018 R'000
Bad debts written off	-	7
Provision for bad debts	(2 175)	(18)
Depreciation - on owned assets	27 993	21 589
- Buildings	6 032	5 207
- Equipment	15 830	10 593
- Office furniture	674	655
- Motor vehicles	3 137	2 365
- Aircraft	102	1 122
- Computer equipment	2 218	1 647
Reversal of impairment	631	-
Amortisation - intangible assets		
- Computer software	1 319	961
Rentals in respect of operating leases		
- Land and buildings	1 045	1 098
- Multifunctional printers	519	883
Other operating expenses		
Net loss on disposal of equipment	474	393
Net loss on disposal of vehicles	4 077	415
Net loss on disposal of intangible assets	-	108
Net loss on disposal of computer equipment	639	298
Net loss on disposal of office furniture	233	96
Net loss on disposal of aircraft	-	-
Write-off of bad debts	-	7
Foreign currency losses	1 033	264
	6 455	1 581
Staff costs	294 552	255 942
Included in staff costs are:		
Defined benefit plan expense for the post-retirement medical-aid fund	(374)	(15)
Current service cost	73	95
Interest cost	2 020	1 899
Expected return on plan assets	(1 441)	(1 285)
Recognised actuarial (gain)/loss	(1 026)	(724)
Defined contribution plan expenses for the pension and provident fund	13 755	11 580

Surplus/deficit from operations (continued)

Emoluments

Senior management	Pensionable salary	Performance bonus	2018/2019 Provident/ Pension fund contributions	*Other contributions	Total
	R'000	R'000	R'000	R'000	R'000
Mr Mabuza M	2 736	244	166	103	3 249
Mr Matsepe L D	2 455	318	149	120	3 041
Mr Ramagwede L F	1 877	283	122	101	2 383
Ms Shelembe P R	1 850	274	111	99	2 334
Dr Tshipa J	1 633	-	98	91	1 822
Dr Khoza T D	1 351	-	85	72	1 508

	Pensionable salary	Performance bonus	2017/2018 Provident/ Pension fund contributions	Other contributions	Total
	R'000	R'000	R'000	R'000	R'000
Mr Mabuza M	2 074	194	111	73	2 452
Mr Matsepe L D	2 305	388	140	115	2 948
Mr Ramagwede L F	1 762	221	115	96	2 194
Mr Tlowana S I	566	-	27	27	620
Mrs Grobbelaar M	749	-	28	33	810
Mr Craill C	786	-	28	34	848
Ms Shelembe P R	749	-	21	19	789
Dr De Kock G S	620	-	22	18	660
Mrs Kola M E M	1 174	175	61	54	1 464

	2019 R'000	2018 R'000
Board emoluments		
Non-executive Board Members		
Dr Mathe H	170	274
Dr Mahachi J	110	103
Mr Koloi K	67	78
Mr Ramokgopa K	172	229
Mr Mvinjelwa X	101	116
	620	800

*** Other contributions relate to employer contributions towards statutory deductions.**

Details regarding Board Members' service contracts:
Board Members representing government departments are not included above as they received no emoluments.

		2019 R'000	2018 R'000
13	**Interest received**		
	Interest received		
	- Interest income on call accounts	17 698	23 147
	- Interest income on current accounts	3 434	1 278
		21 132	24 425
14	**Finance cost**		
	Finance cost on motor vehicle fleet cards.	28	31
15	**Reconciliation of net (loss)/surplus for the period to cash generated from operations**		
	Net (loss) for the period	(1 086)	(22 253)
	Interest	28	31
	Depreciation on property and equipment	27 993	21 872
	Amortisation - intangible assets	1 320	1 021
	Reversal of impairment of assets	(631)	-
	Proceeds from sale of an asset	(339)	(296)
	Compensation from third parties for property and equipment lost	(214)	(130)
	Net loss on disposal of fixed assets	5 423	1 311
	Interest earned	(21 133)	(24 425)
	Provision for post-retirement medical-aid benefits	(374)	(15)
	Operating cash flows before working capital changes	10 985	(22 885)
	Working capital changes:		
	Increase/(Decrease) in in retained surplus	-	(36 158)
	Increase in provision for accumulated leave pay and 13th cheque	3 849	3 098
	(Increase)/Decrease in trade and other receivables	(112 841)	(2 249)
	Increase/(Decrease)in trade and other payables	(7 955)	6 102
	Increase/(Decrease) in deferred income	101 955	6 332
	Cash generated from operations (including finance costs)	(4 007)	(45 759)
16	**Acquisition of:**		
16.1	**Property and equipment**		
	Land and buildings	3 341	-
	Equipment	19 245	22 463
	Office furniture	234	993
	Motor vehicles	1 956	3 865
	Computer equipment	1 633	1 483
		26 409	28 804
	Work in progress - Acquisitions		
	Land and buildings	2 131	5 336
	Equipment	2	(2 600)
		2 133	2 736

		2019 R'000	2018 R'000
	Acquisition of: (continued)		
	Total acquisitions	28 542	31 540
16.2	**Intangible assets**		
	Computer software	132	279
		132	279
17	**Contingent liability**		
17.1	**Bank guarantees**		
	Performance bonds and bid bonds issued for contract work to various financial institutions	1 431	1 431
		1 431	1 431
17.2	**Pending legal action**		
	The Council for Geoscience has an estimated legal liability due to a pending labour cases	1 078	6 455
		1 078	6 455

18 Taxation

No provision for income tax was made as the Council for Geoscience is exempted in terms of section 10(1)(Ca)(i) of the Income Tax Act.

19 Operating lease commitments

19.1 Lease of office space

The operating lease between a supplier and the Council for Geoscience entered into from 01 December 2017 to 30 Novemebr 2020.
At reporting date, the outstanding commitments under non-cancellable operating leases, which fall due are as follows:

Up to I year	621	415
2 to 5 years	705	1 192
Total lease commitments	1 326	1 607

19.2 Lease of office printing equipment

The operating lease between a supplier and the Council for Geoscience entered into from 01 October 2015 to 31 July 2019.
At the reporting date, the outstanding commitments under non-cancellable operating leases, which fall due are as follows:

Up to I year	1 140	2 347

	Operating lease commitments (continued)	2019 R'000	2018 R'000
	2 to 5 years	-	-
	Total lease commitments	1 140	2 347
19.3	**Commitments**		
	Operating expenditure		
	Approved and contracted	50 659	47 494
	Approved but not yet contracted*	-	33 434
	Capital expenditure		
	Approved and contracted: Property and equipment	5 101	24 966
	Approved but not yet contracted: Property and Equipment*	889	6 199
	Total commitments	56 649	112 093
	Commitments		
	Up to I year	50 993	56 334
	2 to 5 years	5 656	55 759
	Total commitments	56 649	112 093

The Council for Geoscience has usage based contracts for the provision of the following services
- Sampling Services Geophysics
- Accommodation and travel
- Courier services

*Change in accounting policy

A decision was made to change the method of disclosure of its commitments during the period to now disclose the approved but not yet contracted for, committments. The latter method provides more reliable information when evaluating the Council for Geosciences' ability to meet its liabilities and commitments. The change in accounting policy was applied retrospectively and the corresponding comparative figures were restated.

20 Financial instruments

Financial instruments consist of cash and cash equivalents, investments with financial institutions, trade and other receivables and trade and other payables.

20.1 Credit risk

Financial assets, which potentially subject the Council for Geoscience to concentrations of credit risk, consist principally of cash, short-term deposits and trade receivables. The Council for Geoscience's cash equivalents and short-term deposits are placed with high credit quality financial institutions. Trade receivables are presented net of the allowance for doubtful debts. Credit risk with respect to trade receivables is limited due to the large number of customers being dispersed across different industries and geographical areas. Accordingly the Council for Geoscience has no significant concentration of credit risk.

The carrying amounts of financial assets included in the statement of financial position represent the Council for Geoscience's exposure to credit risk in relation to those assets.

Operating lease commitments (continued)

Trade and other receivables are controlled by well-established policies and procedures which are reviewed and updated on an on-going basis. The Council for Geoscience does not have any significant exposure to any individual customer or counterparty.

Trade receivables and other payables are carried at amortised costs. Refer to notes 7 and 9.

20.2 Interest rate risk

The organisation's exposure to interest rate risk and the effective interest rates on the financial instruments at reporting date are: 31 March 2019

	Weighted average effective interest rate %	Weighted average effective interest rate %
Assets		
Cash	3,94%	3,95%
Call accounts	7,20%	7,22%

Short-term deposits

The risk is perceived to be low due to the following factors:

- Funds are only invested with approved financial institutions according to the policy of the Council for Geoscience.
- Short-term deposits are only reinvested or invested with Management approval.

20.3 Foreign currency risk

The Council for Geoscience undertakes certain transactions denominated in foreign currencies, hence exposures to exchange rate fluctuations arise. It is not policy for the Council for Geoscience to take out cover on these outstanding foreign currency transactions due to the fact that these transactions take place on an ad-hoc basis. The Council for Geoscience exposure at 31 March 2019 is disclosed in note 21.

20.4 Airborne operations risk

It is the policy of the Council for Geoscience to transfer risk in respect of airborne operations to third parties, namely insurance and an external operator.

21 Foreign currency exposure

	2019 '000	2019 R'000		2018 '000	2018 R'000
	Exchange rate	Foreign amount	R-value	Exchange rate	Foreign amount	R-value
21.1 Trade receivables						
Foreign currency						
Euro	R 14,343	€ 0,00	0	R 14,343	€ 0,33	5
US$	R 14,288	$72	1 032	R 11,645	$34	396
21.2 Banks						
Foreign funds						
Euro	R 16,026	€ 240	3 846	R 14,343	€ 240	3 442

	2019 R'000	2018 R'000

22 Related-party transactions

During the period, the following related-party transactions took place between the Council for Geoscience and the Department of Mineral Resources:

Total grant received	405 983	366 988

Refer to note 10 for further details regarding transactions with the Department of Mineral Resources.

All other related-party transactions were concluded at arm's length.

Relationships:

Parent National Department: Department of Mineral Resources

23 Irregular expenditure

Opening balance	74	-
Irregular expenses identified in the current year	-	74
Expenditure condoned	(74)	-
	-	74
Details of irregular expenditure identified in the current year		
Non-compliance with National Treasury's instruction on local content when purchasing field clothing.	-	74
	-	74

24 Correction of prior year error

Nature	Period	
A correction was made to the financial statements on revenue that was not recognised in the period to which it relates.	31-Mar-18	(2 544)
A correction was made to the financial statements on revenue that was not recognised in the period to which it relates.	31-Mar-15	(35)
A correction was made to the financial statements to depreciation/amortisation for prior period.	31-Mar-18	514
A allocation correction was made from expenditure and capitalised.	31-Mar-18	(286)
A correction was made to expenditure that was not recognised in the correct period.	31-Mar-18	378
An adjustment was made to payables in the prior period relating to a construction project retention.	31-Mar-18	(2 257)
An adjustment was made to fixed asset in the prior period for the capitalisation of the construction project retention.	31-Mar-18	2 257

Correction of prior year error (continued)	2019 R'000	2018 R'000
Adjustment was made to estimated useful life of property and equipment. Correction could only be made in 2017/2018 financial year due to impractibility of calculation for prior years. This is due to the unavailability of information from inception of the affected property and equipment	31-Mar-18	(3 356)
		(5 329)
Effect		
Statement of financial performance as at 31 March 2018		
Revenue recorded in the incorrect period - MTEF	-	(2 544)
Revenue recorded in the incorrect period - Commercial Revenue	-	(35)
Depreciation/amortisation recorded in the incorrect period	-	514
Work in progress captured as an expense	-	(286)
Adjustment to depreciation/amortisation as a result of change in estimated useful life of property and equipment	-	(3 356)
Reallocation of expenditure erroneously capitalised	-	378
Effect		
Statement of financial position as at 31 March 2018		
Government Grant Project Related Revenue Recognise - Deferred income	-	2 544
Commercial Revenue -Deferred income	-	35
Work in progress not provided for - Payables	-	(2 257)
Work in progress not provided for - Property & Equipment	-	776
Capitalisation of technical asset	-	1 481
Accumulated depreciation/amortisation recorded in the incorrect period	-	(514)
Work in progress captured as an expense	-	286
Adjustment to accumulated depreciation/amortisation as a result of change in estimated useful life of property and equipment	-	3 356
Adjustment for asset capitalisation error	-	(378)
Statement of net assets for the period ended 31 March 2018		
Accumulated surpluses	-	5 329

25 Change in accounting estimate

The useful lives and residual values of property and equipment was reassessed. This resulted in change of estimated remaining lives of certain assets in categories listed below:

	Old	New
Motor Vehicles	5 - 8 years	5 - 9 years
Equipment	5 - 7 years	5 - 8 years
Office furniture	20 years	20 - 21 years
Computer equipment	6 years	8 - 9 years
Computer software	2 - 5 years	2 - 6 years

The effect of the change in accounting estimate has resulted in depreciation amounting to R 2,096, 543 in 2018/2019.

Change in accounting estimate (continued)	2019 R'000	2018 R'000
The change of R1,259,338 will be reflected in future periods.		
Due to the change in accounting estimate regarding the useful life of assets, the depreciation expense is reported at	23 178	-
Equipment	15 830	-
Office furniture	674	-
Motor vehicles	3 137	-
Computer equipment	2 218	-
Computer software	1 320	-
Depreciation expense using the previous rates would have been reported at	21 082	-
Equipment	14 617	-
Office furniture	671	-
Motor vehicles	2 863	-
Computer equipment	1 889	-
Computer software	1 042	-
Difference	2 096	-
Equipment	1 213	-
Office furniture	3,29	-
Motor vehicles	274	-
Computer equipment	329	-
Computer software	278	-

	2019 R'000	2018 R'000

26 Heritage assets disclosure

GRAP 103 defines heritage assets as assets which have a cultural, environmental, historical, natural, scientific technological or artistic significance and are held indefinitely for the benefit of present and future generations.

Certain heritage assets are described as inalienable items thus assets which are retained indefinitely and cannot be disposed of without consent as required by law or otherwise.

Nature
The Council for Geoscience has the following different classes of heritage:

- Gemstone collections	1 445	1 445
- Meteorite collections	2 804	2 804
- Mineral collections	13 313	13 313
Take on value	13 313	13 313
	17 562	17 562

The heritage assets were at initial recognition valued at fair value using evaluators with the following credentials :

Fossils	- Professor for Paleontological Research, University of the Witwatersrand
Mineral collections	- M.Sc. Geology and Professor and Chairman of the Department of Geology, University of the Witwatersrand
Meteorite collections	- Author of "Meteorites", Private collector of meteorites
Gemstones	- M.Sc. Geology

Various valuation methods were used taking into account the different types of heritage assets held by the Council for Geoscience.
The valuations reports are held at the Council for Geoscience offices and are available for inspection.
The Palaeontological (fossil) assets have no monetary value as legislation does not permit the purchase or sale of fossils.
(National Heritage Resources Act 1999 par 35(4)(c).
The Council for Geoscience is in possession of old scientific equipment only for display purposes. This equipment does not carry any value.

Contact information

Pretoria
280 Pretoria Street,
Silverton, Pretoria

Private Bag X112,
Pretoria, 0001,
South Africa

Tel: +27 (0)12 841 1911
Fax: +27 (0)12 841 1221
e-mail: info@geoscience.org.za
website: www.geoscience.org.za

Bellville
3 Oos Street, Bellville,
South Africa

PO Box 572,
Bellville, 7535,
South Africa

Tel: +27 (0)21 943 6700
Fax: +27 (0)21 946 4190
e-mail: info@geoscience.org.za
website: www.geoscience.org.za

Pietermaritzburg
139 Jabu Ndlovu Street,
Pietermaritzburg, South Africa

PO Box 900,
Pietermaritzburg, 3200,
South Africa

Tel: +27 (0)33 345 6265/6
Fax: +27 (0)86 675 6880
e-mail: info@geoscience.org.za
website: www.geoscience.org.za

Polokwane
30A Schoeman Street,
Polokwane, South Africa

PO Box 620,
Polokwane, 0700,
South Africa

Tel: +27 (0)15 295 3471
Fax: +27 (0)15 295 2826
E-mail: info@geoscience.org.za
website: www.geoscience.org.za

Port Elizabeth
16 2nd Avenue,
Walmer, Port Elizabeth

PO Box 5347,
Walmer, 6065,
South Africa

Tel: +27 (0)41 581 1164/1128
Fax: +27 (0)41 581 1165
e-mail: info@geoscience.org.za
website: www.geoscience.org.za

Upington
24 Josling Street,
Upington, South Africa

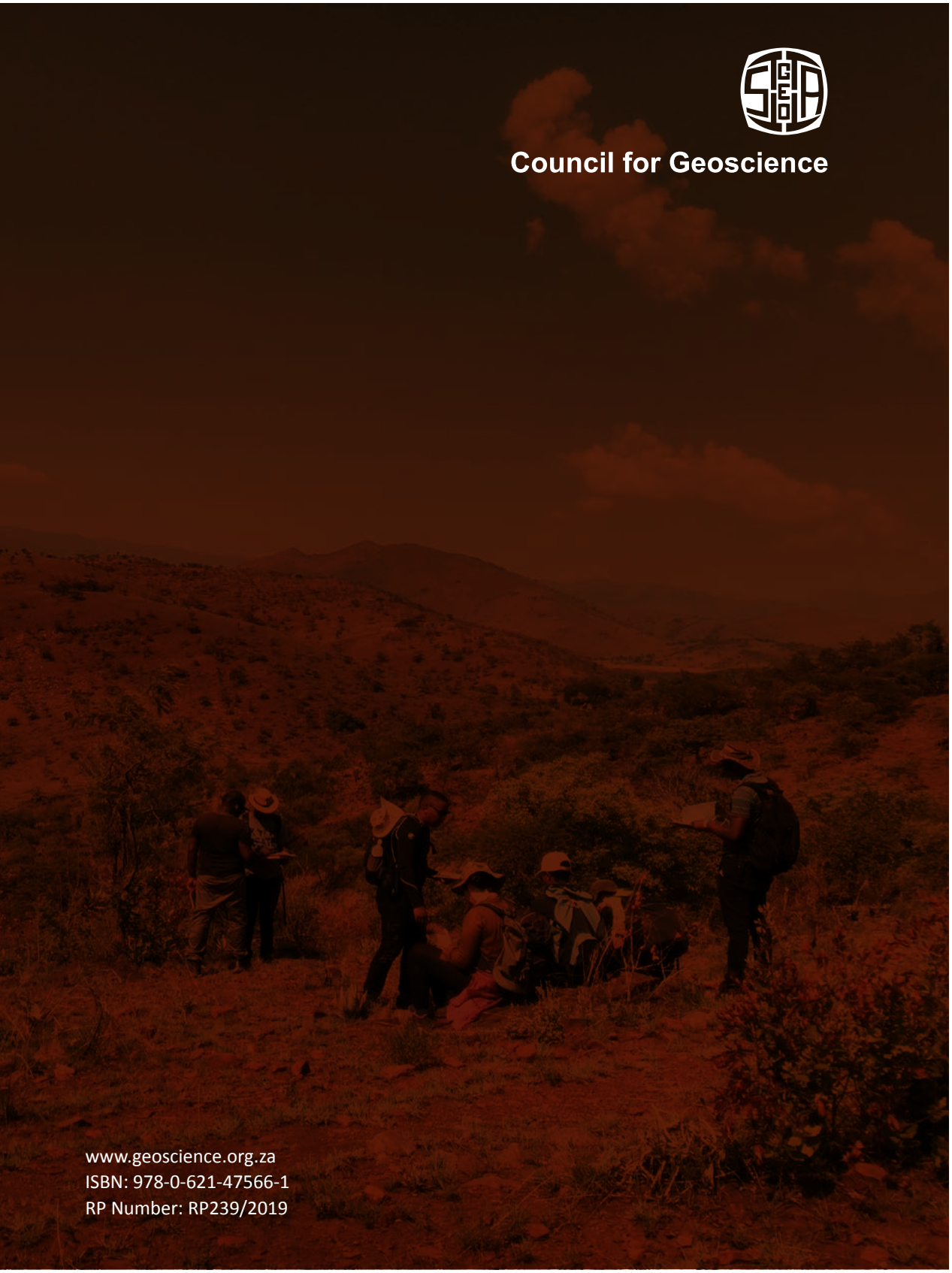
PO Box 775,
Upington, 8800,
South Africa

Tel: +27 (0)54 332 1403
Fax: +27 (0)54 332 3961
e-mail: info@geoscience.org.za
website: www.geoscience.org.za

www.geoscience.org.za
ISBN: 978-0-621-47566-1
RP Number: RP239/2019

NOTES

Council for Geoscience



www.geoscience.org.za
ISBN: 978-0-621-47566-1
RP Number: RP239/2019