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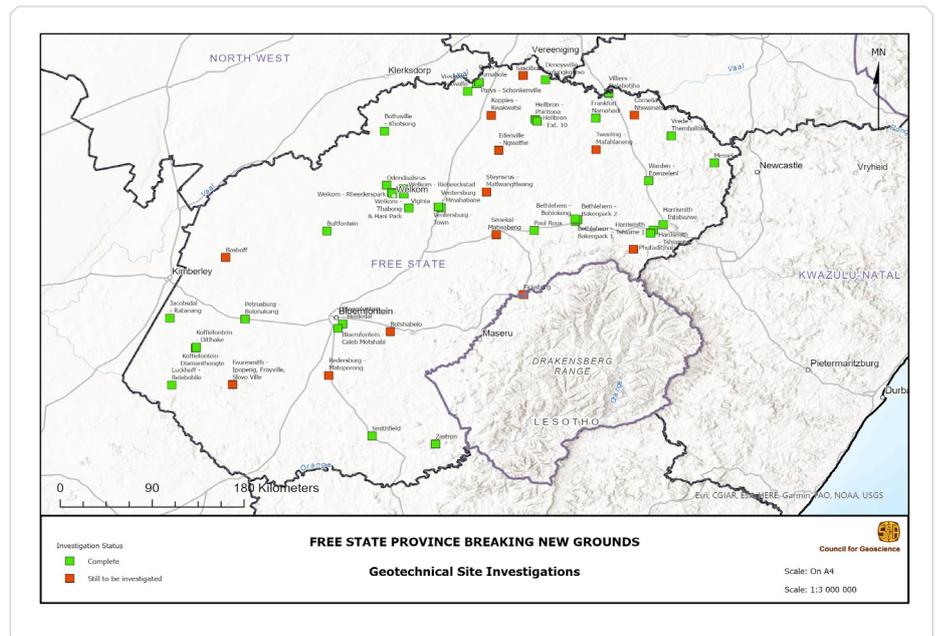
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Geoscience contributions to infrastructure development, land use optimisation and community safety



Spatial extent of the sites where detailed geotechnical site investigations are being undertaken across the Free State Province.

Introduction

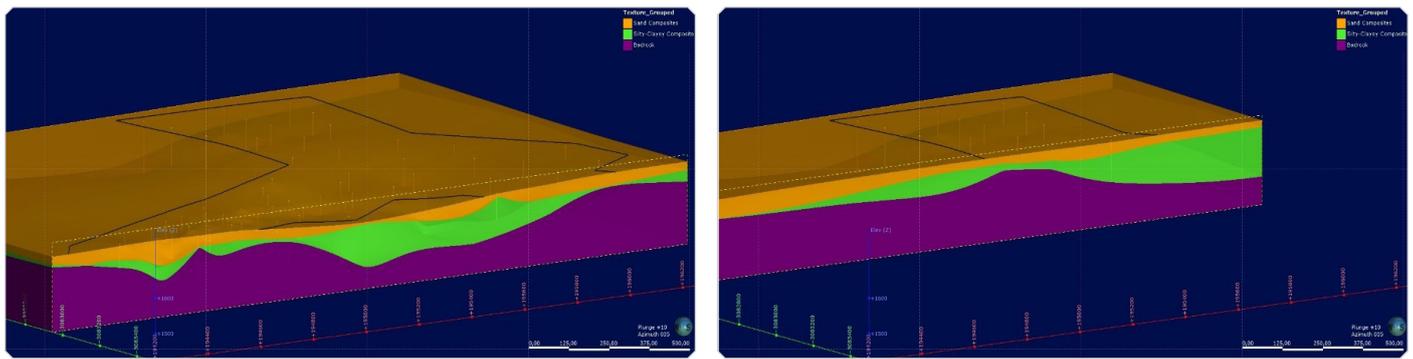
With infrastructure development as one of the cornerstones of South Africa's National Economic Recovery and Reconstruction Programme, the efforts of the Infrastructure and Land Use Unit of the CGS focus on providing geoscientific contributions in support of this national imperative. Recently, this work found expression through the tactical alignment

of our Geoscience Technical Programme with commercial collaborations with other organs of State.

Over the last three years, the CGS been focussing on key projects with a view to contributing to a prosperous and transformed society enabled by geoscience solutions – especially in the Infrastructure and Land Use thematic area. The intention of these projects is



Photographs of various geotechnical site investigation activities and exposed profiles during fieldwork. **Top:** TLB excavation of an exploratory hole in progress. **Top and middle left and right photos:** transported fine colluvium (hillwash) overlying interbedded sandstone-mudrock bedrock. **Bottom photo:** imported fill, overlying fine alluvium and residually weathered sandstone.



Leapfrog Geo 3D models (vertically exaggerated) indicating subsoil/bedrock variability (based on textural composition) across the Warden area.

Table: Summarised soil mechanical properties of materials obtained from the Warden region.

Profile No.	Depth (m)	Material description	Material Grading Material (%)				Atterberg Limits (%)			% Passing 0,425 mm	Grading Modulus (GM)	Potential expansiveness	Modified Aashto		CBR Values Compaction MDD (%)					Classification			pH Value	Conductivity (S.m ⁻¹)	
			Clay (%)	Silt (%)	Sand (%)	Gravel (%)	LL	PI	LS				MDD (kg/m ³)	OMC	90	93	95	100	Swell (%)	Unified soil classification (USCS)	H.R.B	COLTO / TRM 14			
Ferrogised Reworked Residual Shale																									
WTP6	0,30-0,70	sandy Clay	22	23	55	0	35	21	10,7	85	0,62	MEDIUM	-	-	-	-	-	-	-	-	CL	A-6	-	-	-
WTP5	0,40-0,65	sandy Clay	26,6	23,9	49,6	0	37	21	9,9	75	0,76	LOW	-	-	-	-	-	-	-	-	CL	A-6	-	-	-
Ferrogised Residual shale																									
WTP1	0,40-0,90	sandy Clay	30,7	26,9	42,4	0	30	9	4,2	83	0,69	LOW	-	-	-	-	-	-	-	-	CL	A-4	-	8,1	0,016
WTP4	0,50-1,20	sandy Clay	33	18,9	48,1	0	30	10	4,6	63	1,31	LOW	1888	11,7	5	8	11	15	0,28	CL	A-4	GS	-	-	-
WTP5	0,30-0,80	silly Sand	21,3	30,1	48,6	0	-	NP	0	59	1,51	LOW	-	-	-	-	-	-	-	-	SM	A-2-4	-	-	-
WTP8	0,30-1,00	sandy Clay	30,9	19,3	49,7	0,1	30	12	5,2	69	1,18	LOW	1889	12,6	2	4	6	10	0,33	CL	A-6	G10	-	-	-
Residual shale																									
WTP17	0,60-0,90	sandy Clay	23,3	7,8	68,9	0	53	26	10,6	58	1,2	MEDIUM	-	-	-	-	-	-	-	-	CL	A-7-5	-	-	-
WTP28	0,40-0,70	sandy Clay	45,7	13,7	40,6	0	38	22	11	83	0,51	LOW	-	-	-	-	-	-	-	-	CL	A-6	-	-	-
WTP38	0,50-0,80	sandy Clay	30,8	12,9	56,4	0	22	9	3	94	0,66	LOW	-	-	-	-	-	-	-	-	CL	A-4	-	-	-
WTP6	0,45-0,70	sandy Sil	53,4	18,5	28,2	0	50	21	8,9	92	0,31	LOW	-	-	-	-	-	-	-	-	ML	A-7-6	-	8,3	0,032
WTP11	0,50-0,80	sandy silty Clay	19,5	16,7	63,9	0	24	5	2	89	0,4	LOW	-	-	-	-	-	-	-	-	CL-ML	A-4	-	-	-
WTP1	0,90-1,60	sandy Clay	51,8	21,9	26,3	0	37	17	7,5	100	0,11	LOW	-	-	-	-	-	-	-	-	CL	A-6	-	-	-
WTP1	0,70-1,00	sandy Clay	38	17,7	44,2	0,1	37	22	11,1	66	1,16	LOW	-	-	-	-	-	-	-	-	CL	A-6	-	-	-
WTP4	1,00-1,50	sandy Clay	49,9	15,4	34,6	0,1	33	18	9,1	76	0,89	LOW	-	-	-	-	-	-	-	-	CL	A-6	-	7,8	0,069
WTP5	0,65-1,00	sandy Clay	49,8	16,6	33,6	0	29	11	5,6	43	1,83	LOW	-	-	-	-	-	-	-	-	CL	A-2-6	-	7,3	0,017

to derisk new developments, to assist with strategic land use planning and optimisation, and to inform disaster management and preparedness. Ultimately, the CGS aims to provide a scientific basis for infrastructure development decision making and development. Some highlights of the geotechnical work undertaken in the Free State Province since 2019 are highlighted below.

Background

The CGS concluded a collaborative agreement with the Free State Department of Human Settlements during 2019 to provide geotechnical investigation services in support of the Breaking New Grounds housing development programme in the Province. As part of this work, the CGS engineering geology team is undertaking detailed geotechnical site investigations in support of the design and construction

of low-cost housing and bulk municipal infrastructure across 54 towns in the province. This work is scheduled to be completed by March 2023.

Approach

The geotechnical investigation, aligned with the prevailing national standards and industry guidelines to support the design and construction of housing projects, will undertake the following:

- To assess the geological character of the areas where the sites are located;
- To determine and describe the different successions of soil and rock materials underlying the study area by means of trenching;
- To assess the geomechanical properties of the soil layers deemed to have an effect on residential development by undertaking laboratory analysis;
- To classify the sites according to

National Home Builders Registration Council (NHBRC) guidelines;

- To provide foundation recommendations for the proposed housing developments;
- To comment on geotechnical factors that may impact the development of the sites.

New methodologies will be deployed to assist with development potential zonation. These include 3D geological modelling, comparisons and updating of methodologies to assess heave potential and, ultimately, the integration of all collected data into a regional engineering geological model of the Free State Province in the next few years.

Results

To date, the project team has investigated 40 sites, covering 12 700 hectares, at a design-and-construction level. In total, 2 790 exploratory holes have

been excavated (typically up to 3 m deep) by means of a TLB-type light mechanical excavator and logged in detail, and 976 material samples have been submitted for detailed geotechnical laboratory analysis.

The CGS team is undertaking classifications of inferred adverse soil mechanical behaviour that can impact foundations, problematic environmental

considerations that may influence the structural integrity of infrastructure, construction practices and potential geohazards. This work typically entails identifying problem soils, areas prone to flooding and shallow groundwater seepage, excavatability constraints affecting the installation of bulk services and foundation trenches and areas of imported fill and made ground, for example.

Typical results, from a selection of areas investigated over the past three years, are presented above.

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PanAfGeo-2 project: strengthening geological surveys in Africa through geoscientific training

PanAfGeo-2 (2021–2024) is a continuation of the successful PanAfGeo-1 project, which took place from 2016–2019. The project comprised 42 training sessions for 1 068 geoscientists from 49 African countries, and generated notable impacts at an institutional and technical capacity level on the African continent. PanAfGeo2 aims to strengthen African geological surveys by developing innovative geoscientific training programmes in partnership with the Organisation of African Geological Surveys (OAGS).

The PanAfGeo-2 project online kick-off meeting took place on 25 and 26 November 2021. The event attracted about 70 representatives from nearly 50 African and European countries.

Participants included representatives of various African geological surveys (e.g. Chad, Cameroon, Djibouti, Ethiopia, Ghana, Malawi, Morocco, Namibia and South Africa) and European organisations, the African Union Commission, the European Union, the United Nations Educational, Scientific and Cultural Organisation (UNESCO), and the Minerals Africa Development Institution (MADI).

The PanAfGeo-2 project comprises eight work packages (WP). These are WP-A: geoscientific mapping, WP-B: mineral resources assessment, WP-C: artisanal and small-scale mining, WP-D: new frontiers in geosciences (geoheritage and geothermal energy), WP-E: geohazards and the environmental management of mines,



PanAfGeo-2 attendees in Pointe-Noire, Democratic Republic of Congo.



PanAfGeo-2 attendees in Lobatse, Botswana.



(a) Dr David Khoza presenting during the PanAfGeo-2 special session at the Mining Indaba 2022. (b) PanAfGeo-2 booth at the Mining Indaba 2022.



Attendees of the Pan AfGeo-2 special session at the Mining Indaba 2022.

WP-F: geo-resources governance and OAGS/GSOs institutional strengthening, WP-G: geoscientific information management and WP-H: communication, dissemination and dialogue.

The project aims to host 40 training sessions and ten workshops throughout its four-year project lifecycle. Since the kick-off meeting, a number of scientific training sessions have already been conducted. These have included training on geohazards and the environmental management of mines (WP-E) in Cameroon from 3–9 April 2022, a geoheritage training session (WP-D) in the Republic of Congo from 13–8 June 2022, geoscientific information management (WP-G) training held in



OAGS and PanAfGeo-2 team with the African Union Commissioner for Economic Development, Trade, Tourism and Minerals, His Excellency, Ambassador Albert Muchanga of Zambia.



From left to right : Dr Jean-Claude Guillaneau (BRGM), Dr Rokhaya Samba Diene (OAGS President), Prof. Ezzoura Errami (AAWG President), Krishnan Subramani Ramakrishnan (EuroGeosurveys), Céline Andrien (EuroGeoSurveys), Dr Julie Hollis (General Secretary, EuroGeoSurveys), Ms Ndivhuwo Cecilia Mukosi (CGS and OAGS representative), and Dr Ozlem Adiyaman Lopes (UNESCO Senior Programme Manager) posing with the PanAfGeo-2 banner during the EGS 50th Anniversary Conference in Brussels.

Botswana from 12–23 September 2022, and a WPG2-PT training session titled “Gestão de Informação Geocientífica” (Management of geoscientific information) dedicated to GIS and databases. The session was held in São Tomé from 7–18 November 2022.

To increase the visibility of PanAfGeo-2, the team and representatives from member countries of the OAGS attended the Mining Indaba in Cape Town in May 2022 where they hosted a special session, aimed at fostering collaborations and partnerships between the European Union and Africa. In June

2022, the PanAfGeo team accompanied the EuroGeoSurveys (EGS) team to the Prospectors and Developers Association of Canada (PDAC) event in Canada.

In July 2022, the PanAfGeo-2 team, led by Dr David Khoza and Ms Céline Andrien, met with the African Union Commissioner for Economic Development, Trade, Tourism and Minerals, His Excellency, Ambassador Albert Muchanga of Zambia for a joint European Union–Africa meeting, with a view to accelerating collaborations between the two entities.

In October 2022, the PanAfGeo-2 and OAGS team, led by Dr Rokhaya Samba Diene (OAGS President) attended the EuroGeoSurveys 50th Anniversary Conference and Director’s workshop held in Brussels, Belgium.

PanAfGeo-2 is currently running a #PanAfGeo photography competition. The theme of the competition is **“What does the PanAfGeo project mean to you?”**. Entrants are invited to deliberate on how PanAfGeo is likely to benefit them, their geological survey, their society and their country. Ten finalists will see their photo printed in high resolution, framed and exhibited during the final meeting of the project in 2024. Winners will be announced during that meeting and on the PanAfGeo website and social media platforms. Interested geoscientists can enter the competition by submitting an application to Ms Céline Andrien at celine.andrien@eurogeosurveys.org, and copying tracey@dancyenergy.com.

More information regarding upcoming geoscientific training can be found on the PanAfGeo website at <https://panafgeo.eurogeosurveys.org/> or on social media platforms (LinkedIn — PanAfGeo Project Phase 2; Twitter: @PanAfGeo; Facebook — PanAfGeo).

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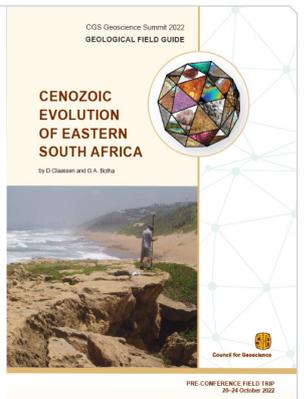
Showcasing South Africa's geology

CGS Summit field trips to celebrate 110 years of rich institutional knowledge

In celebration of 110 years of geoscience excellence, the CGS showcased some of South Africa's most unique and interesting geology by leading three geo-educational field trips to highlight aspects of the CGS's current geoscientific programme. The excursions, expertly led by CGS staff, were part of the CGS Geoscience Summit held in

late October 2022. The field trips were attended by postgraduate students from various universities (NMMU, FHU, UV and Wits), CGS managers, executives and Board members. The first of the three field trips entailed a five-day pre-Summit field trip led by Ms Debbie Claassen, Dr Greg Botha and Dr Thomas Muedi. Attendees explored the Cenozoic landscape evolution of the Eastern Cape and KwaZulu-Natal Provinces by visiting 23 sites to view deposits of aeolian, marine and

fluvial origin and prominent landscape surfaces and geomorphological features. Several stops were made in and around Gqeberha to investigate transgressive and regressive deposits of the Algoa Group. In the vicinity of Addo, the lower Sundays River Valley provided an excellent opportunity to observe the best-preserved succession of strath fluvial terraces in southern Africa. In the vicinity of Mthatha, the accretion and erosion of hillslope deposits associated with the Late Quaternary Masotcheni



Cenozoic Evolution of Eastern South Africa



Landslides in the eThekweni Municipality (KZN)



FIELD TRIPS
Council for Geoscience

These field trips will follow a path along key focus areas within the current programme of the Council for Geoscience. Participants will be able to join some of the Council for Geoscience scientists as they unpack some recent findings and elusive questions that remain.

A PRE-SUMMIT CONFERENCE FIELD TRIP will be held from 27-28 October around the eThekweni Municipality, near Port Shepstone. The field trip will focus on the geomorphological and geological context of landlides. The field trip will showcase a fine example of recent landlides that have transpired in the eThekweni region during the high-intensity rainfall event of April 2022. The results will be shared with participants that occurred in various material types, beginning at the base of the slope and moving up the slope. Where a slope failure transpired in an area oriented to the west, the results will be shared with participants. The results will be shared with participants. The results will be shared with participants.

ANOTHER PRE-SUMMIT CONFERENCE FIELD TRIP will be held from 27 October to 22 November and will journey through geological time and investigate the formation and evolution of the Kaapvaal Craton. The evolution of the Kaapvaal Craton will feature various features linked to the formation and geodynamic evolution of the Kaapvaal Craton. The trip will begin in the vicinity of the Kaapvaal Craton. The trip will begin in the vicinity of the Kaapvaal Craton. The trip will begin in the vicinity of the Kaapvaal Craton.

A FIELD TRIP TO THE MOUNTAIN PASS will be held from 23-24 October. The field trip will focus on the geological and geomorphological context of the Mountain Pass. The field trip will focus on the geological and geomorphological context of the Mountain Pass. The field trip will focus on the geological and geomorphological context of the Mountain Pass.

A FIELD TRIP TO THE MOUNTAIN PASS will be held from 23-24 October. The field trip will focus on the geological and geomorphological context of the Mountain Pass. The field trip will focus on the geological and geomorphological context of the Mountain Pass. The field trip will focus on the geological and geomorphological context of the Mountain Pass.

PLEASE RSVP BY 07 October 2022

For more information: www.geoscience.org.za/ Tel: 011 811 1811

Journey across the Kaapvaal Craton



Figures: (a and b) Exposures of the Quaternary Sainova Formation at Hougham Park Beach and Brighton Beach near Gqeberha. **(c)** View from the right flank of a landslide that had displaced a church building and its surrounds approximately 30 m downslope, in Umgababa (photo by Mr Mbuyiseni Ngcobo). **(d)** View from the left flank of a slope failure that had transpired on the Amandlakhe Comprehensive Primary School property (photo by Mr Mbuyiseni Ngcobo). **(e)** Metasedimentary sequences of the Mesoarchaeon Mozaan Group **(f)** Massive pillow lavas of the Paleoarchaeon Komati Group.

Formation were explored at two large erosional gullies, including a 15 m deep donga, informally known as the Eastern Cape's "Little Grand Canyon". Towards Kokstad, the delegates visited two large palaeolandslides. In KwaZulu-Natal Province, "Red Desert" deposits, Late Cretaceous beach deposits at the Mtamvuna River mouth and various other Maputaland Group deposits highlighted the rich post-Karoo geology of area.

A post-Summit field trip led by Ms Rebekah Singh, Messrs Goodman Chiliza and Mawande Ncume focussed on the geomorphological and geological controls of landslides in the eThekweni region. This two-day field trip included visits to six landslides in different parts of the eThekweni Metropolitan Municipality. The field trip guides highlighted the devastating slope failures triggered during the high-intensity rainfall event of April 2022 and the havoc unleashed by landslides. This included human fatalities and injuries and damage to or destruction of residential homes, school property, roads, railway bridges and critical water infrastructure. The field trip guides emphasised the association

between landslide activity and various geological units (Natal Metamorphic Province granitoids, Natal Group sandstones, Vryheid Formation rocks and Cenozoic deposits). They explained that the landslides had taken place in sloping areas of different land use settings in the eThekweni municipal area.

A final post-Summit field trip was led by Dr Tafeeq Dhansay, Dr Nigel Hicks, Mr Neo Moabi and Ms Ndivhuwo Mukosi. The premise of this field trip was to undertake a journey from the Archaean to the Anthropocene and to expose the participants to a variety of field evidence highlighting how the early earth had formed and evolved. The trip began with the participants crossing the southern extent of the Kaapvaal Craton to investigate different tectonic features exposed within the Natal Belt. Several stops within the Pongola Supergroup highlighted how deposition atop the earliest stabilised fragment of continental crust had transpired. Further north, the delegates entered the Makhonjwa Mountains and spent several days investigating secular change through the Hadean

and Archaean. The guides emphasised the mineralisation of the area. They explained how precious metals such as gold and silver and various ferro-aluminous minerals had formed and evolved, and how South Africa's First Nations population had extracted and benefited these minerals. Finally, the delegates entered the Anthropocene era which led them to consider how long-term extractive processes have negatively affected the environment. Crucially, adequate mitigation scenarios to enable sustainable development across the extractive sectors were discussed in depth. Possible mitigation measures discussed were innovative remediation, coexistence and new technologies such as carbon capture, utilisation and storage.

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Digital Earth Africa launch



Is Digital Earth Africa just yet another remote sensing data downloading platform? Certainly not! Digital Earth Africa (DEA) is different because ready-to-use earth observation data in analysis-ready-data (ARD) format is available for information extraction and decision making on the African continent. The launch of Digital Earth Africa was marked by a celebratory event hosted on Tuesday 4 October 2022 at the South African Space Agency's (SANSA) head office at the Innovation Hub, Pretoria. Mr Mmboneni Muofhe, Deputy Director General of Technology Innovation (DSI), Ms Andiswa Mlisa, interim Chief Executive Officer of SANSA, Dr Adam Lewis, Senior Advisor to Digital Earth Africa, Dr Kenneth Mubea, Capacity Development Lead for Digital Earth Africa and various other members of the African earth observation community attended the event. A cocktail function



(a) Mr Mmboneni Muofhe, Deputy Director General of Technology Innovation (DSI). (b) Ms Andiswa Mlisa, interim CEO of SANSA. (c) Dr Adam Lewis. (d) Dr Kenneth Mubea.

and introductory speeches heralded the official opening of the offices. Delegates were encouraged to network and view the new offices.

The Digital Earth Africa TAC Strategic Meeting took place on 6 October at the Fire & Ice Protea Hotel in Menlyn, Pretoria. Here, further details about Digital Earth Africa were shared with a view to helping South African stakeholders understand the benefits of the platform. A demonstration was given on the various Digital Earth Africa platforms — the maps, the GeoPortal, and the Sandbox. The take-home points from this community engagement session were that vast amounts of earth observation imagery such as Sentinel-2 and Landsat are available in ARD format from the inception of the satellite to its dissemination through Amazon Web Services. The platform is user friendly (unlike the more difficult to use Google Earth Engine) and time series products over any area in Africa can be processed in an instant. The Africa Geoportal and Sandbox allow for custom processing and all code is visible, thereby eliminating the “black-box” creation of products. While these two platforms are available to subscribers only, the Digital Earth Africa map is freely available (<https://maps.digitalearth.africa/>).

DEA has touched the lives of Africans by eliminating specialised and time-consuming remote sensing data preparation processes. For example, the tool has successfully been used to demonstrate the importance of mangroves in Zanzibar where the State University of Zanzibar used DEA and collaborated with local communities to re-establish depleted mangroves and to communicate the advantages of mangroves for carbon storage and the prevention of floods.

So what does this mean for the CGS? Is the CGS responsible for adding geoscience layers to this platform? This task would certainly fall within the CGS mandate. And what is the significance of Digital Earth Africa for CGS scientists? Firstly, scientists are now readily able to view processed remote sensing imagery. The time series information is especially useful for environmental studies.



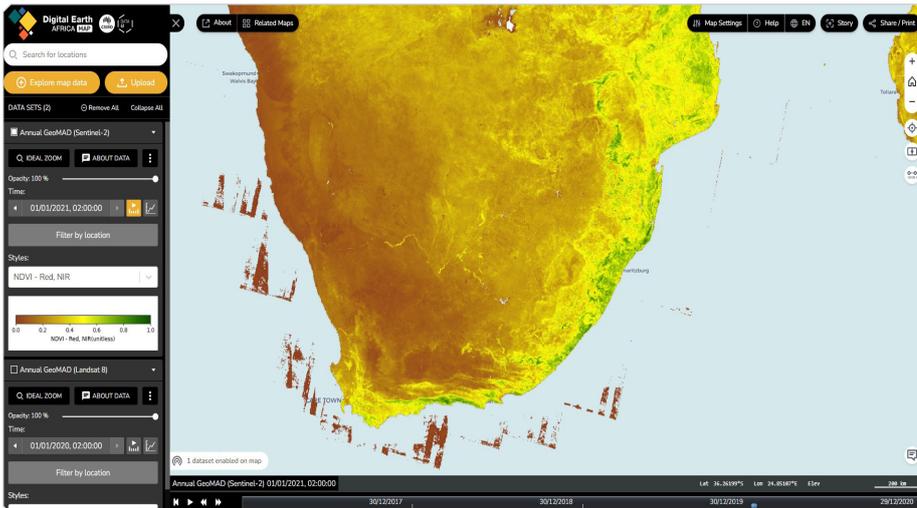
Ms Gabrielle Janse van Rensburg from the CGS with Ms Andiswa Mlisa, interim CEO of SANSA at the Digital Earth Africa office launch event.



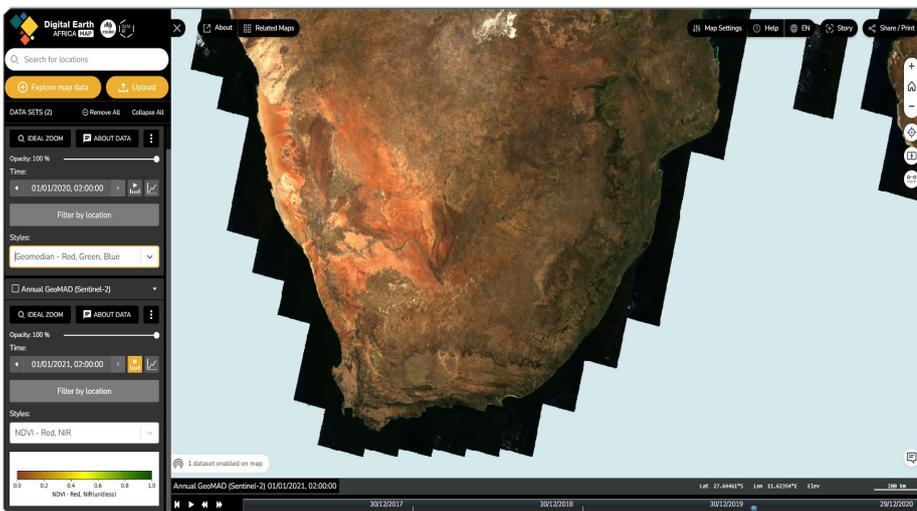
The new SANSA offices at the Innovation Hub in Pretoria.



Ms Gabrielle Janse van Rensburg at the Digital Earth Africa TAC Strategy Meeting.



Digital Earth Africa maps showing the Sentinel-2 normalised difference vegetation index over South Africa.



Digital Earth Africa maps showing Landsat's true colour over South Africa.

Secondly, DEA is a demonstrated platform for community involvement. Scientists are encouraged to use the tool to start exploring!

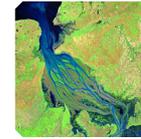
Resources



DE Africa Map

Our user friendly map-based access to DE Africa data and products

[MORE](#)



Sandbox

Access to data and analysis tools for technical users to explore ideas and develop reports

[MORE](#)



Africa GeoPortal

Imagery from DE Africa is available in Esri's Africa GeoPortal, providing geospatial tools, data and training

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Online training

Our 6-week training program is a self-paced online course that helps users work autonomously on our platform

[MORE](#)

Various Digital Earth Africa platforms.

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SASQUA Congress 2022: CGS's contribution to Quaternary research in South Africa

The Southern African Society for Quaternary Research (SASQUA) held its 23rd Biennial Congress at St Lucia in KwaZulu-Natal between 25 and 30 September 2022. The congress focussed on southern African climates and environments in a changing world: a view from the Quaternary. Scientists from the CGS showcased a wide variety of research projects through poster and oral presentations. These presentations intend to advance Quaternary science by supporting effective environmental management, geohazard identification and deciphering palaeo-environmental archives in

South Africa. In a poster presentation, Ms Rebekah Singh highlighted some findings of the recent landslide mapping conducted in the eThekweni region, KwaZulu-Natal Province. A poster presentation by Ms Debbie Claassen shared results on the integrated drivers of recent rates of gully expansion in the Eastern Cape. Dr Hayley Cawthra gave a plenary talk on the ancient human use of coasts and seascapes in Mpondoland. She also presented an informative oral presentation on the submerged palaeolandscapes of the southern hemisphere. Two poster presentations and a talk by Dr Greg

Botha presented an overview of a set of 18 new lithostratigraphic geological maps covering the Maputland region, a reinterpretation of the Cenozoic lithostratigraphy of the Maputland coastal plain and a description of the Pleistocene dune-dammed palaeolake and palustrine deposits in the southern Kalahari region. Dr Botha also led the mid-congress educational field excursion to the Eastern and Western Shores Reserve, iSimangaliso Wetland Park. This field excursion provided congress delegates with the opportunity to admire Cenozoic sediments and landscape development.



(a) Dr Greg Botha leading the mid-congress educational field excursion during the SASQUA Congress with (b) CGS staff in attendance.

SASQUA members thanked three CGS staff members for their service from 2019–2022. Dr Hayley Cawthra

had served as Vice President, Dr Greg Botha had served as President and Ms Rebekah Singh had served as Treasurer of SASQUA. Dr Hayley Cawthra is the current SASQUA President and will serve in this leadership role until 2024.

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International Mine Water Association (IMWA) conference: Christchurch, New Zealand

The International Mine Water Association (IMWA) is a scientific-technical association, established in 1979 to assist in finding mine water-related solutions. The association comprises members with different skills, backgrounds and expertise, who share a common interest in mine water and mine drainage issues. The members are made up of mining engineers, consultants, specialists, decision makers, regulators, scientists and academic researchers.

The IMWA conference took place from 06–10 November 2022 in Christchurch, New Zealand, under the theme “Reconnect”. Six delegates represented the CGS. They were Mr Robert Netshitungulwana, Ms Selaelo Ramugondo, Ms Lufuno Ligavha-Mbelengwa, Ms Sisanda Gcasamba, Ms Pamela Nolakana and Mr Rudzani Lusunzi. The conference consisted of 15 sessions, with talks focussing on broad mine water management themes. Scientists and engineers across the world showcased leading-edge research

and the deployment of innovative passive and *in situ* mine water treatment technologies, waste rock and tailings storage solutions, world-class surface water and groundwater prediction and monitoring technologies and innovative geochemistry.

At the IMWA conference, the CGS scientists were introduced to new mine water ingress prevention, treatment and management methods and technologies. The new insights and knowledge gained will be useful in enhancing ongoing work at the CGS. In particular, the mine and environmental water management programme will benefit the passive treatment of polluted mine water and ingress control of water into mine voids through the application of new and improved solutions in South Africa.

Delegates from the CGS shared some of the ongoing mine water management work undertaken at the CGS and discussed various methods and technologies currently being

implemented. The talks included discussions on *in situ* mine water treatment technology using waste concrete to treat mine influenced water and successes in upgrading the Van Ryn Canal as an ingress control measure to reduce water ingress. The focus is shifting from active mine water treatment to passive treatment in the Witwatersrand goldfields and to the geochemical characterisation and modelling of mine wastes and stream sediments along the Sabie River system and in the Witbank coalfields. As part of the conference procedure, papers were also prepared, to be published under the conference proceedings volume.

One of the highlights of the conference was a talk that stressed the importance of understanding the system of a flooded mine before undertaking any investigations into or predictions of mine water quality changes. Understanding the system is useful in deciding when to change from active to passive treatment. This talk was relevant to the ongoing

discussions on implementing passive treatment methods in the Witwatersrand goldfields in the Mine Environment and Water Management Programme. The outcomes from this research will serve as a solid basis on future best practices for large affected mine water systems such as the Witwatersrand goldfields. In addition, another talk discussed passive treatment of acid mine drainage using a full-scale up-flow mussel shell reactor. This study showed that mussels, as one of New Zealand's largest exports, leave vast amounts of shells as a waste product. It was proposed that these shells should be applied to treat mine-influenced water due to their high calcite composition. This presentation on how to use waste products effectively is similar to the current feasibility study being undertaken at the CGS into *in situ* mine water treatment of flooded underground mines using waste concrete.

A platform such as the IMWA conference is important to the CGS, as one of



The CGS delegates at the IMWA conference. Left to right, Ms Selaelo Ramugondo, Ms Lufuno Ligavha-Mbelengwa, Mr Robert Netshitungulwana, Mr Rudzani Lusunzi, Ms Sisanda Gcasamba and Ms Pamela Nolakana.

the organisation's projects focusses on managing mine-polluted water by protecting clean water from contamination and treating water that has already been contaminated.

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Moves to wellness

As part of creating a happy and healthy workforce, the CGS Bellville and Uppington offices held their wellness event on 15 and 16 November 2022.

Organised across the organisation by Human Resources and the Communication and Stakeholder Relations Units in partnership with Life Health Care, the wellness event takes place annually, giving colleagues an opportunity to interact through team-building activities. The event focusses

on fostering a healthy lifestyle by encouraging staff to adopt healthy physical and social habits. Colleagues also have the opportunity to experience a change of scenery from the office setup.

On 15 November, staff participated in activities that bring meaning to their lives while enhancing their health. Faiez Abrahams gave a presentation on stress and achieving a work-life balance while Health and Safety professionals

gave a presentation on cancer awareness. Also included were blood pressure monitoring and voluntary HIV testing, BMI/waist screening. Day 2 involved entertainment and games offsite at the Oakdale Club in Bellville. CGS staff played bowls, did stretching exercises to improve suppleness, danced the Jerusalem, participated in egg racing, took selfies in a photo booth and showed off their fitness at performing jumping jacks and playing "voetjie".



Colleagues showing their competitive side, participating in a sack race. Far left: Chiedza Musekiwa, Louis Jonk, Zine Masoka, Nqobile Manyaki, Hayley Cawthra and Avril Johnson.



CGS Bellville and Upington office staff. Back row, from left to right, Liesl Adams, Cynthia Yanta, Chiedza Musekiwa, Edowe Domingo, Mdumiseni Mazibuko, Louis Jonk, Lebogang Nhleko, Nkosixolile Nobangula, Wahiebah Daniels, Takalani Sikhapha, Nokuthula Boozi, Talicia Pillay and Khululekile Isaac. Front row, from left to right, Nqobile Manyaki, Zine Masoka, Phakama Magele, Hayley Cawthra, Samukelisiwe Mtshali, Avril Johnson, Bulelani Busakwe, followed by Eloise Ely and Haajierah Mosavel in front.



CGS dance crew doing the Jerusalema dance challenge.



Colleagues loosening some joints.

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CGS palaeontology collections team: leaving no fossil unturned

During the second half of 2022, the CGS palaeontology collections team has been involved in showcasing the illustrious fossil heritage of South Africa curated by the CGS at two events. These were the 21st Biennial Meeting of the Palaeontological Society of South Africa held at the iconic Golden Gate National Park (12–15 September) and the CGS Geoscience Summit held at the Durban International Convention Centre (25–27 October). The team presented papers that looked back at

our deep time heritage, and in doing so, revealed the important contribution of the CGS and its provincial precursors over the past 125 years in creating an understanding of the critical role of the South African record in terms of the evolution of life over the past 3.6 billion years. Other than the role of these fossils in helping us to understand our origins, the team also demonstrated their historical importance in coal, oil and gas exploration and in uranium research. Therefore, these

fossils are still useful to us in the present day to bolster the country's economic development.

In addition to this historic overview of the CGS collections, the team presented papers on work currently being undertaken to take stock of our expansive and diverse collections, ranging from fossil pollen, animals, plants and trace fossils and to create integrated relational databases. This work will ensure that the CGS



The CGS palaeontology collections team in action. A – Ms Samukelisiwe Mtshali, Mr Louis Jonk and Dr Cameron Penn-Clarke. B – Dr Penn-Clarke presenting on the history and importance of palaeontology at the CGS at the Geoscience Summit. C – Ms Mtshali presenting her poster on the creation of policy documentation pertaining to fossil collections at the CGS. D – Mr Jonk presenting his poster on the creation of an integrated relational database for palaeontological collections at the CGS.



Visit by the Strategic Management Office to the CGS to the palaeontology collections at the Bellville office. **A** – Ms Samukelisiwe Mtshali taking a photograph of a fossil specimen. **B** – The CGS palaeontology collections team: Mr Louis Jonk, Ms Samukelisiwe Mtshali and Dr Cameron Penn-Clarke, with the manager of the SMO, Dr Valerie Nxumalo (second from right). **C** – Mr Louis Jonk generating a query on the CGS palaeontology collections database. **D** – Stills of a 3D photogrammetry rendering of a trilobite fossil, *Ormistonella*, generated in-house by the team, showing the specimen being virtually separated from shale.

achieves and maintains its mandate as the custodian of all geoscientific information in South Africa while enabling geoscientific research and ensuring the continued safeguarding

of South Africa’s palaeontological heritage for future generations. The support for this work by the broader palaeontology community has been overwhelming. Our peers are excited

to learn what material is available for research. Potential collaborative research was discussed in terms of fossil preparation and curation, data interrogation, use of hyperspectral

imaging for fossil exploration, and 3D photogrammetry scanning.

The CGS team further presented research which showcased the power of the integrated relational databases that we have created. Here, a subset of the collection metadata from the Devonian Period was interrogated using intensive data-mining techniques to search for spatial and temporal clusters in past fossil diversity to create biostratigraphic and biogeographic frameworks. These patterns, when related to additional sedimentological and stratigraphic data, have allowed us to pinpoint a past

intense stepped extinction event from the Devonian of South Africa, that had previously been unknown.

The team hosted the CGS Strategic Management Office (SMO) at the Bellville office during the first week of November to assess the importance of this geoscience collection repository through effective knowledge management. Here, the team showed the SMO the curation efforts that are currently underway on this collections subset, the use of 3D photogrammetry to create interactive virtual models of fossils and the use of the integrated

relational database for research. This visit by the SMO, as well as the presentation of the work undertaken by the CGS team helps to improve public awareness of the CGS brand, services and products and will continue from strength to strength.

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Reverse circulation drilling of the mineral targets in the Giyani area in response to the government's post-COVID-19 economic reconstruction recovery plan

The Giyani mapping project forms part of the Geoscience Technical Programme of the CGS and covers an

area spanning approximately 2 800 km² in the vicinity of Giyani in northeastern Limpopo Province. The objectives of the

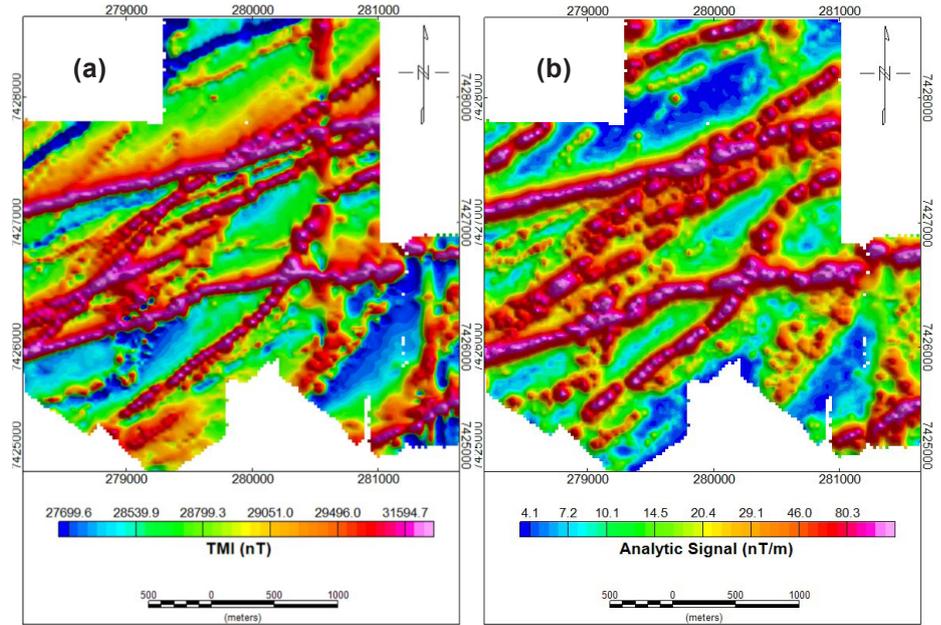
project are to support economic growth, address water security and promote environmental stewardship through



Field exposures: (a) Crenulated tremolite-actinolite schist. (b) S1 foliation cut by S2 fine crenulation. (c) Folded banded iron formation outcrop. (d) Gossan outcrop.

an integrated approach that covers multidisciplinary tasks (i.e. detailed geological and structural mapping of mineral targets, high-density soil geochemical investigations, geophysical surveys, environmental and groundwater studies). Fundamentally, the project harnesses geoscientific research into Archaean rocks (dating back over 3 billion years) to understand the tectonic setting and structural controls of mineralisation with a view to addressing current societal challenges in the area through hydrogeological, environmental and geotechnical studies.

One of the tasks in the 2021/22 financial year was to drill previously generated promising mineral targets. In order to increase the level of confidence within the target area, detailed geological and structural mapping on a scale of 1:10 000, a high-resolution ground magnetic survey, a three-dimensional magnetotelluric survey and an induced polarisation survey were undertaken to generate localised mineral targets. A preliminary structural and geophysical survey revealed the predominance of east-northeast-, north-south- and northwest-trending structures. The latter structures appear to be associated with gold mineralisation in the area. Banded iron formation and ultramafic rocks were identified as ideal hosts or trap lithologies for gold mineralisation.



(a) Total magnetic intensity (TMI) map of the survey mineral target area. (b) Analytic signal of the TMI of the survey area.

Reverse circulation (RC) drilling commenced in December 2021 targeting gold mineralisation in the shallow ground (at a minimum depth of 20 m) to a maximum depth of 121 m. A total of eight boreholes were drilled, with 823 samples collected. These samples were handled as follows: the chips were logged; the mineralised zone was zipped using a portable XRF for immediate results; the rock chips were sampled

for assay; ICP-MS and XRF analyses as well as petrographic studies were carried out. In addition, water strikes and yield estimations were recorded for every borehole. Water samples were collected and tested for pH and electrical conductivity (EC) and submitted for laboratory analysis (i.e. cations, anions, pH, total alkalinity, total dissolved solids and EC). An environmental assessment was conducted during the drilling period.



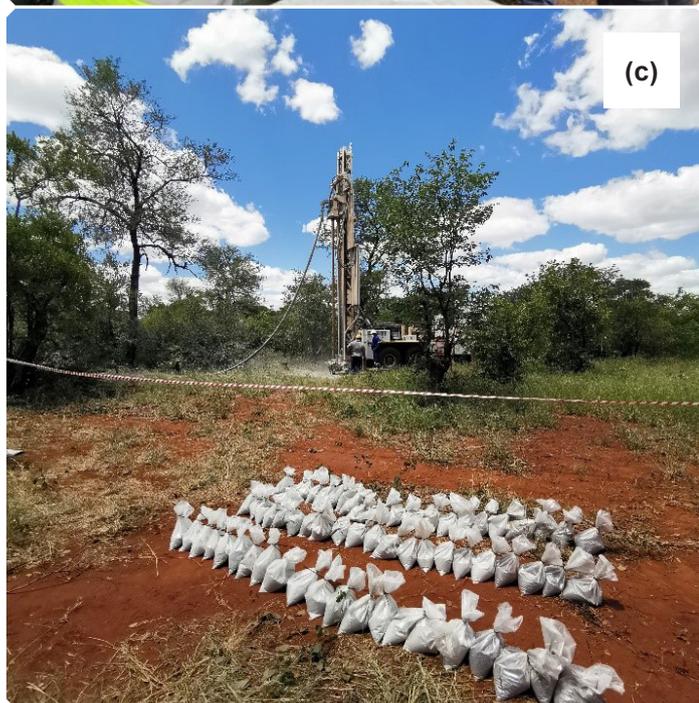
(a) Drilling team connecting the sample pipeline to the cyclone. (b) The team conducting a safety briefing.



(a)



(b)



(c)



(d)

(a) Team of scientists examining sieved rock chip samples. (b) A scientist demonstrating the use of a portable XRF onsite — the rock chip samples with sulphides were analysed for immediate results. (c) RC samples laid out for quality control and assurance. (d) A scientist measuring groundwater levels after completing RC drilling.

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