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CGS flag flies high at the 37th International Geological Congress in Busan, South Korea

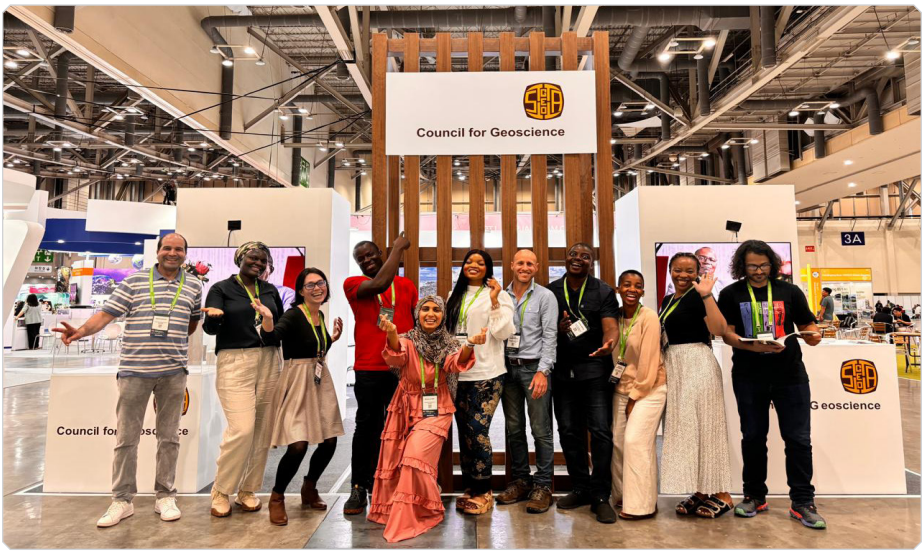

Figure 1: CGS team- from right to left: Dr.. T. Dhansay, Ms Z. Sibewu, Ms M. Mathabatha, Mr N.C. Ndou, Mr C.A. Groenewald, Ms N. Dunga, Ms M. Safi, Mr T.C. Thiba, Ms D. Classen, Ms N.C. Mukosi and Mr M. Bensid.

Background

The International Union of Geosciences (IUGS) is the founder of the International Geological Congress (IGC). The first Congress was held in France in 1878, with the aim of bringing together geoscientists from the northern hemisphere to share new geoscientific knowledge and to network. Over the years, the Congress has been held on several continents, and in more than 33 countries. For the first time in more than a century since the inception of the IGC, South Africa became the first African country to host such a prestigious event in 2016, attracting more than 4000 delegates from 117 countries with more than 5000 abstracts submitted for oral and poster sessions. Since then, India was scheduled to host the 36th IGC in 2020, but due to the global COVID pandemic, the event was shifted to an online event in 2021. So, it has been eight years since the international geological community gathered for what is widely known as the *Olympic games of geology/geosciences.*

Conference Attendance

The 37th IGC was held in Busan, South Korea, from 25th to 31st August 2024 under the theme *"Great Travelers:*

Voyage to the Unifying Earth". The South African team was well represented by scientists from various scientific institutions such as the University of Johannesburg, the University of Free State, the University of the Witwatersrand, Stellenbosch University, and the Council for Geoscience (CGS). The CGS team was led by Mr M. Mabuza (CEO), Mr W. Meintjes and Ms S. Buthelezi (Executive Managers), and Dr. T. Dhansay (Minerals and Energy Manager). The CGS team was composed of scientists including Mr M. Bensid, Ms M. Safi, Ms D. Classen, Ms N. Dunga, Ms Z. Sibewu, Mr C.A. Groenewald, Mr N.C. Ndou, Mr M. Ncume, and Ms N.C. Mukosi, Ms M. Mathabatha (Marketing Officer) and Mr T.C. Thiba (Technical Officer) (see Fig. 1 and 2).

The Congress consisted of more than 250 symposia under a total of 41 themes. The CGS team had 9 oral and one poster presentations. The CGS presentations fell under the following sessions of the congress:

- Energy and Carbon Neutrality where Ms M. Safi gave a presentation titled *'Hydrochemical features of geothermal waters in the Namaqua-Natal Province, South Africa'* which highlighted the characterisation of the geothermal waters at the Shu Shu hot spring in KwaZulu-Natal Province.

- Ms N. Dunga gave a presentation titled *'Preliminary assessment of CO_2 storage capacities in the northern portion of the Offshore Orange Basin, South Africa'.*

- Mr M. Bensid presented an abstract entitled *'Regional geochemical mapping of the Rooikraaldam area of the eastern Bushveld Complex, Limpopo Province'* during the Low temperature geochemistry session highlighting the importance of regional geochemical mapping to enhance exploration in the region by generating mineral targets using geochemical datasets.

- Mr M. Ncume presented an abstract entitled *'Assessing the influence of geological structures and lineaments on the tragic landslides in KwaZulu Natal Province'* during the geohazards session.

Figure 2: CGS team-from left to right: Mr M. Bensid, Ms N.C. Mukosi, Mr C.A. Groenewald, Ms M. Safi, Ms N. Dunga, Ms Z. Sibewu, Mr N.C. Ndou, Mr T.C. Thiba, Ms M. Mathabatha, Ms D. Classen, and Dr. T. Dhansay.

Figure 3: The CGS Executive team led by Mr M. Mabuza (CEO) posing with the delegation of Geological Survey of India.

- Mr N.C. Ndou gave a presentation entitled *'Hyperspectral core scanner: an effective mineral mapping tool for apatite in the upper zone, Northern Limb, South Africa'* during the mineralogy session, highlighting the application of hyperspectral borehole scanning to identify phosphate potential in the Bushveld complex.

- Mr C.A. Groenewald presented an abstract entitled *'Unravelling the evolution of the Richtersveld magmatic arc: Insight from integrated geological*

mapping' during the Earth history and Stratigraphy session.

- Dr. T. Dhansay gave two presentations in the Geoscience and Policy as well as Mitigation and adaptation in climate Crisis sessions. The presentation under Geoscience and Policy session was titled *'Integrated Geoscience mapping toward minerals and Energy Development: A case study of lithium prospectivity in the northern cape, South Africa' and the second presentation was titled 'Carbon Capture, Utilisation and Storage in South Africa's highest CO_2 emissions hub: Opportunities for the Just Transition'.*

- Ms N.C. Mukosi presented an abstract entitled *'Integrated & Multidisciplinary Geoscientific Mapping of the Limpopo Greenstone Belts'* under the Resource Geology and Economic Geology session. The presentation highlighted the importance of the integration of various geoscientific datasets applicable to support economic growth through exploration and to address societal challenges of the region.

- Ms D. Classen presented an abstract entitled *'Decadal and millennium scale Gully expansion rates, Mthatha, Eastern Cape Province'* under the Quaternary Geology, during the poster session, which demonstrated the impact of gully erosion in the rural part of the Eastern Cape and how it affects the infrastructure and potential land use of the region.

Figure 4: Ms N.C. Mukosi giving a talk titled 'Integrated & Multidisciplinary Geoscientific Mapping of the Limpopo Greenstone Belts' under the Resource Geology and Economic Geology session. Highlighting the importance of integration of various geoscientific datasets applicable to support economic growth through exploration and to address societal challenges of the region.

The congress afforded the CGS with an opportunity to showcase its work, interact with industry stakeholders, set benchmarks for innovations, and exchange knowledge with other scientists. CGS held several bilateral meetings with other geoscience institutions such as the Geological Survey of India among others (Fig 3). Furthermore, the CGS followers were kept informed of congress proceedings through the Communication and Stakeholder Relations initiatives, which increased the organisation's reach on social media platforms The CGS personnel conversed with other attendees at the exhibition booth, which was bustling with enquiries from delegates regarding CGS services and possible partnerships. The CGS team displayed a special publication highlighting significant strides made by the Integrated and Multidisciplinary Mapping Programme (IMMP), which was first launched in the 2017/2018 financial year. The special publication is entitled *'37th International Geological Congress 2024 special publication'* and can be accessed through the CGS library.

Conclusions

The diverse contribution of CGS presentations (ranging from Minerals and Energy themes to Infrastructure and Land Use) during the 37th IGC is a reflection of the diverse geology of South Africa, and the desire of the CGS as one of the science councils in South Africa to solve societal challenges using geoscience knowledge, and to contribute to the Batho Pele *(people first)* principles, through an IMMP. The IMMP harnesses fundamental geoscience research and addresses societal challenges, which ultimately aligns to the National Development Plan (NDP) 2030 vision of contributing to a prosperous South Africa by attracting investment and stimulating economic growth and supporting other government imperatives through fundamental geoscience research (Fig. 4 and 5).

The 37th IGC in Busan attracted thousands of scientists from around the world and curated sessions that ignite scientists with thought-provoking questions related to both fundamental geoscience research and societal challenges influenced by climate change. The Congress lived up to its theme of "unifying earth'' through robust sessions, keynote addresses, a session dedicated to women in geosciences and field trips which ultimately unified the geoscientific community after 8 years since the physical IGC meeting in Cape Town, South Africa.

Figure 5: (a) Ms D. Classen presenting her work during the poster session of the 37th IGC in Busan, South Korea. **(b)** Ms M. Safi giving a talk titled *'Hydrochemical features of geothermal waters in the Namaqua-Natal Province, South Africa'* which highlighted the characterisation of the geothermal waters at the Shu Shu hot spring in the KwaZulu-Natal Province. **(c)** Dr. T. Dhansay giving a talk titled *'Integrated Geoscience mapping toward minerals and Energy Development: A case study of lithium prospectivity in the Northern Cape, South Africa'*. **(d)** Mr N.C. Ndou giving a talk titled *'Hyperspectral core scanner: an effective mineral mapping tool for apatite in the upper zone, Northen Limb, South Africa'*. **(e)** Mr M. Ncume gave a talk titled *'Assessing the influence of geological structures and lineaments on the tragic landslides in KwaZulu Natal Province'*. **(f)** Ms N. Dunga giving a talk titled *'Preliminary assessment of CO_2 storage capacities in the northern portion of the Offshore Orange Basin, South Africa'*. **(g)** Mr C.A. Groenewald giving a talk titled *'Unravelling the evolution of the richtersveld magmatic arc: Insight from integrated geological mapping'*. **(h)** Mr M. Bensid, gave a talk titled *'Regional geochemical mapping of the Rooikraaldam area of the eastern Bushveld Complex, Limpopo Province'*. **(i)** Ms N.C. Mukosi engaging with the PanAfGeo team hosted under the EuroGeoSurveys booth. **(j)** Ms D. Classen engaging with delegates during her poster session.

Another highlight of the Congress was the election of the new IUGS president, which takes place every four years during the IGC congress, and resulted in Prof Hassina Mouri, Professor of Medical Geology at the University of Johannesburg becoming the first African, to be elected as a IUGS President.

In conclusion, the IUGS voting committee members voted in favour of Canada hosting the 38th IGC. This significant event will take place in Calgary, Canada, in the year 2028.

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Geoscience Diplomacy in Action: CGS Participates in CTBTO Working Group Session

The Council for Geoscience (CGS) proudly represented South Africa at the 63rd session of the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO) Working Group B, held in Vienna, Austria, from 26 August to 6 September 2024. This critical gathering brought together global experts to discuss the progress of international efforts to prevent nuclear testing and promote global peace.

Leading the CGS delegation was Ms Nomvelo Mkhize, accompanied by her colleagues Mrs Tebogo Matlou, Mr Leonard Tabane, Mr Francois Delport, and Mr Joseph Matamela. They were joined by representatives from the Non-Proliferation Secretariat at the Department of Trade and Industry, as well as members of the South African Mission to Austria, led by His Excellency Ambassador Molekane.

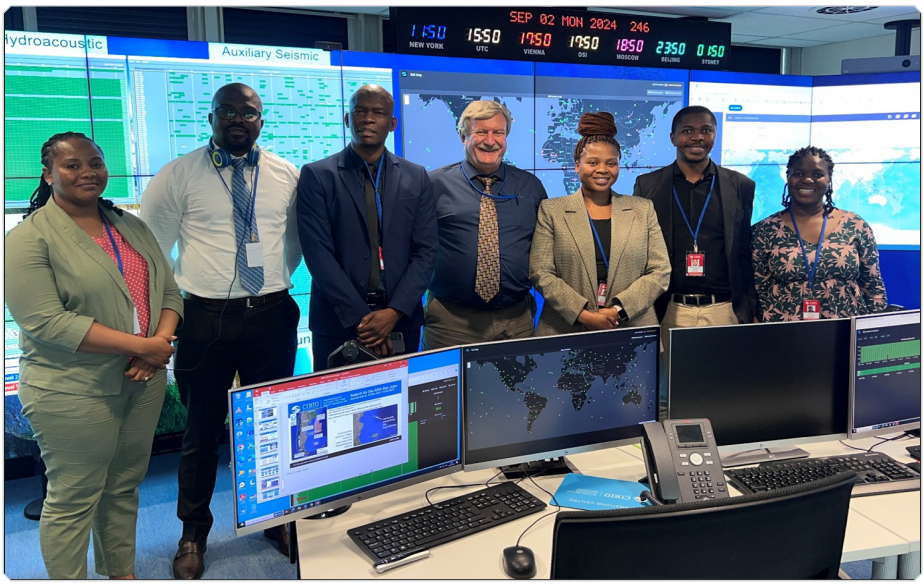

Figure 1: CGS and DTI Colleagues at the International Data Center, Vienna Austria. From left: Mrs Tebogo Matlou, Dr. Matome Mookodi, Mr Leonard Tabane, Mr Francois Delport, Ms Nomvelo Mkhize, Mr Joseph Matamela and Dr. Takalani Cele.

The CTBTO, established on 19 November 1996 by a United Nations resolution, is tasked with preparing for the enforcement of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Its primary goal is to ensure the global cessation of nuclear weapon testing, which remains a significant threat to global security. The CTBTO plays a pivotal role in establishing a verification system to monitor compliance with the treaty, ensuring that no nuclear testing occurs, whether underground, underwater, or in the atmosphere.

One of the key components of this global verification regime is the International Monitoring System (IMS), which includes 321 monitoring stations and 16 radionuclide laboratories worldwide. These facilities work together to detect any nuclear explosion. The International Data Centre (IDC) processes and analyses data from the IMS and supports the provisional operation of the system. The establishment of an on-site inspection capability is also a crucial part of the verification regime, ensuring the CTBT can be effectively enforced once it enters into force.

In a world increasingly marked by geopolitical tensions and the looming threat of nuclear proliferation, the importance of the CTBTO's mission cannot be overstated. The organisation's work is an intersection where science informs diplomacy and policy, contributing significantly to global peace and security.

South Africa's Role in the CTBT

South Africa ratified the Comprehensive Nuclear-Test-Ban Treaty on 30 March 1999, becoming the 33rd State Signatory to do so. South Africa holds a unique position as one of the 44 countries listed in the treaty whose ratification is essential for its entry into force. Furthermore, South Africa was the first signatory from the African region to ratify the CTBT, underscoring the country's commitment to promoting nuclear disarmament and non-proliferation.

The South African government has entrusted the CGS with the technical responsibilities related to the CTBT. As part of its mandate, the CGS manages several key monitoring stations that form part of the CTBTO's global network. These include a primary seismic station in Boshof, Free State, two auxiliary seismic stations in Sutherland, Northern Cape, and Antarctica, and an infrasound station also located in Boshof. These stations are critical in detecting and verifying any nuclear explosions globally, contributing to the CTBTO's monitoring efforts.

Working Group B and the Role of CGS

Working Group B of the CTBTO is responsible for overseeing the scientific and technical aspects of the treaty's verification regime. Comprising experts from member states, this group regularly convenes to discuss advancements in monitoring technology, the progress of the IMS, and the operation of the IDC.

The CGS delegation's participation in the 63rd session of Working Group B was a significant opportunity to showcase South Africa's contributions to the global effort against nuclear testing. The CGS team presented updates on the status of the monitoring stations under their management and participated in discussions regarding the establishment of a National Data Centre

in South Africa, a project that will further enhance the country's role in the CTBT verification regime.

Additionally, the session provided a platform for the CGS to engage with other member states, exchanging ideas on improving monitoring systems and exploring potential collaborations. This engagement is vital in fostering international cooperation and ensuring the effectiveness of the global verification regime.

Figure 2: A view from inside the IDC, the center receives and records information from 316 monitoring stations globally in real time, providing a critical pillar of the verification regime.

Figure 3: Network of CTBTO Seismic stations managed by the CGS in South Africa. 3a, Primary seismic station in boreholes at Boshof, Free-State. 3b, auxiliary seismic station located in Sutherland. 3c, Infrasound station located few kilometres South of Boshof and 3d, Auxiliary seismic station located in Antarctica.

Advancing Geoscience Diplomacy

South Africa's active participation in the CTBTO's work is an important aspect of its broader commitment to promoting peace and stability on the international stage. The CGS's involvement is a testament to this commitment, with the organisation's staff playing key roles in the CTBTO. For example, Mrs Tebogo Matlou currently serves as the Vice-Chairperson of Working Group B, and Ms Michelle Grobbelaar has recently been appointed as an official at the CTBTO. These appointments highlight South Africa's leadership and influence within the organisation.

Looking ahead, the CGS is poised to continue its contributions to the CTBTO, particularly in areas that align with its expertise in geoscience diplomacy. Through the operation of world-class seismic stations, the establishment of a National Data Centre, and ongoing scientific contributions, the CGS will play a crucial role in upholding the objectives of the CTBT and ensuring that nuclear testing becomes a relic of the past.

In conclusion, the CGS's participation in the 63rd session of Working Group B reflects the organisation's dedication to advancing geoscience diplomacy and promoting global peace. Through its technical expertise and international engagement, the CGS continues to fly the South African flag high in the global effort to end nuclear testing.

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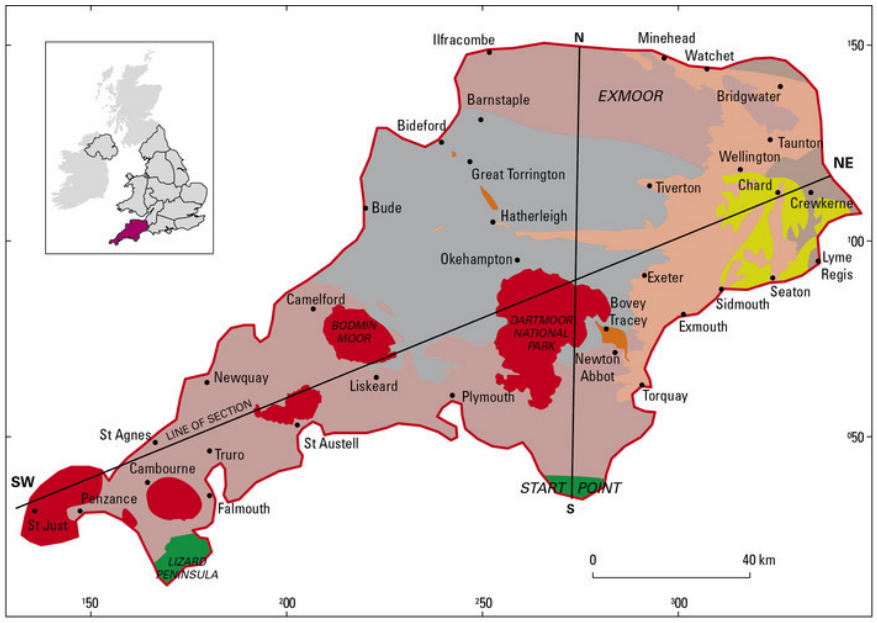
The Cornish geology nexus to South African's geothermal energy

The Council for Geoscience delegation visited the geology of Cornwall, United Kingdom earlier this year. Cornish mineworkers are not the only connection to South Africa. The sites visited in Cornwall share similarities with South African prominent geothermal prospective regions, i.e., along South Africa's Neoproterozoic and Pan-African orogenic belts. The similarities associated with geothermal development, are associated with the tectonic evolution of these regions. That is the Variscan Orogeny that affected the southern extent of the UK, and the Pan-African Orogeny that affected much of South Africa's south-western areas close to the coastline. This summary will present salient observations made during the study tour in Cornwall, highlighting key geological similarities that may influence geothermal energy development in South Africa.



Age (My)	Map/Section Descriptor	Geological sub-units	Text sub-units	Text Descriptor
25-55	Palaeogene Sediments		Interbedded clays, silts and sands	Sedimentary Bedrock
90-110	Cretaceous Sediments	Chalk Group Selbourne Group (Upper Greensand and Gault Formations)	White limestone (major aquifer) Sandstone overlying low permeability clay Sandstone aquifer overlying interbedded low permeability clays and sandstones	
185-200	Jurassic Sediments	Inferior and Great Oolite Groups Lias Group	Shelly limestone minor aquifer Low permeability clays	
200-290	Permo-Triassic Sediments	Mercia Mudstone Group Sherwood Sandstone Group and Permian sediments	Low permeability clay, sandstone aquifer and Interbedded sandstones and mudstones	
295	Igneous Intrusions		Granite	Basement Rocks
(370-500)		Lizard and Start Point Complex	Metamorphosed gabbro and ophiolite	
315-345	Carboniferous Rocks	Holsworthy Group and Teign Valley Group	Interbedded sandstone, mudstones with minor coals	
360-410	Devonian Rocks	Upper, Middle and Lower sandstones, conglomerates and mudstones	Sandstones, conglomerates, mudstones with some igneous rocks	
415 and Older	Lower Palaeozoic Rocks	Ordovician and Silurian sediments		

Figure 1: Regional geology of the Cornwall region in the UK (after BGS, 2016).

Geological similarities

The salient geological similarities between the Pan-African orogenic belts of South Africa and the Cornwall region of the UK reflect various volcano-sedimentary basin sequences, particular structural features and the emplacement of high heat producing igneous rocks (Figure 1). Moreover, salient observable features are critical to developing the underlying resource potential of geothermal energy. Field examples collected from Cornwall, UK and similarities from South Africa refer to Figure 2. The section below presents these similarities.

Basin deposits

In the southernmost region of Cornwall, the oldest sequences and best preserved observations are Precambrian ophiolite sequences exposed around the Lizard Peninsula (Mackay-Champion *et al*., 2024). These sequences represent slices of obducted oceanic crust that thrust upon the continental shelf during the earliest phase of the Variscan Orogeny. The ophiolite sequence includes mantle sequences and various mafic and ultramafic volcanic rocks. Structurally beneath the ophiolite sequences unconformably are Devonian to Carboniferous volcano-sedimentary and sedimentary sequences. The Devonian to Carboniferous sediments are exposed as interlayered sandstone, shale, and mudstone. The deformation in the Cornwall area is related to the Variscan Orogeny and the closure of the Rheic Ocean. Metamorphism related to the deformation is greenschist facies. Chloritoids and the development of

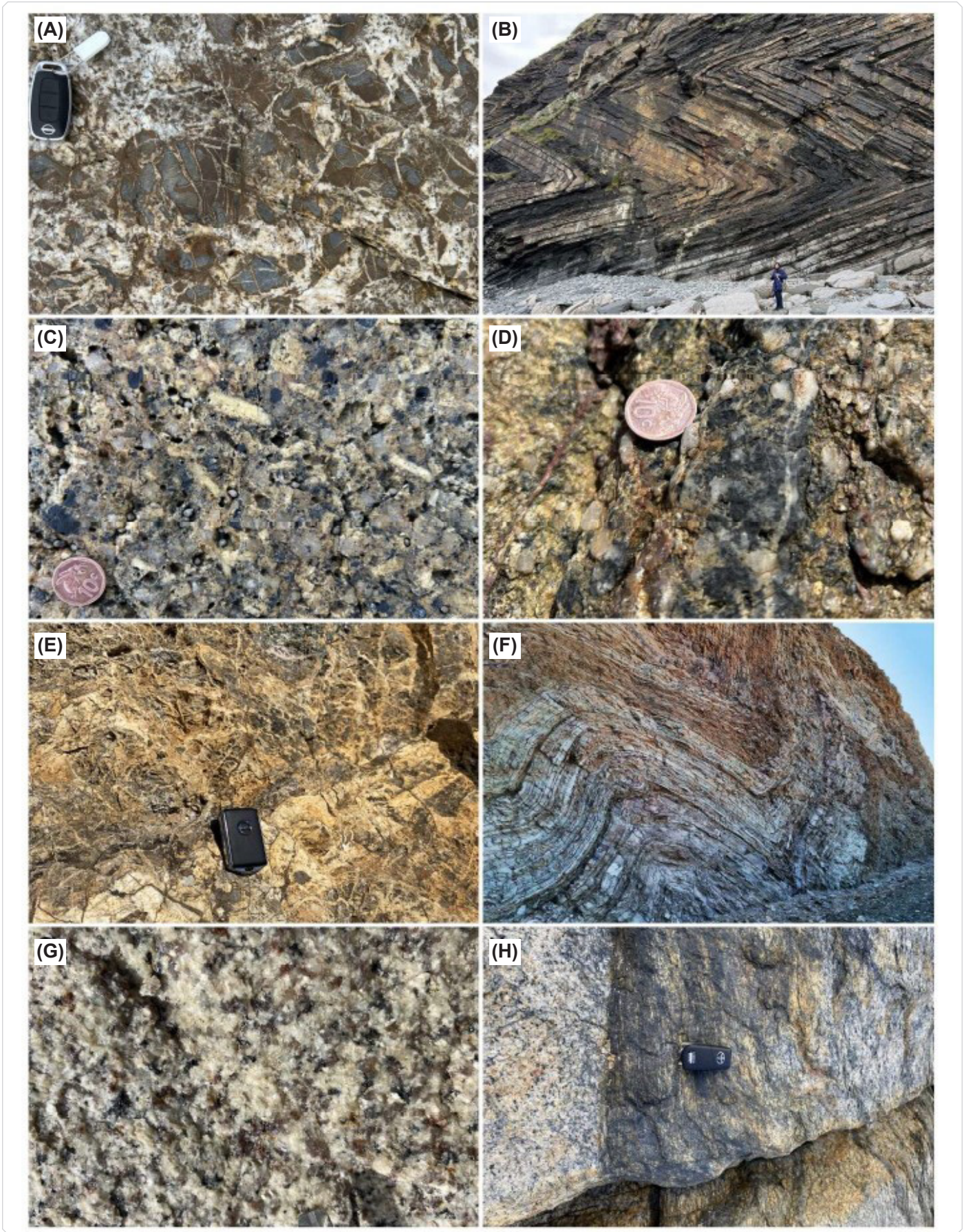


Figure 2: Geological similarities between Cornwall and South Africa. Breccia in Cornubian Batholith (A) and Cape Granite (E); Folding in the Devonian strata of the Cornwall area (B) and folding in the Ordovician strata of South Africa (F); Cornubian Granite (C) and Cape Granite (G); and mylonite in the Cornwall Granite and in the Cape Granite (H).

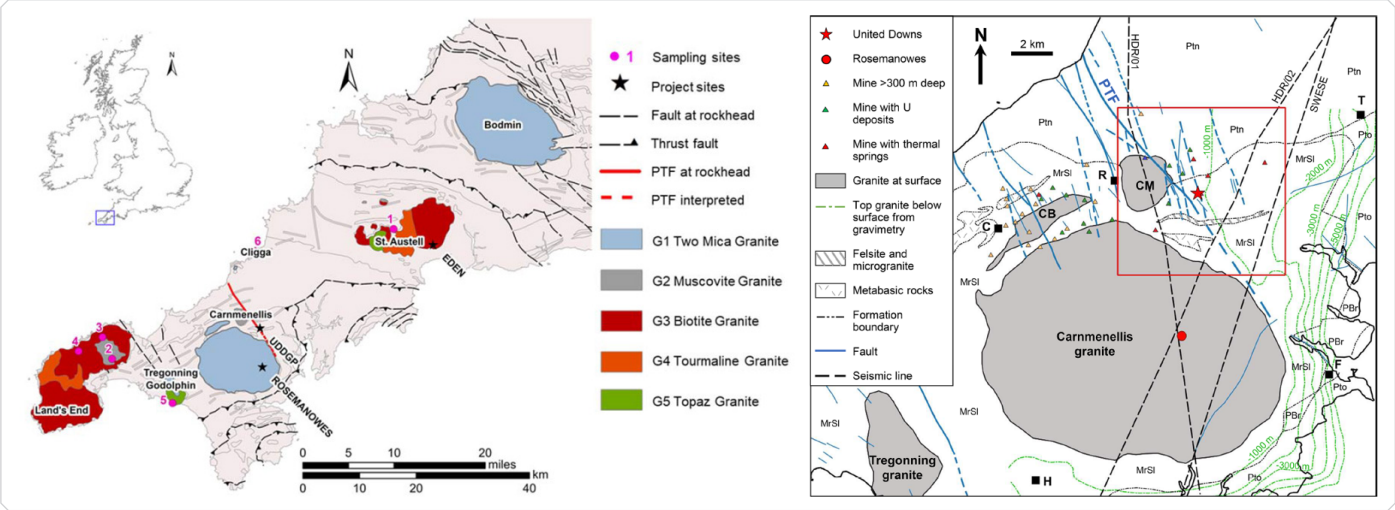


Figure 3: Schematic illustration of regional salient structural features within the Cornwall region (left). An example of a detailed view of a geothermal region (Reinecker *et al*., 2021 and Schulz *et al*., 2022).

schistose fabrics are observed. In the Bude area, the sedimentary sequences display significant faulting and folding that is fossiliferous.

The South African resemblance to the Variscan orogeny generally includes slightly older basin sequences like the Neoproterozoic Malmesbury Group and Ordovician Table Mountain Group. The South African sequences are interlayered volcano-sedimentary layers often fossiliferous that are exposed along the southwest corner of South Africa. These sequences share similar features to the basin sequences observed in Cornwall. The deformation of the Malmesbury and Table Mountain Groups occurred during the Pan-African and is related to the formation of Rodinia and Gondwana, respectively. Large-scale folding and multiple generations of faulting are also commonly observed (Rino *et al*., 2008).

Intrusive sequences

The geological similarity between Cornwall and South Africa is the occurrence of post-orogenic intrusive sequences. These include large granite plutons that display elevated concentrations of heat producing elements. In Cornwall, the granite sequences are the target geological strata for geothermal energy development. Granite plutons are part of the Cornubian Batholith, particularly around the Cambourne region (Charoy, 1986). These generally occurs as a S-type granite emplaced during the final stages of the Variscan Orogeny. The Cornubian Granite displays several different igneous melt variants. These include from older to younger sequences: two-mica granite, muscovite granite, tourmaline bearing granite, and topaz-bearing granite. The granite texture is typically megacrystic with centimetre large and elongated plagioclase phenocrysts. The phenocrysts often display flow banding along specific planes. The flow banding is related to the effect of synorogenic intrusion along structural planes that accommodated most of the tectonic stress. The later granite phases often display fluorite mineralisation.

In addition to providing high heat flow, Cornubian Granite is the source of significant tin mineralisation in the region. The mineralisation occurs as late-stage mineralisation that concentrates along c. NW-SE, and c. E-W orientations. Polymetallic Sn-W-Cu are often formed along the granite aureole with the surrounding sedimentary country rock. Similarities in South Africa are the occurrence of Pan-African Cambrian aged granites (Clemens and Stevens, 2021). These include the Cape Granite and associated granite bodies that extend north into Namibia. Likewise, these appear as often megacrystic granites displaying elevated heat flow profiles. These are mainly S-type granites but also include I- and A-type. Mineralisation is relatively limited in the Cape Granite.

Structural geology

The structural geology of the Cornwall region is a significant aspect enabling the development of geothermal energy. The development of fractured zones creates permeable horizons that allow heated water to move and concentrate. Two dominant structural trends occur in the Cornwall region at different stages in the Variscan orogeny for example, the early stages display older c. NW-SE-orientated structures and final stages display younger c. E-W orientated structures. On the surface, both structural features have varying widths of a few centimetres to several metres, often defined by mylonitic textures, tourmaline and tin mineralisation.

In South Africa, similarities like mylonitic fabrics that concentrate along regional tectonic features are evident. Furthermore c. NW-SE orientated fabrics developed within the granites along the deep-seated Colenso Fault. Principally, these structural features control heat flow throughout this region (Rino *et al*., 2008).

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CGS technical visit to ICDP-BVDP borehole drill site

A delegation from the Council for Geoscience (CGS) visited the Bushveld Drilling Project site of the Intercontinental Drilling Project (ICDP-BVDP) at Impala Platinum's Marula Mine in Burgersfort, Limpopo led by Mr Willem Meintjes. This visit is part of ongoing collaboration between the CGS as a national Science Council responsible for geological research in South Africa, and the ICDP, which also included the Barberton Drilling (BASE) and Deep Seismic (DSEIS) projects. The BVDP is a collaboration between several research partners which include Wits University (Host), Free State University (UFS), University of Limpopo (UL), Stellenbosch University (SU) and CGS (South Africa), GFZ Potsdam, University of Erlangen and BGR (Germany), University of Tokyo (Japan), and University of Basel (Switzerland). Industry partners involved in research include Impala Platinum (Marula Mine) through permission and access for drilling and some technical support. Impala and Anglo Platinum have also donated over 10 000 meters of Bushveld Complex core for the stratigraphic studies and 40% of these are archived at the National Borehole Core Depository (NBCD) at Donkerhoek and the rest at UFS.

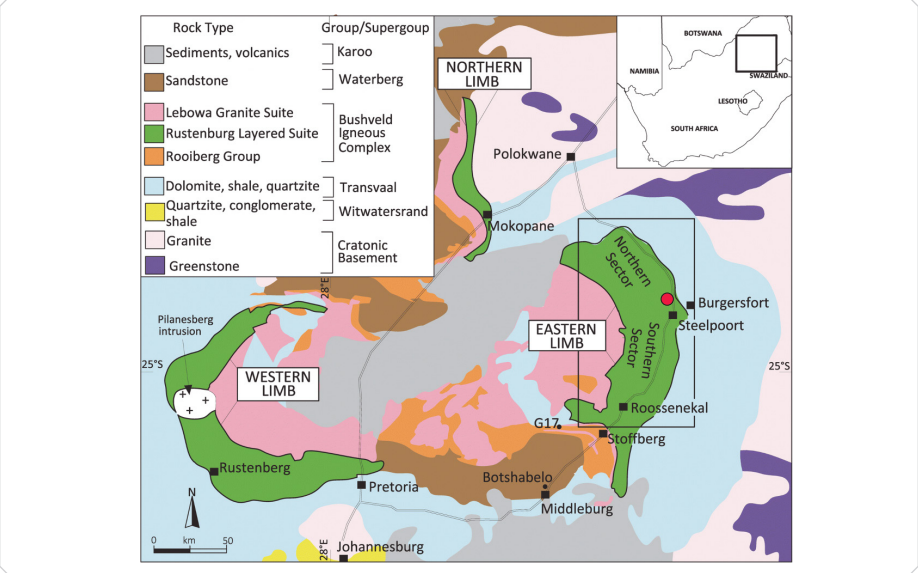

Figure 1. BVDP drillsite (red dot) at Marula mine on the Eastern Limb of Bushveld.

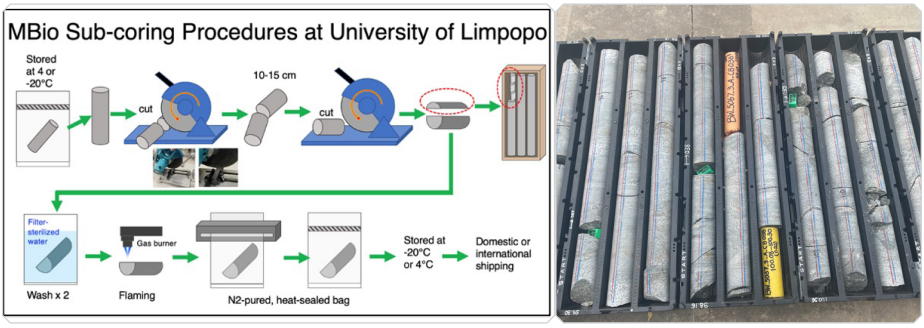

Figure 2. Sample preparation procedure for microbiology (L) for samples taken on BVDP borehole core (R).

The planned drilling of the over 2 500 m deep stratigraphic borehole is funded from a Project budget of over 30 million rands mainly from the ICDP, NRF, German Research Foundation (DFG), and in-kind contribution from the CGS. The borehole is drilled up-dip from the mining at Driekop Shaft and intersects strata below the UG2 chromitite zone, which is the main mining horizon at Marula, and had reached the depth of 1 000 meters by the beginning of September 2024.

Several research activities are currently being undertaken on the fresh BVDP core which include lithology and multispectral logging, comprehensive geological logging, surface and downhole seismic profiling, continuous real-time offsite gas sampling and monitoring, water sampling, and microbiological sampling. Microbiology research is one of the major components of the drilling to check for microbes within the Main and Lower zones in the Eastern Limb of the Bushveld Complex. This requires up to 60cm of whole rock core to be sampled at the drill site for immediate refrigeration before any contamination with air (Fig. 2). The samples are then transported to the University of Limpopo (UL) for storage, where the Microbiology team will then cut the sample and return about a quarter of the sample for archiving and storage. However, this is only applicable to the PQ and HQ-size core due to the size of sample required for the tests. The NQ-size core (47.5mm diameter) will be sampled whole to obtain enough material for analysis. The engineering design of the borehole is such that drilling of the NQ-size will only be at the non-economic zones of the Lower Bushveld until the end of hole in the Transvaal Supergroup.

Publicity and fund raising for the project was recently flighted on Japanese National television on the detection of living microbes at depths of between 400 and 800 meters, the news reports can be accessed via the following link (https://www3.nhk.or.jp/nhkworld/en/news/20240718 28). The project is currently supporting several Masters, Doctoral and Post-Doctoral researchers, interest has also been received from universities in China (Nanjing University), Cardiff University in the United Kingdom,

Figure 3. CGS and Microbiology team at University of Limpopo for core cutting supervision.

Figure 4. CGS team at a 2-day mDIS training conducted at the NBCD in Donkerhoek by Ms Katja Heeschen (Bottom left), ICDP Database Manager in April 2024.

Figure 5: CGS delegation at the BVDP drill site (left to right) Mr Hakundwi Mandende, Ms Vhuhwavhohau Nengovhela, Ms Muneiwa Mukwevho, Mr Clement Ndou, Ms Zama Sibewu, Mr Willem Meintjes, Mr Thulani Maupa, Ms Simamkele Mafanya, Mr Kwena Mathopa, and Ms Mmabatho Mapiloko.

and University of Halle and the Natural Sciences Museum in Germany.

The geology team in the field is currently logging and taking photographs of all the core as it comes out from the drillhole, and records are stored on the ICDP mDIS database server for record keeping and future reference. Each scientist working on the project has been assigned a unique user code for access on mDIS, and this includes the CGS team after they underwent training (Fig. 4). Once all the lithological logging is completed on site, the core will be transported to the NBCD for scanning on the hyperspectral scanner and archiving.

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The Council for Geoscience UAS pilots attended training with YellowScan for LIDAR sensor

The CGS bought drones and several sensors for conducting geoscience surveys. Unmaned Aircraft System surveys are envisioned to improve our understanding of the geology, surface terrain and spectral signatures of rocks in a study area. Geoscientists will be able to capture detailed 3D surface models quickly, enabling high-precision mapping of the topography, buildings, and geological outcrop characteristics, as well as identifying and analysing stream flow routes. This will improve our capacity to interpret the surface with remote sensing and geophysical information for different CGS initiatives.

The Council for Geoscience (CGS) scientists attended a LiDAR training session held at the National Core Borehole Depository on the YellowScan mapper+ LIDAR sensor on the 14th to 15th August 2024. The training was conducted by Mr Julien Bernard (Customer Support Engineer - Technical Referent) and Mr Jacques Coetzee Head of Drone Solutions & RPAS Pilot (MR) / B.Eng. (Electronic) (Official Distributors: YellowScan Lidar).
The CGS team members included Ms Noluvuyo Dudumashe, Ms Mihlali Hobo, and Ms Janet Bunk. The training covered theory, equipment background, instrument assembly, and real-world data collection. Day one of training focused on theory and data collection, the data was acquired by one of the CGS pilots with the YellowScan Mapper+ mounted on the Matrice 600 Pro, under the guidance of the YellowScan trainer to ensure good quality data was collected. Day two of the training was dedicated to data processing. The UAS Lidar system rapidly captures detailed 3D surface models, allowing detection and analysis of stream flow directions and high-precision mapping of terrain, structures, and geological outcrop characteristics. The goal of the training was to test the YellowScan fitted on a UAS, collect the data, and introduce the sensor unit for aerial mapping in various settings. The LIDAR data UAS-based photogrammetry was acquired and the GPS base station ground control point to help to establish the precise position and orientation of these data. The 3D point-cloud result from the photogrammetry was then used like a mesh onto which the LIDAR data would be projected and displayed.

UAS are used to collect high-resolution data from remote sensing technology, which allows for monitoring of our planet's land, sea, and atmosphere. The problem lies in the fact that free

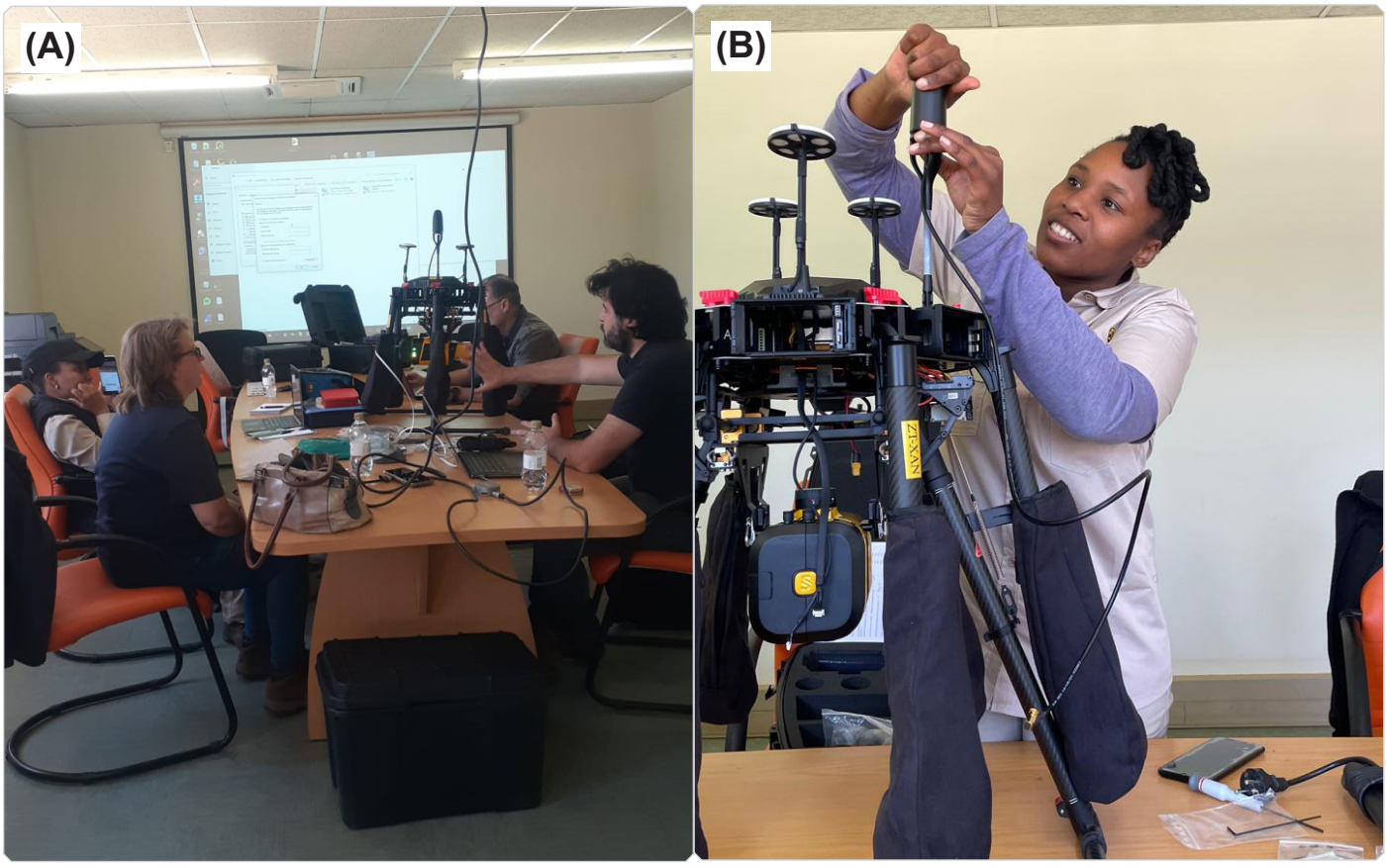

Figure 1: Left photo: Ms Mihlali Hobe (far left), Ms Janet Bunk (left), Mr Jacques Coetzee (far right) and Mr Julien Bernard (right) attending theory; Right photo: Ms Noluvuyo Dudumashe setting up the YellowScan LiDAR onto the Matrice 600 Pro.

Figure 2. Matrice 600 pro mounted with the YellowScan LIDAR sensor.

satellite data cannot acquire as much comprehensive data as UASs, and even when they do, the resolution is not as high as UASs which can reach a 5 or 1-cm scale. The goal of CGS is to collect high-resolution data at the local scale after regional mapping has been completed and this technology with different sensors will enable quick and efficient data collection and ensure accurate data quality. The advantage of the LIDAR sensor is that it can penetrate vegetation and reach the surface, providing reliable information and high-resolution aerial imaging. The UAS and sensor technologies will provide the CGS an opportunity to use innovative and emerging technologies in the geoscience field. The CGS is currently finalising the compliance process with the South Africa Civil Aviation Authority SACAA and piloting the UAS technology for the various GTP projects from October 2024. There is also a plan to train more UAS pilots in the next financial year including data processing.

Figure 3. Preparation for data collection a) and c) Mounting the YellowScan LIDAR sensor, b) Pilot-in-Command ready for take-off and data collection d) GPS base and rover ground control points.

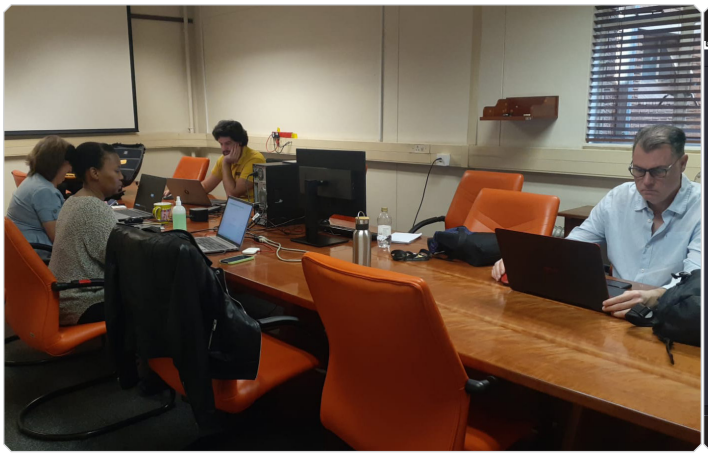

Figure 4. Day two of training: YellowScan and CGS team members processing the data that was collected.

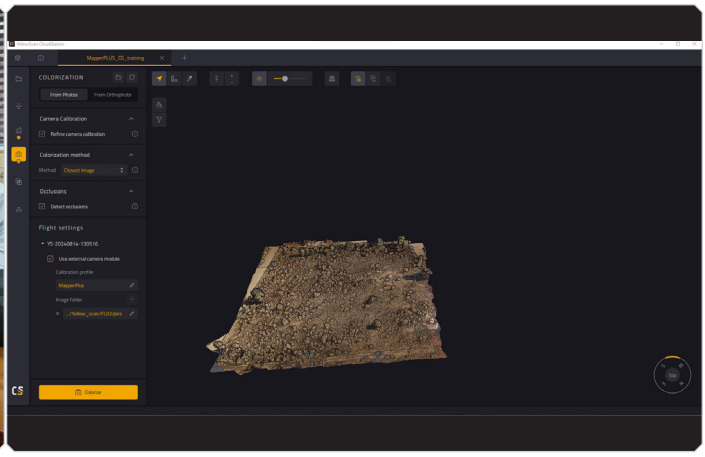

Figure 5. Ortho-mosaic product of the processed data using the Cloud Station software.

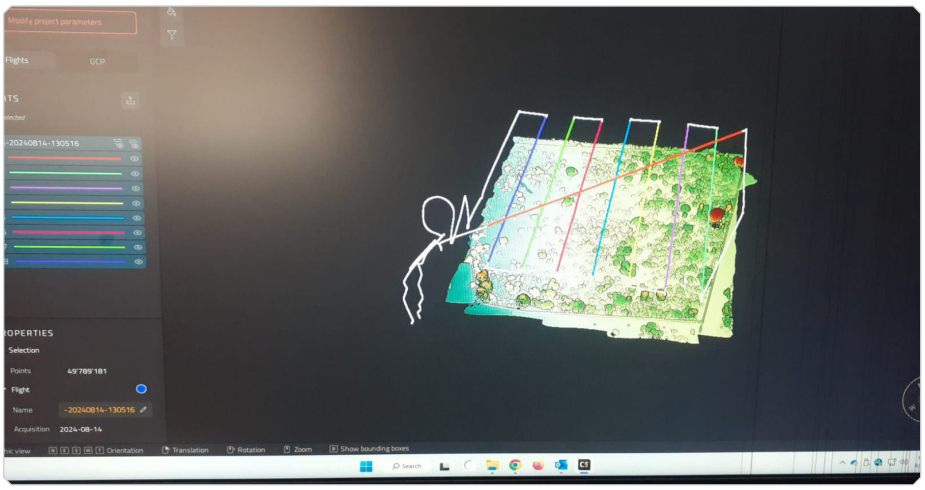

Figure 6. DEM product produced from the data collected.

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The Time Machine on Your Doorstep: The Karoo fossils of the CGS in Silverton and their significance

During my year at the Council for Geoscience (CGS), two common questions often arise regarding palaeontology and the importance of protecting and conserving fossils. These questions inspired me to write this article to inform colleagues about the scientific and practical significance of palaeontology.

The first question often concerns the scientific methods used for fossil dating, specifically radiometric dating techniques, and the limitations and uncertainties associated with these methods. The second question delves into the educational and cultural considerations of exhibiting fossils in museums. This highlights the potential impact of exhibiting fossils on scientific research, conservation efforts, and public engagement with palaeontology. Both questions carry considerable relevance and merit, particularly within the ongoing endeavours by the CGS to resuscitate and safeguard the palaeontological collections.

However, it is important to consider additional facets of palaeosciences that serve as conduits for understanding fossils, thereby facilitating their dating and exhibitions. Although paleobiology may not be universally relevant, it undeniably assumes a pivotal role in the overarching discipline. Serving as the foundational step in any paleontological research, it is mostly important in imbuing the term "bio" with substance in the context of biostratigraphy. When considering the heritage significance of fossils, it is crucial to have a comprehensive understanding of a specimen's biology before displaying it in a museum. Displaying a specimen without such understanding would lack contextual meaning and educational value.

Figure 1. Fossils of the Council for Geoscience, Silverton which include (a) an ammonite, (b) a Gorgonopsian, c) a plant fossil, Glossopteris and (d) a bradysaurus, Paraiesaur.

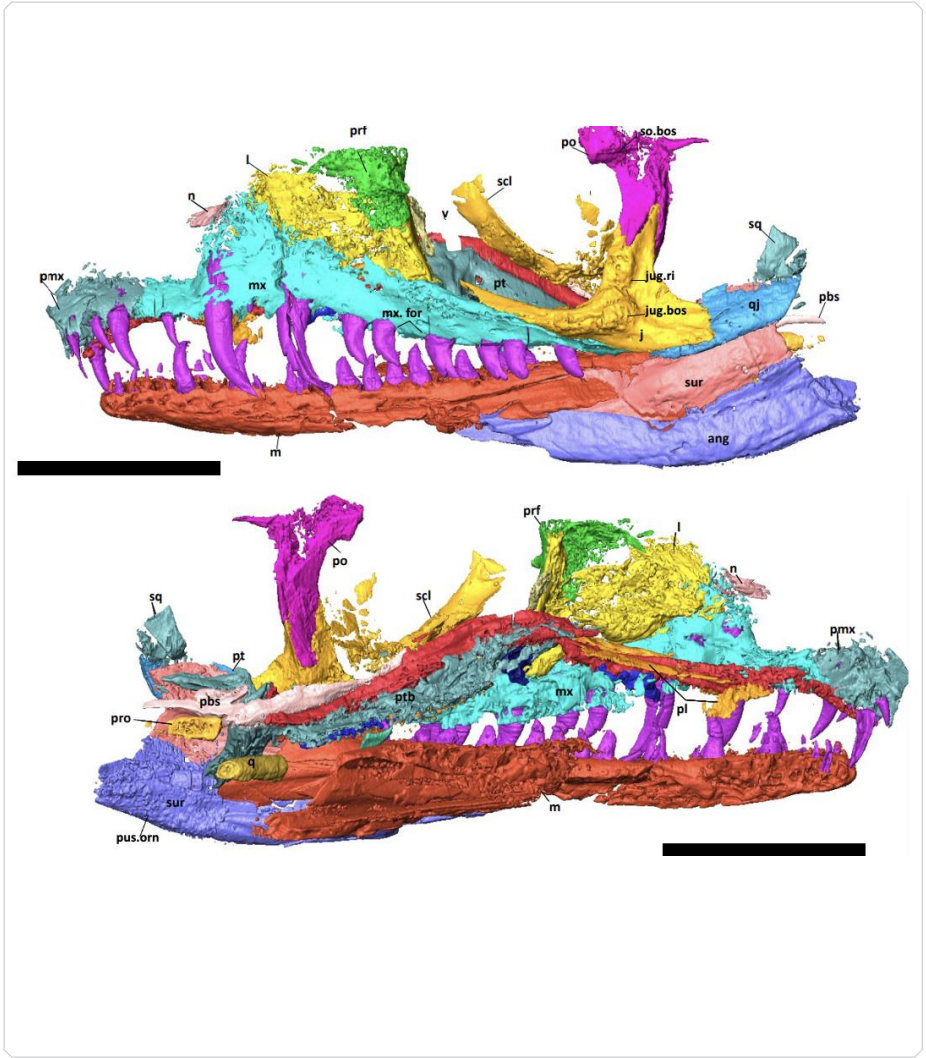

Figure 2. A 3D reconstruction of a varanopid specimen, CG-RMS353. Scans from the University of the Witwatersrand, segmentations by Zoleka Sibiya.

The Karoo Basin of South Africa spans a significant era of biological evolution on Earth. This extensive region, encompassing over half of South Africa, is renowned for its exceptional fossil record, showcasing a diverse array of tetrapods (four-legged animals), plants, fish, invertebrates, and trace fossils. Of note is the abundance of therapsid fossils, commonly known as "mammal-like reptiles," predominantly found in the Beaufort Group. These remarkably preserved relics provide a unique and meticulously documented insight into the transition from reptilian to mammalian species, marking a pivotal moment in the evolution of life on Earth. The CGS curates one of the largest collections of Karoo tetrapods, including therapsids on the continent, and it is located in the CGS head office, Silverton. The collection consists of exceptional fossil specimens and is of considerable importance in terms of both biostratigraphy and cultural significance. Although relatively unknown, this collection garners significant attention from national and international palaeontologists, highlighting its scientific significance and the rich history it represents.

The CGS houses the best-preserved specimens of the herbivorous parareptiles, known as pareiasaurs (Figure 1d), a spectacular collection of Permian apex predators, Gorgonopsians (Figure 1b) and the largest dicynodont skull in the country. Together with the lesser-known invertebrates (such as insects, shelled organisms, etc.) and plants (Figures 1a & c), the fossil collection presents a glimpse of life in the Karoo paleoenvironments. It comprises exceptional fossils that make significant advancements in paleontological research, particularly in the domains of paleobiology, including palaeobotany, and biostratigraphy.

The work includes morphological descriptions and taxonomic interpretations of the Late Cretaceous Mosasaur. This was vital in incorporating South African mosasaurs into the global framework of the clade. Additionally, the collection contains one of only a few known pelycosaur varanopid specimens in the country (Figure 2). In

a recent study conducted for my MSc, I reclassified the species exclusively found in the Abrahamskraal Formation into one species instead of four based on an ontogenetic sequence. Following decades of discourse, the genus was also recognised as a synapsid instead of a reptile. These findings were crucial in expanding our knowledge of the evolution of parental care and integumentary elements in the Synapsida. This genus is also valuable for biogeography because it is the only pelycosaur-grade synapsid to coexist with therapsids in the middle Permian of South Africa. This progress was made possible through a thorough study and analysis of the morphology of one of the specimens housed at the council.

The scientific field of palaeobiology plays a crucial role in enhancing our comprehension of the complex evolutionary processes that have shaped life on Earth. This field is important in uncovering the intricacies of current biodiversity and the ever-changing environments in which it thrives. Therefore, a comprehensive understanding of the morphology and taxonomy of fossils is crucial as it allows us to date them, determine where they lie in stratigraphy, display them in a museum, and inform how we store them for future generations of palaeontologists. Even before being deemed heritage assets, it is important to acknowledge that these fossils were once living animals and should be studied as such.

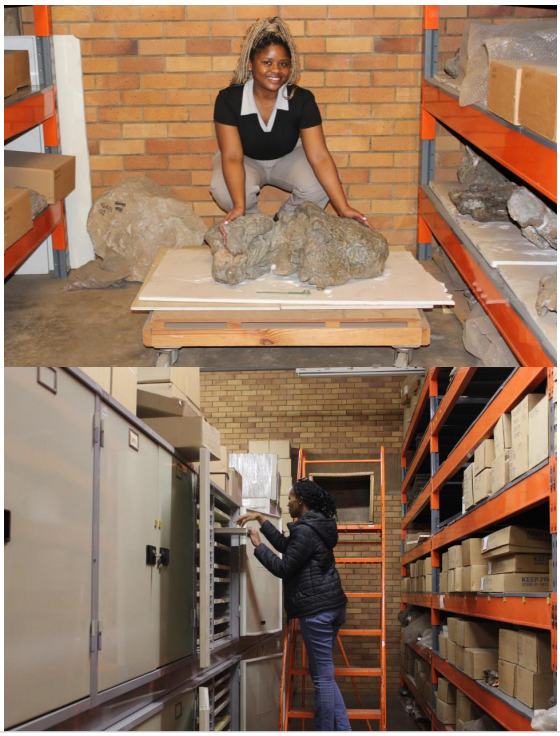

Figure 3. Junior scientists (Palaeontologists) in the Silverton fossil store.

Our primary focus as the new junior palaeontologists involves immersing ourselves in the collections (Figure 3). In our work, we consistently uncover previously unknown unique specimens. These findings demand meticulous study as we confidently pursue further discoveries and their significance. Although the CGS collection is vast, it remains significantly under-researched, with many of the specimens not having been fully prepared since they were collected. Despite its size, the lack of research can be viewed positively, as it emphasises its potential to make significant contributions to the advancement of palaeontological knowledge for the community and the public. This collection of the Karoo fossils is truly remarkable, featuring some fascinating specimens. Colleagues within the institution are encouraged to explore and appreciate these collections.

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