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## Council for Geoscience's participation in the 29<sup>th</sup> meeting of the Conference of the Parties (COP29)

The 29<sup>th</sup> meeting of the Conference of the Parties (COP29) took place in Baku, Azerbaijan, from 11 to 22 November 2024. This annual gathering brings together nations committed to addressing global climate change under the United Nations Framework Convention on Climate Change (UNFCCC), an initiative established during the Rio Earth Summit in 1992. The COP meetings include representatives from 198 nations, encompassing a wide range of economic and social development contexts. COP29 specifically aimed to advance efforts to limit global temperature rise to well below 2 degrees Celsius compared to pre-industrial levels, with aspirations of staying within 1.5 degrees Celsius.

The focus on pre-industrial benchmarks is critical because the current acceleration of anthropogenic carbon emissions can be traced back to

industrialisation. The unrefined and extensive use of coal in the Global North not only enabled rapid and unequal socioeconomic development but also initiated a "runaway" greenhouse gas effect. This process intensifies extreme weather patterns, disproportionately impacting vulnerable nations. This disproportionality is further evident in greenhouse gases linked to Global North vs Global South trading (Figure 1). COP meetings aim to address these disparities by supporting global interventions that enable carbon mitigation technologies and by mobilising financial resources to assist the most affected nations in achieving energy security and mitigating climate change risks.

Several key outcomes emerged from COP29: (1) Reaffirmation of the Need to Transition Away from Fossil Fuels:

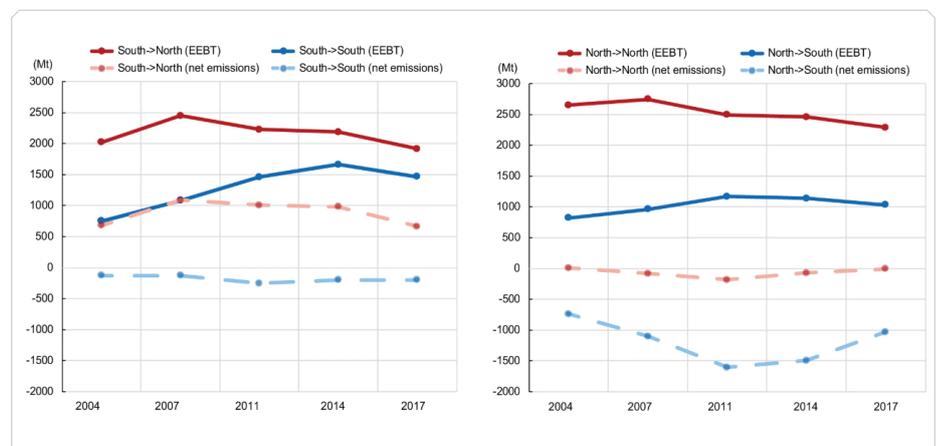


Figure 1: Overview of emissions linked to various Global North and Global South trading (Meng et al., 2023<sup>1</sup>).

<sup>1</sup> Meng, J., Huo, J., Zhang, Z., Liu, Y., Mi, Z., Guan, D. and Feng, K., 2023. The narrowing gap in developed and developing country emission intensities reduces global trade's carbon leakage. Nature Communications, 14(1), p.3775.

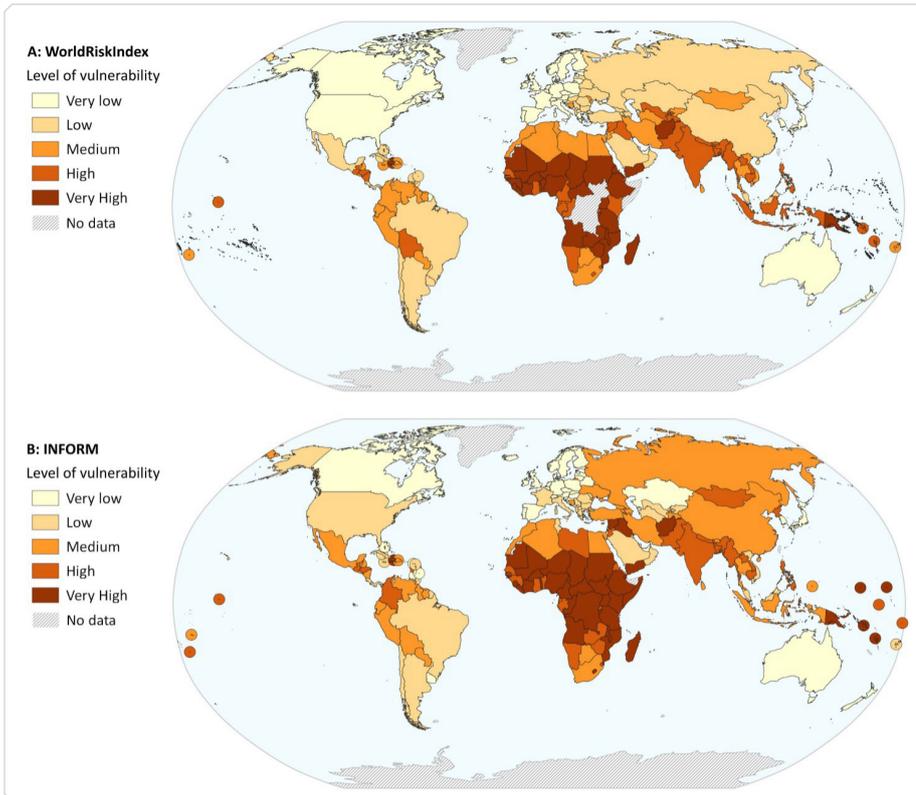


Figure 2: Global risk maps highlighting countries with the highest risk and vulnerability profile associated with continued extreme weather patterns (Birkmann et al., 2022<sup>2</sup>).

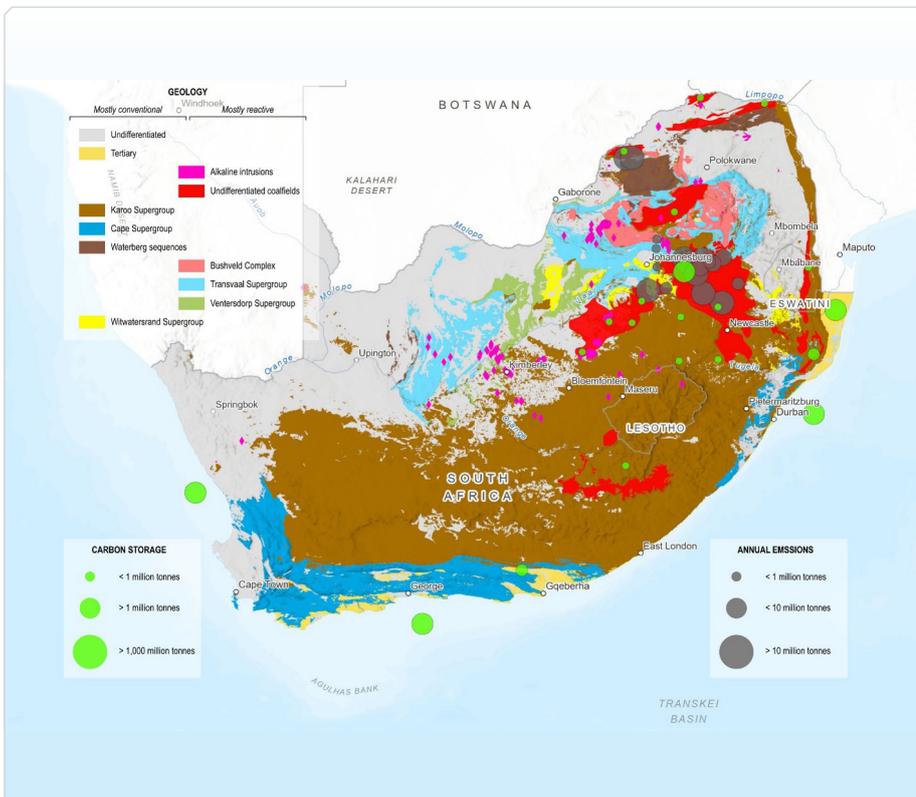


Figure 3: Overview of potential CCUS sites around South Africa. Map also indicates coalfields and large point source carbon emitters<sup>3</sup>.

Discussions included the gradual phasing out of fossil fuel investments and development, including oil, gas, and coal resources. (2) Accelerated Development of a Global Carbon Market: Efforts were made to streamline carbon trading mechanisms between high- and low-carbon-emitting nations. (3) Commitments Toward Risk and Vulnerability Funding: Plans were discussed to ensure that the nations most vulnerable to climate change effects have access to necessary funding to mitigate these risks. Figure 2 presents an overview of global climate change risk and vulnerability. (4) Gender Equity in Climate Change Action: The meeting highlighted the importance of inclusivity and greater gender equality in addressing climate change.

Despite ambitious goals, the funding pledged to support developing nations fell significantly short of expectations. While there were hopes for an annual allocation of USD 1.3 trillion from 2025, the final commitment amounted to only USD 300 billion per annum by 2035. This shortfall has underscored the urgency of innovative, region-specific solutions that cater to the Global South.

The Council for Geoscience (CGS) has been a consistent contributor to COP discussions, presenting Africentric solutions for a Just Transition. This approach prioritises the socioeconomic development of natural resources while mitigating associated anthropogenic carbon emissions. At COP29, CGS focused on the development of Carbon Capture, Utilisation, and Storage (CCUS) technologies in South Africa. Presentations included the geological and environmental characterisation necessary for CCUS implementation and outlined how an approximate investment of ZAR 1 billion could generate a carbon market hub valued at USD 2 trillion annually. Furthermore, CGS demonstrated how these technologies could mitigate the carbon emissions associated with South Africa's reliance on coal. Importantly, the CGS presentation highlighted that South Africa has significant storage volumes

<sup>3</sup> Dhansay, T., Maupa, T., Twala, M., Sibewu, Z., Nengovhela, V., Mudau, P., Schalenkamp, M., Mashale, N., Muedi, T., Ndou, C. and Zilibokwe, N., 2022. CO<sub>2</sub> storage potential of basaltic rocks, Mpumalanga: Implications for the Just Transition. *South African Journal of Science*, 118(7-8), pp.1-7.

to reduce the country's anthropogenic carbon emissions. Much of this remains available to enable dedicated carbon markets (Figure 3).

The CGS's proposals were well-received for their technical rigor but faced resistance due to prevailing geopolitical dynamics and opposition to fossil fuel-based solutions. The Africentric nature of CGS interventions emphasises the importance of enabling regionally tailored technologies through firm local

commitments. Moreover, it highlights the prowess of African scientists and their ability in representing innovative and inclusive research on the global stage.

This work is far from complete. The Council for Geoscience is now shifting towards pilot-scale development of CCUS technologies. This move aligns with the vision of driving a Just Transition in South Africa and similar developing nations. By fostering inclusive development and advancing climate

change mitigation, CGS aims to achieve tangible progress in reducing carbon emissions while supporting economic growth. The CGS committed to have injected anthropogenic carbon dioxide successfully and sustainably before the next COP meeting.

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## 6<sup>th</sup> Southern African Development Community (SADC) Groundwater Conference, 13-15 November 2024, Maseru, Lesotho

The 6<sup>th</sup> Southern African Development Community (SADC) Groundwater Conference was held in Maseru, Lesotho, from 13<sup>th</sup> to 15<sup>th</sup>, November 2024 under the theme "*Promoting Peace Across Borders through Conjunctive Water Management*". This theme was inspired by World Water Week's initiative, "Bridging Borders: Water for a Peaceful and Sustainable Future," and seeks to foster collaboration in water management to enhance peace and security. The event featured high-level plenary sessions focused on subthemes such as advanced technologies, establishing innovative governance structures, and harnessing data.

The conference was organised by the Department of Water Affairs through the Government of Lesotho and Ministry of Natural Resources. It was attended by delegates of the SADC Region including the Ministry of Natural Resource: Kingdom of Lesotho Honourable Mhloni Moleko, Dr. Alice Aureli who is the Head of the UNESCO IHP Groundwater Resources and Water Cooperation Department, Ms. Palesa Mokorosi who is the Senior Water Resource Specialist Water Global Practice, World Bank, as well as the Executive Director of SADC-GMI Mr. James Sauramba.

Four delegates from the Council for Geoscience (CGS), namely

Ms. L. Ligavha-Mbelengwa, Ms. S. Makubalo, Ms. G. Mohale, and Ms. S. Ramugondo attended the conference. Ms. L. Ligavha-Mbelengwa delivered an oral presentation titled "**Occurrence and spatial distribution of emerging organic contaminants (EOCs) in surface water, groundwater, and mine shafts in Gauteng, South Africa.**" This study aimed to understand the occurrence and spatial distribution of EOCs in various water resources, including surface water, groundwater, and mine shafts, within the Eastern Basin of the Witwatersrand Goldfields. Her presentation emphasised that understanding the occurrence and distribution of these contaminants is crucial for identifying potential sources of contamination and assessing long-term water quality risks, which provide valuable insights for effective water management and protection.

Ms. G. Mohale gave a talk on "**Hydrogeological Characterisation of the impact of climate change and anthropogenic factors on groundwater resource in the Klein Letaba River Catchment, Mopani District of Limpopo Province.**" This research study used groundwater modelling to simulate groundwater flow and evaluate the fluctuations of water levels in response to the impacts of climate change and anthropogenic factors to understand the extent of

groundwater vulnerability in the area. From this research, it is evident that the impacts of climate change and anthropogenic factors have considerable impact on groundwater resources in the study area and this will have detrimental environmental effects due to the reduction in baseflow towards the low-lying areas which includes communities around the town of Giyani.

The lessons and highlights from the conference as outlined below can be implemented in some of the ongoing ground water projects at the CGS.

### Hydrogeological Mapping Programme

There is generally insufficient knowledge in groundwater research highlighting the need for improved data coverage on water isotopes and hydrochemistry. Expanding hydrogeological characterisation is essential to assess the impacts of climate change and anthropogenic activities on groundwater resources.

Updating hydrogeological maps to higher resolution is another priority in South Africa, necessitating collaboration to avoid duplication of the work and misalignment of map products. The CGS is already mapping hydrogeology at 1: 100 000 scale, while the Department of Water and Sanitation (DWS) is mapping at 1:250 000 scale. Since the objectives

align, a collaboration between these organisations will ensure consistency, alignment, and high-quality mapping products. Collating of the already existing groundwater data through partnerships is crucial for developing comprehensive, informative hydrogeological maps.

### Managed Aquifer Recharge (MAR)

MAR offers a potential solution to address the increasing demand for groundwater. However, it is important to understand that MAR with treated effluent and stormwater can introduce

EOCs. Therefore, while MAR serve as a solution to water demand pressures, it requires regular monitoring and treatment adjustments to mitigate the risk of contaminants entering the systems. However, a key challenge in this process remains the lack of regulated standards for EOCs. Therefore, understanding EOC behaviour and implementing subsurface monitoring are crucial steps towards establishing threshold concentrations that can give an indication of groundwater vulnerability to contamination.

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## JOGMEC (Japan Organisation for Metals and Energy Security)

### SOUTHERN AFRICAN REMOTE SENSING WEEKS 2024

Hosted @ JOGMEC Botswana  
Geologic Remote Sensing Centre

#### Background

The Council for Geoscience (CGS) team participated in the **JOGMEC Southern Africa Remote Sensing Weeks 2024**, held in Gaborone, Botswana, with representatives from 12 Southern African Development Community (SADC) countries in attendance. The JOGMEC Remote Sensing Weeks included a two-week workshop and one week competition. This annual event,



Figure 1: left: Mr. Kurihara Masaomi (JOGMEC: General Manager), Ayanda Lawu (CGS), Mzoli Breakfast (CGS) and (JOGMEC).



Figure 2: Workshop participants from SADC countries.

organised by JOGMEC, has been hosted in Botswana since 2009 to promote and enhance mineral resource exploration technologies using Remote Sensing and Geographic Information Systems (GIS).

### Workshop and Competition

The workshop was attended by 24 participants from across the SADC region with each country represented by two participants. The CGS was represented by Dr. Thomas Muedi and Mr. Sifiso Bucibo from Minerals and Energy and Technical Services units, respectively.

The first half of the workshop focused on foundational topics, such as accessing free satellite imagery from sources like ASTER, Sentinel, and LANDSAT. The second half delved into applied topics, including advanced analysis and processing techniques using QGIS open-source software, as well as leveraging data for field surveys.

In the competition segment, CGS was represented by Mr. Mzoli Breakfast (Minerals and Energy unit) and Mr. Ayanda Lawu (Knowledge Management unit), competing alongside teams from 12 other SADC countries. The challenge required participants to apply advanced remote sensing techniques and integrate multiple datasets to enhance and support the mineral exploration. Each team selected a unique target, and the CGS team focused on exploring porphyry copper deposits by identifying alteration zones critical to mineral prospectivity. Through innovation, teamwork, and meticulous analysis, the CGS team utilised remote sensing methods such as PCA, band ratios, and false-color composites, showcasing the organisation's expertise in mineral exploration.

Within the competition segment, CGS was represented by Mr. Ayanda Lawu and Mr. Mzoli Breakfast, who competed alongside teams from twelve other Southern African Development Community (SADC) countries. The challenge required participants to employ advanced remote sensing techniques and integrate multiple datasets to address issues related to



Figure 3: CGS team preparing and processing data for a competition presentation.



Figure 4: (a) Mr. Mzoli Breakfast presenting on "Anomaly delineation of porphyry copper deposits in Okeip / Springbok regions through Remote sensing techniques". (b) CGS team with Mr. Kurihara Masaomi (JOGMEC: General Manager) in the middle. (c) JOGMEC 1st price certificate with a trophy.

mineral exploration effectively. Each team selected a distinct target for their analysis, with the CGS team focusing on the exploration of porphyry copper deposits within the Namaqua Mobile Belt.

The CGS team concentrated on pinpointing alteration zones associated with the porphyry copper deposit. By employing innovative techniques, fostering collaboration, and conducting comprehensive analyses, the team skillfully utilised remote sensing methodologies. These included Principal Component Analysis (PCA), band ratios, and false-color composites to delineate the alteration zones (Figure 5).

Additionally, the team integrated the remote sensing findings with other geospatial data sets that encompass geology, geochemistry, and geophysics, thereby enhancing the understanding of these alteration zones.

The competition also highlighted the integration of remote sensing with geology, geophysics, and geochemistry to unlock exploration potential. On the final day, all teams presented their analysis, with their results evaluated by Japanese experts and fellow participants. The CGS team emerged victoriously, claiming first place.

This achievement is a testament to CGS's commitment to excellence, continuous learning, and collaboration. We are proud to have brought home the top award and look forward to applying these insights to advance our mineral exploration initiatives.

## Conclusions

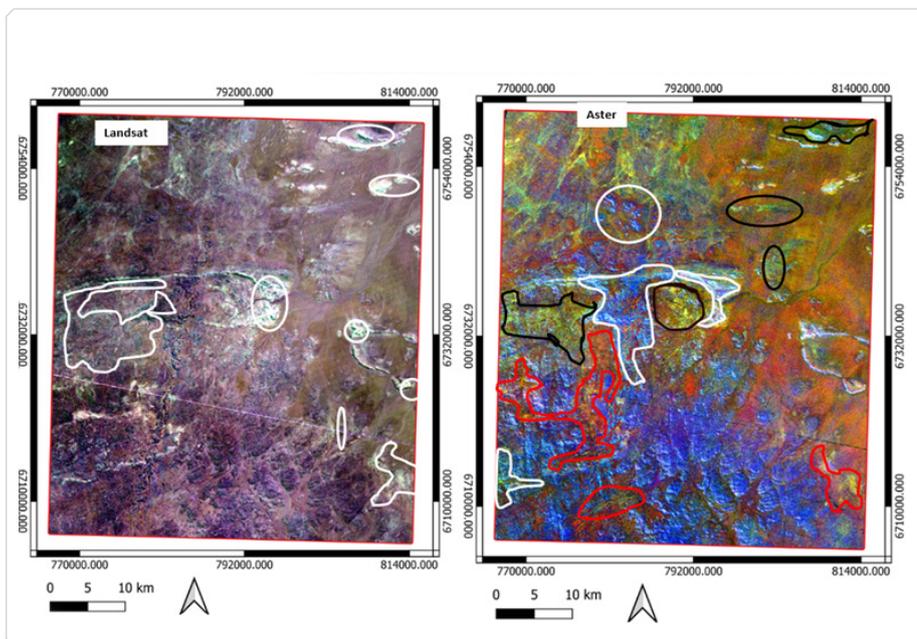
The (CGS) possesses an extensive collection of datasets, particularly in the domains of remote sensing, geochemistry, and geophysics, which are vital for exploration in "greenfield" areas. By strategically leveraging these datasets, the CGS has the potential to significantly enhance its ability to identify and prioritise areas of geological interest. This strategic approach aims to increase exploration activities by 5% across the nation.

Furthermore, by employing 1:50,000 scale mapping to integrate these diverse datasets, CGS can enhance the precision and effectiveness of exploration endeavors. Specifically, the integration of remote sensing, geology, geophysical, and geochemical data provides a comprehensive analytical framework that is poised to vastly improve the scope and detail of exploration.

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**Figure 5:** (a) Landsat band ratios  $[(4/5)-(3/2)]$ ,  $[(4/6)-(3/2)]$ ,  $[(4/7)-(3/2)]$  delineate argillic alteration zones (muscovite, kaolinite), in green and white. (b) Aster band ratios (R=7/6, G=5/6, B= 9/8) delineate argillic alteration zones (biotite, muscovite), in green phyllic alteration zones, in yellow to reddish (sericite, quartz). Propylitic alteration zones, (chlorite, epidote) in light blue.

## Exploring Cornwall's development of geothermal energy

The Council for Geoscience delegation visited several active geothermal exploration, development, and utilisation sites around the Cornwall region in 2024. These geothermal sites focus on developing heat to support food security, power, and critical mineral extraction.

The Cornwall region of the UK has a rich history of geothermal development that dates to the early 1950's. Importantly,

geothermal development is intricately linked to considerations of post-mining closure and utilisation. Many of the geothermal development sites are currently being built around abandoned, and active mining regions.

### Eden Project

The Eden Project consists of several large greenhouse biomes and agricultural

development initiatives. These were built in a discarded China clay mine that had reached its end of life. The mine itself was in one of the large Cornubian Batholith plutons. The granite pit itself highlighted elevated heat flow signatures, which correlated with the elevated geothermal gradient in the Cornwall region. The greenhouse biomes required a significantly large supply of energy. The energy supply requirements especially

focused on a constant heat supply that is needed for temperature control and for use in the various horticulture processes. Various energy investigations highlighted geothermal energy as being the most promising source of heat. The Eden Geothermal Project was thus started with a focus on providing a sustainable and baseload heat, and ultimately power to supply the greenhouse biomes.

The Eden Geothermal Project is largely privately funded. It has a total funding amount of 23.6 million British Pounds (c. R 550 million). The project aimed to drill at least approximately 5 km deep into the granite. It was modelled to intersect a c. NW-SE oriented fracture controlled permeable horizon that would provide a geothermal heat source of approximately 200 degrees Celsius. While drilling, a highly permeable fracture network was instead intersected at c. 4.87 km. This feature appeared as a steeply inclined feature that was responding to the surrounding stress as a strike-slip to normal fault. This fracture zone proved to be significant enough to provide geothermal temperatures for specific heat generation (i.e., c. 170 degrees Celsius). This was an important discovery because limited funding forced the project to develop the shallower reservoir and focus on heat production. Energy generation is targeted for later development. Moreover, the funding constraints also forced the project to drill only one well, which served as both the injection and production well, i.e., as a coaxial design. This is not efficient because of the proximity of the cold injected waters and the hot production waters. While the reservoir temperatures are 170 degrees Celsius, the water temperature at the surface is only c. 75 degrees Celsius. The Eden Geothermal Project drilling operations took a total of 162 days and was completed in October 2021. The total well depth is 4,871 metres and 5,277 metres total measured depth.

Future development of the Eden Project is focussing on raising additional capital to support the drilling of an additional well. This will enable a dedicated injection and production well. It is envisaged that this design would enable higher thermal efficiencies. The increased efficiency will therefore enable the development of



Figure 1: View of Eden Project: Original Open pit mining of China clay (top) and rehabilitated pit into greenhouses, housing the rain forest and mediterranean biomes of the world (bottom) (i.e., edenproject.com).

power production. Currently the project produces 4.0 GW of energy for heating the greenhouses.

#### United Downs

The United Downs and the Eden Geothermal Project are relatively closely located and are targeting similar geological controls. The United Downs project has acquired funding of approximately 40 million British Pounds. The funding is primarily sourced from various private and public entities.

This includes the main shareholder, Geothermal Engineering Limited and the Cornwall Council. Much of the initial research focused on the development of the geological model that could be used to define the prospective geothermal reservoir and defining a feasibility model. The study noted key stress controls that would enable the formation of dilation fractures. The models suggest geothermal temperatures of 180 degrees Celsius at reservoir depths of approximately 5 km. The target feature appeared as a steeply-

incline fracture zone. Importantly, the surrounding country rock was modelled to be relatively impermeable. Therefore, much of the development focused on the dilation features. These were further modelled to be favourable for energy generation at pumping rates of around 50 litres per second.

Drilling of the United Downs Project was completed between November 2018 and June 2019. The production well was drilled to a total well depth of 5,275 metres. The injection well was drilled much shallower and reached a total well depth of 2,393 metres. The shallowing was to enable the downward flow of the cold injected fluid. The downward flow was modelled to be highly efficient and enable the heating of the working fluid. The two wells are separated by 8 metres at the surface and are deviated by about 35 degrees at a depth of 4 km.

Seismicity is often associated with geothermal energy development. A high-density seismic array was installed throughout the United Downs development phase. At least 18 seismic events were recorded during the drilling operations. In general, these events were all at a magnitude of less than zero. The seismic events were concentrated at two depths, i.e., 4,417 metres and 4,890 metres. There are several possibilities for the depths. These may include larger dilation zones, or the occurrence higher permeability linked to changes in the granitic composition. Injectivity tests were undertaken after drilling. Flows rates of between 900 to 4,000 litres per minute was used. At least 300 events occurred during these tests. The largest recorded a magnitude of 1.7 and was largely felt by the surrounding communities. The occurrence of these events correlated with the modelling clusters as recorded during drilling.

### Cornish Lithium

Geothermal exploration in the Cornwall region highlighted the presence of highly concentrated lithium brines at geothermal reservoir depths. Studies highlighted that the lithium is sourced from mica minerals present in the surrounding granitic rocks. The exposure to geothermal waters over

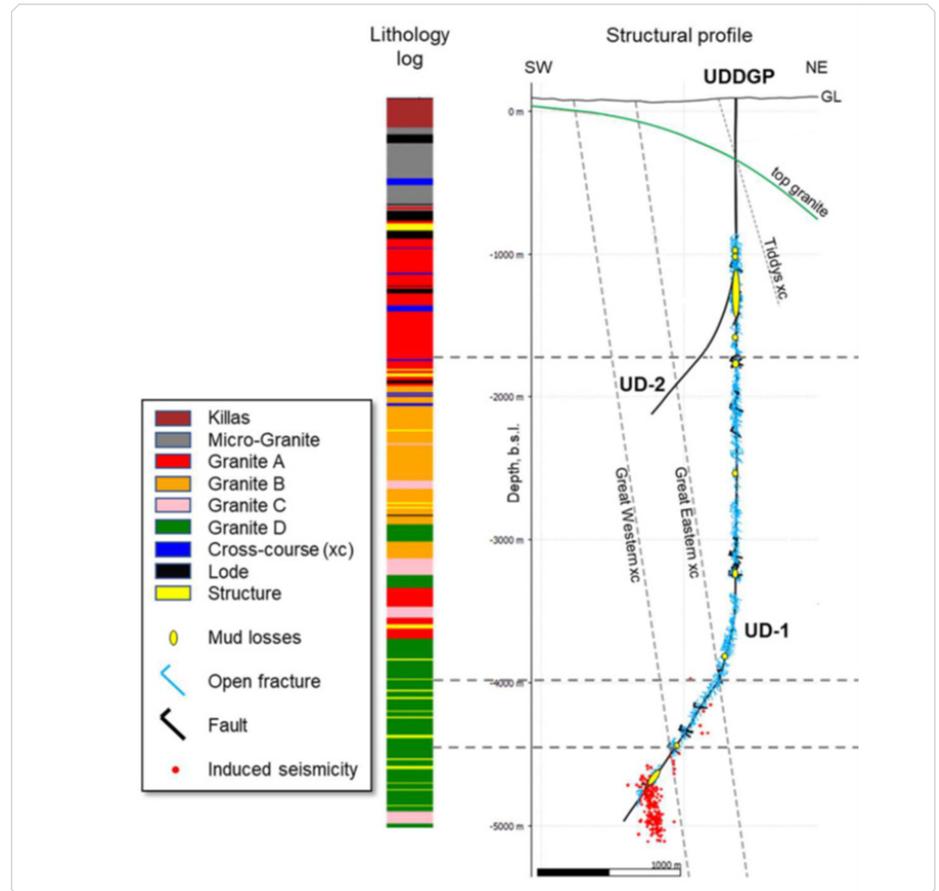


Figure 2: Schematic view of the drilled boreholes including key structural features (i.e. Reinecker et al., 2021).

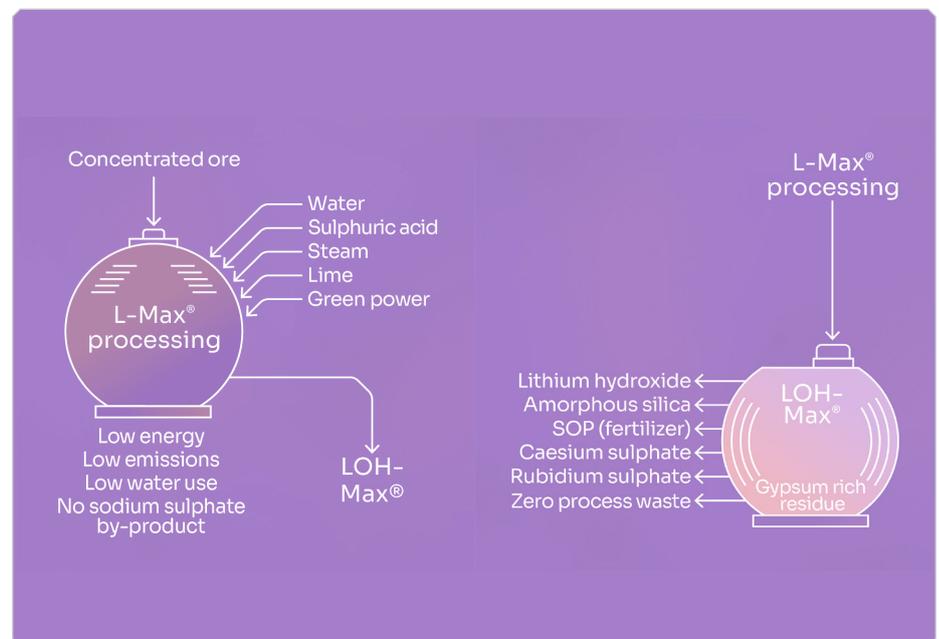


Figure 3: Schematic overview of the direct lithium extraction being employed at Cornish Lithium (i.e., lepidico.com).

time extracts the lithium from the country rock and concentrates in the geothermal waters. The geothermal waters highlight lithium concentrations of up to

300 PPM, equating to a total resource of approximately 52 million tonnes at a grade of 0.24% lithium oxide. The Cornish Lithium project raised capital of

approximately 20 million British Pounds. A proportion of this amount was largely crowd funded. The money was invested in developing the first direct lithium extraction plant in the UK. The lithium extraction technology is partnered with Lepidico, which is an Australian based company developing technologies to extract lithium from mica. Cornish Lithium has an exclusive right to employ this technology in the UK.

In general, this has been a highly troublesome process for the last

decade. As much as half of possible lithium resources from a prospective pegmatite region can be locked in mica mineralisation. The extraction process itself is relatively straightforward, in principle. The lithium salts are leached from the geothermal waters as lithium chloride. Its then selectively extracted from the solution through various temperature and pH controls. The process has a reasonably small heat requirement, which is aimed to be accommodated through the geothermally produced heat from the same brine

waters. The geothermal brines also have various other metal resources, e.g., rare earth elements. The process will be adapted to extract these minerals too.

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## CGS among the Top Players at the Mineralisation Summit in Iceland

### Background

Carbfix Mineralisation Summit is an event focused on carbon capture and storage technologies. The purpose of the summit is to bring together experts, policy makers, industry leaders, academics, students and other stakeholders, to share the latest research and developments in mineralisation, and to facilitate discussions and collaborations around this important topic. One of the main goals of the Carbfix Mineralisation Summit is to promote awareness and engagement around mineralisation technologies which play a vital role in reducing greenhouse gas emissions and mitigating the impacts of climate change. Most importantly, the summit provides a platform to discuss challenges and opportunities associated with the deployment of this unconventional method. The first and second editions of the Carbfix Mineralisation Summit took place in Reykjavik (Iceland) in 2023 and 2024 respectively. This year's summit had 3 CGS delegates in attendance.

### Let's take it back, shall we?

We have all witnessed the devastating impacts of climate change in the world and we are currently experiencing its effects right here in South Africa during our lifetime. This is due to various influencing factors that lead to the emissions of CO<sub>2</sub> and other greenhouse gases into the atmosphere. The primary



Figure 1: CGS delegates pose for a picture at the summit. From left: Dr. Frederic Doucet, Ms. Zama Sibewu and Dr. Taufeeq Dhansay.

contributor is the coal industry, because South Africa still heavily relies on coal for energy generation, followed by the steel and manufacturing industries. What then happens to all the excess CO<sub>2</sub> that accumulates in the atmosphere? South Africa must take action to reduce CO<sub>2</sub> emissions while still utilising our valuable coal reserves.

Countries around the world are adopting this technology, with Iceland being the first to demonstrate its effectiveness. There is an urgent need to implement this technology, and the CGS is well-

positioned to do so. Naturally, there are concerns surrounding this technology, especially because it is a new concept in the South African context and in Africa as a whole. Essentially, this process occurs naturally, we are merely accelerating the rate at which it occurs, because of the urgency at which the intervention needs to take place.

### Conference highlights

Following the extensive geological characterisation that was completed by the CGS's CCUS team, which has since

published a paper on the subject, the CGS has gained global recognition. The next crucial step involves conducting laboratory scale experiments, which will guide the injection model of the injection well. Due to the advancements made by the CGS, the organisation was invited to attend a Mineralisation Summit on 12-13 September 2024. The delegation consisted of three CGS staff members, Dr. T. Dhansay, Dr. F.J. Doucet and Mrs. Z. Sibewu (Figure 1).

The conference attracted 650 participants. The program consisted of a cohort of esteemed speakers, which included our very own Dr. Taufeeq Dhansay. Dr. Dhansay delivered an

oral presentation entitled “Teaching an old basalt new tricks: Carbon Capture, Utilisation and Storage in South Africa” that presented the South African CO<sub>2</sub> test injection project (Figure 2a). He emphasised the multi-disciplinary approach employed by the CGS for this initiative. He captured the audience from his striking presentation title, to emphasising South Africa's stance on plans to burn coal for decades but doing so in a cleaner and sustainable manner. He further outlined our next critical steps and expressed the CGS's openness to mutually beneficial partnerships. His presentation generated significant interest, and participants were queuing to talk to the CGS team (Figure 2b), leading

to many enquiries in our research, new collaboration opportunities with potential partners such as the U.S. Pacific Northwest National Laboratory, and strengthening of existing partnerships.

The conference concluded with a visit to the Carbfix operating site, which consists of the geothermal plant that heats up the town, the injection and monitoring wells, as well as the largest direct air capture (DAC) plant known as Mammoth. The participants were taken through the entire operation in smaller groups (Figure 3), where they got to appreciate the technology, the process and the not so pleasant smell of H<sub>2</sub>S gas.

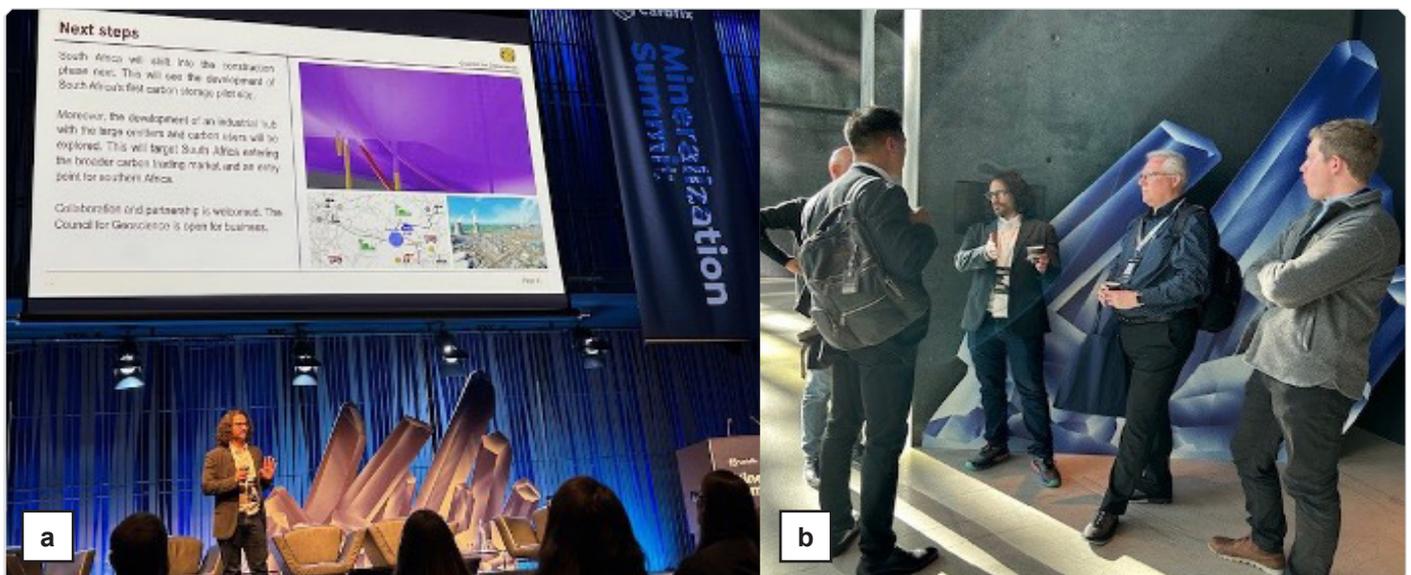


Figure 2: (a) Dr. Dhansay delivering his captivating presentation at the main stage. (b) The CGS team engaging further with interested parties.



Figure 3: The participants of the conference were taken to the Carbfix operating sites. (a) wider view of the site, and (b) inside the igloo structure which houses both the injection and monitoring wells.

The conference ended on a high note with a cocktail party, which further allowed for networking in a more informal setting.

#### So, what's next?

The CGS team came back from the summit in high spirits and with great enthusiasm to do more. We have been exploring the idea of developing the very first DAC system at the Leandra site, which is a technology used to capture CO<sub>2</sub> from the air. The idea is still in its infancy and much research and investigations are being undertaken. Progress is rather slow with the lab scale experimental design, which

necessitated that we employ other means of answering the scientific questions, “will the Klipriviersberg basalts react? How long will it take for the carbonates to form?”. Science must continue; therefore, a forward approach was undertaken to simulate the mineralisation process. Computational simulations of the proposed reservoir conditions were undertaken using the React module in the Geochemist’s Workbench. The programme enables geochemical modelling and the calculation of stable isotopic fractionation. The simulations were run using different water sources, which include acid mine waters, deep saline waters, portable waters and treated acid mine waters. The preliminary

results of the computational simulations suggest that mineralisation is possible in our proposed Leandra site. The next step is the construction of the injection well, with the ultimate prize being the safe and permanent sequestration of anthropogenic CO<sub>2</sub>.

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## CGS Geophysicists and Seismologists rocks the SAGA conference in Namibia

A delegation of CGS Geophysicists and Seismologists attended the recently held biennial Southern African Geophysical Association (SAGA) conference in Windhoek, Namibia, during the first week of October, 2024. This year’s event was the 18<sup>th</sup> edition of the prestigious SAGA conference and exhibition.

The theme of the event was:

“Collaborative Geoscience for critical supply” which signified a call to action amongst geoscientists to seek innovative solutions to critical economic imperatives within our respective countries, using collaborative efforts and multidisciplinary approaches to meet the growing demand for discovery of new mineral deposits and other valuable commodities. The technical sessions held during the conference were an ideal platform to engage directly with partners, clients, experts and showcase one’s scientific work. The conference attracted a range of delegates, which included: Geophysicists, seismologists, geologists, hydrologists, junior mining companies, petroleum companies, equipment manufacturers, geoscience consultants, researchers and many more. Attendees came from mainly the SADC region, North and West Africa, Asia, Europe and some from the North American countries.



Figure 1: CGS Executive Manager for Integrated Geosciences Development and leader of the delegation at the conference, Mr. Willem Meintjes giving a speech at the opening day of the conference.



Figure 2: CGS scientists posing for a picture.

The CGS was strongly represented at the event with a team including the Executive Manager for Integrated Geosciences Development, Mr. Willem Meintjes who led the CGS delegation, and also delivered a speech on behalf of the CEO. The speech encompassed the strategic objectives and the mandate of the CGS, and the CGS's contribution to the current economic recovery efforts through exploration for critical minerals and other important projects currently being undertaken.

The CGS delegation comprised of 8 scientists who were participating through giving oral presentations, posters presentations and workshop attendances. At the request of the CEO, the delegation also included a young junior scientist who had travelled to gain valuable experience and exposure of such international conferences. The Council for Geoscience secured a gold sponsorship package for the event, to raise the profile of the CGS brand and highlight its programs, as well as bolstering the organisation's participation in the conference alongside the presentations. The CGS had an exhibition booth which was manned by CGS's Ms. Mahlako Mathabatha and Ms. Karabo Mphuthi, who were supported by CGS technical colleagues. The exhibition booth showcased geophysics maps as a drawcard for participants and distributed promotional material and advocacy for marketing purposes.

As expected, the SAGA Conference maintained, and even elevated its standards of delivering on an informative, engaging, insightful and very well attended conference. The quality of the presentations and workshops offered was world class. The CGS presenters also showcased their work and current projects, to gauge their standards with industry standards. CGS speakers presented on their current scientific activities in line with the current integrated geoscience mapping programme. Most of the CGS presentations were hailed as outstanding, groundbreaking and industry leading research work which is valuable to the exploration industry and the geoscientific fraternity as a whole.



Figure 3: Ms. Mpumelelo Dube giving a presentation.



Figure 4: The CGS delegation that participated at the 2024 SAGA conference.

The CGS delegation of attendees at the conference garnered valuable lessons, and experiences from the conference. These included opportunities to network with fellow industry peers, to connect with academics in similar fields, learn from experts in particular disciplines, and to showcase one's scientific works and receive critical feedback from their peers. Attendees also gained opportunities to keep abreast with the latest developments in the Geophysics industry through engagements with manufacturers of state-of-the-art geophysical equipment and software developers to ensure continual innovation at the CGS.

Some of the main takeaways from attending the conference were that the CGS exhibition and presentations raised the CGS flag high, by promoting the visibility of CGS' brand, the data portal, research and innovation initiatives and the CGS resounding commitment to scientific excellence. The lessons learnt from the conference attendance included gaining an appreciation of the new advances in application of geophysics for exploration purposes, imminent innovations in exploration, advances in the use of conventional airborne systems, integration of multidisciplinary geophysical approaches, latest innovations in the data analytics space and many more.

As expected, the conference didn't disappoint when it came to social conferencing side of things. A number of meet and greet sessions were encouraged during the conference, as well as specifically planned social events. These included the Safari

themed night out and an Octoberfest themed networking dinner, which gave attendees an experience of celebrating scientific excellence with a bit of song and dance, while enjoying the majestic beauty that the host country offers.

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## CGS Supports the Department of Mineral and Petroleum Resources at the 26<sup>th</sup> China Mining Conference and Exhibition in Tianjin, People's Republic of China

### Background

The Department of Mineral and Petroleum Resources (DMPR) participated in the 26<sup>th</sup> China Mining Conference and Exhibition in Tianjin, China, from October 15-18, 2024. This international multi-stakeholder investment promotion drive focused on diverse topics, including the global economy, mining trends, policies on investment and finance, geological exploration, and green mining development.

The department invited the Council for Geoscience to join the Minister in this initiative, with the goals of explaining mining policies and regulations, clarifying mining rights transactions, attracting investment, and addressing mine health and safety issues alongside sustainable development.

### Conference Attendance

The delegation of DMPR including the officials from the respective state-owned entities consisted of the following:

1. Mr. Tseliso Maqubela, Deputy Director General, DMPR
2. Mr. Mosa Mabuza, Chief Executive Officer, CGS
3. Ms. Nosiphiwo Mzamo, Chief Executive Officer, SDT
4. Mr. Cecil Khosa, Chief Executive Officer, SADPMR.
5. Dr. Jones Papo, Executive Mining Materials and Automation, Mintek



Figure 1: South Africa's Exhibition Pavilion.

6. Mr. Bothlale Seageng, Director of Investment Promotion, DMPR
7. Ms. Mahlatse Mononela, Manager: Communications and stakeholder relations, CGS
8. Mr. Sibongiseni Hlatshwayo, Manager: Technical Services, CGS
9. Mr. Clement Ndou, Acting Section Head, Knowledge Management Unit, CGS.

### The bilateral meeting between the Council for Geoscience and the China Geological Survey

The Council for Geoscience had a bilateral meeting with the China Geological Survey with the intention

to strengthen cooperation on mutual geoscientific research and other related technological interventions. The bilateral meeting was led by Minister Wang Guanghua; Minister of Natural Resources; P.R. China and Minister Gwede Mantashe, Minister of Mineral and Petroleum Resources, supported by their respective delegations of officials and their state-owned entities. The Memorandum of understanding (MoU) was signed by the Council for Geoscience and the China Geological Survey.

### South Africa Investment Seminar

The DMPR hosted a South African investment seminar co-led by Minister of Minerals and Petroleum Resources, Mr. Gwede Mantashe, and Mr. Cheng Liwei from the China Mining Association.

The seminar focused on sustainable economic growth and social responsibility, highlighting the importance of continuing bilateral programs between South Africa and China, stemming from a state visit in September 2024.

Dr. Siyabonga Cwele, South Africa's ambassador to China, emphasised China's role as Africa's largest trading partner since 2012, noting a \$25 million investment in South Africa aimed at boosting economic growth and employment, particularly in the mining sector. Minister Mantashe introduced a DMPR panel of experts and highlighted Mintek's activities, including revitalising the ferroalloys and iron ore industries, energy storage initiatives, and developing medical diagnostics manufacturing.

The Council for Geoscience provided insights into geological mapping efforts in South Africa, aimed at uncovering untapped mineral resources. Mr. Mabuza discussed critical minerals that support energy transitions and announced a mineral exploration fund of approximately R400 million to support prospecting rights holders.

Investors learned about the regulatory framework from the MPRDA act, which has provided stability since 2002 and governs the issuance of mining rights. The mining charter, promoting 26% ownership for historically disadvantaged citizens, faces challenges concerning financial returns. South Africa currently oversees 948 mining operations

### Highlights of the Exhibition

The Minister of the Department of Mineral and Petroleum Resources, Hon. Gwede Mantashe, along with Ambassador Dr. Siyabonga Cwele and DDG Mr. Tseliso Maqubela, visited the South African exhibition stand where Mr. Clement Ndou from the Council for Geoscience (CGS) presented the pilot Virtual Core Library (VCL). This demonstration showcased how users can remotely access the country's drill core depository through an interactive map and virtual images generated by a Hyperspectral scanner, along with a suite of mineral image products from boreholes.



Figure 2: South Africa Investment Seminar's panel led by Minister Gwede Mantashe.



Figure 3: CGS bilateral talks led by CEO Mr. Mabuza with the China Metallurgical Geology Bureau (CMGB) delegates.



Figure 4: Mr. Clement Ndou presenting the Virtual Core Library to the Minister and his delegation.



The CGS team, led by Mr. Sibongiseni Hlatshwayo, also interacted with various drilling equipment manufacturers to evaluate their drill rigs based on several criteria, including drilling depth, costs, training, maintenance, and delivery timeframes as part of a benchmarking exercise.

### Conclusions

The Mining Investment Conference in China was a success, with the investment seminar highlighting opportunities for exploration and mining. A key achievement was the MoU signed between the Council for Geoscience and China Geological Survey, paving the way for collaborative geoscientific programs.

Further cooperation with China was explored, particularly with the China Metallurgical Geology Bureau. Several Chinese entities expressed interest in partnering with the Council for Geoscience for research and exploration investment. The upcoming Mining Indaba in February 2025 offers an opportunity to finalise cooperation agreements with Chinese entities and investors.

Figure 5: CGS team with drill rig exhibitors.

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## CGS community outreach through air quality monitoring project

### Background

The Council for Geoscience (CGS) has set its focus on mitigating the effects that the asbestos mines and dumps have on the surrounding environment. The CGS air quality team under the Integrated Research into Mine Closure (IRMC) Project conducts monthly monitoring of the post rehabilitation impact as part of the mitigation process. This is done in selected high-risk sites located close to within human settlements.

During a performance audit on rehabilitation of legacy mines conducted by the Auditor General in 2009, air pollution was identified as one of the major environmental challenges associated with legacy mines. Poor air quality has been reported around the air shed priority areas that affect the former asbestos mining areas such as in Limpopo (LP), Mpumalanga (MP), and Northern Cape (NCP) Provinces.

The air quality research team uses a three-legged research strategy which

is implemented in three different tasks simultaneously. Different complementary methods are used without duplication to answer the Department of Mineral and Petroleum Resources (DMPR) question on the contribution of individual mining sources to airborne dust, air pollution, and climate change. The study is undertaken around human settlements that are near both legacy and operating mines.

## Legislative framework

Section 239 of the Constitution of 1996 defines an organ of state as "... any state department or any other functionary or institution that exercise power or perform a public function in terms of the Constitution or any legislation". The CGS qualifies as an organ of state as it exists through the Geoscience Act of 1993 as amended. Section 8 of the Constitution provides that the Bill of Rights applies to all law and binds all organs of state. A clearest mandate is in section 2(2) of the NEMA (1998), which states that people and their needs must be placed at the centre of environmental management. This article informs about how the air quality team is responding to the needs of local communities around the study areas across the country.

## Stakeholder engagements and air quality fieldwork

In 2022, prior to establishing air quality monitoring stations, comprehensive stakeholder engagement sessions were held. These sessions introduced the research objectives of the project and provided an overview of the Council for Geoscience (CGS), ensuring stakeholders were informed about the organisation's role and the initiative's purpose.

Upon concluding these engagements, the project transitioned to the operational phase, which involved the monthly collection of dust and air quality samples. As the team conducted these field activities, stakeholder confidence grew, fostering regular interactions on various matters. These monthly engagements proved essential for maintaining strong relationships and effective communication, facilitating seamless collaboration.

Several outcomes emerged from these stakeholder interactions. Such as requests for various forms of support were made, including financial assistance, CGS-branded marketing materials, and donations of old office furniture. In particular, the requests for old office furniture donations were escalated to project and Business Unit leadership for consideration and approval, following CGS's internal processes.

The donation of old CGS furniture was approved and successfully implemented at various stakeholders in need. The delivery of these items was met with enthusiasm and gratitude, highlighting the positive impact of these contributions on stakeholder relationships and community goodwill.

## CGS outreach

### Hlapogadi Creche in Limpopo



Figure 1: Hlapogadi Creche staff presenting an NGO certificate to Mr. Motlakeng and accepting the furniture.



Figure 2: Before and after the CGS donated the furniture.

### Bhankara Creche in Northern Cape



Figure 3: Mrs. Saartjie the principal at Bankhara Crèche presenting an NGO certificate to Mr. Motlakeng.

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# Groundwater Short Course by Ground Water Division

The Groundwater Division (GWD) of the Geological Society of South Africa (GSSA) was founded in 1978 to promote professionalism and advance best practices within the groundwater sector. This division comprises a network of scientists and technicians directly or indirectly engaged in the sustainable development of South Africa's groundwater resources, recognised as a finite natural asset. Additionally, the GWD is dedicated to ensuring the preservation of groundwater quality.

From September 16<sup>th</sup> to 19<sup>th</sup>, 2024, the GWD hosted a Groundwater Short Course in Pretoria, South Africa, attracting approximately 20 delegates from various organisations and sectors from across the country. This event served as an excellent platform for the sharing and the exchange of groundwater knowledge, fostering research collaboration and creating networking opportunities among potential collaborators, mentors, and supervisors. The course emphasised engagement, bringing together emerging hydrogeologists and scientists from diverse backgrounds to share insights. Presentations and lectures were delivered by esteemed institutions such as the University of Pretoria, the Department of Water and Sanitation, and Delta H, all encouraging active participation throughout the course.

Participants gained a foundational understanding of groundwater science, acquiring essential skills in sampling, data analysis, and practical field techniques such as aquifer testing. The course also introduced attendees to modern tools and technologies, alongside discussions on recent advancements in research and the regulatory frameworks that govern groundwater management. By the end of the course, participants had gained an understanding of the geohydrological concepts covered leading them to be able to contribute to groundwater studies and the sustainable management of these critical resources.

The Groundwater Short Course was structured into five sessions, each



Figure 1: Groundwater Short Course attendees and presenters on the first day of the course.



Figure 2: Field Day Aquifer pump test demonstration by GPT Consultants.



Figure 3: Field Equipment by GPT Consultants for on-site measurements.

covering a range of relevant topics, including:

- Aquifer Conceptualisation
- Groundwater Governance
- Groundwater Exploration, Sampling Techniques, Modelling, and Data Management
- Field Day and Laboratory Visit

- Geochemistry, Contaminant Hydrology, and Remediation

The Council for Geoscience (CGS) was well represented, with seven attendees: Ms. Lindiwe Nkabane, Dr. Sameera Mohamed, Ms. Khayaletu Madikizela, Mr. Mafeto Malatji, Ms. Phuthi Magasela, Ms. Matseleng Lekgothoane, and Ms. Selaelo Ramugondo. The field day and laboratory visit were particularly engaging, providing a practical

perspective on the theoretical concepts covered in the course. Participants witnessed the entire value chain of water, soil, and rock samples as they were processed in a laboratory setting.

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## Investigation of smoke/fire coming from the ground in the Ratsaka village, Molemole Local Municipality, Limpopo Province

The Council for Geoscience (CGS) received a report of a smoke/fire coming from the ground in Ratsaka Village, located few kilometres east of Morebeng (formerly known as Soekmekaar) in the Molemole Local Municipality, Limpopo Province. According to the community, the smoke started as a small portion on the 22<sup>nd</sup> of October 2024 and expanded to a bigger radius. Upon receiving the request from the Municipality and the Provincial Department (Department of Co-operative Governance, Human Settlement and Traditional Affairs), the CGS sent a team to investigate the cause of the fire/smoke.



Figure 1: The CGS team comprised of (from the left) Dr. Ravi Vadapalli, Ms. Joyce Shongwe, Mr. Mpho Mothetha, Ms. Ongeziwe Mtyelwa, and Dr. Henk Coetzee.



Figure 2: The fire fighters' team from the Capricorn District Municipality (Shift A), from the left Ms. LF Negukhula, Mr. SO van Rensburg, and Ms. SF Mogoboya



Figure 3: Fire on the ground in Ratsaka village, Limpopo Province.

The CGS team upon arrival met with the fire fighters from the Capricorn District Municipality and were informed and observed that the firefighters have been containing the situation by:

- Barricading the site for safety reasons;
- Putting a compulsory 1 metre safety walking zone from the fire because the fire was extending and expanding underground before it surfaces; and
- Digging a trench around the site with the help of a TLB to fill it with water.

*The CGS team's observations are:*

- The area of impact (radius) was found to be bigger than initially reported to the team;
- The site is located in a dried-out wetland; and
- After discussions with the fire fighters and thorough visual inspections, it was found that the fire/smoke was caused by the burning of peat.

The CGS team assessed the area, took pictures, and thermal images using a thermal camera. The thermal camera measured varying temperatures on the burning ground (Figure 4 and Figure 5), the dark colours represent lower (minimum) temperatures, and the brighter colours represent higher (maximum) temperatures. The temperature readings varied from 400 °C to a maximum of

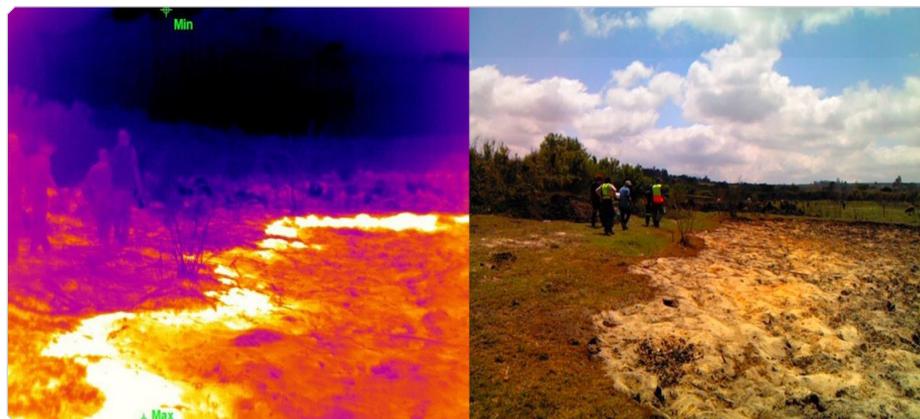


Figure 4: Thermal image (left) of the burning ground (right) on the northern side of the burning area.

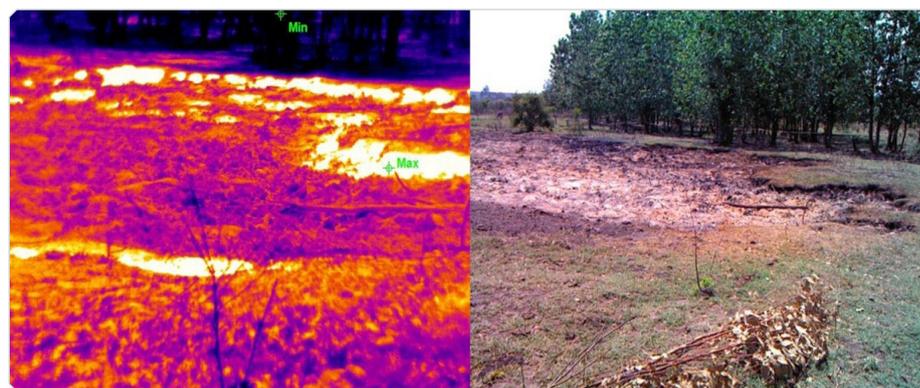


Figure 5: Thermal picture (left) of the burning ground (right) on the southern side of the burning area.

660 °C. The deduction was that the fire/smoke is not related to any mining activity but was caused by spontaneous combustion of peat and that the fire fighters were taking the necessary steps to contain the situation. It was confirmed by the locals that a similar incidence happened 2 km upstream in 1969, however, they were unaware of what

caused the fire to stop it. The information collected from the field was reported to the manager of the Water & Environment unit.

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