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Geological Society of South Africa

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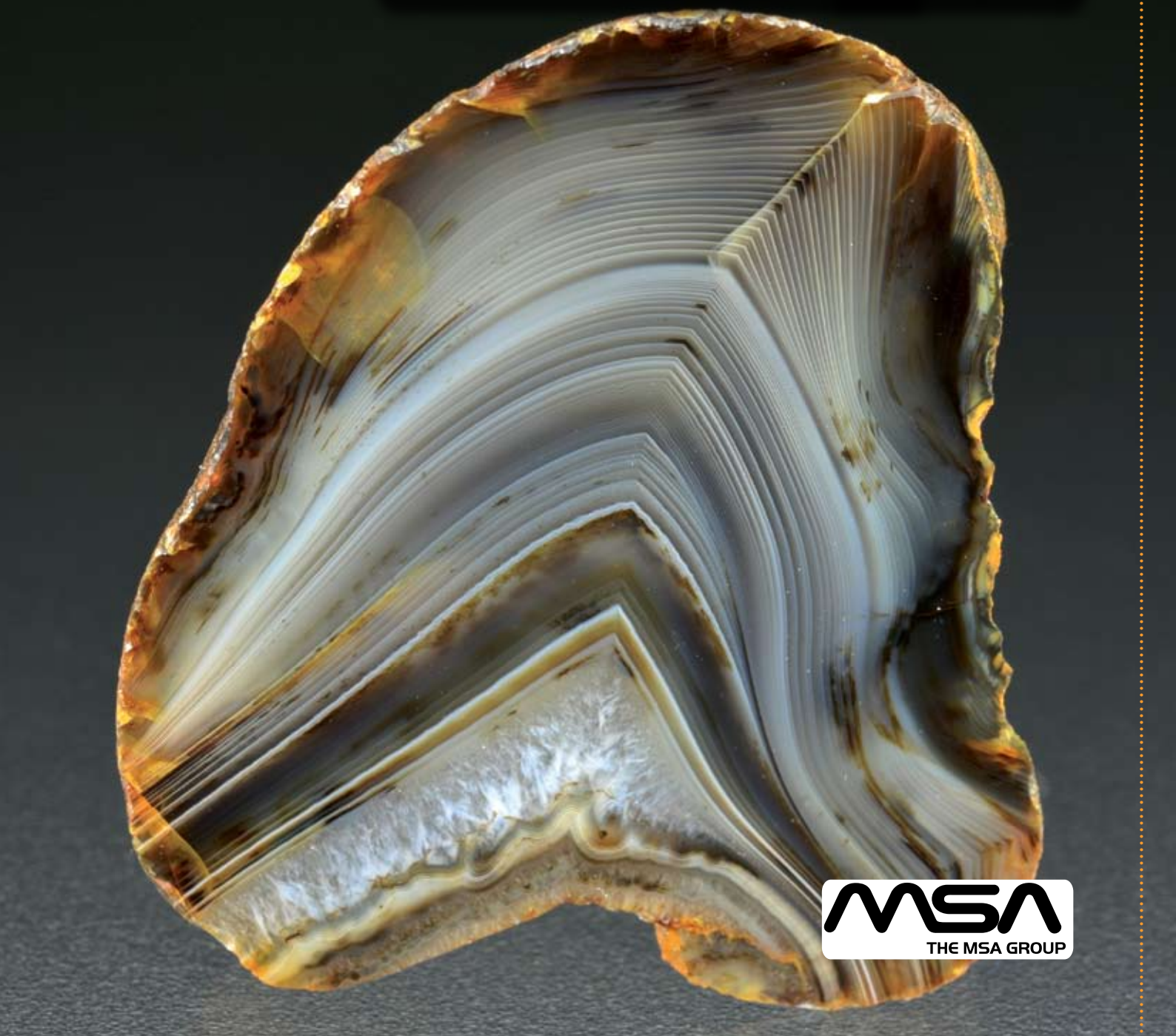

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Front cover photo:
Asymmetrically banded agate from Butha-Buthe, Lesotho, 5.2 cm. (Specimen and photo: Bruce Cairncross ©)

For more about agates from across southern Africa, see Mineral Scene on pg. 32.

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guest editorial

Dr Wendy Taylor

Using puppetry to inspire learners with South Africa's unique geoheritage legacy

The current education system in South Africa is in crisis. We read almost daily about a system in freefall, rife with longstanding inequities and historic challenges. The ongoing impact of COVID-19 is further crippling schools and could potentially result in the loss of an entire generation of learners. Amnesty International's most recent report on the pandemic describes a dire situation, with South African schools struggling with chronic infrastructure problems and a pervasive digital divide.

In 2020, an international survey was completed to benchmark the quality of education within a country at a global level. While Finland, Japan, South Korea and Denmark were at the top, South Africa was ranked second-to-last among the 76 countries surveyed. Recent statistics document a dismal 52% of learners making it to Grade 12, compared to 80% from other emerging countries. Additionally, the *Economist* recently declared that South Africa has one of the world's worst education systems, while the BBC pointed out that roughly one out of four South African students failed their end-of-school exam last year.

While the issues facing our country's education system seem overwhelming, out of these challenges, new and exciting opportunities are emerging. The pandemic has forced us to embrace digital learning nearly overnight and use online modes to deliver our content to learners, resulting in some educational innovations, but also requiring students to study in often-challenging home environments. The adoption of educational technology in teaching is now a necessity, and teachers as well as university instructors have been forced to develop and hone their digital skills to stay connected with their students. This shift in teaching has been particularly difficult for science teachers and has nearly eliminated practical work, which is an essential element for teaching the natural sciences. Navigating this new educational landscape has been difficult.

With all these challenges, inspiring change is taking place through the grassroot efforts of many organisations and individuals working with schools and school systems to create and expand real opportunities for learning. Many new programs for after school, weekends and summer break have been established by a variety of groups, including schools, not-for-profit organisations and even museums. Despite the pandemic-related educational slow down, these programs offer learners meaningful learning experiences outside of the classroom. These programs seek to establish relationships directly with communities and actively engage with broader networks of support among parents, community leaders, funders, and, sometimes even, political groups.

As a geoscience educator and learning designer, my goal is to find innovative ways to showcase South Africa's world-class natural and cultural wealth. The country's unique natural heritage spans billions of years and offers us a captivating window into the evolution of our planet. Up until very recently our role as humans has been a small part of this cosmic narrative, but now the impact of our actions is central to the continuing habitability of the planet.

Over the past several years, there has been a push in many countries to incorporate lessons and activities that use STEAM: science, technology, engineering, art and math. This inquiry-based approach encourages students to work in teams where they engage in

hands-on activities that use artistic expression and creativity, as well as scientific and mathematical principles, to explore new ideas or solve problems. Using this approach helps remove inhibitions (e.g., fear of giving the *wrong* answer), fosters innovation and makes science and engineering far more welcoming, especially to those who are often intimidated by these subjects.

The STEAM approach can be a very effective means of teaching science to young learners, particularly if combined with the power of storytelling. Stories are uniquely human. They enhance and make the educational experience richer and more meaningful. Now combine storytelling with puppetry. Telling stories with puppets can be used to bring stories to life and to spark the imagination of learners through creative drama. There is a wealth of evidence indicating that puppets have a unique way of engaging with children, and their use is already well established in many primary schools in areas such as drama and social education. However, the use of puppets in science education, and particularly for telling the Earth's story (i.e., geology and palaeontology) has barely begun. There is huge potential for captivating students with exciting tales of fierce dinosaurs, flying reptiles, and other giant creatures who roamed and hunted (and were preyed upon) on Earth for hundreds of millions of years. Geoscience education draws from many subfields and has a way of captivating audiences because of the way it connects the Earth we see around us to tremendous forces and spans of time. The amazing geological, fossil and anthropological record, from Archaean time to the present, preserved in South Africa makes it even more important that learners understand their country's proud natural legacy. Sadly, the role of geology and palaeontology in the current school curriculum is woefully inadequate. The use of puppetry as a vehicle for geoscience storytelling is a powerful combination that can help to make our geological history come alive for learners.

Puppet Planet was born to address the need for novel geoheritage education. This new program is a collaboration between local palaeontologists, theatre performers through Cape Town-based Jungle Theatre Company, and the Iziko South African Museum. Our plan is to create a children's television series that uses puppetry to celebrate South African natural heritage and the professional and amateur scientists who study, teach and learn about it. The program is at its heart a theatrical production. We use large rod puppets, with the puppeteers unconcealed, which allows maximum freedom for characters to interact. The puppeteers and most crew come from local communities and have a long association with the Jungle Theatre Company (JTC). JTC is a not-for-profit organisation that has run for 20 years. Their mandate is to create, perform and facilitate theatre shows and workshops for children, youths and families. The program draws on our diverse cultural heritage and finds moving ways to connect people to their environment and shared humanity. Although they offer an array of original African theatre productions for children and youths, JTC also presents theatre workshops, performing-arts clubs and theatre skills training programs. *Puppet Planet* is a new project that came about through seed funding from the DSI-NRF Centre of Excellence in Palaeosciences in 2020. Support was received to develop a pilot TV show for children and create a website with free online teaching resources.

Puppet Planet main characters, Thandi and her dog Oogies, exploring a fossil Lystrosaurus on their farm in the Karoo.

Filmed and televised theatrical performances introduce young learners to topics such as deep time, evolution, and the history of life. We use

☞

puppet characters as a vehicle to take learners on exciting adventures and tell stories that educate them about how their world came to be. Through the eyes of puppets and puppeteers, learners explore South African palaeontology and archaeology, as well as other topics that connect with issues such as climate change, sustainability and conservation. By incorporating the arts, which play a key role in the development of language skills, imagination, and creativity, our project will reach learners who are not innately interested in science.

The main show characters are Thandi, a nine-year-old girl and budding scientist (puppet height of ~1 m) and her magical dog, Oogies. Other characters include a *Lystrosaurus* ("cow-like" reptile of the Permian), *Proterosuchus* (South African carnivorous reptile) and a giant Cretaceous frog (based on the fossils of *Beelzebufo* from Madagascar). The script is trilingual, with an English base, but with both isiXhosa and Afrikaans phrases as well, which will be subtitled on the finished program. The production also includes original music and atmospheric sounds and is designed to work both as a program viewed on TV or the internet, and as a live performance. The first episode follows Thandi and Oogies, who live on a farm in the Karoo, as they travel through time and explore what their home was like millions of years ago. They investigate the ancient landscapes and find themselves in exciting situations as they meet very strange, extinct plants and animals. The show's main audience is children between 6 and 10 years of age, but both younger and older audiences should enjoy it too. Planned future shows will focus on topics of interest to South Africans, such as recent high-profile discoveries and important topics of local interest.

Puppets visiting the Karoo Palaeontology Fossil Preparation Lab at the Iziko South African Museum.

The lifelike behaviour of Thandi, Oogies and the friendly (and not-so-friendly) creatures they encounter are achieved using highly detailed rod puppets and shadow puppets. These were designed and made by the well-known local artists Angela and Sean MacPherson of the Cape Town Carnival. Innovatively crafted sets, including a shadow theatre, allow for quick change between three different environments in time. A trilingual script

One of the theatrical sets used in the filming of the pilot TV episode.

for episode one was developed with members of the cast Joce Engelbrecht (Afrikaans) and Siya Badi (isiXhosa). Gershan Lombard composed the soundtrack, including two new songs sung by the performers.

Puppet Planet will have a public launch at the Iziko South African Museum on Heritage Day in September, with our first TV show to be broadcast on Cape Town TV in October. It's our hope that the program will become a regular children's TV show, and that we connect with new partners across South Africa to offer engaging performances and STEAM workshops for teachers and learners.

To watch a trailer for the first episode of Puppet Planet, visit the Jungle Theatre website.

Dr Wendy L. Taylor
Faculty Research Associate and Curriculum Developer at the Center for Education Through Exploration, School of Earth and Space Exploration, Arizona State University, and Honorary Research Associate at the University of Cape Town

executive manager's corner

Craig Smith

During the last two months, we have been subjected to news of all kinds of catastrophes around the globe, including record-breaking heat waves in Canada and Europe, out of control wild fires in the Western USA and Canada, southern Europe, Turkey, North Africa and Siberia, and devastating floods in Germany and Belgium. Most of these events appear to be weather related (except for arson in the case of some of the fires); and around the world informed and uninformed news sources are linking these extreme weather events to climate change. It may be so. In July, the Intergovernmental Panel on Climate Change (IPCC) Working Group I (physical science) released in draft form their sixth assessment report. Those of you who have read the report and the various summaries will likely agree that it is a lengthy and turgid document that is ideal bed time reading insofar as sleep inducement is concerned. But the (alarming) detail is important and conclusions are comprehensively supported. The jury is in. Climate change is happening, it is human induced for the most part, and the consequences will be severe unless mitigation commences now.

One of the best summaries I have seen was published in EOS by the American Geophysical Institute on August 9.[1] There are five key conclusions. First, the planet has warmed by 1.1 degrees Celsius from pre-industrial levels, and is headed north at a rapid rate. Second, there is a range of future warming trajectories, and which path we take depends on the mitigation effects that must begin now. Third, CO_2 is the culprit, being of far greater importance than other greenhouse gases, and is directly correlated with temperature. Fourth, limiting warming requires significant cuts in CO_2 emission (fossil fuels). Fifth, the two scenarios that limit temperature increases to less than two degrees require carbon capture—but these technologies are still at research stage and furthermore, there could be unintended consequences.

Earth scientists need to be familiar with the science, and the implications of policy choices made by non-expert politicians who may well not have an eye on the science. You may have to explain or lobby.

I know that some readers will find this unpalatable, and (dare I say) will remain denialist. But I would rather accept the evidence documented in 14,000

peer reviewed papers than unsupported opinions of a few.

The insurance industry is certainly taking notice; the increasing severity of natural disasters is not only costing them a great deal of money, but is making risk calculation far more difficult and uncertain. More money is being paid by insurers because of more frequent and more damaging events.

There are opportunities for earth scientists in the necessary shift to a green economy. The general consensus is that to move away from fossil fuels over the next two decades or so will require double the number of mines and a much deeper understanding of the environmental factors of resource extraction. Nuclear power will likely see a resurgence. Nuclear does not generate CO_2. There will have to be tectonic shifts in policy development by government, changes in educational curricula in schools and universities, and fundamental changes in industry strategy. Earth scientists need to be at the forefront of change, but the foundations have to be laid for it to happen. Can our institutions deliver?

The GSSA is certainly going to try to stay abreast of these changes in our event offerings, so keep an eye out for the regular Thursday mailer on upcoming events and meetings.

On top of climate change, we are still in the grip of the COVID pandemic, and we do not know when or if we will ever get back to normal. The GSSA offices remain closed for now, and we are not clear when they will re-open. The only way to get on top of the virus is to vaccinate, so I appeal to all of our readers to get the jab as soon as possible. If we do not do this, the odds are that new variants will continue to appear, and if that happens, newer much deadlier strains may also appear.

Craig Smith

Reference:

1. Duncombe, J., 2021, "What five graphs from the UN climate report reveal about our path to halting climate change", EOS 102, https://doi.org/10.1029/2021EO161811, *published 9 August.*

president's column

Tania Marshall

Over the past 125 years, the GSSA has served the academic and professional geoscience community with pride and enthusiasm. The Society has faced many challenges during its history, but has managed to weather them with varying degrees of success. The future is no different, except that it is easier to look backwards and contemplate decisions than it is to decide how best to serve the membership going forward.

Spider Robinson noted that "*mankind is divided into two basic sorts: those who find the unknown future threatening . . . and those who find it thrilling*." As geoscientists we, hopefully, find ourselves firmly in the latter camp. As exciting as the future might be, the unknowable aspect of it means that having started down one road, we may find ourselves having to change direction in mid-stride, whether it be in our career or as an organization—we should never be afraid to do so; we will not be judged adversely by forward thinkers.

A particular passion of mine is mentoring our next generation of geoscientists and helping to ease their transition into the work environment. It is with this in mind that I would like to expand on the current Candidate Mentoring Programme that the GSSA

runs in conjunction with, and supported financially by, SACNASP. The only way we can do this is to increase the number of mentors, so this is a call to all of our members to make yourself available for this programme when the call goes out.

In making the GSSA more applicable to our younger members, we are also expanding the current Student Division of the GSSA to include young graduate professionals. This Division will seek to provide meetings and networking events catering to the interests and needs of the under-35s, as well as promoting the GSSA at tertiary and even secondary level throughout the country.

Interest in Geoheritage is surging ahead, with numerous interest groups and subcommittees progressing in specific areas. The GSSA plans to make these exciting ventures more available and accessible to more of our members and the general public—watch this space!

In addition, we will continue to provide quality technical and professional events throughout 2021/2022. In the first instance, these will continue to be virtual in recognition of safety. As the vaccination programme gathers impetus and the pandemic wanes (hopefully), we look forward to being able to offer hybrid meetings, field visits and face-to-face networking events again.

I would like to recognise the contribution of my predecessor Sifiso Siwela, whose calm presence, leadership abilities and wisdom (to say nothing about his fedora reminding us of Covid-19 safety protocols) has helped steer the GSSA through the worst (with any luck) of the pandemic. I look forward to working along with him and all the other Past Presidents going forward.

A big thank you also to Council, MANCO and Craig Smith for their support and for dedicating their time, as well as Lully, Marliese and Sally from the GSSA office for their continuous support. Last, but by no means least, I would also like to acknowledge the membership for their support for the Society through the years and into the future.

I look forward to the many challenges that lie ahead and hope to serve the broader geoscience community faithfully in "business unusual".

Tania Marshall

Geological Society of South Africa

membership

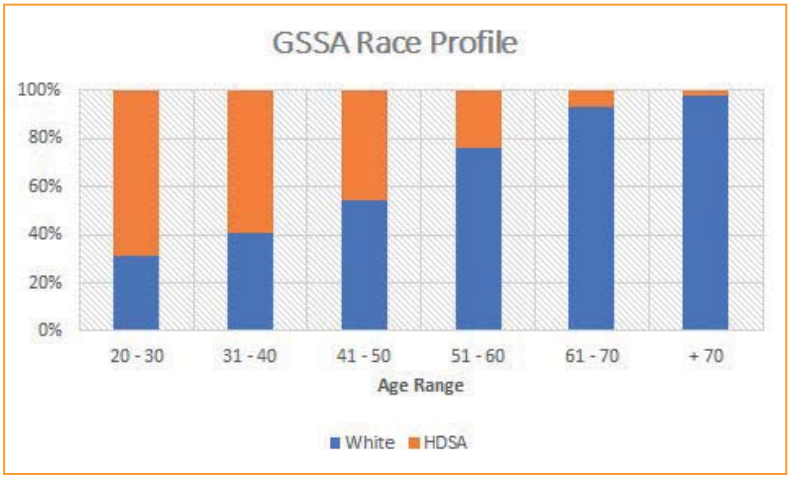
THE PROFESSIONAL (AFFAIRS) CORNER

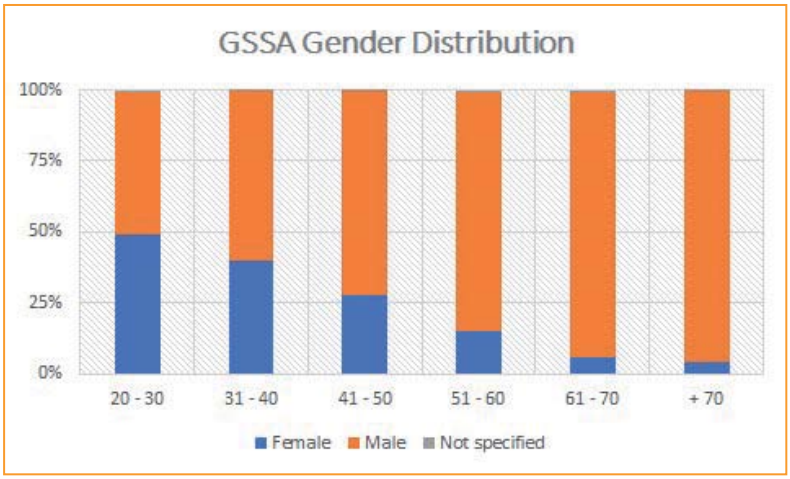
Membership and Transformation

When political, societal, economic or regulatory change takes place then organisations, even voluntary associations, must adjust their design and activities to accommodate these changes. If the change is simultaneous, fast, or large, then turbulence can easily follow. Turbulence in the external and internal space is a trigger forcing transformation. Since this turbulence can stem from a range of places and vary in intensity, being able to respond to turbulence represents one of the largest predictors of survival

or growth. The triggers for a voluntary association to transform itself vary over time and in different arenas.

The GSSA enjoyed a steady growth in its membership in the last decade, peaking at slightly over 3,600 in 2016, but has since fallen to close to 2,300 members currently. Members younger than 40 years of age form 41% of the total membership, but only around 29% of Council. Historically Disadvantaged South Africans (HDSA) form 37% of the GSSA membership. However, it is heartening to note that the 20 to 40 age group is dominated by the HDSA. Historically, the sector was male dominated, but in the democratic era, of the 23 presidents of the GSSA, five of them have been women. It is indeed a reflection of changing times for such an esteemed organisation. Although women form only some 26% of our membership, they comprise 40% of the 20–40 year age range.





These two trends—the increase in HDSA and female members in the younger age ranges—bodes well for the future composition and transformation of the GSSA. As these trends continue, we would expect to see more HDSAs (including women) represented in all of the GSSA's management structures to bring in renewed energy and fresh ideas. As such, we call on them to get more involved, to the extent possible as they build their careers, in Branch and Council events now and help to guide the future growth and direction of the GSSA. The Student Division has been expanded to encompass all Young Professionals in an attempt to understand the modern challenges of emerging professionals, including issues of unemployment and working mothers with difficulties juggling careers and family responsibilities.

Membership Challenges

The GSSA is faced with similar issues to many other voluntary organisations.

- The management of an association as diverse as the GSSA adds pressure on individuals who are volunteers to their positions. In such an environment where it is difficult to sustain tasks to completion, over-run of timeframes is a regular feature. To overcome this the GSSA has opted for a larger Council.
- There are strategic projects or growth initiatives that run over periods longer than a year. The previous Presidential term (one year) saw projects being started well but finished slowly or abandoned mid-way. It has been helpful that the last four presidents could hold a term of two years, enabling them to see initiatives through to completion.
- There is a growing awareness of the continued struggle of geoscience graduates to find full-time employment in South Africa. The reasons are vast and include a decline in exploration and mining activities, in some areas a mismatch between teaching curricula and industry needs, and

the increasing diversification of careers geoscientists pursue post-graduation.

- At its commencement, the young GSSA was focused on the Witwatersrand, a massive gold target, but by today's standards, a narrow area of focus. Due to a growing field of practice, emerging research interests in earth science locally and internationally, and in response to ever-changing needs of industry, the GSSA has transformed into an association that has significant breadth and scope as well as depth. It is this myriad of interest groups, branches, associations, and alliances that represent the many beating hearts of a very diversified GSSA and as is well known, it is diversification that allows sustainability to continue through difficult times.
- One of the roles of the learned society is to provide a platform for exchange and dissemination of scientific ideas. The primary way this is achieved by the GSSA is through the *South African Journal of Geology* (SAJG), which was first published in 1897 and remains one of the foremost international geological publications. The GSSA has embarked on a partnership with SABINET and Geoscience World to ensure that the SAJG reaches a wider audience and attracts interest globally. A secondary way of encouraging new research is through limited funding assistance through the REI fund.
- Our younger members are looking for new ways to interact and obtain information and the GSSA has adopted many of these. It has a LinkedIn profile, maintains a Facebook page and a presence on Instagram to engage with members.
- One of the fundamental responsibilities of the Membership Portfolio is to assess membership applications. With the rapid expansion of geoscientific influence into other academic and industrial spheres, hybrid degrees are proliferating, resulting in limited numbers of corporate membership applications from individuals who may not have a core "geoscience degree", but who are, nonetheless, working in the geoscience and/or minerals industry. In moving with the requirements of future geoscience professions, the GSSA regularly reviews its bylaws.

The Present Covid-19 Challenge

The Covid-19 pandemic is a societal, health, economic and political crisis that has recently created a new surge of turbulence in the South African geoscience landscape. At the start of the Covid-19 pandemic the GSSA, like many voluntary associations, was not able to influence national health policy but it did intervene on behalf of its members, lobbying the authorities to permit all geoscience practitioners the opportunity to keep working through lockdowns level 4 and 3.

The lockdown period allowed the GSSA to roll out 'Lunchtime Talks' within two weeks of lockdown. Over 100 talks have been made available through the GSSA's YouTube Channel, which is accessible to all members as well as the public. The many presentations on this channel have been viewed by more than 32,000 individuals from as far afield as Canada, Australia, London, New Zealand and the USA since it commenced in March 2020.

Different parts of the South African economy have been impacted by the pandemic in different ways. Members that operated in the public sector continued their work, even if this had to take place from home. Members working for mining companies or servicing mining companies were able to continue if they complied with some of the concessions made. Members that were operating in the consulting and compliance areas had to stop work almost immediately. Members that were working in academic areas had to quickly adapt their style of teaching and make amendments to the way in which they conducted their research. All these changes point to how diverse the membership of the GSSA has become and how it has migrated in the last two

decades from being heavily focused on the mining sector to operating in a wider part of the economy. A diversity survey will be conducted in the near future to understand some observed discrepancies and to develop strategies to close the gaps.

Looking Ahead

Fast approaching 130 years of existence, the GSSA has evolved from its original focus on the Witwatersrand geology to something that encompasses a global footprint. The Council of the GSSA is deliberately kept large so that inputs can be obtained timeously and so that a response can be planned.

From nature we have learnt that survival is better guaranteed where organisms show greater degrees of diversification. The GSSA has remained true to its founding objective, as a learned society. It has however grown into far more than this, which specialist interest groups, branches across the country, relationships with geoscience faculties and an international network of aligned organisations. The GSSA is well placed to respond to internal and external challenges and has grown more robust, but it must guard against complacency because there is always another unexpected trigger waiting to pounce.

Members are urged to participate in their closest structures, like branches and divisions, to have national impact. Taking a leaf from JF Kennedy's 1961 speech, *"Ask not what your country can do for you—ask what you can do for your country"*, all members should review their intentions of having joined the GSSA and actively participate to grow this society.

This is an Executive Summary of the full article, which will be placed on the GSSA website. Look out for these and other fascinating glimpses of GSSA Membership issues.

Compiled by ***Dumi Sibiya*** *(VP Membership),* ***Neale Baartjies*** *and* ***Masibulele Zintwana***

all the news fit to print

UNIVERSITY OF JOHANNESBURG

(including CIMERA and PPM)

The COVID-19 pandemic has had a large impact on how we are teaching and conducting research. This is true for all departments and UJ Geology is no exception. The Department of Geology's efforts last year to adapt to this "new normal" were recognised when it was awarded the 2020 Top Team Award in the UJ Faculty of Science. Criteria for this award span a broad selection of metrics such as publication output, national and international footprint, teaching interventions, popularising of science, curriculum updates and enrolment.

During the first half of 2021, we were able to catch up on first- and second-year field schools that were deferred from the previous year, and while academic lectures remained online, on-campus practical sessions and assessments could take place. The year has also brought about the promotion of Dr **Tebogo Makhubela**, who is now a senior lecturer in the department. We welcomed the appointment of Ms. **Henriette Ueckermann** in a permanent position as a lecturer with responsibility for the mass spectrometry laboratory. In other human resource news, the department would like to wish Prof. **Sebastian Tappe** all the best for his move to Norway, where he will be taking up a professorship at the University of Tromso starting on 1 October 2021 after a very productive six-year tenure at UJ.

Some staff members have been recently been honoured by various organisations and publishers. The Department of Geology celebrates with Prof.

Left: *Dr Tebogo Makhubela was recently promoted to Senior Lecturer in the Geology department.*
Right: *Jan Kramers (right) and Igor Tolstikhin (left) having the last touch of the manuscript of their book "The evolution of matter" at the University of Bern on 1 November 2008.*

Jan Kramers, A-rated post-retirement researcher in the department, who has received two international accolades in 2021, honouring his numerous geochemical chemical contributions. Jan has been at UJ for almost 12 years since joining the department in 2009 after his retirement from the University of Bern.

At the beginning of 2021, Jan was announced as one of the 16 international researchers honoured with the Geochemistry Fellows award, presented jointly by the Geochemical Society and European Association of Geochemistry. In support of this award is another international honour of a special volume in the journal *Chemical Geology*, put together by some of Jan's former PhD students: Balz Kamber, Thomas Pettke, Mirjam Schaller and Ronny Schönberg. The special volume is titled "Geochemical and isotopic constraints on the dynamics of the Earth, a celebration of the contributions of Jan Dirk Kramers" and will be a collection of articles that are currently published online in *Chemical Geology* volumes 562

Ms Henriette Ueckermann has joined the department in a permanent lecturing position.

Some of Jan's former students at the University of Bern in 2006, appropriately posing with the core of a huge magnet. Those co-authoring articles in the special volume in Chemical Geology: (standing from right to left) Thomas Nägler, Igor Villa and Martin Wille, and Robyn Pickering (squatting next to magnet).

Students exploring the bifurcating chromitite layers at Dwars River during a deferred second year field school.

to 580 so far. The articles reflect most of Jan's work and contributions to geochronology and isotope geochemistry as follows:

Modelling of the origin and chemical evolution of the continental crust and studies related to mantle and kimberlites:

- Hawkesworth, C. and Kemp, A., 2021. A Pilbara perspective on the generation of Archaean continental crust. *Chemical Geology*, 578, 120326.
- Kleinhanns, I.C., Nägler, T.F., Villa, I.N., Kramers, J.D, 2021. Age disequilibrium between zircon and their granitoid hosts caused by intracrustal reworking: Nd-Hf-Ar isotope evidence of Archaean Granitoids from Barberton Mountain Land (Kaapvaal craton, South Africa). *Chemical Geology*, 570, 120129.
- Ngwenya, N.S. and Tappe, S., 2021. Diamondiferous lamproites of the Luangwa Rift in central Africa and links to remobilized cratonic lithosphere. *Chemical Geology*, 568, 120019.
- Smart, K. A., Tappe, S., Woodland, A. B., Harris, C., Corcoran, L. and Simonetti, A., 2021. Metasomatized eclogite xenoliths from the central Kaapvaal craton as probes of a seismic mid-lithospheric discontinuity. *Chemical Geology*, 578, 120286.
- Tolstikhin, I.N., 2021. Preface to "Geochemical and isotopic constraints on the dynamics of the Earth" a celebration of the contributions of Jan Dirk Kramers". *Chemical Geology*, 562, 119978.

^{40}Ar/^{39}Ar and U-Pb geochronology, speleothems, palaeoclimate and environmental geochemistry (research focus since Prof Kramers joined UJ):

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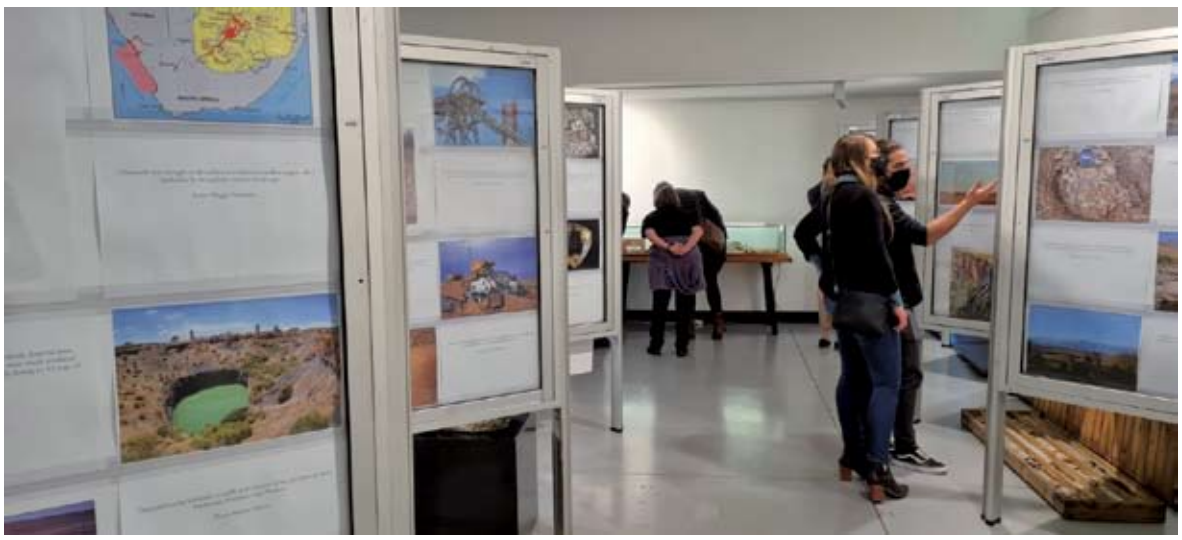
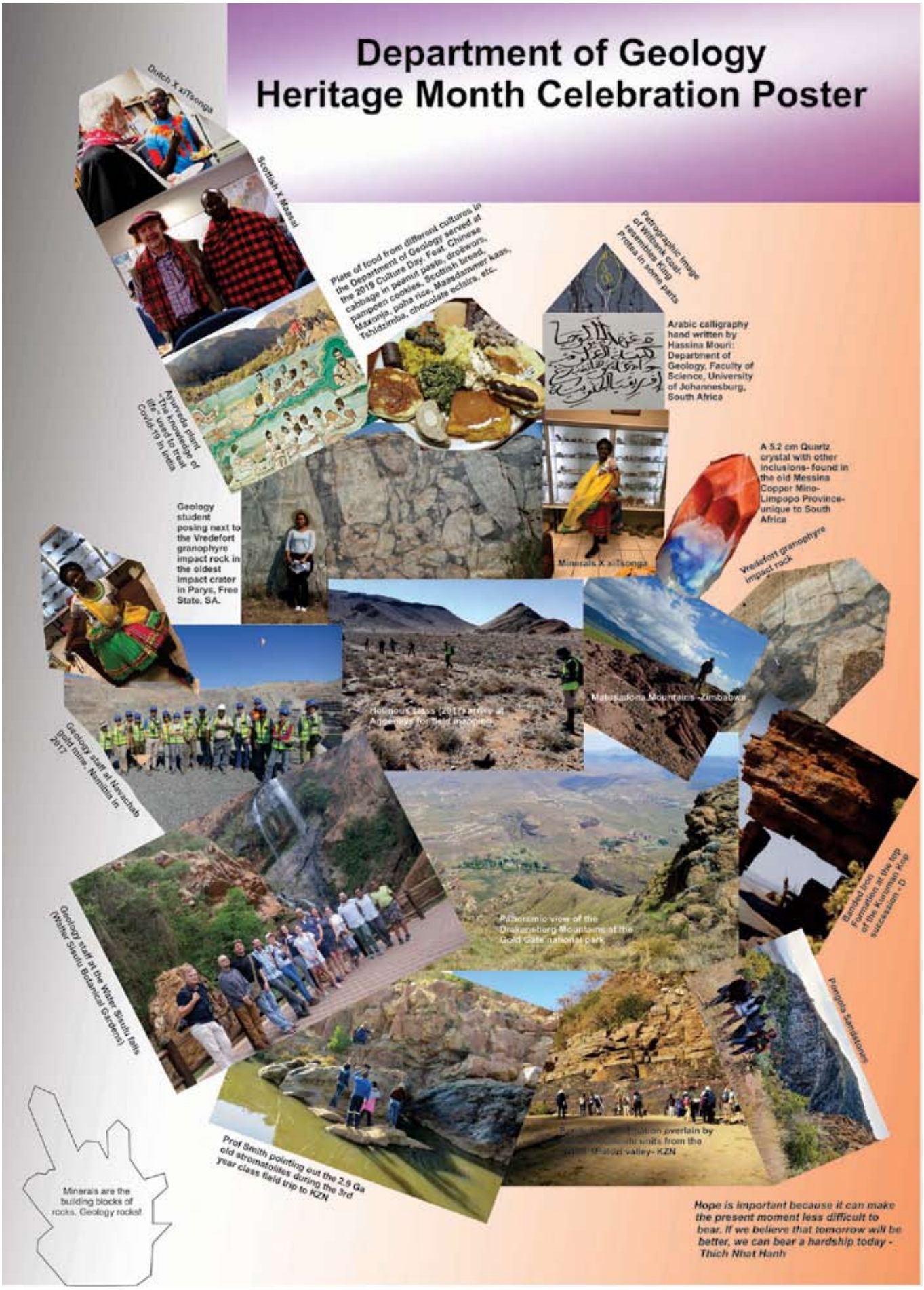
In September 2020, **Hassina Mouri** was appointed by the UNESCO Director General as Council Member for the International Geoscience Cooperation Programme (IGCP) for 4 years (2020–2024) and, in October 2020, she was elected by the Council members as Vice-President of the IUGS (2020–2024). She is the first African female to be elected for this position in the history of IUGS. In February 2021, Hassina was selected by the United Nations Economic Commission for Africa (ECA) as one of 25 African women scientists to be profiled in a high-quality publication that aims to establish the legitimacy and prestige of women scientists within the African and global research and development communities. In June 2021, she was appointed by the National Research Foundation (NRF) South Africa as a member of the Rating Specialist Committee (SC) for Earth Sciences. Hassina was also invited to share the outcomes of recent developments in medical geology at UJ in a book on "Practical Applications of Medical Geology" (Springer, 2021), through a chapter entitled "Medical Geology in Africa: An Example of a Successful Educational and Research Initiative at the University of Johannesburg, South Africa". This contribution was in addition to two other chapters in the book, based on results from projects led by postgraduate students.

Bruce Cairncross has been serving on the Geological Museum Association (GMA) committee for 26 years. The GMA is a volunteer body that has served the Johannesburg Geological Museum since the 1930s. The GMA embarked on a geoheritage project titled "Geology through a lens". This is a display based on photographs highlighting the many facets of geology, but mainly with a southern African theme. Featured themes include the Bushveld Complex, Diamonds, the Karoo, Minerals and Gemstones of East Africa, and several more. Many of Bruce's photos feature in the exhibit. The exhibition is on display at the Origins Centre at the University of the Witwatersrand until end-September. It is a collaborative effort, co-hosted by the GMA, the Faculty of Science and the Earth Sciences Cluster at Wits. AfriTin generously sponsored the exhibit.

The Faculty of Science at UJ celebrates cultural diversity in a number of ways, and the Geology department participates in this initiative. As part of the Heritage Month celebrations, the department produced a poster that highlights the fusion of diverse cultural and geological heritage that exists in the department. The collage, in the shape of mineral crystals, features some members of the department dressed in their heritage clothing and a plate with some of the foods served at the departmental



Visitors examining some of the many photo panels contained in the "Geology through a lens" exhibit currently on display at the Origins Centre at Wits University.



The UJ Geology Department Heritage Month poster.

culture day, intermingled with photographs of field trips undertaken by members of the department all over southern Africa.

DSI-NRF CIMERA

Dr **George Henry** retired from his position as DSI-NRF CIMERA CoE Manager in March 2021, and we welcomed Ms **Segopotso Mashego** as our new CoE Manager. Sego joins us from industry and is rapidly learning the complexity of the NRF and CIMERA. We continue to benefit from George's in-depth geological knowledge, as he is appointed as a researcher in the UJ Geology Department.

DSI-NRF CIMERA continues to grow and now partners with 12 South African geoscience departments, 2 international partners, and the CoE recently completed a MoU with the Council for Geoscience in order to promote our research collaboration. Over 40 academic staff and 60 postgraduate students currently benefit from CIMERA funding. We met virtually with all our South African university partners earlier in the year to gain an understanding of economic geology research and geoscience student numbers. Unfortunately, across the board, geoscience enrolment figures are down, and, as a community, we need to ensure high school students understand the need for geoscience, especially in clean energy technologies and advanced electronics. Geoscience research remains imperative in the global and South African domain as we use mined products in our everyday lives.

Other activities that keep us busy include addressing our long-term sustainability as we begin to diversify our funding approach and transition out of the NRF CoE model into an independent national centre for economic geology research. The CoE provided an independent public comment submission to the DMRE on the draft Geoscience Act, along with the GSSA and other geology departments. The Intercontinental Drilling Program (ICDP) Moodies Project is rapidly gaining traction, with Prof Nic Beukes driving the drilling campaign to commence as soon as October this year. The ICDP Bushveld project will commence in 2022. DSI-NRF CIMERA and UJ successfully completed a short-term research contract with the Mandela Mining Precinct on the Advanced Orebody Knowledge program Au and PGM Resource Atlas. The Atlas is free to use and the final updates will be available on-line shortly. As a CoE, we would like to become actively involved in economic geoscience outreach projects, so please do get in touch with us if you have ideas. Please diarise the date for the annual DSI-NRF CIMERA Colloquium: 18–19 November (hybrid event). Refer to the website (www.cimera.co.za) for further details.

*Compiled by **Bruce Cairncross** from various departmental contributors.*

***Left:** Dr George Henry retired from CIMERA but still maintains active collaboration with Geology and CIMERA.*

***Right:** Ms Segopotso Mashego, who has taken over as CoE Manager at CIMERA.*

UNIVERSITY OF THE WITWATERSRAND

Many of you have probably already heard the sad news of **Matt Kitching** passing away in May of this year, after a brief struggle with cancer. Matt was an integral part of the School for 46 years, and even after his retirement had plans to continue assisting the department by re-vamping the Bleloch Museum. Unfortunately, due to his illness he was unable to. In his memory, and as a tribute to all the work he put in over the years, the School is seeking financial contributions to upgrade and redesign the Bleloch Museum, and would be grateful if you would consider offering a donation in Matt's memory. To contribute, please click on the link https://devman.wits.ac.za/devman/online/giving/ and select "other" under the project dropdown list, and then type the reference "MattMuseumGEOS" as the project name.

We were also deeply saddened by the news of **Morris Viljoen**'s passing in August, and would like to extend our condolences to the Viljoen family, as Morris was a close friend of the School for many years.

In happier news, the School would firstly like to congratulate **Robert Bolhar** on being promoted to full professor, as well as offer its congratulations to Prof. **Judith Kinnaird** and her former student **Tim Gray** on their recent publication making the cover of *Economic Geology*. The publication by Prof. **Roger Gibson** and Prof. **Lew Ashwal** mentioned in the last issue also made the cover of *Meteoritics and Planetary Science*.

The current head of the School of Geosciences, Prof. Gillian Drennan, pictured with Matt Kitching.

Lastly, the School welcomes Dr **Kimberley Beaton** as the new WIGL lab manager, taking over from Dr **Linda Iaccheri**, who has moved to a lecturer post.

*Compiled by **Sarah Glynn** from various contributors within the School*

Stellenbosch University

The Department of Earth Sciences at Stellenbosch University is pleased to report an eventful end to the first semester, with most of our planned teaching and research activities completed despite the ongoing Covid 3rd wave. Significant highlights include a successful Honours tour of southern African geology and mining environments (June 2021), exceedingly positive feedback from the independent departmental review panel, and the opening up of international travel, which has allowed our researchers opportunity to further develop their international research footprint.

2021 Honours tour onto the Kaapvaal Craton

The 2021 SU Honours tour ran between 30 May and 11 June 2021, bang in the middle of a dire cold snap (first night camping temperatures in Douglas hit as low as −4°C), but fortunately before the official onset of the Covid third wave. Covid considerations indeed complicated the organisational aspects of the tour, with many of our traditional visits not being approved due to possible Covid exposure risks to production. Fortunately, several mines were still able to accommodate us despite these risks, and we are most grateful to them for the learning opportunities and exposures that our students were afforded.

The 2021 Honours tour delegates pose at the petroglyphs at a granophyre dyke located in the center of the Vredefort Dome.

After a bitterly cold night camping, our first stop was a small-scale mining operation on the terraces above the Orange River between Prieska and Douglas. Lyndon de Meillon led us through the geology of the trapsites associated with the Orange and Vaal River diamond megaplacer system, further providing detailed insight into the nuances of the small-scale diamond business. At the mine site, we were afforded the opportunity to evaluate the diamond terraces, which included exposure to the interesting Rooikoppie gravels. Luckily we were able to stick around long enough to watch a blast of one of the sections of the terrace—for many of the students this was the largest and most impressive explosion that they had yet experienced. The next three days were spent in the Vredefort Dome, a world heritage site boasting an array of meteor-impact associated features. The time here was spent mapping the metamorphic mineralogy and stratigraphy of the Witwatersrand collar rocks (using Kopjeskraal Lodge as generous host and base), visiting the local quarries to observe pseudotachylite textures, and a visit to the rock engravings at the impact melt-related granophyre dyke located in the middle of the dome (many thanks to Gustav Engelbrecht from Dome Tours for the insightful tour).

More posing, this time a fun one at the Bourke's Luck potholes.

After a brief stop at the Cradle of Humankind to visit Mrs Ples and the carbonate-hosted Sterkfontein Caves system, we continued our tour with our first underground mine site visit—the Eland Mine, owned and operated by Northam Platinum. Here we were very impressed by the scientific rigour that Coenie Roux and his team were using to provide high-level geological insights about their orebody—one that is made complex by the presence of a hanging-wall fault, among other geological complexities. Staying with Bushveld geology (this time the felsic component), our next stop was at the old Zaaiplaats Tin workings, where we were led through the geology by Tim Marais and his team from AfriTin Mining. The visit was a great opportunity to experience the scale of tin mining that took place during South Africa's tin mining glory days, and to collect specimens of minerals like fluorite, cassiterite and molybdenite. After the tour of the old mine, we headed down a transect through the Rustenburg Layered Suite, stopping off to see the vanadiferous magnetitite layers, the bifurcating seams of the UG1 chromitite and the nearby unique iron-rich ultramafic pegmatoid pipe-like body.

The next day took us on a casual tour along the escarpment, viewing Transvaal Supergroup rocks and its unique array of waterfalls. The two main stops were at the Bourke's Luck potholes and the historical gold mining town of Pilgrim's Rest. The students all breathed a sigh of relief once we had completed our descent to the Lowveld, where two nights' accommodation at Diggers Retreat with Mark Seady brought a welcome reprieve from the Highveld's cold night-time temperatures. Our tour of the Barberton Greenstone Belt comprised a brief site visit to the old Scotia talc mine, field observations of the Sheba Fault, and a trip up the world-class Geotrail.

The final two stops of our tour were again back on the Highveld, where we based ourselves in Secunda to easily access the surrounding goldfields and coalfields. First up was a mandatory afternoon of Covid testing, to ensure that our visits did not compromise the mining activities. Fortunately, our field trip protocols had been sufficient, and the results all came back negative. During the trip to the Evander gold mine, we were fortunate to see the underground mining operation where pillar extraction is currently taking place. The students who study the Environmental Geochemistry BSc Honours stream were taken to the surrounding pans and wetlands to obtain insights into the environmental management components of a mining operation. The entire class was also given a tour of the massive tailings retreatment program, where we were impressed by the sheer scale of the operation. A big thanks goes out to Walter Seymour and his team at Pan African Resources, Evander Mine for making this mine tour truly exciting and informative. The final stop of the tour was at the SASOL's Impumelelo Colliery, where Patrick Ndlovu, Andre Coetzee and the extended SASOL team provided us with an opportunity to experience a world-class underground coal mining operation. Students were exceedingly impressed by the scale of the equipment underground, the friendliness of the underground personnel, and the advanced technologies (e.g., directional drilling) that are used to understand distributions of the coal and intrusive dolerite dykes.

Departmental review

Between 28 and 30 June, the Department of Earth Sciences underwent a Quality Assurance Quality Control-type exercise involving detailed interviews and evaluations by an independent review board. Such an exercise is crucially important for our department to ensure that it continues to provide high-quality teaching offerings to our current and future student cohorts, and to ensure that our academic staff are well equipped to continue excelling at their research pursuits, both on the national and international stage. The review board comprised the following highly-experienced academics: Prof Chris Harris (UCT), Prof Nikki Wagner (UJ) and Prof Ben Mapani (Namibia University of Science and Technology). We thank these panel members sincerely for their time, efforts and insights, and we were very pleased with their overall commendation (quoted verbatim here): *"Staff and students appear to be very happy with the current situation in the DES, and the whole department should be commended for their efforts in making it a good place to work and study. The courses*

are perceived as being strong and internationally recognised. The department move to on-line instruction was considered very well organised by the undergraduate students. The panel would like to commend the international reputation of the DES, the high Honours class numbers, the publication output, links to the mining industry, and the general stability and satisfaction of the DES as viewed by all students and staff."

International research opportunities

Dr **Ryan Tucker**, sedimentologist and palaeontologist at SU Department of Earth Sciences, has just returned from an expedition near to the Cathedral Valley, Central Utah (USA). Ongoing work in the Western Interior is part of a multifaceted, multinational collaborative effort currently funded by the National Science Foundation, Frontier Research in Earth Sciences. Currently, Dr Tucker is continuing to contextualise sedimentary environments for a suite of newly discovered vertebrate fossil assemblages in the upper Cedar Mountain Formation, with focus on the uppermost Mussentuchit Member (Zanno et al., 2019; Tucker et al., 2020; Tucker et al., Accepted). Key discoveries thus far include the basal Tyrannosauroid *Moros intrepidus* and multiple new Caenagnathasia egg shell assemblages. Current student work in the area by **Ray Renaut**, an MSc student, is focusing on the near-shore Naturita Sandstone and the marine Tununk, with key implications for age placement for both sedimentary successions. With ongoing work, Dr Tucker and collaborators hope to address numerous inconsistencies in the poorly contextualised "mid-Cretaceous" of North America's Western Interior Basin.

Dr **Matthew Mayne** recently conducted a research visit to the Institute of Geological Sciences at Universität Bern in Switzerland. Here Dr Mayne presented his latest work in planetary sciences entitled "A metamorphic origin for Europa's ocean", which was recently published in *Geophysical Research Letters*. Dr Mayne was introduced to the researchers in the department by his host, Dr Pierre Lanari, and discussions were held on the latest advancements in the XmapTools community, including the use of principal components analysis and random forest to auto-assign mineral identification to compositional maps and standards. Dr Mayne spent time teaching the Swiss researchers about University

Dr Tucker examining outcrop in the Naturita, USA.

Fieldwork in the Alps requires long hikes and a head for heights. Dr Mayne is standing in front of the Blüemlisalp glacier at 2 840 m after a long hike.

of Stellenbosch's Rcrust thermodynamic modelling software, and a mutually beneficial collaboration was established. During a field campaign, a number of samples of iconic Alpine metamorphism were collected to assist in teaching SU undergraduate students about metamorphism, using highly relevant field samples and specimens.

Ms Muofhe Tshibalanganda, recipient of the best MSc presentation award at the recent IMRAD conference.

Student awards

Ms **Muofhe Tshibalanganda**, an Earth Sciences MSc research student and analyst at the X-ray Tomography Unit at the Central Analytical Facility (Stellenbosch), was recently awarded first prize for the best MSc level presentation at the Imaging and Radiation (IMRAD) 2021 virtual conference. Her MSc research focuses on utilising X-ray Computed Tomography (XCT) for characterising microfossils, with particular application as exploration vectors in the oil and gas industry. We are very proud of her achievement and wish her luck with the last phases of her thesis write-up.

As a final note, and as many of you already know, the Geocongress has been shifted again. The scientific organisational committee remain devoted to hosting an in-person event, and currently hope to run this during November 2022. The proposed date is one that allows for the vaccination drive to run its course, and also seeks to benefit from the warmer summer weather as opposed to a wintery mid-year event.

Bjorn von der Heyden

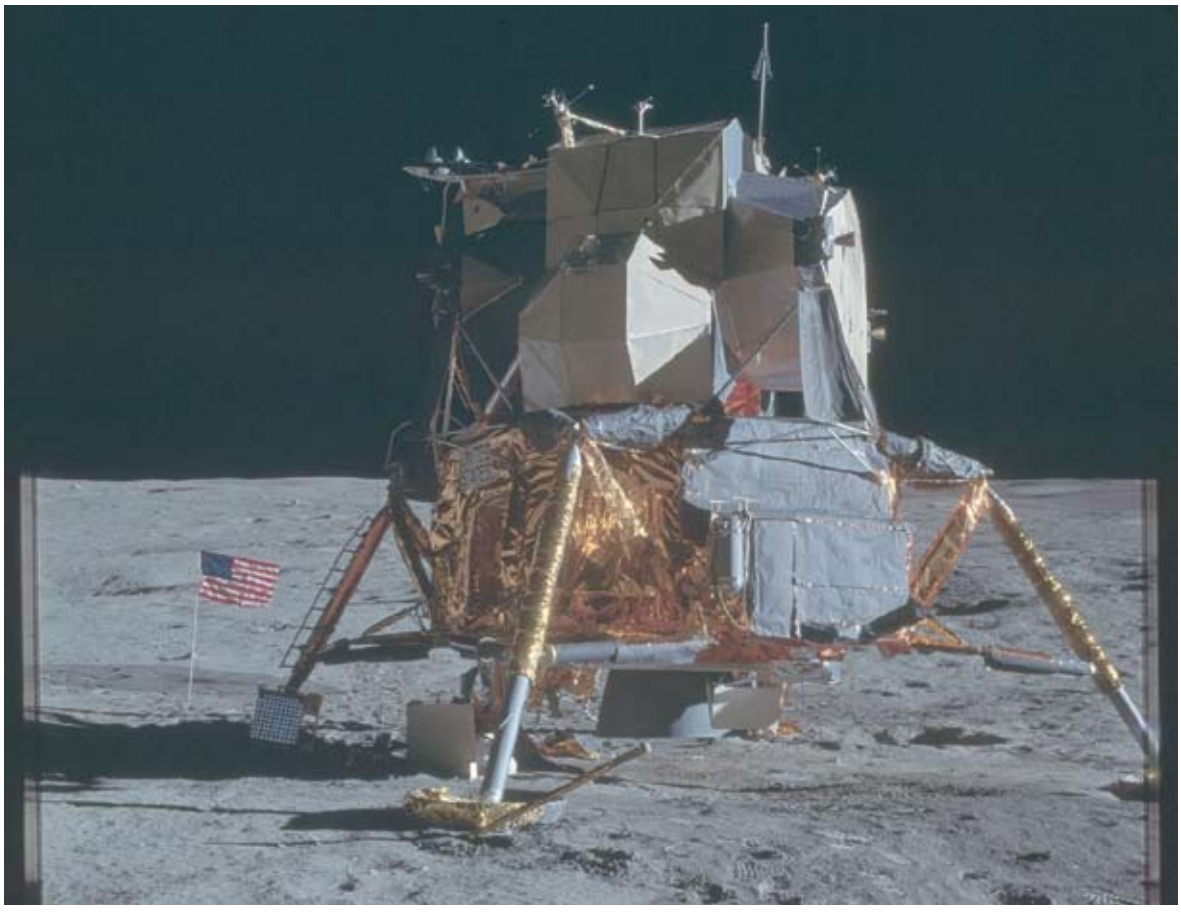
the geological hot pot

A big THANK YOU to those readers who indicated that they enjoy this column, and apologies for its absence in the past couple of issues. With a change in lifestyle now that I am officially retired, this column will be more regular. And I also aim to improve my cooking skills, and will one day actually produce a palatable hotpot!

We as geoscientists are always interested in beginnings: When did the Earth form? When did life begin? When did plate tectonics start? An article in *National Geographic* published in 2019 reports that the oldest *rock* on Earth was found on the Moon! We know about the circa 4.4 billion year old zircons from the Jack Hills in Australia that are the oldest *minerals* (not rocks) found on Earth. So how did this surprising finding come about? It is from the study of a breccia sample brought back from the Moon by the Apollo 14 mission in 1971—read the article to learn more.

Subduction (as opposed to seduction) is a vital component of the plate tectonic processes that control how the Earth operates. It might not make the world go round, but it certainly affects the daily lives of many of us, whether directly or indirectly. Many earthquakes and volcanic eruptions result from the subduction of oceanic plates under either a continental or another oceanic plate. The subduction process is thus well studied, but how it starts is still a topic for debate. A series of Open Access articles in *Nature Communications* deals with this fascinating topic, and is well worth reading.

Another favourite topic for academic arm-wrestling is the origin of layered mafic intrusions, with the Rustenburg Layered Suite (RLS) of the Bushveld Complex attracting more than its fair share of attention. This is not surprising taking into consideration the vast wealth that the RLS has generated for South



The Apollo 14 Landing Module on the surface of the moon. (Source: Wiki Commons courtesy of NASA)

Africa from the extraction of the minerals it contains. South Africa has been able to afford to mitigate the disastrous effects of the Covid-19 pandemic from the extra (not to say extraordinary) profits being earned (and hence taxes paid to the fiscus) by the platinum and chromium mining companies, among others. In an article in *Nature*, Yao *et al.* (2021) use thermodynamic modelling of crustal assimilation by komatiitic magmas to propose that a large magma chamber is not required to form the RLS. The paper has already elicited a strong response, published in the *South African Journal of Geology*, from Latypov & Chistyakova (2022) and it will be interesting to see the comments of other igneous petrologists studying layered intrusions, as the debate rages on.

And now for the ultimate question: How did the elements form? In particular, how did the heavy elements form? The answer lies in the origin of stars, a subject in the realm of the astronomers. None the less, we geoscientists should also be cognisant of this since we study Earth materials that are made up of all the elements. Astronomers conventionally theorised that the elements heavier that iron formed in supernova explosions, while the lighter ones originated from nuclear reactions during star formation. The latest report in *PNAS* finds that heavy elements form when two dense neutron stars spiral into each other.

From the distant past to the distant future. What will the Earth look like in 50 to 200 million years' time? We, of course, will be long gone by then, and humanity will have become extinct (worse-case scenario) or will have colonised the stars. We know that supercontinents, such as Gondwana and Laurasia, existed in the past, formed by plate tectonic movements. Now modelling based on robust geological data has enabled a plausible look into the configuration of Earth's continents in the future. I like the reference to the mantle acting like a boiling pot of water (which is in essence, with the addition of spices, a hotpot!). The geoscientists' findings are concisely summarised in this article in *Science Magazine*.

A good book deserves a good review, and this review on the book '*Meteorite: The Stones From Outer Space That Made Our World*' is a pleasure to read. The reviewer states that the book is "approachable", meaning that it is aimed at the informed layperson, i.e. not overly technical. I must remind myself to recommend it for my institution library.

When humankind does begin to colonise the stars,

The UG1 chromitite seam at the famous Dwars River outcrop in Limpopo Province. The UG2 Reef is mined for its important platinum group metals.

Native gold in a quartz vein cutting through Witwatersrand Supergroup rocks. From the former West Driefontein Gold Mine near Carletonville. Largest specimen about 5 cm in length.

the first stop after the Moon is most likely to be Mars. The current "space race" involving NASA, Elon Musk, Jeff Bezos and the Chinese space agency, among many, is to do with being the first to send humans to the Red Planet. As part of the build-up to the momentous occasion in the near future when the first human step is taken on Mars, remote landers have been conducting scientific studies, one of which is the Insight Lander. This vehicle has detected rumblings that are interpreted as due to underground magma flows, as reported in this article in *Quanta Magazine*. Whether this is good or bad news for our future Mars explorers is an open question, but it will certainly be exciting to find out!

We all love Lost Things, especially very large ones such as gold mines or even continents, because they have a certain mystique about them. Who has not been attracted to El Dorado, Atlantis or the Lost City of the Kalahari? This was recently been exemplified by a scholarly article co-authored by Lew Ashwal at Wits about the probable existence of ancient continental crust below the Indian Ocean island of Mauritius. Somehow the popular press got hold of the article and read it as proving the existence of a "lost continent" centred on Mauritius. Lew is still chuffed with the fact that *Cosmopolitan* magazine interviewed him about the topic. Imagine that! Equally exciting is the ongoing scientific work to prove the existence of a real sunken continent between Australia and New Zealand. This entity has been named "Zealandia" and will go into future text books as the Earth's 8th continent if the research work provides sufficient evidence to justify the contention. A good article is available from the BBC.

George Henry

Very young (and slim!) geologists Sharad Master, George Henry, Thomas Wallmach and Michael Meyer posing on the largest known meteorite on Earth—the Hoba Meteorite in Namibia. Photo taken during the Wits Geology Honours Class excursion in 1988. Sharad and George were doctoral candidates, while Thomas and Michael were lecturers.

diamond rush 2021

KwaHlathi Diamond Rush 2021

The small village of KwaHlathi, in KwaZulu-Natal, experienced a small diamond rush in June 2021 after rocks that resemble diamonds were discovered in the soil by a local herder. This marks one of several small gold and diamond rushes in the last couple of months in the rural parts of South Africa.

There are no known diamond occurrences, either primary kimberlite or secondary alluvial deposits, in the greater vicinity of where the discovery was made. KwaZulu Natal as a province also has no known economical diamond occurrences. However, it was reported by uncorroborated sources that a single alluvial diamond was discovered in Natal in the early 1900s. With the proximity to Lesotho, the potential of as yet undiscovered diamonds cannot be completely excluded.

The greater Ladysmith area is underlain by the Volksrust Formation, comprising blue-grey or black siltstone and shale. These rocks are intruded by abundant dolerite sills and colluvial hillslope sediments mantle the slopes. The soils are commonly clay-rich, structured profiles and the underlying Masotcheni Formation colluvium is highly erodible, forming deep dendritic gullies.[1]

At first glance, based on the photos that have been circulating on the internet, the crystals in question appear to be quartz. In the KwaHlathi area, there are a significant number of dolerite intrusions. These dolerite intrusions do contain pockets of secondary quartz mineralisation. These quartz pockets range in appearance from veins of various thickness, massive, to geodes of quartz crystals with crystal faces. The dolerite is susceptible to weathering, resulting in the clay soils that characterise the area. This leaves the more resistant quartz crystals to be recovered freely from the soil horizon.

The DMRE has dispatched a team of geological and mining experts to the area to collect some samples. The results are expected to be released in due course.

Nicolaas C Steenkamp
*Independent Consultant (*ncs.contract@gmail.com*)*

Reference:

1. Lindström, W. 1987. The geology of the Dundee area. Explanation sheet 2830. Department of Mineral and Energy Affairs, 52 pp.

bushveld ICDP project

Update on the Bushveld ICDP (BVDP) project

The first phase of operations of the Bushveld ICDP (BVDP) project kicked off at the University of the Free State in April 2021 with the commencement of logging of 6000 m of donated drill cores from the Eastern Limb of the Bushveld Complex, logged into mDIS, the logging data management program of the ICDP. These drill cores, donated by Impala Platinum, cover the upper two-thirds of the Rustenburg Layered Suite (RLS) down to the level of the LG5 chromitite layer of the lower Critical Zone. Several research projects on the donated cores have received funding from South African and German sources.

Another milestone was achieved in June 2021, with agreement being reached with the Council for Geoscience (CGS) to support the BVDP project with an in-house Bushveld research unit. The CGS will further support the project through the provision

Be the mentor you wish you had!

Bridge the Gap Geosciences Guidance Program (BTG), is a student run organization that focuses on mentorship between undergraduate and postgraduate students as well as students and industry professionals. In addition BTG hosts a number of informative talks, workshops and field trips to expose students and graduates to opportunities and expectations in the work environment.

Earn CPD points through mentoring!

Be the mentor you wish you had and assist in giving some guidance to geology undergraduate and postgraduate students by signing up to be a mentor through BTG. We invite all geosciences/ mining related companies, industry professionals and academics to 'bridge the gap' between university and industry, and to act as positive role models by joining the BTG program as a mentor, sponsor or motivational speaker.

BridgeTheGap
GeosciencesGuidanceProgram
EMPOWER || INSPIRE

If you are interested in getting involved please complete the Google form by clicking on the following link: https://forms.gle/Sf5tMciuSStAQuFL8

Your influence can go a long way in encouraging and shaping aspiring geologists to become future leaders. We believe that each of us can inspire and empower students by being 'the mentor you wish you had'

The program will start in February/March 2021

Marking and logging drill cores from the Bushveld Complex Main Zone (photo: J. Magson).

of staff and resources at the National Core Library in Donkerhoek. The cores that will be generated during the second operational phase of the BVDP project, along with ~10 000 m of existing cores, including the well-studied Bellevue core, will be logged and documented for use in the project by the CGS.

Drilling of new cores on the Eastern Limb of the Bushveld Complex is expected to start in late 2021 or early 2022 and will target ~3000 m through the lower reaches of the RLS, starting in the Lower Critical Zone and continuing into the floor of the intrusion.

Research projects on the donated drill cores that have already been funded include:

i) A high-resolution Sr-Nd-Pb isotopic study across the Pyroxenite Marker, Merensky Cyclic Unit and Lower Critical / Upper Critical Zone boundary to further our knowledge regarding the reasons and nature for isotopic excursions across these zones (funded by CIMERA);
ii) High-precision Sr-Nd-Hf isotope measurements by TIMS for ~100 whole-rock samples from all of the major zones of the Complex (funded by CIMERA);
iii) A study aimed at documenting the Sr-isotopic stratigraphy of the Eastern Limb of the RLS (funded by CIMERA);
iv) A study aimed at identifying breaks in the variation of density and mineral compositions throughout the Main Zone, which may be indicative of episodes of magma chamber recharge (funded by the German DFG);
v) A study aimed at the development of combined EDXRF (Energy Dispersive X-Ray Fluorescence), hyperspectral and LIBS (laser-induced breakdown spectroscopy) scanning for the rapid 2-D quantification of mineral modes, textures and composition in drill cores (funded by the German DFG).

Researchers with an interest in making use of the donated cores or wishing to access the new drill cores (once available) for their own research projects are encouraged to make contact with the project coordinators immediately to discuss sample access. All requests for access to the cores will be reviewed by the coordinating committee and preference will be given to collaborators capable of contributing to the operational costs of the project.

Coordinating committee:

Frederick Roelofse (roelofsef@ufs.ac.za)
Robert Trumbull (bobby@gfz-potsdam.de)
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***Lew Ashwal** on behalf of the coordinating committee*

the GSSA brand

The GSSA brand

Do you know what the symbols of the GSSA represent? This month we take a brief look at the meaning of the various crests, emblems and logos that we see every day and take for granted.

The **coat-of-arms** is the legal crest of the GSSA and was designed and trademarked in 1973. It comprises a shield with a central motif, a crest above a helmet, and a motto.

- The circled cross on the shield (the central motif) is the astronomical symbol of the earth and is probably of Medieval origin.
- The crest is the Springbok head, which symbolises South Africa. A neck band that repeats the central motif has been added to distinguish between it and the Springbok head appearing on sport arms.
- The helmet below the crest, facing sideways with the visor closed, is representative of gentry, as opposed to military.
- The colours and forms in the shield are all representative of the four elements of Aristotle: air = white, water = blue, earth = black, fire = red and yellow. The four elements not only represent the ingredients of the material world, but also characterise the fundamental geological environments, namely the atmosphere, hydrosphere (together with the exosphere, the uppermost region of the atmosphere as it gradually fades into the vacuum of space), the lithosphere and the endosphere (the mantle beneath the lithosphere). These four regions are shown in their normal sequence from top to bottom. Exosphere and endosphere also agree with the two main subdivisions of geology, namely the study of sedimentary (soft) and the igneous (hard) rocks. The contrast between the exosphere (alternating wavy bands of air and water) and the endosphere (angular alternating bands in the colours of fire) are thus accentuated. At the same time, the wavy bands could be interpreted as a symbol of the relatively small-degree deformation of near-surface rocks, whereas the angular bands symbolise more intense deformation that originates at great depths.
- The motto, **TERRAM COGNOSCENDO PROGREDIMUR,** translates to: *We go forward y knowledge of the Earth.*

The **hammer and pick** symbol is not used on the GSSA coat-of-arms. Such icons are generally associated with mining *sensu stricto* (cf. the SAIMM coat-of-arms). However, they are often used informally to represent the entire minerals industry.

In 2009, it was decided that the GSSA needed something a little more modern and distinct from the official crest, which led to the development of the current logo that we are much more familiar with, either as a full shield or cropped. The modern GSSA logo is a combination of the symbolic (the colourful shield) and typographic, providing a distinctive and trademarked brand identity. The GSSA look and feel is one that is bold, neutral, clean and uncluttered and was designed to resonate with a broad target audience—academics, industry professionals, government officials and students (future members of the GSSA).

In this instance, the shape of the shield represents Southern Africa. The colours reflect the national colours of South Africa, but also denote the modern representation of air (yellow), fire (red), water (blue) and planet earth (green). The wavy pattern of the colours is representative of the layers in the Earth. The blue and grey colouring of the GSSA typography represents status, dignity, quiet authority and practicality. The basic serif typeface font used is elegant and distinctive, representing respectability

and academic prowess, which is contrasted by the use of a complimentary neutral and contemporary sans serif font depicting simplicity.

In 2021, a more consistent corporate identity is being developed around the logo in order to promote the GSSA brand locally and internationally. This is being reflected in our stationery, website, social media posts and presentations. We have introduced small amounts of yellow as a highlight, especially in the social media field, as it is perceived as the colour of a communicator and of the networker and journalist.
You will have noticed small changes in our digital footprint already, and over the next few weeks you will see more as we upgrade, streamline and refresh our website. Most of the changes are functional, which we hope will allow you, the user, to find things more logically. However, we are also improving some features and introducing additional ones that we believe will benefit our members. We look forward to you using the website and continuing to follow your preferred social media platform as we progress our objective of promoting geoscience and geoscientists, locally and abroad.

We are proud of what the GSSA has been able to achieve over the past 125 years and especially over the past two years, which have been characterised by the global Covid-19 pandemic. We, further, believe that we are able to support our members going forward and one of the modest ways we can do this is by raising the profile of geology, the GSSA and the relevance of professional geoscientists in the academic, industry and governmental spheres.

geoheritage

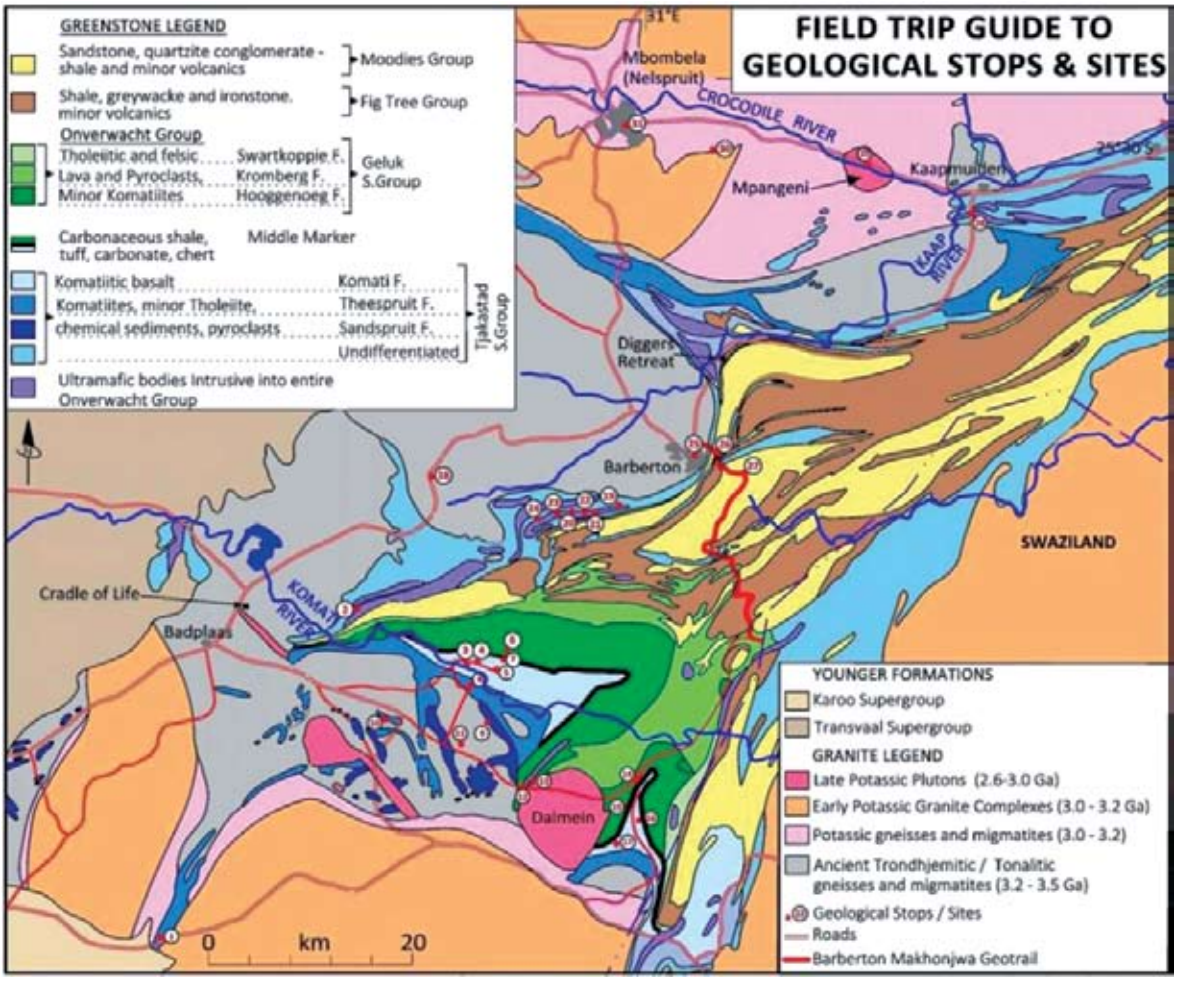
Geoheritage

Geoheritage Conference

Subject to Covid conditions, a Geoheritage Conference will be held on Tuesday 5 April and Wednesday 6 April 2022, with field trips on Sunday 3 April (International Geologists' Day) and Monday 4 April preceding the conference.

This hybrid conference will follow the Spiral of Life, beginning in the early Archaean rocks of Mpumalanga and Northern KZN, then moving to the middle and late Archaean rocks of Gauteng and Mpumalanga, the early Proterozoic rocks of Mpumalanga and Limpopo, the middle and late Proterozoic rocks of North West and Northern Cape, the Palaeozoic rocks of the Western Cape, the Mesozoic rocks of the Eastern Cape and Free State, and ending at the Cradle of Humankind in Gauteng.

Live venues at these seven localities will be linked via Zoom. At each locality, the local geoheritage groups will describe the attractions and activities in their area. The meetings will be open to the general public, school teacher groups, field guides and tourist organisations, with keynote addresses and invited lectures from these groups. Abstract submissions will be open on the Geoheritage page of the GSSA website from 1 November until 31 December 2021. Registration for the live venues will open on 1 February 2022.



Geological map of Barberton where the conference will begin. The exhibition of these and other images depicting the geological evolution of South African geology will be on display at the Walter Sisulu Botanical Gardens, after the official opening of the exhibition at the Geoheritage Conference. Virtual field trips to localities depicted will be available on Geologists' Day, Sunday 3 April 2022. Contingent on the course of Covid, physical field trips will be held to these localities on Monday 4 April, before the conference begins on Tuesday 5 April.

12 IKC POSTPONED TO 2022

The 12th International Kimberlite Conference is postponed to

15 - 19 August 2022

The postponement reflects the COVID-19 situation and resulting difficult times for the diamond industry together with the goal of maintaining the symbiotic mix of industry and academia that makes International Kimberlite Conferences unique. This change has the full support of the International Kimberlite Conference Advisory Committee

The intention is to host the 12IKC at the same venues in Yellowknife, with the same scientific programme, field trips, short courses and social events, but delayed by one year.

Further updates will be available on the 12 IKC Bulletin Board as well as via the 12 IKC mailing list.

We look forward to welcoming you to Yellowknife in 2022!

Countdown to the Groundwater Conference

GSSA Members - Your personal invitation

GROUND WATER DIVISION

18-20 OCTOBER 2021
GROUNDWATER CONFERENCE
RESILIENCE & VISIBILITY

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MANAGING/ MONITORING

INNOVATE

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DEVELOP/ IMPLEMENT

Highlights on the Conference Agenda

Final Programme will be available by mid-September

KEYNOTE SPEAKER
David Kreamer (IAH)
Professor of Geoscience

GUEST SPEAKERS
- Neno Kukuric (IGRAC)
- Colin Rice (Colin Rice Exploration Drilling Advisory)

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GROUND WATER DIVISION

conference SA consultancy

mineral scene

Quartz variety agate

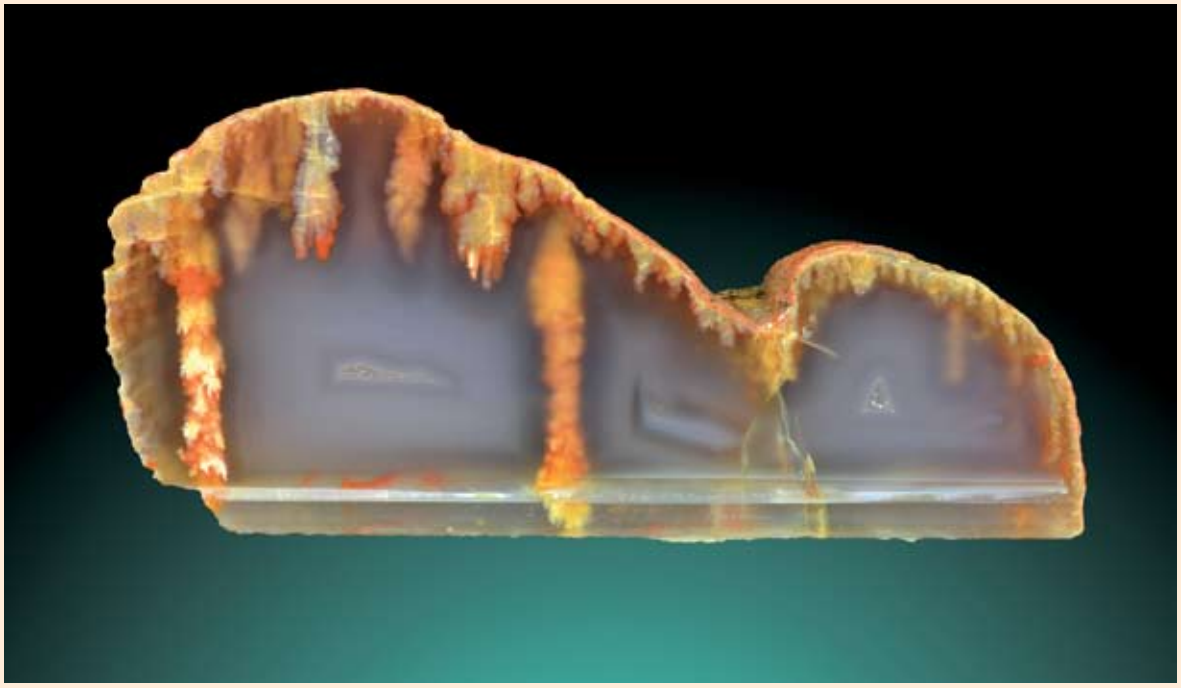
If one considers collectable minerals, then agates must be near the top of the list for most people who have some or other mineral or 'rock' collection. Agates are relatively common globally and because of the infinite shape, colour and structure, are often used in jewellery design and *objet d'art*. They have also been the subject of innumerable publications in the amateur and professional literature.[1] Agates are characterised by multiple, thin laminations of chalcedony (micro-crystalline quartz) that define distinct banding, although concentric banding is not always present. One of the reasons for an abundance of agates is their high durability in the weathering cycle, primarily a function of their chalcedonic cryptocrystalline structure. Rivers draining agate-bearing lithologies invariably contain well-preserved agates in the riverine sediment, and this is applicable to present-day rivers and ancient alluvial deposits.

Southern Africa has a variety of agates, most of which are weathered out from basaltic lavas. Some typical examples are shown here. All are cut and polished to highlight their internal features.

In South Africa**,** the Drakensberg basalts that outcrop in KwaZulu-Natal, the Free State and Eastern Cape contain many agates.[2] In northern KwaZulu-Natal, in the Jozini–Pongolapoort area, grey-blue agates up to a metre in diameter weigh many kilograms. Most of the alluvial diamond-digging dumps at Bloemhof, Barkly West and Lichtenburg contain a variety of agates. Agates also occur in present-day alluvial sediments of the Orange (Gariep), Vaal, Limpopo and Caledon rivers.

Agates are plentiful on some of Namibia's beaches, particularly at the appropriately named Agate Beach north of Lüderitz. A famous deposit of blue-lace agate occurs in veins associated with dolerite in southern Namibia, south-west of Karasburg, on the farm Ysterputz 254. North of the Ugab River, brown, grey, red and yellow alluvial agates eroded out of basalt.

Agates fill amygdales and geodes in Karoo



Moss agate from Jozini, KwaZulu-Natal. (Specimen: Massimo Leone, photo: Bruce Cairncross ©)

Complexly banded agate from the Windsorton alluvial diamond diggings, 7.2 cm. (Specimen and photo: Bruce Cairncross ©)

basalts, notably in the Tsholotsho, Bumi Hills and Featherstone areas, Zimbabwe.[3] Being resistant to weathering, they are liberated when basalts weather and crumble, accumulating in alluvium and other weathered debris. Most Zimbabwe agate is grey or blue-grey to pink. Agates occur together with amethyst, jasper, unakite, quartz and fuchsite in the Nyamandhlovu district (at the Mazibope property and at Chikodzi and Madombe). In the Lupane district, agates occur with green jasper and rose-pink quartz (pink amethyst). Agates are also found in the Hwange–Bulawayo area and the Save–Limpopo region.

The famous pink and cream Botswana agates come from present-day alluvial deposits in the Bobonong district.[1,4] Pink varieties are the most sought after, but other colour variants are also popular. These are

Polished blue lace agate cabochon, 6.2 cm, from the farm Ysterputz 254, southern Namibia. (Specimen and photo: Bruce Cairncross ©)

Beautiful, concentrically banded agate, 10.5 cm, Botswana. (Specimen and photo: Bruce Cairncross ©)

found in the Tuli region, several kilometres north of Pontdrif, which is on the South African/Botswana border, west of Beitbridge.

Agate is relatively common in certain geological environments in Mozambique, notably associated with volcanic rocks such as in the Lebombo Mountains in the Maputo Province that borders South Africa and Mozambique. Similar deposits are found in the Canxixe–Doa area of Sofala Province, and the volcanic units in the Tete Province, where some geodes occur up to 30 cm diameter.[5] In general, the agates display a wide range of colours including white, grey, pink and red. The Gaza Province is a source of alluvial agates and alluvial deposits on the Zambezi River in the vicinity of Chemba, Sofala Province.

Agates are found in many of the streams in Lesotho.[6] As in South Africa, they are weathered from the Drakensberg basalts that make up much of the

Somewhat atypical Botswana agate displaying a complex internal structure, 9.7 cm. (Specimen and photo: Bruce Cairncross ©)

Asymmetrically banded agate from Butha-Buthe, Lesotho, 5.2 cm. (Specimen and photo: Bruce Cairncross ©)

country. Fine yellow-and-blue banded examples come from the upper Sani Pass.

Bruce Cairncross

*Department of Geology, University of Johannesburg (*brucec@uj.ac.za*)*

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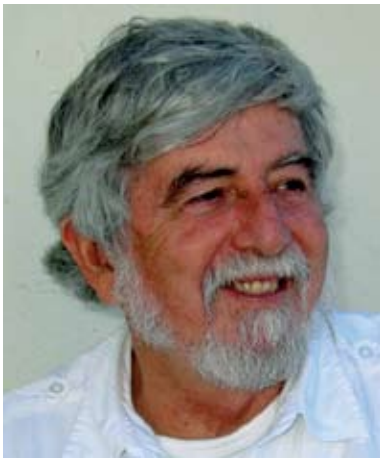
obituary

Christopher John Hubert Hartnady †

Christopher John Hubert Hartnady
4 July 1945 to 23 July 2021



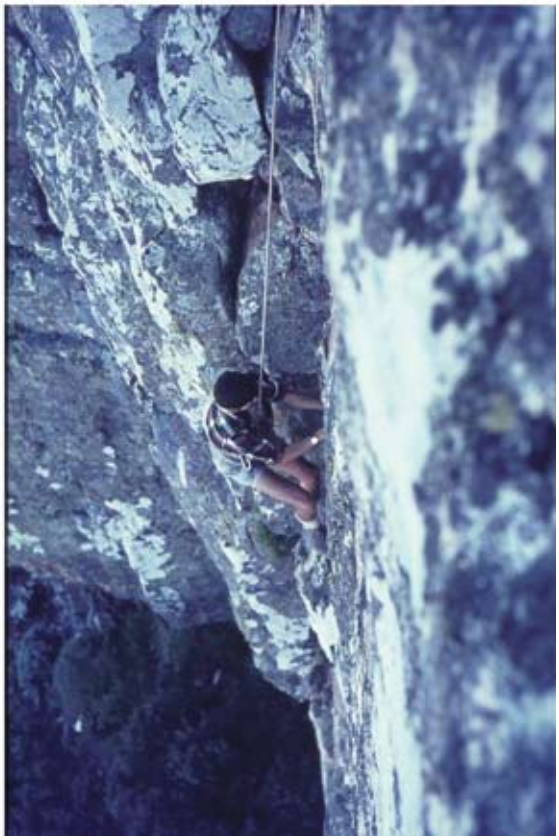
Dr Christopher Hartnady sadly and unexpectedly passed away from complications following COVID-19 treatment on Friday 23 July at the age of 76. Chris had a storied career as a researcher at the University of Cape Town until 2000. After taking early retirement from the University of Cape Town (UCT) in 2000, he became the technical director of Muizenberg-based earth science and groundwater consultancy Umvoto Africa until 2016, following which he fulfilled the role of non-executive director until his passing.

Chris was born in Cape Town on the 4th of July 1945, to Edna May Hartnady (neé Bensimon) and Hubert Sylvester Hartnady. Growing up in the shadow of Table Mountain in Plumstead, he developed a great love of the natural world and the exploration of the unknown. This led him to become an active cave explorer during the 1960s, becoming one of the youngest members of the Cape Peninsula Speleological Society. As an undergraduate geology student at UCT Chris became attracted to rock climbing, and that activity started to supplant the time he spent in caves.

There was a considerable overlap between the geoscience student community and the membership of the UCT Mountain & Ski Club. Chris climbed regularly with other people straddling these two groups, including Goonie Marsh, Steve Marsh, Greg Moseley, Andy Moore, Jimmy Marchant, John Moore and Andy Killick. During this period Chris also became a member of the Mountain Club of South Africa. Chris climbed many of the classic rock climbing routes on Table Mountain, particularly on Barrier Buttress and from Africa Ledge, and was in the opening party of one new route—Chock-a-Block on the Saddle—with Chris Walker and Andy Killick. He also enjoyed exploring in the Hex River Mountains, and contributed an article on Jan du Toit's Kloof to the 1966 UCT Mountain & Ski Club Bulletin. In addition to his climbing escapades, Chris also spent time in the mountains around Worcester and Franschhoek, studying the pre-Cape geology. These outings formed the basis for his MSc thesis on the structural geology of the Malmesbury Group, for which he was awarded the prestigious Corstorphine Medal of the Geological Society of South Africa in 1970. It would become a great source of delight to Chris that 45 years later his son Michael (also a geologist) would go on to win the same award for his MSc thesis on the Damara Belt in Namibia.

Following completion of his MSc, Chris attended the Master's course in structural geology at Imperial College London, taught by the late John Ramsay (of *Folding and Fracturing of Rocks* fame), where he received training in continuum mechanics approaches to structural geology and tectonics. Being in the United Kingdom during the late 1960s and early 1970s, Chris also witnessed first-hand the development of some of the seminal works on the theory of plate tectonics. These new ideas about how the Earth worked made an indelible impression on Chris and sparked a love affair with geology and plate tectonics that would go on to shape much of his academic career. It was John Ramsay who then, having previously spent some time in southern Africa on a sabbatical, convinced Chris to return to South Africa to undertake a PhD mapping the Naukluft Mountains in Namibia (supervised by Professor Joubert in the Precambrian Research Unit based at UCT). The detailed geological and structural

UCT Geology Department photo from 1966 showing a younger Chris (third row from the front, second from the right) alongside his undergraduate field-mapping partner and life-long friend John Rogers (third row from the front, far right).



Photographs of Chris rock-climbing (supplied by Goonie Marsh).

maps Chris made during his PhD are still used by researchers in the Naukluft Mountains to this day.

Chris then went on to be a Junior Lecturer at the UCT Geology Department from 1972 to 1974, Research Officer (1974–1980) and Senior Research Officer (1980–1986) in the Precambrian Research Unit at UCT, and finally an Associate Professor in Structural Geology at the UCT Geology Department from 1987, until his early retirement in 2000. During his academic career, Chris continued to work on

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Precambrian geology in Southern Africa, undertaking numerous mapping expeditions to the Damara and Gariep Belts in Namibia. Chris also participated in a number of marine-geological cruises undertaking seafloor mapping of the continental margins off the east coast of southern Africa, the Southwest Indian Ridge and the Andrew Bains Fracture Zone. Chris' remarkable understanding of the mechanics of plate motions and mathematical rigour allowed him to use the results from these expeditions to unravel the plate tectonic evolution of Southern Africa following the break-up of Gondwana. Chris became internationally renowned in the field of geotectonics for this work, which ultimately culminated in his discovery of a new tectonic microplate with Sarah Stamps (Virginia Tech) and Eric Calais (ENS Paris). He named this the Lwandle Plate ("Lwandle" is an isiXhosa word meaning "sea/ocean"), which is now recognised as one of the plates making up the global tectonic system (forming the African Plate with the Somali, Nubian, Rovuma and Victoria Plates).

Photos of Chris aboard the R/V Melville during the Protea Expedition to the Southwest Indian Ridge between 14 January and 15 February 1984. Top: Chris (right) and Hugh Bergh (left) analysing data. Bottom: Chris helping students to haul out trawl wire.

Following his early retirement from UCT in 2000, Chris took on the role of Technical Director of Umvoto Africa, a Muizenberg-based earth science, groundwater and integrated water resource management research consultancy founded by his wife, Rowena Hay. The combination of Chris' technical brilliance and Rowena's vibrant creativity and business acumen helped them to build Umvoto Africa into one of South Africa's leading earth science consulting firms. Together, Chris and Rowena made great strides in the understanding and development of the deep fractured aquifer systems of the Table Mountain Group (TMG) in the Western Cape. In particular, Chris pioneered the use of remote-sensing, geothermal, space-geodetic and hydroseismic studies of these unique fractured aquifers. He became a respected legend known as "the Professor" with farmers in the Citrusdal and Klein Karoo regions, owing to his knack for finding groundwater in the TMG at depths and areas where it was thought impossible.

While at Umvoto Africa, Chris also played a major role in studying and better understanding geohazard risk and promoting disaster-risk reduction on the African continent and abroad. In particular, Chris was a strong advocate for appreciating the seismic risk in Cape Town and the Western Cape, and tsunami risk in Southern Africa. There are very few, if any, people with as exhaustive knowledge about the history of earthquakes in Cape Town as he had. During the hype about the possibility for significant reserves of natural gas in the Karoo shales in the early 2010s, Chris was a public voice of reason; cautioning about the risks that hydraulic-fracturing techniques used by the natural gas exploration/mining industry posed in terms of groundwater contamination and for the potential of induced seismicity. With characteristic quick wit, he is quoted saying: "*I call the Karoo the 'Cape Stress Province'. Poking and stressing holes in the Karoo is like poking a lion with a stick—you do it at your own peril*."

After his semi-retirement from active work at Umvoto Africa in 2016, Chris became active in promoting geoheritage (he was busy developing a Henno Martin

Left: Chris standing over the 605 m deep, high-yielding (50 litres per second) C1b3 Blossoms Wellfield artesian borehole he sited in the Klein Karoo near Oudtshoorn. Right: Chris explaining evidence for past-recent deformation along the Milnerton Fault during an interview for Carte Blanche about earthquake risk faced by Cape Town.

Chris and Rowena near Bullspoort entrance to the Naukluft Mountains in Namibia in 2014.

Geotrail in Namibia at his passing) and geoethics (he presented a keynote session on the geoethics of bulk groundwater abstraction at the Geoethics & Groundwater Management International Congress in 2020). During his academic and professional career, Chris published over 50 peer-reviewed papers, book chapters and monographs, and over 100 conference abstracts and presentations.

Chris at Piton de la Fournaise shield volcano (Reunion Island).

Chris was the epitome of a geologist, in the best way possible. He was active in the field even into his 70s, and would stay up until the early hours of the morning, or wake up at the crack of dawn, to watch volcanoes such as Mount Etna (his third great love, after Rowena and his children) on live stream, or review the impacts of major earthquakes, perusing any data he could find. He was meticulous in the analysis of the most fine-scale geological and hydrogeological data, and would identify trends and features invisible to even the best geologists. Despite his intense focus and sometimes stubborn nature ("*it's the Catholic Irishman in me*" he would always say with a giggle), he was never selfish with his knowledge and would joyfully spend hours discussing whatever topic was at hand with students, colleagues and friends. This is shown in the over 40 Honours, MSc and PhD students he supervised, many of whom have become major leaders in their respective geological fields and industries.

Chris was a loving partner of Rowena (who also sadly passed away from COVID-19 recently), father to Michael and Ruth, much loved brother to Pam, and mentor to numerous Umvoto Africa staff and UCT

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(and other university) students. He was positively stoic and hugely caring, and only ever wanted people to reach the potential that he could see in them. Along with his incomparable mind and knowledge, his stories (such as how the Bensimon family found their way to South Africa) after a few glasses of good red wine will be greatly missed. One of his retirement goals was to walk the Appalachian Trail, and we hope he and Rowena are out there hand in hand walking it together right now.

*Compiled by **Michael Hartnady**, **Ruth Hartnady** and **Dylan Blake** (with contributions from Andy Killick, Judy Bryant, John Rogers and Steve Richardson, and discussions with many other friends and colleagues)*

Chris with Eric Calais (left) discussing geodetic monitoring at a TMG production borehole in Gateway Wellfield (Hermanus).

obituary

Elizabeth Rowena Hay †

Elizabeth Rowena Hay
21 October 1955 to 8 July 2021

Rowena Hay sadly and unexpectedly passed away on Thursday 8 July at the age of 65, after a battle with COVID-19. Rowena founded the Muizenberg-based earth science, groundwater and integrated water resource management research consultancy Umvoto Africa in 1992, and was managing director until her passing.

Elizabeth Rowena Hay was born in Queenstown in the Eastern Cape on the 21st of October 1955 to Penelope Anne Elton Hay (neé Mills) and Kenneth Ian Hay. She grew up on Oxton Manor, her family farm near Whittlesea, attending Queenstown Girls' High School where she was an accomplished all-round sportswoman and head girl.

Riding horses and hiking in the mountains on the family farm during her childhood cultivated a deep appreciation for the natural world and its beauty. To escape the drudgery of boarding school during her teenage years, Rowena would often go for long runs in the hills surrounding Queenstown. This love of the outdoors drove her to study geology at the University of Cape Town (UCT), achieving her BSc (1978), BSc Honours (1981) degrees and ultimately an MSc (1984) entitled "Sediment Dynamics on the Continental Shelf between Durban and Port St. Johns (Southeast African Continental Margin)".

At the time Rowena was an undergraduate student, a young Chris Hartnady was starting out as a lecturer in the UCT Geology Department, and it was here that they first met. She would often recall that when Chris first walked into the lecture theatre her first thought

Rowena in a prefects' photo at Queenstown Girls' High (front row, third from left).

was "*hmm, I could marry that man*". Rowena and Chris would not get together until over a decade later, and did not officially 'tie the knot' until 11 February 2006.

After completing her studies, she worked at Anglo American and the South African Atomic Energy Corporation. While working at the Atomic Energy Corporation, she developed an interest in hydrogeological modelling. During a secondment as a visiting scientist at the National Cooperative for the Disposal of Radioactive Waste (NAGRA) in Switzerland, she enhanced her modelling experience in connection with the hydrogeological and practical challenges of the long-term storage of nuclear waste. After returning to South Africa, she joined the Chamber of Mines, where her modelling expertise was used in studying the deposition of gold on the Witwatersrand. This numerical modelling experience would help lay the principles for Rowena's "monitor-model-manage" approach she would later apply across Umvoto Africa's groundwater development projects.

In 1992 she founded the earth science consulting firm Umvoto Africa; the word "Umvoto", a tribute to her Eastern Cape heritage, is a respectful isiXhosa word for water used by women. Through Umvoto, Rowena played an integral role in the understanding and development of the deep fractured aquifer systems of the Table Mountain Group (TMG) and pioneered the drilling of 500–1000 m ultra-deep exploration and production boreholes across the Western Cape. Rowena's jovial (but strict when required) rapport with even the most hardened drilling

Rowena and her MSc cohort outside the UCT Geology Department in the early 1980s.

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Left: Rowena conducting fieldwork in Lesotho in the early 1980s. Right: Rowena outside her house in Cosmos near Hartebeespoort Dam.

contractors, farmers and government officials was a joy to watch and a learning experience for many a young scientist—"*It is all about the theatre, my dear*" she would say with a huge grin and conductor-like waving arms, upon doing (or getting someone to agree to let her do) the "impossible".

This pioneering work was first demonstrated during the Citrusdal Artesian Groundwater Exploration (CAGE) project in the late 1990s. During this project, Rowena sited and drilled several high-yielding artesian boreholes in the Olifants River valley near Citrusdal. The successes of these boreholes demonstrated that not only was it possible to drill to great depth through the hard and fractured quartz-rich sandstones that comprise the lower TMG, but also that there were significant groundwater reserves in deeply buried parts of these aquifers. Based on the success of this work, and Rowena's dogged determination, she convinced the City of Cape Town through the then TMG Aquifer Alliance in the early 2000s that the TMG aquifers were a significant source of groundwater, and should be further studied, explored, and incorporated into the City's water management plans (which they now are through the recently developed Steenbras Wellfield, and future planned TMG wellfields). This resulted in significant exploration in the TMG throughout the Western Cape over the next two decades. One notable success story is the development and conjunctive use of groundwater in the water supply system of the greater Hermanus area. Owing to the town's ability to draw on its TMG groundwater resources (which now supply ~30–40% of the area's water), Hermanus was largely unaffected by the severe "Day Zero" drought of 2015–2018, and was also able to get through the 2009–2011 Southern Cape drought.

Rowena was a trailblazer in the truest sense of the word, particularly for women in science and engineering and small business entrepreneurship (of which she and Umvoto Africa won numerous awards and recognition) not only in South Africa and Africa, but globally. In 2005 she was nominated for the Department of Water Affairs and Forestry's "Women in Water Award". In 2009 she was the runner-up in the Department of Science and Technology's L'Oréal-UNESCO Achiever Award in the category

Rowena alongside then Minister of Science and Technology Naledi Pandor (left) after receiving the NSTF-South32 Award on behalf of Umvoto Africa.

"Woman Scientists in Industry", as well as the "Cape Entrepreneur Winner" in the Businesswomen's Association Regional Business Achievers Awards. In 2015, Rowena was the winner of a Water Research Commission Knowledge Tree Award in the category "Empowerment of Communities". In 2016, Umvoto Africa was the winner of a National Science and Technology Forum (NSTF)-South32 Award for "Research Leading to Innovation by a Team or Individual through a Small, Medium and Micro Enterprise".

In addition to her scientific endeavours, Rowena was also engaged in many social projects. Owing to her family's farming background, Rowena understood the intimate connection between a community's resilience and the health of the surrounding natural environment. She was passionate about helping communities improve their livelihoods through the betterment of their surrounding natural environment, and was deeply involved in disaster risk reduction, gender mainstreaming and social hydrogeology initiatives and projects. Over the years she undertook many such projects for various international organisations, including a situation analysis for the World Bank's disaster risk reduction (DRR) work in Malawi, a capacity needs assessment for the United Nation (UN) Development Programme's DRR work in Lesotho, and training education officials in Namibia in support of DRR at school level.

She provided key input to several UNDRR and UN Environment Programme initiatives in Africa, and served on the African Advisory Group (AAG) and the Gender Platform for UNDRR (the latter as expert support to the working committee for detailing and implementing the African Action Plan in DRR, and for mainstreaming gender in DRR globally). She has also developed DRR strategies for Small Island Developing States for the Commonwealth Secretariat, was Jury Member for the UNDRR Sasakawa Awards for DRR from 2005 until her passing, and was one of coordinating lead authors for the water chapter in the sixth edition of UNEP's Global Environment Outlook (GEO 6).

Rowena had a natural eye for beauty. She had a love for gardening, which she inherited from her mother, and always kept a beautiful garden wherever she lived. She was also an avid collector of art and Persian carpets. Rowena always sought out ways to combine her love for art and earth science. She recently established the Umvoto Foundation, a non-profit organisation aimed at merging art and science to foster mutual learning and co-create sustainable solutions for resilient and empowered communities. The rehabilitation of the Lotus River/Canal to improve the functioning of the Cape Flats Aquifer and lives of people in the adjacent communities was one of her final goals, and will be continued through the foundation.

Rowena and Chris on holiday in Barcelona in 2017.

Rowena was a loving partner of Chris, mother to Michael and Ruth, much loved sister of Catherine, Louise and Mary, and aunt to Erin, Andrea and Paula. She was also a mentor (and in some cases second mother) to her Umvoto Africa staff (and numerous interns) over the past 30 years. Rowena was a true maverick. Her unique humour, wit, passion, vibrancy and insight will be greatly missed, but her legacy will continue onwards in the people who had the privilege of knowing and working with her. Many of her famous terms ("*no squirrelling rule*", "*sideways arabesque*", among many others), huge smile and boisterous laugh will be forever remembered, and her spirit will wash in time with the tides into her favourite South Peninsula tidal pools.

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Compiled by ***Michael Hartnady***, ***Ruth Hartnady*** *and* ***Dylan Blake*** *(with contributions from Judy Bryant, John Rogers and Steve Richardson, and discussions with many other friends and colleagues).*

The Love of geologists

For Rowena & Chris 11/2/06

If you asked me to describe it in a poem,
I'd use the obvious metaphor, namely that
On the lowest stratum it's fossil in stone,
After that, the well-drained loam:
A smooth paste that embraces
Decaying straws and dying traces.
(You've fought a lot, but it's been productive.)

That's not to say there wasn't a tender beginning --
You know that more than most, I'd guess.
A bed in a place called Cosmos
is surely a cosmic bed.
There were flowers too, and Persian carpets
And, later, children who looked like you.

That's why you part the grass on the high plateau
And walk on crisscrossing pathways still:
Because you know what's beneath.

This is not young love,
This is the love of geologists.

With my love, Nuala (Dowling)

Poem written for Rowena and Chris' wedding in February 2006.

obituary

Lesley Turner †

Lesley Turner
29 April 1947 to 16 July 2021

It is with a profound sense of sadness that I pay tribute to Mrs Lesley Turner, who passed away due to Covid-19 on Friday 16 July.

Mrs. L.M. Turner (or Lesley as she preferred to be known) was born Lesley Owen in Newcastle KZN in 1947. She attended Durban Girls High School, then between 1965 and 1967 went to the University of Natal Durban (UND), which is now part of the University of KwaZulu-Natal, graduating with a degree in Geology and Chemistry. However, her decision to follow a career in geology, apparently inspired by her grandfather W.S.F. Cameron (a gold-prospector and miner), was not popular with her family, as at that time Geology was not considered a 'lady-like' occupation, and indeed the then mining legislation prevented women from going underground in mines.

Between 1968 and 1985, Lesley worked as Research Assistant to Professor E.P. Saggerson, the well-known igneous and metamorphic petrologist. Lesley assisted many of Prof Ted's research students and played a major role in compiling and co-authoring the Metamorphic Map of Africa for UNESCO and the Metamorphic Map of South Africa for the Council for Geoscience. She was also co-editor for the International Atomic Energy Agency publication on the "Correlation of Uranium Geology between South America and Africa". On the completion of these projects in 1987, Lesley joined the MINTEK group based at the University of Natal, undertaking technical and analytical support (XRD, XRF, light microscopy and SEM) for research on mineral processing. During this time Lesley not only honed her skills and knowledge of applied mineralogy, but also presented classes on mineralogy to the chemical engineering students at UND, and mineralogy, metamorphic and igneous petrology courses at the newly formed University of Durban-Westville Geology Department with Dr I. Forster.

In 1992, Lesley was invited to join Minemet Technologies (Pty) Ltd, a Durban-based group specialising in mineral processing and metallurgy, as a director; a post she still actively held until she passed away. The work involved a vast variety of applied mineralogy related studies that ranged from the beneficiation of kaolin, to the composition of atmospheric dust, and the mineralogy of the scale that formed on sugar cane juice evaporators—work that required the integration of a wide range of geological, chemical and engineering knowledge, and her expertise was sought by firms locally and abroad.

Lesley joined the Geological Society of South Africa in 1969 and although based in Durban, served on the GSSA Council for many years, as well as in several

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other activities, notably becoming the first 'Lady President' of the GSSA in 2001. Lesley was very active in the development of the SAMREC (South African Mineral Reporting Committee) code of conduct and a proponent of the Professional Scientist scheme. She was also a founding, and very active, member of the Mineralogical Society of SA (MINSA) and the KZN Branch of the Geological Society, regularly attending the meetings and participating in excursions. Lesley encouraged and mentored a number of young female geologists and, in recent years, she revelled in the growing number of women in all parts of the profession. Her commitment to the geological profession was immense and she will be sorely missed by all those who knew her, and most of all by those she guided and mentored during her career.

Many colleagues and work associates who knew her have commented on her passion for life and her profession, her warmth and cheerful greetings for friends and strangers alike, and commitment to her family, her siblings, and extended family.

In addition to her active participation within the GSSA community, Lesley thoroughly enjoyed, and was a contributing member to a number of other community activities in Durban. These included the Decorative Arts Society, the Botanical Society, the Royal Daulton Society and the "Bald and Beautiful" team on the pub quiz circuit (where she reigned supreme!). She also frequented antique fairs on the lookout for old jewellery, especially pieces that had interesting or unusual stones.

Lesley is survived by her husband of over 50 years Keith, sons Duncan and Gordon, and grandchildren Jessica, Kimberley, Shannon, Cameron and Ella. She will be greatly missed by all her many friends and colleagues.

John Dunlevey

obituary

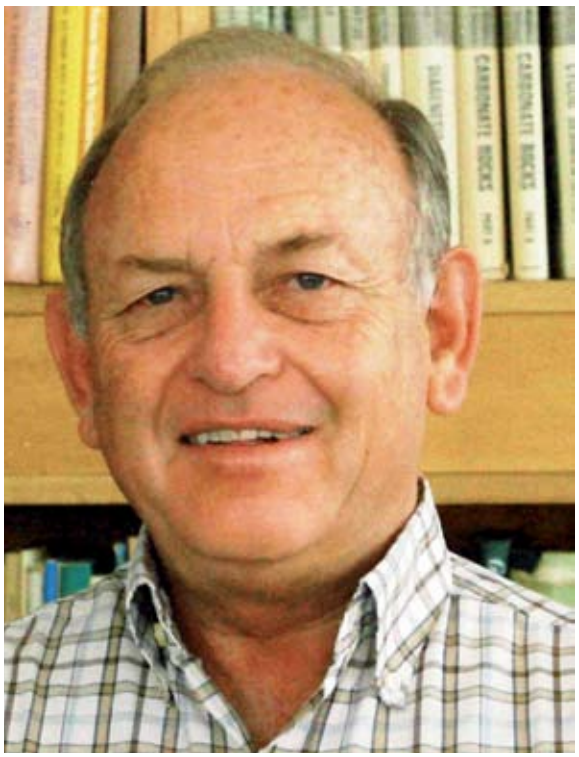
Morris James Viljoen †

Morris James Viljoen
21 July 1940 to 19 August 2021

And then there were two—A tribute to the life and times of Morris James Viljoen (1940–2021)

In 1958 the twin brothers Morris and Richard Viljoen, together with Carl Anhaeusser, registered for a science degree in geology at the University of the Witwatersrand (Wits) in Johannesburg. Subsequently, and until 19 August 2021, when Morris passed away of Covid-19 related complications, the three colleagues had kept in close contact for the past 63 years, sharing similar interests and contributing to the well-being of the geological fraternity.

After graduating with a BSc degree in 1960, Carl and Morris, in particular, undertook student vacation



jobs together, one being in the Malelane area of the Barberton greenstone belt, and the other in the Lesotho Highlands, where they carried out prospecting for diamonds for Colonel Jack Scott who earlier had discovered and developed the Stilfontein Gold Mine near Klerksdorp.

Morris, Richard, Carl, Peter Tyson and Dave van der Schyff on Wits graduation day in April, 1961.

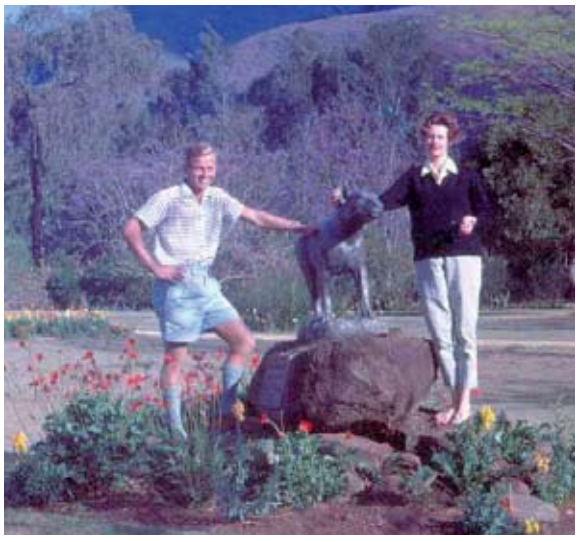
After completing an Honours degree at Wits in 1961, the three colleagues were offered bursaries to undertake further studies at Wits and they became MSc students in the recently established Economic Geology Research Unit at Wits, under the directorship of Professor Des Pretorius. Here again, Carl and Morris found themselves together and were given the task of field and structural mapping in the gold-producing district of the Barberton Goldfield, while Richard undertook a petrographic and mineragraphic study of Witwatersrand gold reefs in the East Rand. Morris was stationed at the New Consort Gold Mine and Carl worked in the Lily Gold Mine area about 20 km to the east. Their combined mapping along the northern contact of the Barberton greenstone belt led to the publication of their findings, as well as the completion of two MSc theses in 1964. Morris's thesis dealt specifically with the geology around the New Consort Gold Mine and for this study he was awarded, in 1964, the Corstorphine Medal of the Geological Society of South Africa and the Captain Scott Medal for the best thesis in any South African university. Professor Des Pretorius and Chris Roering acted as supervisors of the Barberton research, which followed a short course in structural geology delivered to the Wits Honours Class of 1961 by Professor John Ramsay of the Imperial College, London. Pretorius, in particular, was a hard and demanding taskmaster and to many was like an ogre, being subject to mood swings that terrified his students. He nevertheless rewarded quality work and encouraged students to also see the broader scope and relevance of their research. As a mentor he could not be faulted and his inspiration and stimulus paved the way for the successful careers of many of his students.

Morris in a helicopter leaving Marakabei in Lesotho to prospect for diamonds in the Orange River area.

Morris and Carl partying with Molly Spence and Joy Cradock in Barberton in 1962.

It was not all work and no play for Morris and Carl in the Lowveld. The manager of the New Consort Gold Mine at the time was a Mr Holmes, who was a fanatic cricket lover. He had an odd-shaped cricket field built on top of an old waste dump at the mine and insisted on having the two young 'Witsies' in his cricket team. Matches were played on weekends all over the Lowveld, including White River, Barberton, the Elands River Valley near Waterval Onder, and Bremersdorp (now Manzini) in Swaziland. In addition, social activities included partying and picnicking with local farmers and girlfriends in the Barberton district.

Having completed their MSc degrees, Morris and Richard both again joined the Johannesburg Consolidated Investment Company (JCI) in 1963.



Morris with Molly Spence in the Jock of the Bushveld Park in Barberton, 1962.

Morris was initially involved with exploration of the middle and upper Elsburg gold reefs near Westonaria, which contributed to the establishment of the Cooke Section of Randfontein Estates Gold Mine and the Elsburg Gold Mine. He later undertook field investigations of the Merensky Reef and chromitite horizons in the eastern Bushveld Complex.

In 1965, the twin brothers were offered a CSIR bursary by the South African Upper Mantle Committee to undertake a project entitled "Ultrabasics in fold belts in the Barberton area" under the direction and supervision of Professor Pretorius of the Economic Geology Research Unit at Wits. The research involved a detailed geological, geochemical and economic study of areas in the Barberton region. These investigations, first carried out in the Komati River Valley east of Badplaas, led to Morris being the co-discoverer of a new class of igneous and volcanic rocks that were named "komatiite" after the Komati River. Details of the komatiites have been widely publicised internationally and a field excursion to the Barberton area to commemorate the komatiite discovery was undertaken in October 2019. A feature article on the Viljoen brothers (and the 50th Anniversary of Komatiite) appeared in the *Geobulletin* in December 2019. Komatiites have subsequently been found in Archaean greenstone belts of all continents and are often associated with major nickel and gold deposits and have, furthermore, shed light on the evolution of the Early Earth.

Morris (left), Carl and Richard on Carl's wedding day on 20 February 1965. Throughout their lives few people could tell the identical Viljoen twins apart.

Also in 1965, Carl Anhaeusser chose to get married to Patricia, who he had met with the twins when the threesome decided, in 1961, to forgo being nerds and were determined to gain some social skills by taking dancing lessons at the Tommy Williams Dance Studio in Johannesburg.

The twins subsequently honoured Carl by acting as his Best Men at his wedding on 20 February 1965.

After completing their PhD research, the twins were approached in 1969 by JCI to start a Fundamental Geological Research Unit in the company. Morris and his brother began assessing the economic potential of large parts of southern Africa for base and precious metal mineralisation. Between 1969 and 1977, Morris held the position of Senior Research Geologist in JCI and worked on developing geological models for various classes of mineralisation and target generation for mineral exploration. Areas investigated included the Shangani and Inyati nickel occurrences in Zimbabwe, the Consolidated Murchison antimony–gold occurrences near Gravelotte, and the copper zone deposits associated with the Matchless amphibolites of the Damara Orogenic Belt in Namibia. Extensive travels in southern African countries, as well as world-wide, were aimed at identifying exploration targets for gold, platinum and antimony, and some of the earliest use of satellite and airborne photographic and thermal imagery were developed by JCI. Morris became expert at imagery interpretation, including Landsat and airborne thermal infrared imagery, which greatly assisted many exploration programmes.

Between 1977 and 1984, Morris was Consulting Geologist for the Rustenburg Platinum Mines and became involved with the Bushveld Complex. Here he was responsible for geological services to the platinum mines and held the position of Divisional Consulting Geologist – Platinum. Between 1984 and 1991, he was again with the JCI Research Unit and held the position of Divisional Consulting Geologist. In this capacity he was involved with Witwatersrand and non-Witwatersrand gold studies, including regional and local target selection as well as detailed modelling of existing mines and exploration areas.

Following his years of association with JCI, Morris was appointed Professor of Mining and Geology at his alma mater, the University of the Witwatersrand, a position he held for 16 years between 1991 and

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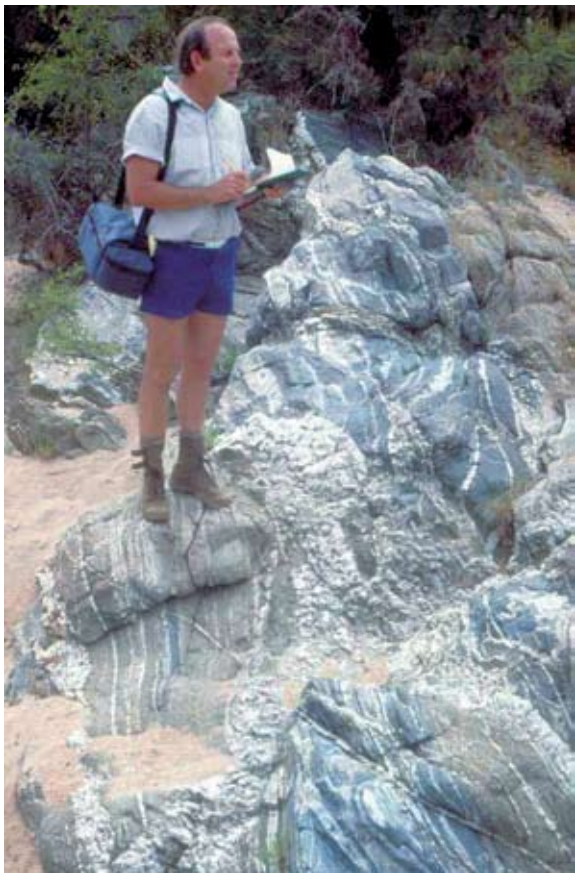
2007. Here he taught courses to Geology and Mining undergraduate and postgraduate students, including courses in Photogeology, Remote Sensing, Exploration Methods, Earth Resource and Resource Modelling, Underground Geological Mapping, Mining Geology, Mining and the Environment, Geology Ore Body Modelling, and Environmental Geoscience. In addition, he established a centre for Applied Mining and Exploration (CAMEG) within the department at Wits. With his pleasing disposition, his unselfishness and his ability to connect with students and develop their skills, he became an excellent mentor to the many geoscientists and mining engineers he trained during his tenure at Wits. He has been described as an academic father to many geoscientists both in South Africa and the world over as a consequence of the role he played in their careers. Morris was a firm believer in, and supporter of, field geology and in the production of detailed geological maps. He was convinced most geological problems could be resolved by detailed field investigations.



Morris in typical field mode standing on ancient gneisses exposed in a river bed near the Pietersburg greenstone belt.

Morris pointing to the Middle Marker on the map of the type locality of the Onverwacht Group of rocks in the Barberton greenstone belt. The map resulted from the combined efforts of the twins in 1969.

Morris had a close association with the activities of the Geological Society of South Africa (GSSA), having served on the Activation, Conservation, Education and Professional Affairs Committees and played a leading role in the establishment of the Economic Geology Division of the Society and the Environmental Earth Science Group. He was elected President of the Society in 1988. He received many awards during his career and, with his brother, was the recipient of the Lindgren Award of the Society of Economic Geologists (USA) in 1979. Morris was also awarded the Geological Society of South Africa's highest award, the Draper Memorial Medal (1985), and the Honours Award (1995), for his many contributions to the earth sciences. He was elected a Fellow of the Royal Society of South Africa, the South African Institute of Mining and Metallurgy, the Geological Society of South Africa and the Society of Economic Geologists.

Morris had a passion for promoting the earth sciences, particularly with regards to geoheritage and geotourism. He led the GSSA initiative of producing a 3D geological model, for the benefit of visitors, which was placed at the cableway terminus on the summit of the Magaliesberg, overlooking the Hartbeespoort Dam. Besides over 80 scientific papers published in peer-reviewed journals, and numerous unpublished company reports, he authored and co-authored a number of books on Geoheritage, including: "An Introduction to South Africa's Geological and Mining Heritage" (co-authored with W. U. Reimold) and

"Africa's Top Geological Sites" (co-edited with R.P. Viljoen and C.R. Anhaeusser). A book in the final phases of preparation entitled "The Earth Life Link in the Kruger National Park" (co-authored with Kruger Park Naturalists) was not completed prior to Morris's death.

Numerous Geological and Geoheritage field trips were led by Morris and he produced a number of field guide books. These include:

- Geoheritage of Johannesburg and Central Witwatersrand
- Geoheritage of Walter Sisulu Botanical Gardens
- Magaliesberg Cableway Guide Book
- Mining and Geological Heritage of the Eastern Bushveld
- The Eastern Mpumalanga Escarpment
- Geoheritage of Southern Kruger Park
- Geological Sites of the Garden Route
- Swartberg, Meiringspoort and Oudtshoorn Valley
- Cape Town, Table Mountain and Peninsula
- Komatiites – 50th Anniversary Field Guide

Furthermore, he made attempts to promote and publicise the Vredefort World Heritage Site in Parys and he made significant contributions to the legacy projects of the 35th International Geological Congress held in Cape Town in 2016. Morris also amassed a large collection of Geoheritage-related photographs, maps and publications with the intention of making this material available, particularly for Geotourism and educational purposes.

Through CAMEG, and after his retirement from Wits University, Morris together with his brother Richard played an instrumental role in the generation of many exploration targets, several of which have developed into advanced prospects and operating mines. In 2010, he was one of the co-founders of VMIC (VM Investment Company), together with Richard, Richard's son Anthony Viljoen, and Fortune Mojapelo. VMIC laid the foundation for the establishment of Bushveld Minerals and AfriTin as fully operational AIM-listed mining companies. The geological base on which Bushveld Minerals and AfriTin were structured followed from the geological expertise of Professors Morris Viljoen and Richard Viljoen, "the Twins" as they were affectionately referred to by company employees. Up until his passing, Morris remained a technical advisor to these companies.

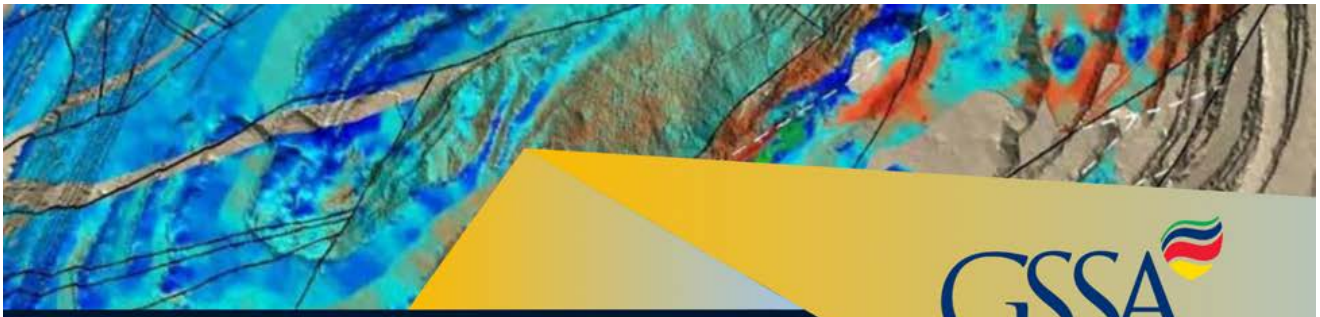
Morris remained single for all of his life, unlike Richard who married Miranda in 1969. Miranda at times got the feeling that she was married to both brothers as Morris spent a great deal of time with Richard on geology-related matters as well as socially. Morris was an eligible bachelor and had many girlfriends

Morris, Maureen and Leopold Bosch at a Geological Society function (ca. 2017)

over the years. If any of them had thoughts of marrying him these were soon dispelled as they saw that they would play second fiddle to Morris's first love—geology. In later years he lived with his long-term partner, Maureen, and they relocated from Johannesburg to Sedgefield, a coastal town along the Garden Route in the Western Cape Province. Maureen sadly passed away a few weeks before Morris, also with Covid-19 related complications.

With the passing of Prof Morris Viljoen, a huge pillar of the geological fraternity has fallen. He will be sorely missed but we take comfort in the fact that our memories of him will live on in the amazing legacy that he has created.

*This tribute has been compiled by the two remaining members of the trio, namely **Carl Anhaeusser** and colleague **Richard Viljoen**.*



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3D GEOMODELLING

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ABOUT THE WORKSHOP

Recent trends in mining and exploration are set to further accelerate the demand and growth of 3D geological modelling software. These trends include the inevitable increase in cost per ton of resource and global economic slowdowns. These require companies to constantly cost-cut during extraction and to improve resource delineation. Add to this the trend that new discoveries are deeper and in more structurally-complex setting, and it's apparent that a great deal of attention needs to be focused on getting the geometry of a deposit, as early as possible in the exploration and mining value chain, correct.

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COURSE INFO

THE GEOTRAVELLER

By Roger N Scoon*

Acheron River, Northwest Greece:
Greek Mythology and Archaeological Sites

View of the limestone cliffs, Acheron Gorge. The massive beds of resistant, grey limestone formed in the Neo-Tethys Ocean during the Triassic and Jurassic.

The Acheron River is situated in the district of Epirus, northwest Greece, a remote region dominated by the Pindus Mountains. The most scenic section of the river is associated with the Acheron Gorge, which contains the Springs of Acheron. The Acheron River is one of the five mythical rivers of ancient Greece and was described by Homer, the Greek poet who probably lived in the 8th Century BC. It was known as the river of Hades. Hades is the king of the "Underworld", an important concept in Greek mythology that refers to an otherworld where the souls (separated from the bodies) go after death.

The Greek philosopher Plato (428–348 BC) identified the Acheron River as the second greatest river. The Acheron was described by the Roman poet Virgil (70–19 BC) as the principal river of Tartarus, a deep abyss where the souls of the newly dead were judged. The Acheron River formed the boundary between Earth and the Underworld. Four other rivers were attached to the mythology, the Cocytus, Lethe, Phlegethon and Styx. The five rivers converge on a great marsh (also known as the Styx) and the dead were thought to enter the Underworld by being rowed across the River Styx by Charon, the ferryman of Hades (thus the expression "a coin to pay the ferryman").

The Pindus Mountains are a series of disjointed, parallel ranges with a length of 160 km. The ranges strike approximately NW–SE, i.e., parallel to the coastline of the Balkan Peninsula. There are several peaks over 2,000 m; the highest is Mount Smolikas

Image showing Charon crossing the River Styx. From the Divine Comedy by Gustave Dore (1880). (Source: en.wikipedia.org)

(2,637 m), near the Albanian border. Rivers have carved broad valleys in the Pindus Mountains. Valleys that trend W–E are invariably associated with grabens. The Acheron River (length of 52 km) is somewhat anomalous in having sections aligned both W–E and N–S. Acheron Gorge (also known as the Stena Gorge in Greece) is situated near the village of Glyki, on the western boundary of the South Pindus Mountains. Glyki is located 74 km by road from the regional capital of Ioannina. The Acheron Gorge occurs 17 km from the mouth of the river, which drains into the Ionian Sea at Ammoudia. The Nekromanteion of Acheron is situated a few kilometres inland at Mesopotamos. The archaeological sites of Dodona, Actium, and Nicopolis are also of interest.

The Balkan Peninsula is one of the most tectonically active areas on Earth. The collision of the African and Eurasian Plates is ongoing and the Alpine Orogeny (which peaked at 34–5.3 Ma) may be considered as active. The sinuous nature of the current plate boundaries triggered formation of microplates with

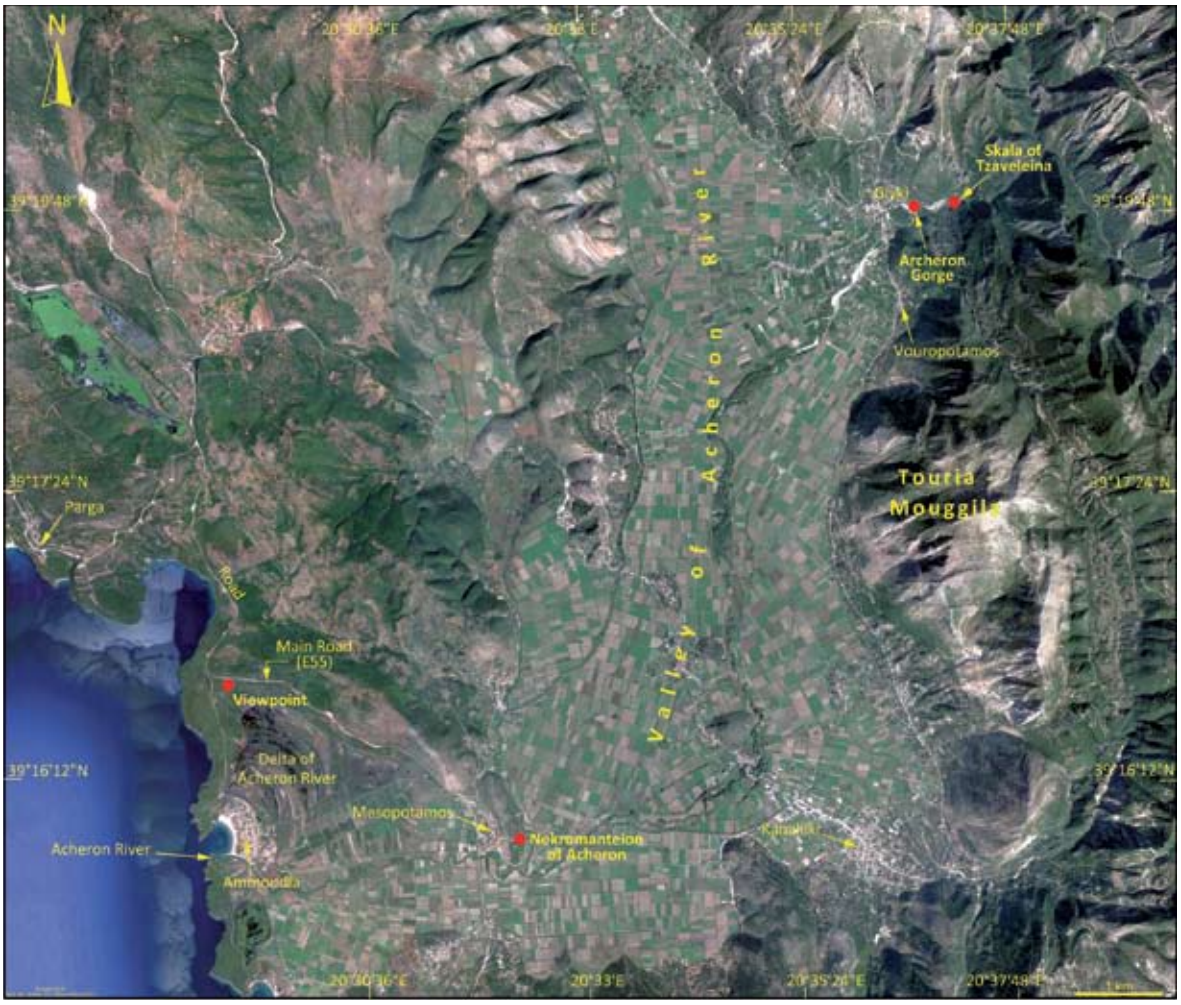


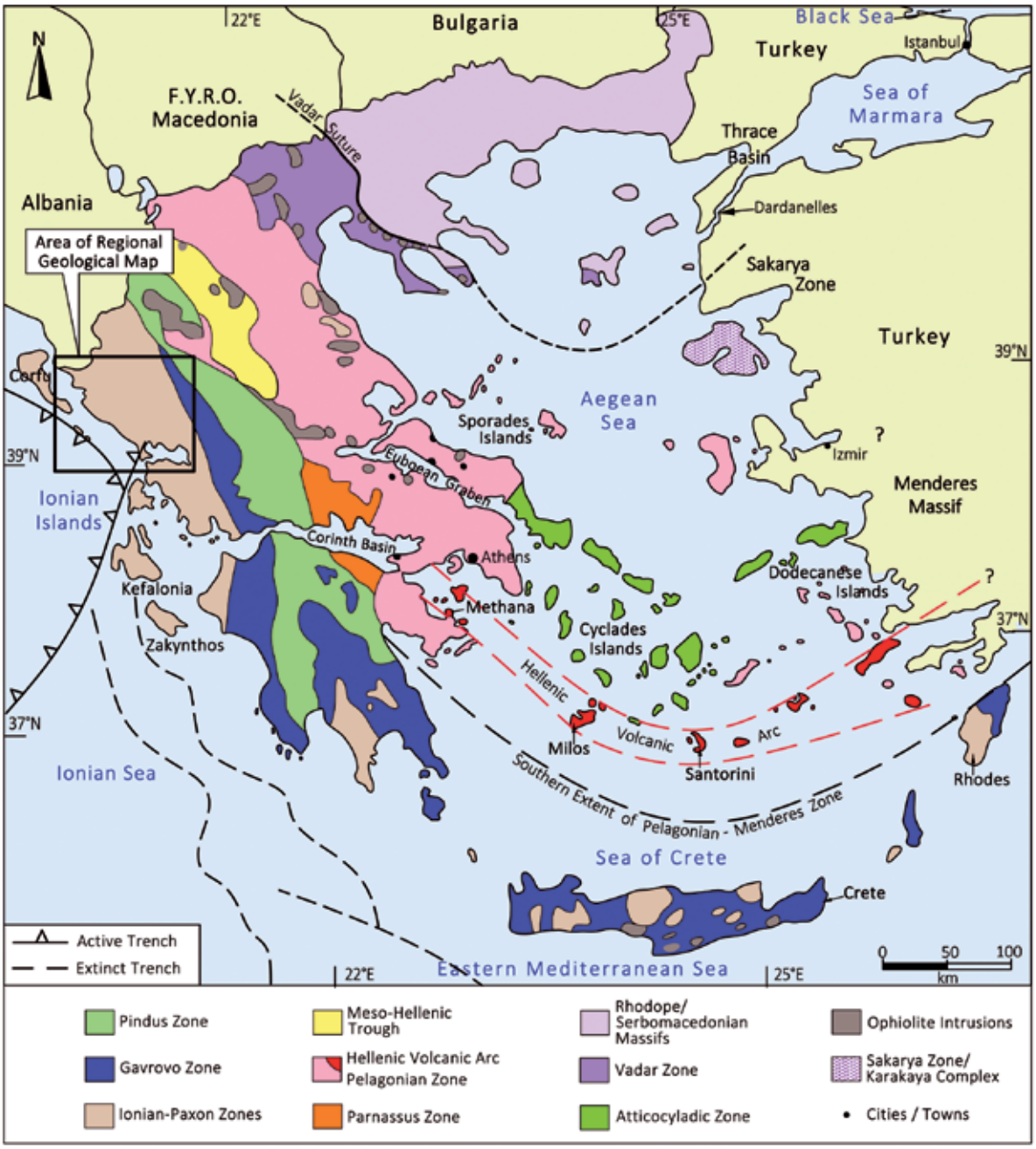
Image of the region in the vicinity of the Acheron River, northwest Greece. (Source: Google Earth)

complex (and unstable) boundaries, e.g., the Hellenic Microplate.[1–3]

The regional geology is dominated by NW–SE-aligned Alpine tectonic zones.[4] The occurrence of remnants of the ancient Tethys Ocean is a complicating factor.[2,5] Repeated opening and closure of the palaeo-ocean occurred due to convergence and collision during the Caledonian Orogeny (Lower Palaeozoic).[6–8] The Tethys Ocean reformed after dismantling of the ancient supercontinents and the Variscan Orogeny (Upper Palaeozoic).

The Neo-Tethys (Triassic–Jurassic) was a shallow, subtropical ocean or sea in which thick sequences of carbonates accumulated. The closure of the Neo-Tethys in the Mid Jurassic triggered the onset of the long drawn-out Alpine Orogeny. The principal expression is the occurrence of fold mountains at right angles to the basin axis (e.g., the Pindus Mountains).[1,2,6–13] The opposite sides of the Mediterranean Basin have a disparate form (unlike the Atlantic Ocean where continental margins can be fitted together).

The Pindus Mountains transgress multiple tectonic zones, e.g., the Ionian-Paxon, Pindus and Pelagonian. Zones are linked to the Alpine massifs of central and southeast Europe and are separated by complex boundaries that may include regional faults and thrusts. The Alpine zones consist of a multitude of primary geological terrains, e.g., continental fragments, sections of islands, ocean ridges and ocean floors. The Ionian-Paxon Zones consist of metamorphic rocks, mostly limestone and marble (Mesozoic). A characteristic feature is the occurrence of thinly bedded limestones and marbles with near-vertical dips. The mountains bordering the Acheron River include thick sequences of mostly massive, resistant, grey limestone (Triassic–Jurassic). Areas closer to the Ionian Sea, and north of the Acheron Valley, include marine limestone (Late Cretaceous

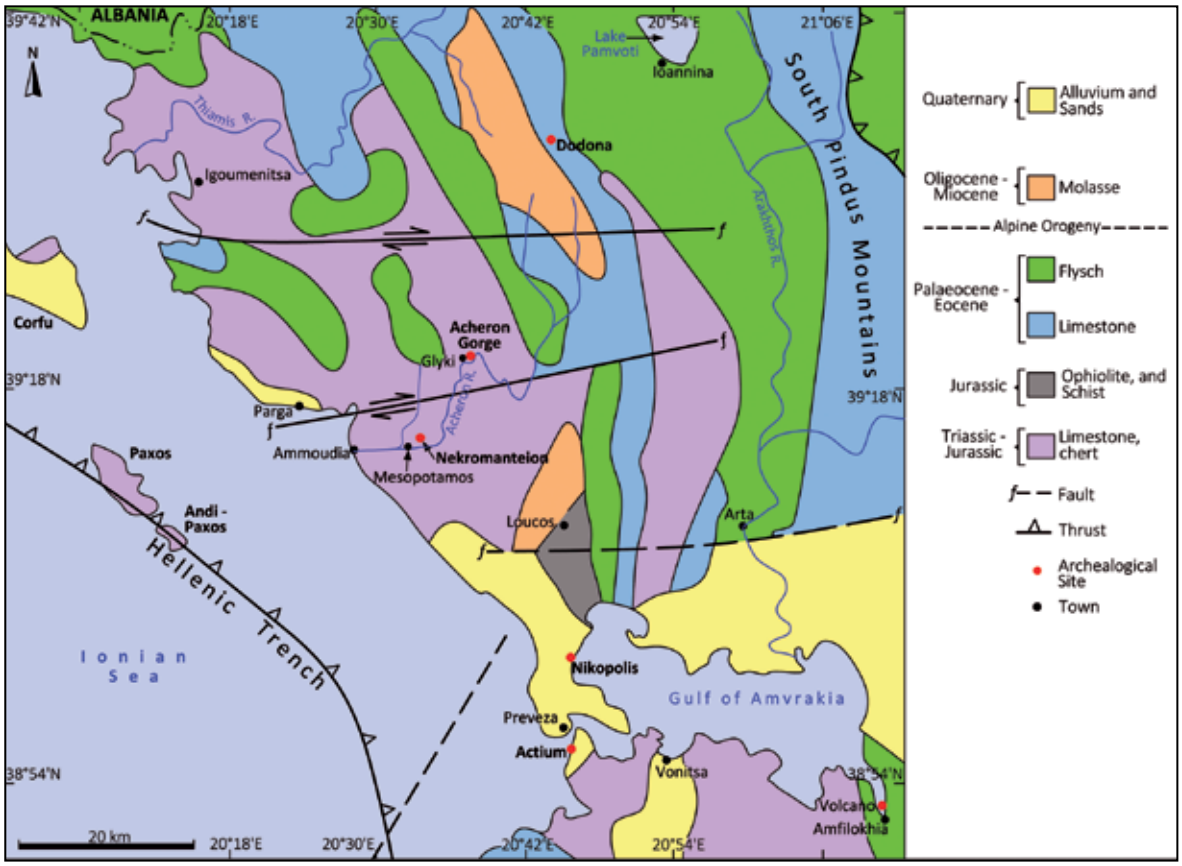


Simplified geological map of Greece showing the NW–SE-trending Alpine zones and location of the Acheron River.

and Palaeocene–Eocene). The younger limestones are less resistant to erosion and have a light grey or pale brown coloration.

The Hellenic Microplate reveals both fore-arc and back-arc basins. Crustal extension occurred in northwest Greece during the Cenozoic, peaking in the Neogene.[3,13] The principal

Thinly bedded limestones and marbles (Triassic–Jurassic) with near-vertical dips are characteristic of the Alpine zones of northwest Greece. Locality near Igoumenitsa.



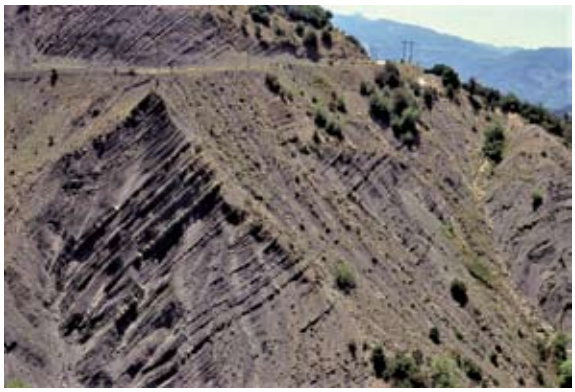
Geological map of the Acheron Valley, simplified from regional maps and the Geoviewer.

manifestation is formation of basins and grabens. Many graben faults are active and are periodically prone to seismic events. Thick deposits of flysch (Late Palaeocene or Early Oligocene) and molasse (Late Oligocene–Miocene) accumulated in the basins and grabens. The flysch (marine sediments, e.g., schist, marl and sandstone) formed in foreland basins at the base of the rising Pelagonian nappes. The bedding may be steeply inclined. The flat-lying molasse (conglomerate and sandstone) has

Pale grey-white marine limestone (Palaeocene–Eocene). Locality near Parga.

low levels of deformation. Deposits of gravel and alluvium (Quaternary) occur in most grabens.

The Acheron River has carved a broad valley, large parts of which are covered by Quaternary sediments. Isolated hills generally consist of the Triassic–Jurassic limestone outcrop. The Acheron Gorge has steep walls carved out of the resistant limestone. The gorge occurs on the western flanks of a range of hills protected in the Touria Mouggila nature reserve. The



The flysch of northwest Greece includes steeply inclined deposits of schist. Locality near Kalarrytes.

The lower and central reaches of the Acheron River occur in a broad, alluvium-filled valley rimmed by mountains of resistant limestone (Triassic–Jurassic).

View from the hiking trail in the Touria Mouggila nature reserve on the southern bank of the Acheron Gorge. The mountains consist of Triassic and Jurassic limestone.

The Acheron River (right) enters the Ionian Sea at Ammoudia (left) by a channel that has been straightened and constrained by dykes of the locally derived limestone.

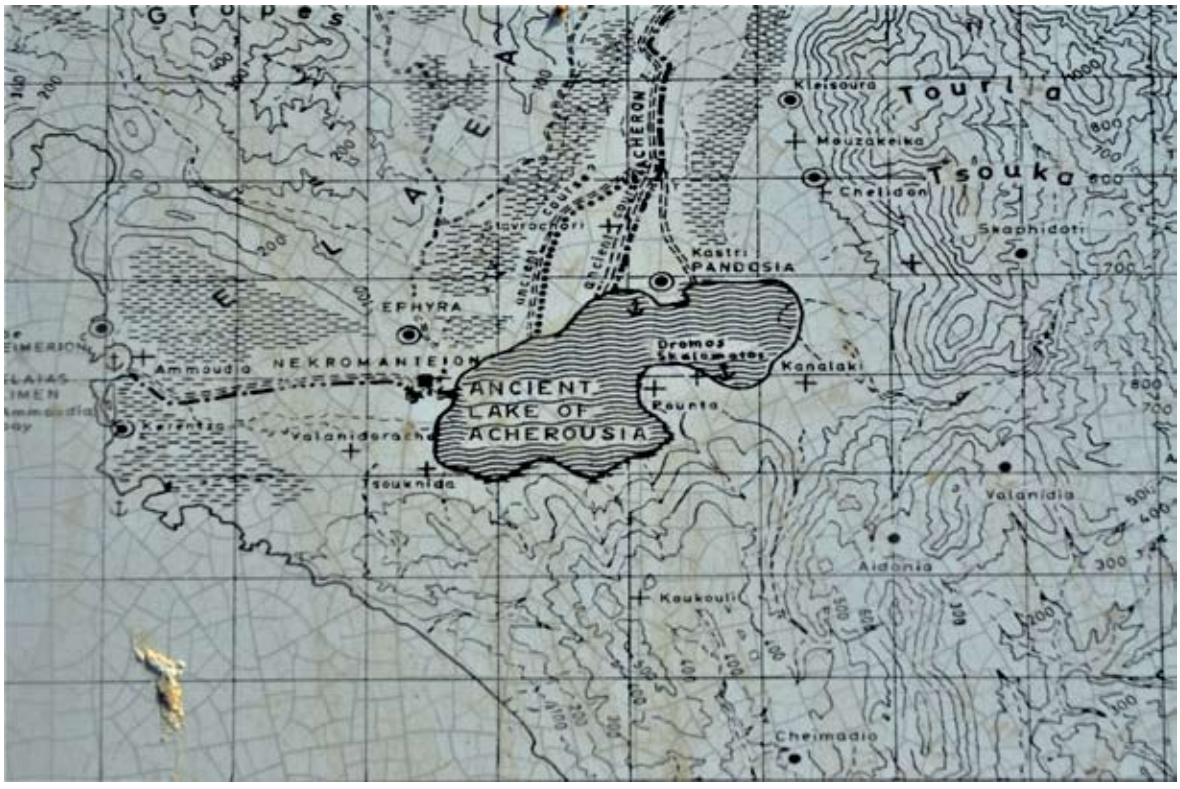
gorge is a tourist attraction, and the clear, cold water is generally shallow enough to allow visitors to wade several kilometres upstream. The Springs of Acheron describe water that bubbles out of the rock walls, from caves and subterranean passageways. Hikes in the Touria Mouggila include a historical trail on the southern banks of the Acheron Gorge. The trail reveals exposures of the Triassic–Jurassic limestone and includes a tunnel through a section of the cliffs.

The Acheron River enters the sea at Ammoudia, via a channel that has been straightened and enclosed by levees. The delta of the Acheron River, which includes thick deposits of alluvium, has been largely abandoned by the main channel.[14] The delta includes

Wetlands associated with the delta of the Acheron River are rimmed by hills consisting of limestone and flysch.

The Nekromanteion of Acheron is an ancient Greek temple constructed on a hill of resistant limestone (Triassic–Jurassic). The hill is situated in the Acheron Valley near the confluence of three rivers.

an endangered wetland and is severely degraded.[15] Changes in the landscape since the classical Greek times are in part related to sedimentation patterns and earthquakes, but also to human activity. The wetlands can be viewed from the main road that links the port of Igoumenitsa with Athens. The delta is enclosed by hills of limestone and flysch.



A plaque engraved with a map of the ancient "Lake of Acherousia".

The ancient crypt at the Nekromanteion of Acheron may connect to a natural cave in the limestone bedrock.

The Nekromanteion of Acheron is an ancient Greek temple located on the banks of a low hill near Mesopotamos (meaning land between the rivers). The site was discovered in 1958. The Nekromanteion (meaning "Oracle of the Dead") is also known as the Temple of Hades and Persephone. The antiquity is constructed on a hill of resistant limestone (Triassic–Jurassic) near the confluence of the Cocytus and Phlegethon tributaries of the Acheron River. As part of the construction the crest of the hill was flattened, probably in the 3–4th Century BC (Hellenistic period). The hill overlooks floodplains formerly associated with the ancient "Lake of Acherousia". The landscape has changed considerably, as the lake has been

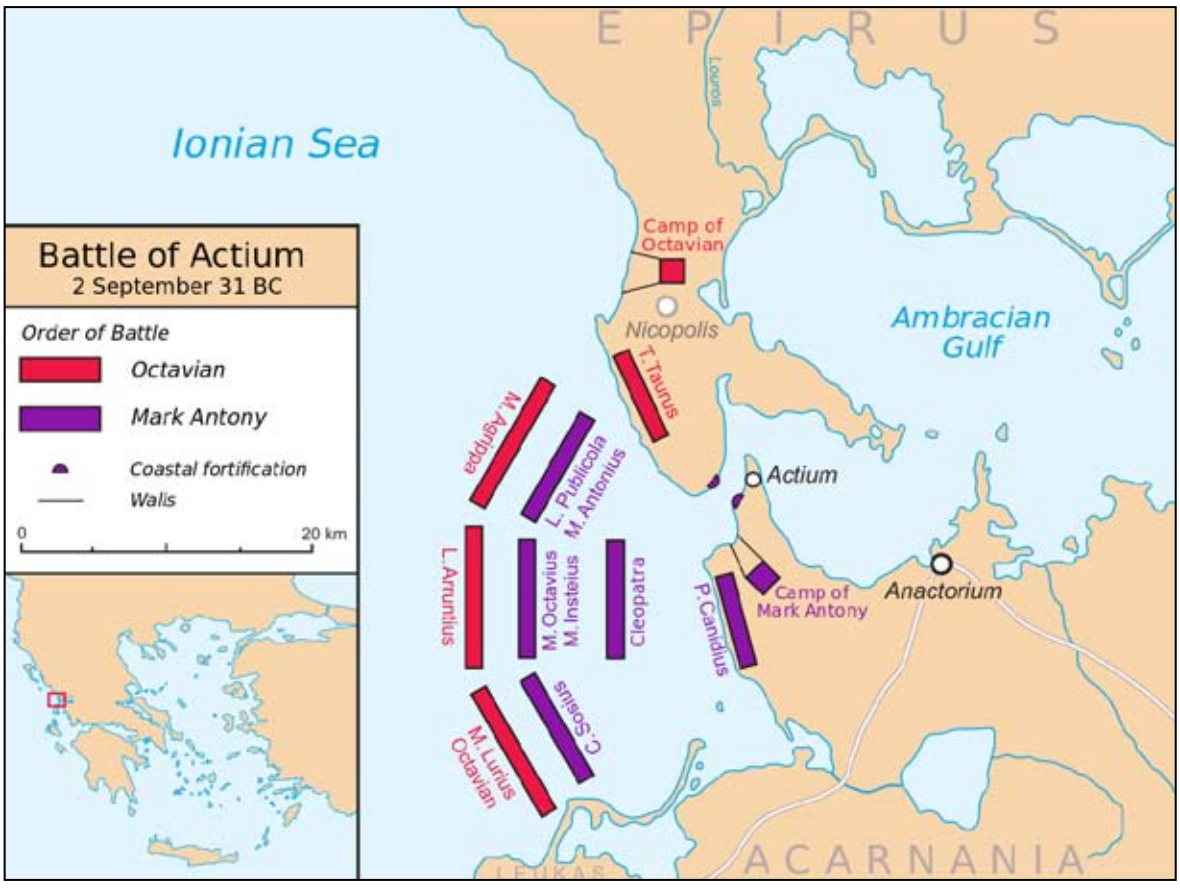
The Dodona antiquity includes a large theatre carved into the hill slopes.

drained and is now an area of fertile farmland.[16]
In Homer's Odyssey, the Nekromanteion of Acheron was described as the entrance by which Odysseus entered the Underworld. There is some dispute, as the main buildings date from the Hellenistic period. Evidence of occupation during the Archaic period is limited to artifacts and literary traditions. The main sanctuary includes a lower level, the roof of which is supported by 15 limestone arches. This structure is hewn out of solid limestone and when excavated showed no evidence of being connected to the newer buildings. The crypt may connect to a natural cave in the limestone bedrock. The usage was probably for worship of the gods of the Underworld.

The most significant of the archaeological sites in the northern part of the region described here is Dodona, situated southwest of Ioannina. Dodona occurs in a dry valley enclosed by high ramparts and scree-covered slopes of Triassic–Jurassic limestone. Streams are associated with sinkholes at the base of the hills.[17] The site includes evidence of an old Bronze Age culture (2,500 BC), but the well-preserved theatre is part of the Classical Greece period (500–323 BC). The theatre includes a platform consisting of blocks of Palaeocene–Eocene limestone with veins of chert.

The historical site of Actium is located on the southern promontory to the Gulf of Amvrakia (also known as the Ambracian Gulf). This feature defines the southern extent of Epirus. The gulf is associated with an active graben and may have a similar origin to the Gulf of Corinth (which has been widely investigated). The peninsulas at the mouth of the gulf are related to recent tectonic uplift (Neogene). There are reports of a small volcano having erupted in the harbour of Amfilokhia during the 19th Century. Gas emissions are reported to be a common occurrence in the vicinity of Vonitsa.

The Battle of Actium in 31 BC is where the Roman Emperor Octavius defeated Mark Antony and Cleopatra in a famous naval engagement. The event marks the end of the Hellenistic period and commencement of the Roman Empire in Greece (although the Romans had controlled the province of



Map showing the site of the Battle of Actium.
(Source: Future Perfect at Sunrise, Wikimedia Commons)

The Roman wall at the archaeological site of Nicopolis. (Photo: Jean Housen, Wikimedia Commons)

Epirus since at least 167 BC). The battle was fought in part of the Ionian Sea (in the vicinity of Aktio international airport) where the prevailing NW wind has built up extensive sandbanks. The discovery in 1980 of several shipwrecks in the vicinity of Actium—as well as the discovery of the Temple of Apollo at Actium in 2009—has influenced the historical view of where the battle occurred. Active sedimentation in the mouth of the gulf, together with the high incidence of earthquakes in this region (noting the proximity to the plate boundary), have changed the position of the coastline over the previous two millennia. There is a possibility that part of the sea battle may have occurred on what is now the southern peninsula.[17]

To celebrate the victory at Actium, a new regional centre for Epirus was constructed by Octavius at Nikopolis, on the northern peninsula of the Gulf of Amvrakia (in 29 BC). The ancient city is located on the narrowest part of the peninsula, adjacent to the Bay of Arta, and covers a large area. Sections of the original walls, an Odeon, a large theatre, and a 10,000-seat stadium (used primarily for the quadrennial "Actium Games") are mostly intact. Most structures use large blocks of locally derived, grey limestone (Triassic–Jurassic). Sections of an aqueduct that brought water over 50 km from the Louros River to Nikopolis are preserved. At one stage the city became a centre of Christianity, but by the Middle Ages was supplanted by the regional town of Preveza.

The Roman city of Arta (formerly known as Ambracia) is situated north of the Gulf of Ambracia. The Ambracian cultural heritage is primarily known for King Pyrrhus and the concept of the "Pyrrhic victory" ("Another such victory and I am lost"). The foundations of a Roman temple can be seen in the city, as well as the restored packhorse bridge (which dates from Medieval times). The bridge crosses a broad meander of the Arakhthos River and is constructed of large blocks of massive, grey limestone.

All photographs, unless otherwise referenced, are by the author.

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The restored packhorse bridge at Arta crosses the Arakhthos River.

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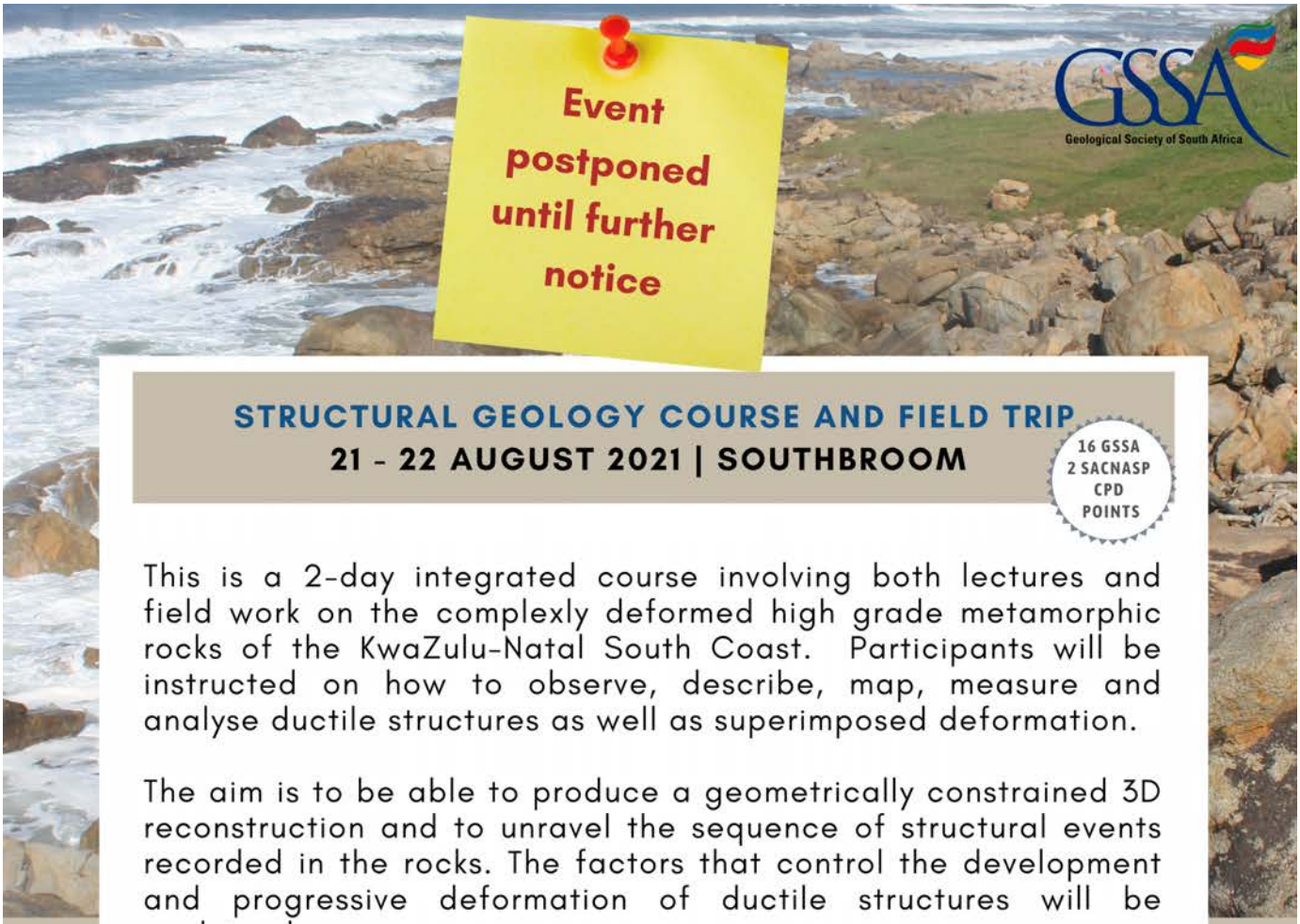

STRUCTURAL GEOLOGY COURSE AND FIELD TRIP

21 - 22 AUGUST 2021 | SOUTHBROOM

16 GSSA
2 SACNASP
CPD
POINTS

This is a 2-day integrated course involving both lectures and field work on the complexly deformed high grade metamorphic rocks of the KwaZulu-Natal South Coast. Participants will be instructed on how to observe, describe, map, measure and analyse ductile structures as well as superimposed deformation.

The aim is to be able to produce a geometrically constrained 3D reconstruction and to unravel the sequence of structural events recorded in the rocks. The factors that control the development and progressive deformation of ductile structures will be explained.

Presenter

Mike Watkeys is a structural geologist with over 40 years' experience of running structural geology courses, particularly field-based courses often for the mining industry both locally and internationally. He completed his Honours degree at the University College of Swansea, Wales and then joined the Geological Survey of the then Rhodesia. After obtaining a PhD at the University of the Witwatersrand, he was at the University of Cape Town before joining the University of Natal, now the University of KwaZulu-Natal. Currently he is an Emeritus Professor of that university and a private consultant.

REGISTRATION FEES

Member - R6000 | **Non Member** - R7500 | **Student / Retired** - R4000

TECT

info@gssa.org.za

The University of KwaZulu-Natal (UKZN) is committed to meeting the objectives of Employment Equity to improve representivity within the Institution. Preference will be given to applicants from designated groups in accordance with our Employment Equity Plan.

COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE

PROFESSOR (GEOLOGICAL SCIENCES)
SCHOOL OF AGRICULTURAL, EARTH AND ENVIRONMENTAL SCIENCES
WESTVILLE CAMPUS

REF NO.: AEES09/2021

The School has an active group of academic staff contributing to research and teaching in a wide-ranging areas of Geological Sciences. The incumbent will be required to provide academic leadership, teach modules at both undergraduate and postgraduate levels, (including but not limited to general geology, environmental geology, geology of South Africa) and to conduct research in the Geological Sciences. S/he will be expected to establish a research programme, attract external research funds and supervise Honours and postgraduate students.

The incumbent will be expected to have a track record that demonstrate success in peer-reviewed publishing and postgraduate supervision. S/he will be required to develop strong links with industry to promote scholarship and research in their area of expertise.

Geological Sciences has a variety of equipment to facilitate research: basic paleomagnetic laboratory; Panalytical XRF and XRD equipment; a Perkin Elmer Nexion ICP-MS with LA system; Ion Chromatograph, a SGE-USGS heating-freezing stage for fluid inclusion studies; a sedimentology laboratory with a Malvern Particle Sizer; full suite of single channel seismic reflection profilers including an Applied Acoustics high-resolution boomer system, an Applied Acoustics moderate resolution sparker with multiple hydrophones, shallow water pinger system and ultrahigh-resolution Klein hydroscan side-scan sonar; Altura Zenith drone; access to marine vibrocorer and ultra high-resolution Norbit iWNBF multibeam system; a rock engineering laboratory with a variety of appropriate testing equipment, research microscopes, basic field hydrogeology and environmental geology equipment; and access to a complete suite of Roc science programmes.

The incumbent will report to the Academic Leader : Geological Sciences

Minimum requirements:
- A relevant PhD degree in Geological sciences
- Experience in teaching at a tertiary institution
- A current and sustained research publication record in peer-reviewed ISI/DoHET accredited journals appropriate for the level of
- Successful supervision of MSc and PhD students
- Demonstrated ability to attract external research funds
- Evidence of strong academic leadership

This appointment will be made in line with the University Guidelines/benchmarks which are available on the University Vacancies website on
http://vacancies.ukzn.ac.za/Academic-Process-Proc-Guides.aspx

Enquiries and details regarding this post may be directed to the Dean & Head of School, Professor Fhatuwani Mudau, on e-mail: MudauF@ukzn.ac.za

Appointment to this position will be on the 2018 Conditions of Service.

Short-listed candidates may be expected to do a presentation on a specified topic.

The remuneration package offered includes benefits.

The closing date for receipt of applications is 17 September 2021.

Applicants are required to complete the relevant application from which is available on the Vacancies website at www.ukzn.ac.za Completed forms AND Curriculum Vitae may be sent to recruitment-aes@ukzn.ac.za. Advert Reference Number must be clearly stated in the subject line.

5TH SOUTHERN AFRICAN MINERAL SYMPOSIUM 2021

SECOND CIRCULAR

A one-day symposium highlighting minerals and mineral and gemstone deposits of southern Africa hosted jointly by the Mineralogical Association of South Africa, University of the Witwatersrand and the South African Micromount Society

IMPORTANT INFORMATION

Date: Saturday 20 November 2021
Venue: University of the Witwatersrand, Johannesburg
Cost: R175 (attendees); R100 (presenters) – Reduced from 1st Call (includes tea/coffee & packed lunch)
Enquiries: Symposium Chairman – Igor Željko Tonžetić: minsa@gssa.org.za
Abstracts Due Date: 12 September 2021 (Extended Submission)

The Mineralogical Association of South Africa (MINSA), in conjunction with the South African Micromount Society (SAMS) and the University of the Witwatersrand, would like to invite you and all interested parties to submit abstracts/extended abstracts/short communications (for presentation) at the 5th Southern African Minerals Symposium 2021. Please try to keep your abstracts/extended abstracts/short communications down to 2 pages (Calibri 11, Single Line Spacing). Submissions longer than 4 pages will not be accepted. You are welcome to include images/figures in your abstract, as well as references. Be sure to include a title, author name, and affiliation/address in your abstract. Accepted abstracts will be published with short biographies.

A poster programme will run concurrently. As such, you are also welcome to submit posters for display.

Background to the symposium...
This symposium will be the fifth 'mineral symposium' that has been held in South Africa, albeit not on a very regular basis. The '*1st International Gem & Minerals Symposium*' was organised in September 1975 by the Pretoria Gem & Mineral Club in Pretoria on behalf of the Federation of South African Gem and Mineralogical Societies. Four overseas and three local mineralogists and gemmologists delivered a series of talks over three days and one day was taken up by field trips. The themes of the lectures were focused primarily on overseas minerals, mineral localities and on gemstones.

Seventeen years later, Bruce Cairncross organised and convened the '*First SA Mineral Collectors' Symposium*' at the Rand Afrikaans University in Johannesburg in September 1992. This concentrated more on local content than the first symposium held in Pretoria, which had a distinct international flavour. This took place over a weekend, with thirteen local experts presenting talks on various aspects of minerals, mineral localities, mineral identification, analytical techniques and gemstones. After a day and a half of talks, delegates then visited some of the local collectors in the Johannesburg–Pretoria area to view their collections.

Eighteen years later, in 2010, the '*3rd Southern African Mineral Symposium*' was held at the Council for Geoscience in Pretoria. Jointly organised by some members of the Witwatersrand Gem and Mineral Club and the South African Micromount Society, this one-day event showcased local experts and specialists (both amateur and professional) in mineralogy, gemmology, mineral collecting and related topics, presenting a wide ranging series of talks and poster displays on the region's minerals and gemstones. The symposium was a tremendous success, with over 100 participants, 14 speakers, along with 9 poster presentations.

Similarly, and building on the success of the previous symposium, the 2012 symposium was held at the Council for Geoscience in Pretoria and attracted 12 speakers with over 100 delegates in attendance. Topics included the Phalaborwa Complex, Okiep Copper District, the industrial archaeology of silver in the Pretoria region, microminerals of the Bushveld Complex, FOSAGAMS mineral excursions, the Museum Africa minerals collection, mineral connoisseurship, detrital rutile, diamond morphology, tanzanite, meteorites, the Kalahari Manganese Field and the Rosh Pinah Pb-Zn Mine.

The purpose of the 2021 symposium (as with previous symposiums), is twofold. Firstly, to bring together the 'professionals' and the 'amateurs' who are experts in their respective fields and to have stimulating discussions on minerals, gems and related topics. Secondly, the symposium acts as a vehicle for promoting and highlighting minerals, mineral heritage, mineral collecting and mineral preservation in our region. It is therefore envisaged to use the success of the current symposium, and the previous ones, to have these on a more regular basis.

Day's Programme

08:00 – 09:00	Arrival, registration and tea
09:00 – 09:10	Welcome and announcements
09:10 – 10:50	Presentations – Session 1
10:50 – 11:20	Morning tea, posters and dealer sales
11:20 – 12:35	Presentations – Session 2
12:35 – 13:45	Lunch and dealer sales
13:45 – 15:25	Presentations – Session 3
15:25 – 15:55	Afternoon tea, posters and dealer sales
15:55 – 17:10	Presentations – Session 4
17:10 – 17:20	Closing remarks
17:20 – 19:30	Posters and dealer sales

COVID Implications:
This event is being planned as a contact event, especially so as to help mineral specimen dealers in these hard times. As such, only the first 70 registrations for applicants will be accepted to ensure adequate social distancing (this is half the number that has been accommodated at previous symposia). Registration forms will be distributed shortly after the 12th of September. However, that is only assuming that the event will be allowed to occur and that we obtain enough abstracts to justify the event. We are holding thumbs, but you will be notified of any cancellations should they occur.

Your understanding in this regard is much appreciated.

The Department of Earth Sciences at Stellenbosch University,
the Geological Society of South Africa,
the Igneous and Metamorphic Studies Group,
the Global State of Affairs, and the local state of the vaccine drive

regret to announce:

EVENT POSTPONED AGAIN

Dear Southern African Earth Sciences community

Earlier this year, the Geocongress Local Organising Committee (LOC) again took the decision to postpone Geocongress on account of continued uncertainty related to public health and the corona virus pandemic. The likelihood of an imminent 'third wave' justifies this decision. If the ongoing vaccination drive proves successful, then we remain hopeful that Geocongress can be run as an in-person event in 2022. It is the LOC's firm belief that such an interpersonal engagement is crucial for the local earth sciences community especially as we emerge from this period of limited interpersonal contacts. As such, we remain committed to running the event at a yet-to-be decided date next year.

In the interim, and to maintain momentum, the LOC plans to run a three week long **GEOCONGRESS APPETISER SEMINAR SERIES (*19 July – 6 August 2021*)**. This will comprise a series of nine lunch time webinars using the GSSA's online Zoom presentations and Youtube recording platforms. The themes of the nine webinars closely match those that were suggested as sessions for the original Geocongress and thus encompass the range of different earth science sub-disciplines being advanced in the southern African context. Please continue to monitor the Geobulletin and the GSSA's mailing list for updates related to this exciting seminar series!

Request for applications to the Research, Education and Investment (REI) fund of the GSSA

CLOSURE DATE FOR APPLICATIONS: 31 JANUARY 2022

The GSSA Research, Education and Investment Fund (REI Fund) is inviting applications from GSSA paid up-members (including current post-graduate student members) for grants from the Fund, to be received at the GSSA office not later than 31 January 2022. Applications can be made using the prescribed application form available on the GSSA website (www.gssa.org.za) or via this link. Supporting information required with each application includes a short description of the project, brief motivation for research and funding requested, a budget describing how funds will be used, and a letter of support from the research supervisor (in cases where the applicants are post-graduate students at South African universities).

Grants are intended to support a variety of earth science research costs, including analytical and field costs, conference attendance and publication costs. Projects that promote and support earth science awareness such as geoheritage, geotourism and geo-education may also be supported. Expenses related to (annual) registration and tuition fees, textbooks, accommodation, etc. required at Higher Education institutions are not covered. Members enrolled at non-South African universities are not eligible to apply for financial support.

In particular we welcome applications from post-graduate student members and would appreciate it if Heads of Departments at Higher Education Institutions and their staff would inform their students of this opportunity. Grants are usually limited to R20 000 per application, but well-motivated applications for larger amounts are also welcome. All applications will be judged on merit and/or the importance to the Society in promoting its image. Note that grants are only awarded to members/student members in good standing. Applications are screened by the REI Fund Committee during February/March with input and ratification by the GSSA Management Committee and Council, respectively. In evaluating the applications and recommendations, the Committee considers the merit of each application, and depending on the amount of money available for that year, makes a final decision on the allocation of grants for that year. The decision of the Committee is final and no further correspondence on the matter will be entertained. By following this procedure, it is anticipated that applicants will be informed by mid-March 2022 whether or not their applications are successful. Recommendations made by the Committee require Council approval, which may delay notifications.

The current members of the REI Fund Committee are: Reinie Meyer (Chairman), Frank Gregory, Bertus Smith, Rob Ingram, Derek Kyle, Steve McCourt, Richard Viljoen, Mike Wilson, Grant Bybee and two office bearers of the Society who have *ex officio* status, namely the President (Tania Marshall) and the Executive Manager (Craig Smith).

GSSA
Geological Society of South Africa

African Earth Science Initiatives

Dear colleagues within the Earth Sciences,

Several pan-African initiatives are underway in which we have the opportunity to promote our scientific discipline and ensure that it receives due consideration when high-level decisions are made.

1) **African Physics Strategy** (https://africanphysicsstrategy.org/): The African Physics Strategy seeks to develop a white paper document that advises the strategic directions likely to effect positive impacts in physics education and research in the next decade (i.e., for use by African policymakers, educators, researchers, etc.). Various sub-disciplines of Earth Sciences fall under the umbrella of Applied Physics and should thus be represented in such a white paper. Should you be interested in contributing to this document and thus representing your research focus area, please submit a short Letter of Interest (0.5–2 pages) at the online portal: https://indico.cern.ch/event/1061921/. It is envisaged that these will be further developed into one or more published, peer-reviewed research contributions. Should you have any questions or concerns, please email ASFAP-EarthScience@cern.ch in this regard.

2) **African Light Source Initiative** (https://www.africanlightsource.org/): Work is underway to motivate for and ultimately commission an advanced light source (synchrotron facility) on the African continent. Currently a Conceptual Design Report is being written up, which will advise the ultimate design of such a facility. Should your research require specific synchrotron beamline configurations or techniques, and should you wish to have such a beamline on the African continent, please contact Dr Bjorn von der Heyden (bvon@sun.ac.za), again with a short 0.5–2 page letter of interest.

3) **Earth Sciences in Africa Zoom conference**: In order to celebrate Earth Science Week in October this year, an online Zoom conference is planned for the week of 10–16 October 2021. The final format for this conference or seminar series is yet to be decided and will be based on the number and quality of the abstract submissions. For registration details (free) and abstract submission (~250 words; deadline 28 September 2021), please visit the Indico website associated with this exciting event: https://events.saip.org.za/event/221/.

Bjorn von der Heyden

ABOUT THE WORKSHOP

This one-day virtual workshop introduces the theory and practical applications of Data Analytics and Machine Learning within the geoscience discipline.

You will learn popular machine learning algorithms, principal component analysis, and geospatial modelling which are the critical methods for data-driven techniques and understanding complex patterns in data. As you build prediction and classification models, you will learn how to train algorithms using training data so you can predict the outcome for future datasets.

REGISTRATION

Members - **R1,000**
Non-Members - **R1,500**
Students/Retired/Academic - **R500**

COURSE INFO

classifieds

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SOUTH AFRICA

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1. ADVERTISING RATES (Excl. VAT & Agency Commission)

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Black & White

Size	Casual 1-3 insertions	4+ Insertions
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June issue:	15 May 2021
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December issue:	15 November 2021

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At least 4 weeks prior to deadline

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8. ADVERTISING BOOKINGS AND SUBMISSION

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