GSSA
Geological Society of South Africa

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news


GSSA
Geological Society of South Africa

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Front Cover:

Multiple intergrowths of shigaite on drusy pink rhodochrosite, with a grey barite crystal. (Specimen and photo: Bruce Cairncross)

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guest editorial

Dr Cameron Penn-Clarke

Lessons learnt from doing a "little bit of a lot of things": The musings of a (formerly naïve) survey geologist

Advances in multi- and hyperspectral satellite imaging, alongside regional isotopic and geochemical surveys, as well as airborne, satellite and ground-based geophysics, have afforded us an unprecedented and expedient means of capturing regional geological data. The processing and integration of these "applied" geoscientific data has drastically improved in the past decade, with advances in computing that are supported by a wide array of software packages that can be used to aid these tasks with relative ease. From the comfort of one's office (either at work or from home), the geologist may now draw these data to their computer and create geological maps (at varying scales, data quality and interpretation permitting); making measurements and interpretations without having to set foot in the field. Added to this are new techniques and computational tools in the realm of artificial intelligence and machine learning that allow for the integration of multiple relational datasets to reveal geological phenomena and patterns that may not be apparent at first glance.

This, naturally, has its benefits and drawbacks. As technology improves and we become more adept at processing, interpreting and integrating these data, the (often expensive) overhead costs for traditional field-based surveying (labour, subsistence, transport, accommodation, passports and equipment) are cut and replaced with (just as expensive) workstation computers, software licences, datasets, server- and cloud-based data stores, training workshops and… coffee. Thus, by taking the geologist out of the field and keeping them in the office, for the first time in the history of geosciences we have been able to conduct regional geological surveys, and process and interpret data in a short amount of time… for roughly the same price. Naturally, as we become more adept at producing, processing and interpreting more data in less time, so the demands of industry and employers increase. There become fewer excuses for not being able to do work. Indeed, it was these technologies and their supporting infrastructure that helped a lot of us stay employed and productive during the COVID pandemic and lockdown. The technologies further assisted students in acquiring "field skills" in the guise of interactive "virtual field trips" that could transport students to geological sites both locally and abroad. At face value, these technologies have made geology and regional reconnaissance studies and the acquisition of knowledge "easy" to do, some may even say to the point of redundancy for survey and field geoscientists, who, *traditionally* are more skewed towards "field-based" fundamental geoscience skillsets (stratigraphy, structural geology, sedimentology, geological mapping, petrography and, to some degree, petrology).

Does this signal the extinction of survey and field geoscientists? At first glance it would appear so. The demands of industry and the economy, as well as government oversight on both matters, often dictate the curricula taught at universities and the research that is undertaken by universities, surveys and science councils, among others. This often shapes the students who enter the workplace and thus the staffing complements thereof. In our "faster-paced" society and economy, expediency is key. The answers to problems are expected to come easily now, after all. Those who are more "applied geoscience minded" are better equipped for these tasks and are snapped up first. I guess that this isn't altogether wrong though. Countries with a rich geoscience heritage, such as South Africa, have amassed hundreds upon thousands of individual datapoints and datasets that can be interrogated further using big data and machine learning. Similarly, any interpretation of remote sensing, geophysics and geochemistry that

hinges on knowledge of the regional geology of an area *shouldn't be a problem as it has been mapped already*… In some ways one may argue that there is really no need to go out to the field for days on end any longer.

Herein lies the problem. A lot of the time, these tools *assume* that the fundamental geoscience is correct. One could argue that it is a matter of faith. Ideas change through time and so do things like stratigraphic and lithological frameworks, structural interpretations, etc., to the point where maps need to be refined and in some cases, completely redrawn. One still needs to verify findings in the field by direct observation. Maps are the summation of the maximum amount of geological information derived from an area. One needs to be there in person to verify that the rocks are indeed there and to take direct measurements, samples, etc. to add to these maps in order to improve/permit any applied geoscientific study. This, of course, can be expanded further for geochemical anomalies and mineral deposits that are identified from applied geoscientific tools—one would still need to directly verify these in the field and to understand the means by which that mineral system was emplaced/came to be. Often, these observations need to be explained using the full gamut of practical fundamental geoscientific disciplines. Nothing beats hands-on experience, and one still needs those fundamental skills if one wants to get the job done properly.

Speaking of hands-on experience, this begins with students. Sure, virtual fieldtrips bring the field to students and it does cut costs, I get that. But we need to remember that this experience is virtual. The students *aren't actually there*. Worryingly, I have come across too many (admittedly younger) geologists in the workplace (some who are either "renowned" in their field or from the "best" universities globally) who, varyingly, cannot use a compass, read a map, describe a rock or identify minerals (either as a hand specimen or thin section). There is something "tactile" about geology—one has to directly handle and interact with it in order to understand it. We should reinforce this with students instead of encouraging them to migrate to a fully technology-based world.

I fondly recall being a second year student in the mid-2000s, at the time when good quality cellphone cameras and smartphones were making their appearance. It was in our palaeontology practical class on a Monday afternoon where we had to draw and identify (giving reasons) all the fossils representative of all the major animal groups. Painstakingly, each nook, cranny, knob and extension of these fossils had to be drawn under the watchful eye of our professor. Of course, this was counterproductive to our need to go to one of the several student pubs to drink beer in the afternoon. Soon we realised that we could photograph the fossils and draw them later, creating more beer-drinking hours in the afternoon… Of course, we all thought we knew better. Our professor saw this, smiled (after scolding us of course) and said, "A famous anatomist once said that the only way to understand an organism is to handle it and to draw it, a photograph won't cut it". Again, of course we all knew better and this came out in the failed practical and exams. Despite the many pictures and notes, we still did not know what we were looking at… The same could be said for our petrology and petrography classes. Pictures counted for nothing without having that *tactility* that geology requires to feel weight, see colour, lustre, etc. that could only be had if we handled the specimen then and there. I still cannot identify a rock (with confidence) from a photograph. I never understood stereonets, deformational histories and the difference between a foliation and a lineation until I went to the field and actually touched the outcrop and observed it in many angles. Similarly, I never understood how to differentiate a fluvial deposit from a marine deposit until I went to these modern-day examples, dug trenches through them and observed the processes that formed them. "Geologists do it best in the dirt"; we must own this.

The fundamental geosciences are still relevant in today's society (with its technological advances) and should be reinforced strongly at universities as well as in the workplace. These disciplines form the

cornerstone for more detailed applied geoscientific studies and they will always do so, whether we like it or not. Instead of shifting our focus (in both education and research) away to "cheaper" and "easier" studies and technologies, we should aim to find a balance and to integrate the two. So much good science for societal and economic benefit is done where these two spheres of geoscience meet. The two should be inseparable. As someone who was squarely in the fundamental geoscience camp, I only appreciated the importance of applied geosciences once I began my career as a survey geologist. Survey geologists sit at the centre of this Venn diagram, having to know and integrate a little about a lot of things in our day-to-day work, and lay down the foundations for regional geological studies. We have come to a point now where we are equally as reliant on technology as we are on doing fieldwork. The benefit of this is that we are able to make better estimations of the regional geology of our study areas before going out to the field. This makes fieldwork shorter and, if need be, more focused. By saving time and money, this is a more responsible use of state funds. By sitting in both camps, we are able to deliver better estimations of regional geology and from there more detailed studies can take place. There will always be a place for survey, and by extension, field geologists.

In closing, what this editorial has taught me is that it is perhaps naïve to think of oneself as a "type" of geologist specialised within a particular field. Our discipline is an inter-related spectrum. No one discipline is better than another. We know a little about a lot of things and we should strive to learn more about all of these things.

Dr Cameron Penn-Clarke
Council for Geoscience

executive manager's corner

Craig Smith

It is mid-2021, and COVID is still with us—and wreaking havoc in some parts of the world. India is particularly hard hit, exacerbated by new strains of the virus combined with poor government leadership. At the time of writing, South Africa seems to be headed for a third wave, and the vaccination roll-out seems to be significantly delayed. In a meeting last week, a financial analyst noted that at the current vaccination rate, we will manage to inoculate the majority of South Africans in 41 years. My back-of-the-envelope calculations bring this down marginally to 35 years. The point is that two things need to happen before we get back to any degree of normalcy. First, the government has to become much more efficient at delivery (pause for laughter….). Second, the private sector is going to have to become involved in the program. We need to be able to access vaccines through our local pharmacy or GP, as happens elsewhere in the world. Vaccination rates are highest in countries where the private sector is an integral part of the process.

Government inability and incapacity has taken centre stage for the GSSA in the last quarter, with a slew of proposed legislation gazetted for comment. The GSSA has commented on some of this. Probably the single most important piece of legislation is the DMRE proposed regulations for the Council for Geoscience. Normally, the GSSA management team works behind the scenes, but given the importance of the issue, the GSSA comments have been posted on the GSSA website. In contrast to past years, we

are unsure that comment is being delivered, because no one acknowledges receipt. And in some cases such as the Department of Communications and Digital Technology, all email bounces and links do not work. Of course, postal delivery is way too much to hope for. Despite the obvious dysfunctionality of the Post Office, it is proposing that it be given sole rights for couriering parcels less than 1 kg in weight around South Africa (see the Justice Malala column in the May 13 issue of *Financial Mail*). If you think 35 years to get vaccinated is a long time, just try to get an urgent document sent from Cape Town to Johannesburg using the Post Office. The wait could be generational. There is one section of the economy that could, however, grow exponentially, and that is brick manufacturing. It has been suggested that if the Post Office gets its way, everyone will be sending letters with 1 kg bricks included, in order to be able to use courier services and avoid the Post Office. Transnet might benefit; to send a few bags of mail by train you would need significant bulk commodity transport capacity.

We are seeing some common threads in the various bits of legislation. First, there is almost always a missive in the preamble or introductory section stating that making South Africa more attractive to investment is a key intent. But several pages in, there is almost always some serious disincentive to investment, such as state ownership of all intellectual property generated by the private sector. No fool would invest in such a regime. Second, there is almost always a serious under-estimation of required capacity and budget, combined with a departmental attitude that there is unlimited funding for pet projects. Third, there is overreach between departments. It is clear that there is no interdepartmental communication when legislation is drafted. For example, the Department of Mineral Resources and Energy and the Department of Communication and Digital Technology both claim sole ownership of resource-related data and information. Finally, the government solution to years of failed delivery—particularly through the SOEs—is to create more of the same. If compared with investment into China, it appears that there is an assumption by government that since it works in China, it will work in South Africa. However, the key reason for investing in China is to access the Chinese market of a billion plus people. With less than five per cent of the Chinese market size, development of a South African market in exchange for giving up intellectual property is never going to be an investment driver.

Climate change has been prominent in the news of late (now that there is a new administration in Washington), and the UK will host the major United Nation Climate Summit (COP26) in November, so expect more coverage of climate-related news as the year-end approaches. As I have stated previously in this column, this topic is important. In a recent online lecture staged by the GSSA as part of a continuing series, Dr Dillon Amaya from the US gave an elegant presentation on why CO_2 is the most critical greenhouse gas, and why the atmospheric increase is due to the burning of fossil fuels since the start of the industrial revolution. The lecture is lodged on the GSSA YouTube channel and is a great review that is accessible and brief.

Climate change mitigation will be the key societal challenge of the 21st century, which will affect the entire mineral resource industry and not just the energy sector. In 2020, the Climate Smart Mining Initiative of the World Bank produced an interesting 112-page report entitled "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition" (see a summary here). A weakness of the report is that it does not cover the platinum group minerals, but the key point is that a low-carbon future will result in significantly higher demand for minerals than economies based on fossil fuel-based power generation. Change is inevitable; there are huge opportunities as well as great challenges coming at us in the not-too-distant future. The Earth Science community needs to meet the challenges. There is currently global concern about falling earth science student numbers but I believe this will turn around when the opportunities become more apparent. We do have to lay the foundations for the coming changes in academia, industry and government sectors sooner rather than later.

Craig Smith

president's column

Sifiso Siwela

Fellow Members,

As this is my last *Geobulletin* column as the Society's President, I therefore wish to reflect on the second year of my tenure.

In my *Geobulletin* column for the first quarter of 2020 and in celebrating our 125th anniversary, I wrote about the "founding father" of the GSSA, Dr David Draper. I had planned to continue on a series of anecdotes and memoirs about some key geoscientists over history for the remainder of 2020. However, due to the COVID-19 pandemic later that same first quarter, I had to address other arising matters. The planned birthday celebration dinner also did not go ahead to due bigger challenges facing the Society and geoscientists.

The theme during my tenure was "relevance" and the Society did see and carry out this vision. From keeping members engaged with the lockdown lunchtime lectures during the hard lockdown to continuing our events calendar virtually, the Society remained relevant. We hosted the biggest Geoskills events ever, with over 300 delegates, and accomplished over 4 days of technical and soft-skills training from distinguished speakers. We also held successful CPD training, drilling methods, commodity days as well as skills and topical days such as ESG and Clean and Green Energy, all virtually. We will continue to assess the pandemic and look at hybrid online/physical online events for the foreseeable future, as well as physical events when the conditions permit. The Geocongress 2020 planned for Stellenbosch University was again postponed to 2022 and therefore this year we will be hosting the Geocongress Appetiser Seminar Series as a teaser. The successes in online events has inspired our Branches and Divisions, interest groups, affiliate as well as regional and global societies to continue hosting successful free and commercial virtual events, and we continue to provide support in this aspect.

We also completed our first mentorship programme for the Society, in conjunction with the SACNASP Candidate Mentoring Programme (CMP). I am happy to announce that due to the successful first year, SACNASP has allowed us to double the number of candidates for this second year of the CMP. I am grateful to the mentors who participated in the first programme, as well as those participating in the second edition.

Our Branches and Divisions continued activities under the pandemic conditions and enhanced on the theme of outreach, which was another focus area for my tenure. At the time of writing, the Northern Cape Branch managed to host the very successful Rhenosterkoppies field trip during May, observing all COVID protocols. Other Branches and Divisions managed to host virtual events successfully. We carried on with the Geoheritage mission and

vision and continued to coordinate various regional initiatives, some of which were planned for 2020 but were postponed due to the pandemic.

Communication was critical during the period and our publications continued with the high-quality work from the world-class *SAJG*, this quality quarterly *Geobulletin* and the informative monthly newsletters. Our social media presence was more than ever before via LinkedIn, Facebook, Instagram and the website. More importantly and as promised, we were also vocal on issues affecting geoscientists such as the Geosciences Act and other gazettes where we provided constructive criticism and sound commentary. We also continued our surveys to understand issues the membership have, but more importantly to assess how the Society can assist.

There has also been a recent resurgence of important discussions on graduate unemployment as well as revitalising exploration in South Africa, both of which the Society has been contributing to in terms of support, commentary and facilitating dialogue.

The Professionalism portfolio continued to keep in touch with global professionalism, diversity and inclusion, ethics, CPD and other issues through representation and advocacy on various professional bodies. Attendance at various global workshops revealed that the Society is doing relatively well under the circumstances. However, we are still facing a huge mission in terms of relevance and unemployment, which we will continue to address.

During the difficult economic conditions and the difficulty in paying membership fees, we continued to support the Members in this regard and therefore membership fees were not increased in the past year.

In my memoir about Dr Draper, I highlighted some of the socio-political challenges faced personally, in the midst of those faced by the whole of South Africa, and importantly how he managed to overcome these. Little did I know at the time that we were about to face the socio-economic challenges caused by the COVID-19 pandemic. Being President during one of the toughest periods in history has been truly challenging, but I could not have things any other way as this time really pushed all of us to find innovative ways of accomplishing missions, which we somehow managed due to the naturally progressive and resilient nature of geoscientists. Experience and resilience, but also youthful exuberance, was key during this time.

I therefore appreciate the support of the administrative staff, Council and MANCO, as well as the membership for suggestions and constructive criticism. Rest assured that I will still be supporting the Society in this great mission.

I would like to thank Tania for accepting and continuing this mission; I guarantee that the Society is in good hands.

I do hope that I have inspired some young geoscientists that we can overcome challenges in this 4th Industrial Revolution and Future of Work. A quote, originally from the late Tupac Shakur, I used during my inaugural speech in July 2019 still holds: *I am not saying I will change the world, but I will spark the brain that will change the world; I guarantee that*.

Arrivederci and I thank you.

Yours in safety,

Sifiso Siwela

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Council for Geoscience

MEDIA STATEMENT

FOR IMMEDIATE RELEASE

1 June 2021

To: All Media

THE COUNCIL FOR GEOSCIENCE'S DATA PORTAL GOES LIVE

The Council for Geoscience (CGS) has today announced that its data management portal has gone live. The announcement comes after its CEO, Mr Mosa Mabuza participated in the Annual Junior Indaba conference which was held virtually. The CGS has been hard at work to ensure that it makes quality geoscience data and information accessible and available to all stakeholders. The organisation began the process with the finalisation of the data and information policy which was approved by its Board. The policy was drafted to provide guidelines on the modalities of releasing the data. Following this, there was a review of the pricing guidelines for data and information. Through the guidelines, the cost of data and information was updated to ensure that the prices are not only current but affordable to the various categories of stakeholders and the public. The Pricing guidelines then necessitated the development of a Data and Information Catalogue which outlines the different categories of maps and databases available at either a cost or no cost.

The CGS plays a central role as a geoscience information repository in South Africa. The launch of the CGS data portal is one of the most crucial tools through which the organisation now distribute data countrywide. The portal provides scientists with applications to discover, query and download CGS data holdings. The portal virtually encompasses all the disciplines of geosciences such as geological, metallogenic and geochemical mapping as well as geophysical surveys done under the auspices of the CGS.

Specific map services interactively displays features for which there are a high demand such as the localities of prospecting coal and core boreholes. These applications focus not only on data discovery and data viewing but are designed to allow for own data uploads and printing layouts. Due to the complex nature of geoscience data, the CGS has further published multi-layered map services to allow users to compose their own map compositions. Data categories are arranged according to topics and data sets available under these categories can be interactively viewed using built-in web map tools. All data are available for download at no cost. Only registration is required. The portal will continue to serve more information as data is captured and validated.

All data requests are streamlined through the Public Information Officer and a dedicated email address has been established to manage all data requests and dissemination. This forms part of the CGS's commitment to ensure that data and information is available and easily accessed to showcase the exploration potential of the country and secure the pledge by Government of attaining 5% of the global share of exploration.

Data requests can be directed to the Public Information Officer; Ms Karabo Mphuthi on data@geoscience.org.za

The link to the data portal is:
https://maps.geoscience.org.za

For more information please contact the Head of Communication and Stakeholder Relations: Ms Mahlatse Mononela on mmononela@geoscience.org.za

ENDS

mineral reporting

THE PROFESSIONAL (AFFAIRS) CORNER

The Importance of ESG for Mineral Reporting

Consideration of environmental, social and governance (ESG) criteria in mining projects and investments is generally a common headline in mining, business and mainstream media. Why is this the case and what does it mean for mineral resource developers in South Africa? This article explores the concept of ESG, the rationale for international concern about the importance of ESG and how the South African Mineral Reporting Codes (SAMCODES) has responded to this increased focus.

What is ESG?

A conference held in Switzerland in August 2005 hosted by the United Nations Global Compact and others has been credited with the first formalised requirement for ESG criteria to be incorporated into the financial evaluations of companies. Final recommendations by the financial industry contributors to the event were compiled into a report titled 'Who Cares Wins',[1] with one of the conclusions being that the "endorsing institutions are convinced that a better consideration of environmental, social and governance factors will ultimately contribute to stronger and more resilient investment markets, as well as contribute to the sustainable development of societies". Recommendations from the report called on all sectors of society and business to integrate ESG into their core activities and, specifically, that investors should "reward well-managed companies" that embrace ESG.

At the same time, the then United Nations Secretary General Kofi Annan asked a group of large institutional investors to collaborate on a process to develop what has become the Principles for Responsible Investment. The Principles (or PRI) were launched in April 2006 with the number of signatories growing since then to over 3 000. Developed "by investors, for investors", the six Principles aim to contribute to a more sustainable global financial system and ultimately in the long-term interests of the environment and society as a whole.[2]

(Source: Fractal Angel / Discharge pipe feeding water into the River E / CC BY-SA 2.0)

While ESG is spoken about as a single concept, it is an amalgamation of three distinct disciplines, each with their own underlying knowledge base, areas of focus and methodologies for approaching problems and solutions. There is, however, considerable overlap among the three disciplines with issues in one area (e.g., pollution of a water resource) typically impacting on, or being impacted by elements of the other two (e.g., reduced quality of water for downstream communities and lack of compliance with legal requirements).

Why is it considered important?

The World Economic Forum (WEF) brings together public and private entities "to shape global, regional and industry agendas". In 1973 the WEF published its first Davos Manifesto,[3] which set out a common code of ethics for business leaders. This was recently updated at the WEF's Annual Meeting in 2020 and builds on the concept of "stakeholder capitalism" first introduced in the initial Manifesto. Stakeholder capitalism recognises that long-term business value is only created when the interests of all stakeholders (employees, shareholders, governments, the environment and society as a whole) are served simultaneously. This model recognises the critical role that private corporations play as trustees of society and therefore stewards of the environment on which societies depend.[4]

By contrast, shareholder capitalism, which has dominated global thinking, prioritises return of profits to shareholders and fails to recognise that companies are social organisms. Profit-seeking at the expense of society and the environment has resulted in a disconnect between companies and the real economy, including natural and human capital assets on which companies depend for their profitability.

The focus on ESG issues has been in response to increasing global recognition of the impacts that human beings are having on our planet. Extensive areas of land have been transformed into the world's cities, farms, industrial complexes and associated infrastructure, resulting in loss of biodiversity at a rate and scale not seen before. As one example, human beings and the livestock we rear as our food source currently constitute 96% of the mass of all mammals on the planet.[5] Increased standards of living for the average person have contributed to this degradation of the planet's natural assets to the point where "the demands we make of its goods and services far exceed its ability to meet them on a sustainable basis".[5]

This decade has been widely recognised as being the critical decade for global action to address climate change. Activists like Greta Thunberg and respected personalities such as Sir David Attenborough have been broadcasting messages of concern to global leaders in an effort to spur increased global action to address the planet's most pressing issues. The Paris Agreement calls on nations to strengthen the global response to the threat of climate change by curtailing the increased average global temperature to "well below 2 °C" above pre-industrial levels, increasing the ability to adapt to the adverse impact of climate change and make financial flows consistent with a pathway towards low greenhouse gas emissions and climate resilient developments.[6]

(Source: http://www.isb-global.com)

In pursuit of sustainable development and recognition of the challenges facing the globe, the United Nations and member states adopted 17 Sustainable Development Goals (SDGs) in 2015. The 2030 Agenda for Sustainable Development is seen as a "blueprint for peace and prosperity for people and the planet, now and into the future".[7] The SDGs are increasingly used by companies and nations to track their contributions to achieving these goals and driving the company's own sustainability agenda.

Against this backdrop of global issues, individuals around the world are voicing their concerns about mankind's impacts on the planet and are responding in a number of ways. One response is seen in the ways that people spend or invest their money. In the United States, approximately 84% of women and 90% of millennials have voiced preferences for sustainable investments. Millennials and women are expected to inherit nearly US$ 60 trillion as a result of wealth transfers in the coming 15 years. Their preferences to entrust their wealth to financial advisors who integrate ESG considerations into their long-term investment strategies is a strong incentive for markets to respond accordingly.[8]

So, what is sustainable investment?

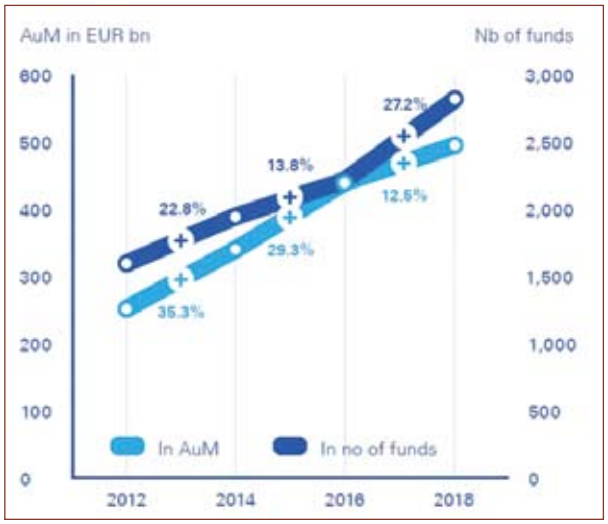
Sustainable (or responsible) investing describes the process whereby ESG factors are incorporated into the investment decisions of individuals when they invest in companies, organisations or funds. These investment decisions are based on the individual's real or perceived understanding of the environmental and/or social impacts (positive or negative) that will result from their investments in parallel with the expected financial returns. People choose to invest their money based on their values and personal priorities and some of the reasons cited as influencing their decisions include climate change, community benefits, gender parity, and health and safety, among others. The purpose of directing funds towards investments that are seen as sustainable is to generate measurable environmental and social impacts in addition to a financial return. In response to the growing demand for sustainable investment offerings, institutional investors and money managers have created investment products that enable investors to put their money into products that meet their ESG performance requirements.

The result of increased focus on sustainable investment is an increase in sustainable assets under management (AuM) in the United States from less than $1 billion before 1995 to more than $16 billion in 2020.[9]

In Europe, responsible investment has also grown, with sustainable investment funds increasing their AuM by 12.5% between 2016 and 2018.[10] The number of responsible investment funds has also nearly doubled from 2012 to 2018.

BlackRock, a leading global investment manager, conducted its first sustainable investing survey in 2020, which revealed that 86% of responders in Europe, the Middle East and Africa (EMEA) stated that sustainable investing is already, or will become, central to their investment strategies.[11] One of the key reasons why this is the case is because ESG integration is recognised as positively influencing the market value of shares and the long-term risk management of funds or a portfolio.[8]

A review of companies listed in the S&P 500 ranking was undertaken in 2019 by NASDAQ. The results concluded that companies that received high sustainability ratings "exhibited both higher returns



(a, left) Sustainable investing in the United States (1995–2020)[9] and (b, right) sustainable investing in Europe (2012–2018) in terms of AuM and number of funds.[10]

(Source: Getty Images/iStockphoto)

and less risk", whereas companies with poor ESG ratings "showed the opposite results".[12] This study suggests that the opinion of the authors of 'Who Cares Wins' is indeed valid and that companies with better ESG performance are being rewarded by attracting more investment compared to those with weaker performance, which are seen as riskier investments.[12]

The Covid-19 pandemic has been a positive catalyst for many investment managers. Around 20% of responders to BlackRock's survey indicated that the pandemic has accelerated their plans to include or increase sustainable investment strategies.[11] The survey respondents expect to double their sustainable assets by 2025, clearly indicating that sustainable investment is not a passing phase but is rapidly emerging as the new normal investment strategy.

What aspects of E, S or G are investors concerned about most?

KPMG reports that the largest number of responsible investment funds in Europe are cross-sectoral funds, where ESG considerations are accounted for by means of screening strategies for potential investments.[10] Within the environmental discipline, the environmental/ecological theme dominated in 2018, with climate mitigation and adaptation as the second largest thematic area in terms of number of funds and AuM. In the social area, while the number of social funds decreased between 2016 and 2018, the AuM increased slightly. In this arena, the social and solidarity theme accounted for almost two-thirds of the number of social investments.

In the United States, investments made by money managers either on behalf of individuals or institutional investors by far account for the largest AuM for sustainable investments. Their investments were fairly evenly distributed across each of the E, S and G categories between 2018 and 2020. The specific criteria used for investment allocation include climate change and carbon, anti-corruption, board issues, sustainable natural resources and agriculture, and executive pay. Of these criteria, climate change and carbon accounted for the largest investments by almost 50% and this criterion grew by 39% over the period.[9]

BlackRock's survey confirmed that the vast majority of responders (89%) ranked environmental issues as their main ESG focus, with climate change perceived as the most urgent issue that investors want to address. Climate change is expected to remain the key focus in the next five years, but social concerns are expected to grow largely in response to societal awareness of the pandemic.[11]

What does this mean for Mineral Reporting standards?

The SAMCODES set the minimum standards for Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves. Such reports, by definition, are prepared for the purpose of informing investors or potential investors and their advisors on the mineral assets of a reporting company.[13] Within the SAMREC Code, ESG issues are considered important contributors of Modifying Factors that can influence the declaration of Mineral Reserves and, furthermore, play an important role in determining the realistic prospects of eventual economic extraction (RPEEE) for Mineral Resources. Investors rely on these reports to inform their investment decisions. The investors

☞

are looking for evidence of how companies integrate ESG considerations into their businesses and this evidence needs to impact all aspects of the business, including geological processes and activities.

Investors obtain ESG information about companies directly through engagement with companies or via information generated by a growing number of ESG ratings agencies (raters). These raters in turn obtain their information from companies actively or passively, or a combination thereof. Active raters will request information directly from a company (for example the Carbon Disclosure Project questionnaires), aggregate this information and provide a rating. Passive raters, on the other hand, will rely solely on reviewing publicly available information to inform their assigned rating. Not all ratings agencies provide insight into their scoring requirements and companies, rightfully, have expressed concerns about what these raters do with their information and how they generate a rating.[14]

Sustainability reporting is largely undertaken voluntarily by companies, regardless of their listing status on a stock exchange. In response to this growing desire to report on their ESG performance, a number of reporting frameworks have been developed. Some of the more commonly used ones include the Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Carbon Disclosures Project (CDP), and Task Force on Climate-related Financial Disclosures (TCFD), among others. The common objective of all of these frameworks is to help those who wish to disclose their sustainability performance by providing guidance and metrics that they can use. Critics of sustainability reporting suggest that these reports have done little to improve the actual management of sustainability issues at a global scale and are utilising company resources to compile the reports that could be better spent managing sustainability issues on the ground.[15] Gaps also remain between society's expectations of mining companies and their performance in respect of ESG issues.[16] Concerns about "greenwashing" remain, with the mining industry failing to present an honest picture of the challenges it faces and its work to support the SDGs.[16]

Yet investors remain hungry for access to information on which to base their decisions. More than half of the responders to the BlackRock survey have noted that the quality or availability of ESG data and analytics are lacking and this has been cited as a barrier to increasing their sustainable investments. More and more investors are applying structured analyses of non-financial disclosures by companies and have noted that there is an increasing dissatisfaction with the ESG information presented by companies.

An EY investor survey in 2020[17] found that there was a 14% increase in dissatisfaction with environmental risk disclosures among survey responders since the previous survey in 2018. And the Responsible Mining Foundation found in its Responsible Mining Index Report (2020) that there is a severe deficit of mine-site-level data on issues that are of particular interest to communities, workers, governments and investors.[16] The risk to mining companies who seek investment is that the information used to inform their ESG rating may not be adequate to reflect the true sustainability performance of that company and investors may move their funds elsewhere as a result.

Furthermore, there is a need, and a call by industry and investors, to increase standardisation of sustainability reporting metrics. Initiated by the World Economic Forum's International Business Council, work is progressing to finalise the development and implementation of a set of common "Stakeholder Capitalism Metrics (SCM)".[18] It is envisaged that these metrics will assist members of the IBC (and by association any organisation desiring to report on ESG performance) to align their mainstream reporting of ESG indicators and track their contributions towards achieving the SDGs. The aligned metrics include 21 core and 34 expanded metrics and disclosures that organisations can adopt. Drawn wherever possible

from existing standards and frameworks, these metrics have been grouped under four pillars, namely Principles of Governance, Planet, People and Prosperity. These efforts are being supported by the leading voluntary ESG framework and standard-setters that have expressed their intent to cooperate towards achieving a "single, coherent, global ESG reporting system".

What is SAMESG?

The South African guideline for the reporting of environmental, social and governance parameters (SAMESG Guideline) supports the SAMCODES by providing information for authors of Public Reports on how to apply the ESG considerations throughout the geological reporting process. Building on existing frameworks and in full recognition of the universe of sustainability reporting that already exists, SAMESG seeks to encourage mineral developers listed on the Johannesburg Stock Exchange (JSE) to distil all the information that many are already gathering in support of their voluntary sustainability reporting processes and answer the fundamental question of "what does this mean for this project"? For junior and mid-tier companies that may not have prepared sustainability reports, SAMESG aims to provide guidance on what information investors want to see and to present it in a manner that best showcases their company's approach to ESG integration. Considering that Mineral Resource and Mineral Reserve reports need to present information at a project level, the SAMESG Guideline is well placed to help address some of the reporting concerns identified internationally, particularly with respect to the lack of available site-level data.

Launched in conjunction with the 2016 versions of the SAMCODES, the SAMESG Guideline resulted from a collaborative process initiated by the SAMCODES Standards Committee (SSC) in 2014 when the development of the guideline was first sanctioned. The guideline was prepared by a working group comprising a range of environmental, social and governance specialists from the mining and consulting industries.

Alignment with the SAMESG Guideline requirements in Public Reports prepared by JSE-listed companies has been patchy. The Committee has been actively working to broaden the membership base of the Committee, as well as developing a second version of the Guideline, which will take into account developments within the sustainability reporting world since its first publication. The updated guideline intends to improve the nature and extent of guidance for authors of Public Reports, particularly for the smaller mining companies.

In order to make SAMESG more user friendly, more applicable to all situations and more inclusive, the GSSA invites you to take part in our first ESG Inquisition, where you will have the opportunity to hear what others think and to voice your own opinion. The focus of this inquisition is to hear from mining companies and mining practitioners about the challenges they face, the benefits they have found and what they would like to see in the ESG-reporting space.

We expect to run the ESG Inquisition over three days (10–12 August 2021) from 9:00 to 12:00. Attendance will be FREE, and we want to hear your opinions and experiences (good, bad or indifferent). If you have a short presentation that you or your company would like to give, please send a proposal to info@gssa.org.za, marked 'ESG Inquisition'. The feedback from this Inquisition will be used to inform the forthcoming SAMESG and SAMREC updates, so your input counts.

Compiled by ***Teresa Steele-Schober*** *(Uvuna Sustainability and Chair of the* ***SAMESG*** *Committee)*

Have you used the SAMESG Guideline? Do you have any feedback that you would like to share with the SAMESG Committee? If so, please use the Contact Us page on www.samcode.co.za.

All images, unless otherwise indicated, are licensed through Microsoft PowerPoint.

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all the news fit to print

WITS SCHOOL OF GEOSCIENCES

The last few months have seen a handful of members of the School having papers published in high-impact journals. The first of these centres around the sedimentary and volcanoclastic deposits of Lake Turkana in northern Kenya, which have provided some of the most important contributions to our understanding of human evolution since expeditions began there in the late 1960s. One such important contribution is specimen KNM-ER 2598: an occipital bone, housed in the National Museum of Kenya since 1974. This specimen has been tentatively regarded as being approximately 1.9 million years old and the earliest evidence for *Homo erectus* (sometimes called *Homo ergaster*). There was, however, some dispute about this claim due to the fact that the depositional context of the fossil was not well documented, and neither was its location, because it was recovered at a time before GPS coordinates could be taken.

Enter PhD candidate **Silindokuhle Mavuso** (in the role of lead project geologist) and his supervisor **Dr Zubair Jinnah**, working together in a team of researchers who took on the task of relocating and describing the original site using old photographs and archival data combined with aerial imaging prior to spending two

field seasons in and around the rediscovered site.

The detailed sedimentological study that followed was used to describe and reconstruct the depositional environment in which the original (and some newly discovered) fossils were found. Combined with work on the fossils themselves, the study has since placed KNM-ER 2598 and the new fossil evidence as the oldest *Homo erectus* in eastern Africa, thus anchoring the species' origins in Africa before diversification all over the world. More information on the study can be found in the article in Nature Communications. Of the experience Silindokuhle has said "this has been an important and rewarding team effort with not only multidisciplinary approaches but multinational collaborations, and more importantly it highlights how important and central the geosciences are in these consequential discoveries".

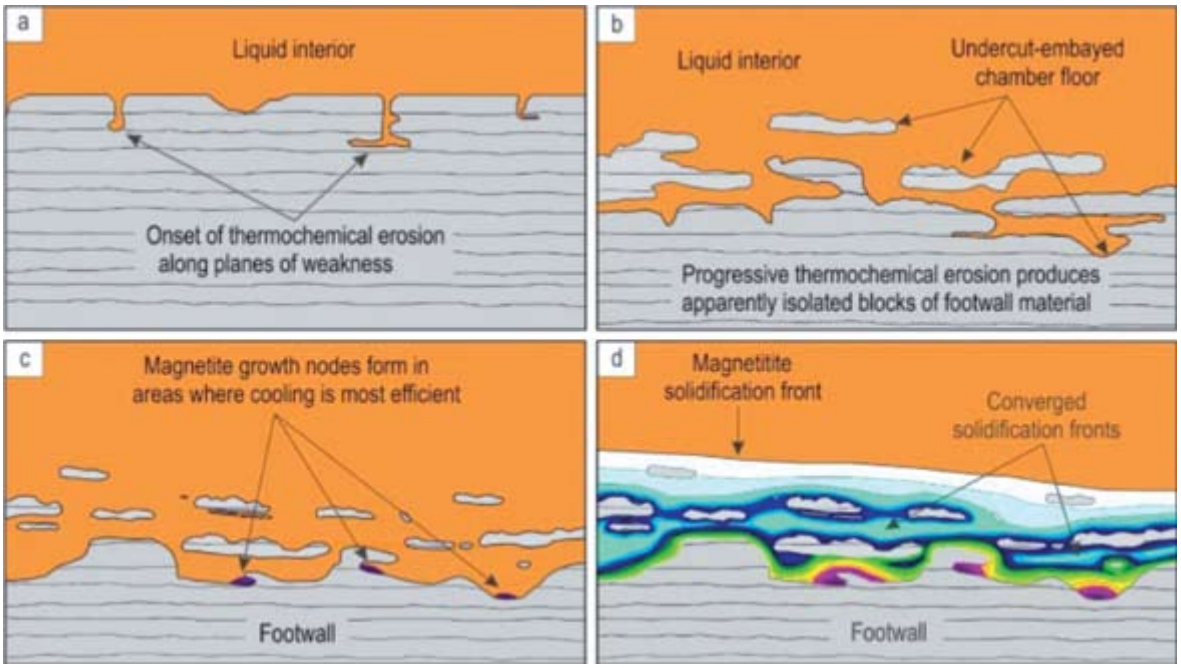
Silindokuhle in the field.

Dr Stephanie Scheiber-Enslin has contributed her geophysics expertise to a study on mapping the magnetic signature of Antarctic rocks covered by ice, and then correlating these with the magnetic signatures and rock types on other continents that would have surrounded Antarctica in Gondwana times. The study used recent European Space Agency SWARM magnetic satellite data to allow for a smooth compilation of data from southern Africa, Australia and Antarctica. These data have also allowed researchers to bring India into the magnetic Gondwana reconstruction, albeit just the long-wavelength component of the signal, as aeromagnetic data for India are not freely available. Follow the links to access the article in Scientific Reports and the associated video.

Also appearing in Scientific Reports is the recent study by Dr Willem Kruger and Prof. Rais Latypov, which provides new insights into three fundamental questions regarding magma chamber development, namely: where, why, and how magma in the chamber starts crystallising and differentiating. The study started with the discovery of an outcrop of massive magnetitite in the Bushveld Complex that contained several enigmatic anorthosite inclusions. In an attempt to unravel the origin of these inclusions, Kruger and Latypov mapped out the two-dimensional distribution of Cr within the magnetitite layer, which showed that magnetite was growing in situ on the outer surfaces of the anorthosite inclusions. Dr Kruger has noted that the best way to explain this fundamental observation is that these anorthosite inclusions are in reality interconnected, forming a three-dimensional framework.

In other publication-related news, two papers on significant bolide (meteorite) falls in southern Africa involving members of the School have recently been published. Petrographic analysis by Prof. Roger Gibson and Prof. Lew Ashwal of fragments of asteroid 2018 LA, which fell on 2 June 2018 in Botswana, led to its identification as an HED type derived from 4Vesta, the second-most massive body in the asteroid belt (for more, see the article in Meteoritics & Planetary Science). Profs Gibson and Ashwal also led the team that investigated the bolide and fall of the Benenitra chondrite on 27 July 2018 in Madagascar, pieces of which were fortuitously recovered by Wits alumnus Timothy Marais a few days later while on assignment in the area (see the article in the South African Journal of Science).

In other department-related news, the School would like to congratulate **Prof. Ray Durrheim** and **Prof. Tamiru Abiye** for being nominated in the 2020/2021 NSTF-South 32 Awards for their outstanding contributions to Science, Engineering and Technology (SET) and innovation in South Africa. Prof. Durrheim was nominated for both the Lifetime Award and the Data for Research Award, while Prof. Abiye was nominated for the NSF-Water Research Commission Award.



The model put forwardby Kruger and Latypov to explain the interconnected anorthosite inclusions, where partial thermochemical erosion of the chamber floor by superheated melt results in a highly irregular morphology akin to karst features.

On the 29th and 30th of April, 20 Wits postgraduate geoscience students (honours, MSc and PhD candidates in both geology and geophysics), 10 University of Pretoria undergraduate geology students and 20 undergraduates from the University of Mpumalanga majoring in Tourism, Cultural and Heritage Studies, as well as staff representatives for all three universities (Profs Gillian Drennan and Robert Bolhar representing Wits), all took part in a multi-university geology trip to the newly inscribed Barberton Makhonjwa Mountains World Heritage Site.

The objective of the trip was to promote domestic tourism and geotourism by exposing students and lecturers to the Barberton Makhonjwa Geotrail (established back in 2014), which is currently the only developed geological trail transecting the core of the Barberton Greenstone Belt. The group was fortunate to also be treated to a warm welcome from the Mpumalanga Tourism and Parks Agency, the Provincial Department of Economic Development and Tourism, and the National Department of Tourism. And as an added bonus, the School's very own **Phumelele Mashele** (an MSc geology candidate who is doing a thesis on how to expand the Geotrail to reach a wider audience, to promote multiculturalism and geoheritage), participated as well, and served as a guide along the Geotrail. Phumelele also presented a brief summary of her MSc work at a gala dinner at the African Rest Hotel on the Thursday evening where the group was hosted by the Deputy Minister of Tourism, Fish Mahlalela, and the CEO of Mpumalanga

Tim's photograph of a typical Benenitra meteorite stone showing the well-preserved black fusion crust with flow striae.

MSc candidate Phumelele Mashele presenting on the use of science outreach as a tool to enhance geotourism for the academic and economic development of communities in and around heritage sites.

Group photo of the Wits delegation after dinner with the Deputy Minister of Tourism, Min. Fish Mahlalela (seated front RHS), and the Chairperson of the Mpumalanga Tourism and Parks Agency board, Mr Thulani Nzima (seated front LHS).

Tourism and Parks Agency, Boy Nobunga, along with a number of other invited dignitaries.

Lastly, the School is proud to announce the unique "Geology through a lens" photographic exhibition currently underway at the Origins Centre until the end of September 2021, which is co-hosted by the Geological Museums Association, the Faculty of Science and the newly established "Earth Sciences Cluster". The exhibition will feature amazing, rare and historically significant photographs taken by geoscientists over the years, displays of special fossil, gem and mineral specimens, as well as some hands-on activities for the more adventurous. The exhibit will display more than 300 photographs with accompanying captions focusing primarily on southern African geological scenes, minerals and gemstones via several themed categories, including Diamonds, the Northern Cape, the Bushveld Complex, the Karoo, the Witwatersrand Goldfield, Namibia, "Big to Small", East African Geology and Gemstones, and Natural Art from around the world. The objective of the exhibition is ultimately to highlight the impressive geology southern Africa has to offer, together with its scenic and mineralogical diversity.

Advertising for the exhibition makes use of some beautiful mineral specimen photographs by Bruce Cairncross.

What is extra special about this exhibition is that all the people involved in organising the event are Wits Alumni as well as members of the Geological Museum Association (GMA), a volunteer committee that advises and assists with the management of the Johannesburg Geology Museum, housed in the Museum Africa building in downtown Johannesburg.

It has taken several years of hard work by the GMA to collect and curate most of the photographs that will be on display, so please do go and check out the exhibition.

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

STELLENBOSCH UNIVERSITY

The department welcomes a new lecturer in geohydrology

It was with great excitement that we were able to welcome our newly appointed geohydrologist when he finally arrived in South Africa earlier this year, after multiple visa- and Covid-related delays. **Dr Reynold Chow** is a hydrogeologist with 12+ years of relevant work experience who specialises in numerical groundwater modelling. He completed his BSc at the University of Waterloo (UW), Canada, in Earth Sciences specialising in hydrogeology. He also completed his MSc in Earth Sciences at UW, where his research focused on comparing different groundwater models and methods for the delineation of source water protection areas. Dr Chow then worked for three years as a hydrogeologist/numerical modeller at BGC Engineering Inc., a geotechnical engineering consulting company based in Vancouver, Canada. His industry experience helped him obtain his Professional Geoscientist (P.Geo.) designation in Ontario and British Columbia, Canada.

Dr Chow then went on to complete his PhD at the University of Tübingen, Germany, where his research focused on the quantification of hydrogeologic model uncertainties when simulating surface water–groundwater interactions. Afterwards, he completed a postdoctoral fellowship at the Swiss Federal Institute of Aquatic Science and Technology (Eawag), where he developed methods to identify long-term trends in water quality from diffuse agricultural pollution. Dr Chow is passionate about catchment-scale hydro(geo)logical modelling and has research interests in fractured rock hydrogeology, managed aquifer recharge, aquatic agricultural pollution, and contaminant transport modelling.

Dr Chow doing what he does best. Water.

Postgraduate enrolments and graduations continue to tick over impressively

In times when Earth Science enrolments are in general decline, our department continues to attract relatively large student numbers into our postgraduate programs. Many of these students are supported wholly or in part by stimulation bursaries amounting to ~R1 million generously supplied by new bursary schemes from Stellenbosch University and its Faculty of Science. In 2021, we enrolled a total of 21 Honours students between the Applied Geology honours stream and the Environmental Geochemistry honours stream. These students have all been performing well and have benefitted greatly from the return to in-person and augmented modes of teaching. At the time of writing, they are busy with active preparation for their 2021 Honours Mine

After the March 2021 graduation ceremony, Dr Jean Loock, Dr Jared van Rooyen, Dr Stephan Dunn and Dr Ryan Cloete pose with their PhD supervisors Dr Bjorn von der Heyden and Prof Roychoudhury (absent: PhD supervisor Prof Jodie Miller).

Tour and Field School, which will take them up onto the Kaapvaal Craton to experience its geological wonders and exceptional mineral endowments. At MSc level, we currently have 26 students enrolled, whereas our PhD candidate numbers currently stand at 12 postgraduate research students. The latter count does not include the five PhDs who graduated during the 2020 graduation cycle. We are very proud of these recent graduates (December 2020: **Dr Joshua Chisambi**; March 2021: **Dr Jared van Rooyen, Dr Jean Loock, Dr Ryan Cloete** and **Dr Stephan Dunn**) and wish them all the best for their future careers.

Graduate students continue to generate and publish new and exciting science

As part of their postgraduate training, research students are encouraged to publish their results in top international journals. Many of these publications have been highlighted in previous editions of the *Geobulletin*, and in this edition, we take great pleasure in exposing the works of **Asmita Singh** (PhD candidate working under the supervision of **Dr Susanne Fietz**) and **Charl Cilliers** (PhD candidate working under the supervision of **Dr Ryan Tucker**). Asmita has recently undertaken an extensive research cruise to Dronning Maud Land in Antarctica where she played a key role in understanding the phytoplankton ecosystem responses by conducting onboard iron-seeding experiments. These results have been published in a recent issue of the journal *Frontiers in Marine Science* and in the *Nansen Tutu* conference proceedings.

Charl Cilliers has recently published his first PhD paper in the journal *PeerJ*. His works focuses on the sedimentological history of the fossiliferous Zuni Basin located in a remote region of New Mexico (USA).

*Asmita Singh poses in front of the Norwegian research vessel RV **Kronprins Haakon** in Dronning Maud Land (Antarctica).*

Charl Cilliers recording sedimentology field data in a remote region of New Mexico.

Using two different geochronological techniques, he was able to constrain the depositional history of the rocks in this basin to two periods with initial deposition after 90.9 Ma and subsequent deposition after 88.6 Ma, younger than the previously postulated ages, which ranged between 92 and 90 Ma. This work significantly strengthens linkages to other early Late Cretaceous strata across the Western Interior of the USA, allowing for improved comparisons with similar ecosystems during this cryptic period in earth's history during which the forerunners to dinosaurs were known to exist.

Bjorn von der Heyden

a new mineral

Parahibbingite—a new mineral found in South Africa

The International Mineralogical Association Commission on New Minerals, Nomenclature and Classification (IMA-CNMNC) has approved the recognition of a new mineral, parahibbingite, identified in samples from the Karee mine, just north of Marikana, operated by Lonplats (now Sibanye-Stillwater). The mineral is intergrown with talc, serpentine and tremolite that are replacing olivine along fractures, in the rocks of the Critical Zone, Bushveld Complex.

Parahibbingite

Ideal chemical formula: $Fe^{2+}_2(OH)_3Cl$

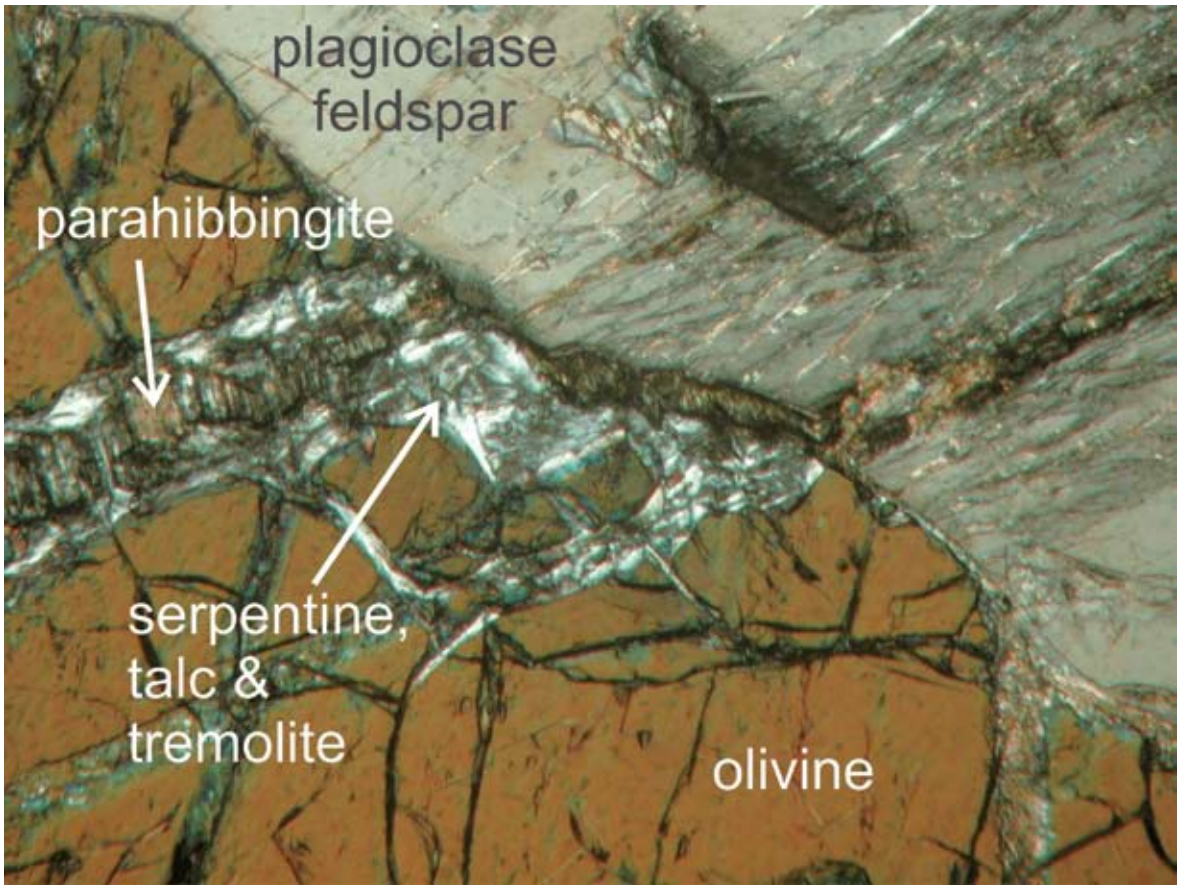
Crystal system: Trigonal

Space group: *R*–3m (#166)

a = 6.94(5), *c* = 14.5(2) Å

The background story

In 2004 I was asked by then-Lonplats to help to understand the cause of the decomposition of borecore from close to the UG2 chromitite that resulted in a rusty and caustic surface in a short time after having been drilled. In 1995 I had been to a conference and field trip on mid-continental magmatism in Duluth, Minnesota. The excursion leader, James Miller, showed borecore that was crumbling, rusty and caustic to the touch due to a secondary alteration product identified as a new mineral, hibbingite. It took me some time to recollect this observation. We approached Mintek, and Archie Corfield prepared polished thin sections under oil (with great intuition guessing hibbingite might dissolve or decompose in water) and found, in some very thin discontinuous fractures, a relationship of olivine being veined by serpentine that was itself replaced by a mat of finely intergrown material.



(This description differs slightly from that found subsequently in the submission that was approved by IMA-CNMNC.) Probe analysis yielded a low total with less Cl than in stoichiometric hibbingite. Sadly, Mintek did not have a high-Cl standard and so the extrapolated value was imprecise. Lonplats gave us permission to publish our findings as 'Suspected presence of hibbingite in olivine pyroxenite adjacent to the UG2 chromitite, Bushveld Complex, South Africa' (*Canadian Mineralogist*, 47, 1075–1085, 2009).

A colleague, Peter Kodera, from Slovakia, asked for material to study the mineral further, and with an assortment of colleagues and a battery of equipment proceeded to quantify the properties listed above, and obtained a higher Cl content consistent with the structural formula. They concluded that it is a polymorph of hibbingite. The prefix para-, in Greek, means besides or beyond.

I hasten to add that the submission approved by IMA-CNMNC has seven authors, of which "yours truly" is number seven:

Kodera, P., Majzlan, J., Pollok, K., Kiefer, S., Šimko, F., Luptáková, J., and Cawthorn, G. (2021) Parahibbingite, IMA 2020-038a, in: CNMNC Newsletter 59, Eur. J. Mineral., 33, https://doi.org/10.5194/ejm-33-139-2021.

Finally, a big thank you to Lonplats (Sibanye-Stillwater).

*Contributed by **Grant Cawthorn** (with some editorial adjustments by **Steve Prevec**)*

International Mineralogical Association
Commission on New Minerals,
Nomenclature and Classification (IMA-CNMNC)

The **Commission on New Minerals, Nomenclature and Classification** (CNMNC) of the **International Mineralogical Association** (IMA) was formed in July 2006 after the active **Commission on New Minerals and Mineral Names** (CNMMN) and the **Commission on Classification of Minerals** (CCM) merged at the request of both commissions.

The CNMMN was established in 1959 for the purpose of controlling the procedure of introduction and acceptance of new minerals and mineral names, and to maintain and rationalise mineral nomenclature.

The CCM was tasked to review existing systems of mineral classification and advise the mineralogical community on arising issues and relevant changes to the classification of minerals.

The CNMNC is headed by an executive committee consisting of a chairman, two vice-chairmen, a secretary and five chairman emeriti. The commission members are representatives appointed by national mineralogical bodies across the globe, in total 34 active members at present. New mineral proposals under review are assessed by the voting members once a month. In addition to the new mineral proposals, there may be proposals regarding nomenclature changes, discreditations, redefinitions, etc. under review. Over the past 25 years, the IMA-CNMMN has published official reports on its activities and publications in several mineralogical journals. They outline the rules and regulations about all aspects of the nomenclature of minerals and mineral groups. A comprehensive list of all valid mineral species is maintained and updated on a regular basis by IMA-CNMNC and can be accessed on the IMA List of Minerals page of the website (http://cnmnc.main.jp/). The IMA List of Minerals is intended as the primary and official source on minerals.

Have a new mineral??? Yes!? No?? Abstain?!?! For general criteria for defining mineral species with coherent guidelines and details regarding preparation and handling of new mineral proposals, you may refer to the famous paper by Nickel and Grice, titled 'The IMA Commission on New Minerals and Mineral Names: Procedures and Guidelines on Mineral Nomenclature, 1998' (*Mineralogy & Petrology,* 64, 237–263, 2008).

Maria T. Atanasova

fossil rediscovered

The first fossil locality in the Karoo Basin rediscovered—after 218 years!

In 1803, the German naturalist Hinrich Lichtenstein made a journey to the far northern frontiers of the then Cape Colony. Following the First British Occupation of the Cape in 1795, the Cape Colony was once again under the control of the Dutch, with Governor Janssens in charge. Lichtenstein had been brought to the Cape as a tutor for Janssens' son. On one of the last farms on the northern frontier, at a place called Daunes, Lichtenstein discovered, at a spring called "De Onwetende Fontein aan den Daunes Kloof", impressions of what looked to him like a fossil eel, about 5 cm wide and about a metre long. He dug into the ground and found further fossils, which he collected. Unfortunately, his sample did not survive the jarring journey in the ox-wagons and disintegrated. Lichtenstein recorded this find in his *Travels*, which were published in 1811. The fossil find was also recorded in the diary of 18-year old Augusta de Mist, who had accompanied the expedition. This was the first ever recorded fossil find in the Karoo Basin, which has subsequently turned out to be one of the richest treasure troves of fossils in the world.

In the twentieth century, fossils similar to those described by Lichtenstein were found in other places within the Karoo Basin. They were compared by Ann Anderson to an ichnofossil form originally found in Sweden, called *Plagiogmus,* which is the track of an

invertebrate worm-like creature that burrowed into the sediment. *Plagiogmus* has been found within the upper part of the Ecca Group, including within the Calvinia region (Northern Cape), where Daunes is located.

But the site of the original discovery has only just been found again, by Sharad Master (Wits University) and George Henry (newly retired from University of Johannesburg). On the 30th April, they made their third visit to Daunes Farm, about 16 km east of Calvinia, and their persistence finally paid off. Under the optimistic guidance of the enthusiastic farm owner, Francois van Wyk, they visited a fourth spring, and there, glinting in a ray of sunshine penetrating the shade of a tree, like a heavenly spotlight, was a beautiful specimen of *Plagiogmus*, found by George Henry, who instantly cried "Eureka!". While Sharad and Francois hurriedly scrambled to see this find, and take photographs, George ambled off about 8 m away, and shortly thereafter, shouted "Eureka Two!" He had found another one! This generated further excitement,

Sharad Master with George Henry pointing out the Plagiogmus ichnofossil still lying on the ground where it was discovered. (Photo: Francois van Wyk)

and more searches, which failed to turn up any more fossils. But elated with these discoveries, we rushed off back to the farmhouse to spread the news of our discovery, to the joy of Francois' wife Maree, who served us tea and biscuits, while we related the story of our discovery, or rather re-discovery, of the

*George Henry pointing to the **Plagiogmus** ichnofossil, which looks like a fossilised bicycle track!*

*The discovery team: Sharad Master, Francois van Wyk and George Henry, with the two **Plagiogmus** fossils from Lichtenstein's original find locality. (Photo: Maree van Wyk)*

fossils first found by Lichtenstein in 1803! And for George Henry this was an unforgettable end to the first month of his retirement! We sincerely thank the van Wyk family for their enthusiasm and hospitality during our brief visits to their farm.

Sharad Master** and **George Henry

exploration data

AngloGold Ashanti lifts the lid on its South African exploration data

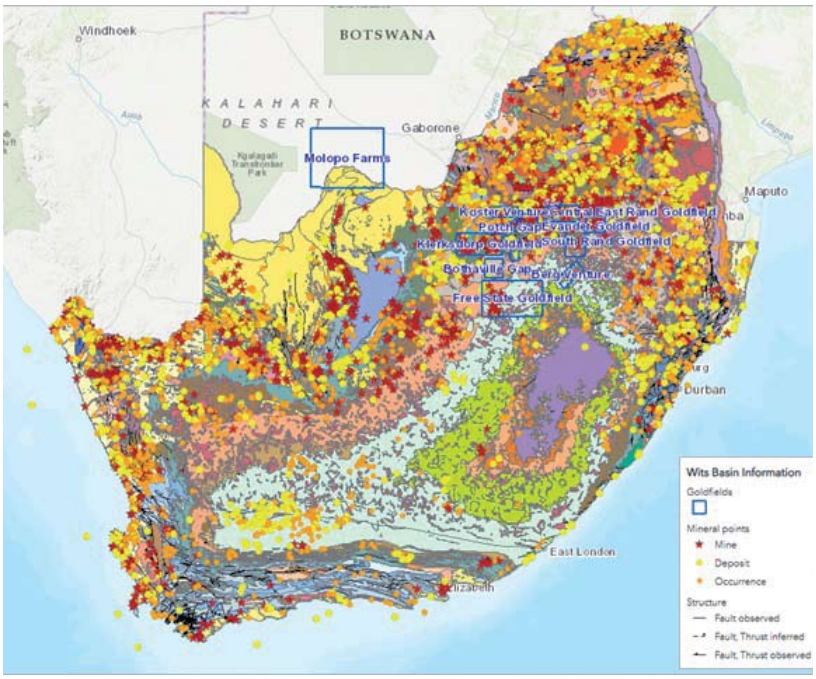
AngloGold Ashanti has retained a wealth of exploration knowledge after completing the sale of its last remaining operations in South Africa last year. Exploration activities undertaken across the Witwatersrand (Wits) Basin included surface drilling in areas extending from the Klerksdorp Goldfield to the Evander Goldfield, as well as in a few lesser-known goldfields.

The data include information from undocumented sub-basins of the main Wits basin. Not only was the Wits Basin extensively explored, but a wealth of information is available about the hanging-wall sequences and structural history of the craton. For instance, deep holes in the Bethlehem area show the southeastern extent of the Transvaal sediments, which display many similarities to those developed in the Griqualand West Basin. Data are also available for the Barberton Mountainland, the Pongola Basin and the Black Reef. These data expose a whole new layer in the geological heritage of South Africa and are now available to all academics.

Extensive exploration resulted in the collection and storage of several hundreds of thousands of metres of drillhole core and logs, geological maps and surveys, as well as assay results of major intersections in drillhole core. Thousands of detailed records and reports that were compiled over the years based on these exploration activities were also retained and may prove to be beneficial to interested persons.

As AngloGold Ashanti remains listed in South Africa, it would like to return value to the country that witnessed the creation and growth of the company.

To this end, the company would like to make this information, collected over 80 years, available to academics for research purposes, to preserve geological heritage and enable research that might otherwise not be possible due to excessive costs to universities and researchers involved to attain such information.



Printscreen taken of the AngloGold Ashanti SA Exploration Hub.

In addition, AngloGold Ashanti is prepared to enter into arrangements for the sale of drillhole core, drilling results and reports to interested exploration and mining companies. This is to support exploration and mining development in South Africa and is in line with the exploration initiatives of the Department of Mineral Resources and the Minerals Council of South Africa. The information will be sold at a fraction of the cost that would be incurred to re-acquire the data today.

The SA Exploration Hub

AngloGold Ashanti has created an online application (the 'SA Exploration Hub') open to anyone interested in searching for available exploration data. Navigating through the SA Exploration Hub is entirely at the discretion of the user and is made easy by using the quick-access guide. Bookmarks are set up to make it easier to navigate to major goldfields along the Witwatersrand Basin. Searches can also be carried out using farm names and/or ventures, which is useful for those areas outside the Witwatersrand Basin.

Once a search is completed, the application will filter the records available to the area(s) specified. It is recommended that the downloaded list of records available and a screen print of the interested search area are attached to the enquiry form submitted to find more information from AngloGold Ashanti.

All interested parties are encouraged to navigate through the SA Exploration Hub to check if there are records available for specific projects or areas of interest, be it for research or exploration purposes. If there are records available, an enquiry form can be submitted via the SA Exploration Hub, or alternatively an email with all the relevant details can be sent to SAHub@AngloGoldAshanti.com.

Disclaimer: All users will have to request access to the full suite of geological information directly from AngloGold Ashanti. Please note that the provision of requested geological and exploration information is not guaranteed and is subject to AngloGold Ashanti's prior written approval, which may be provided or withheld in its sole and unfettered discretion. To access the SA Exploration Hub, click on the link https://gisportal.anglogoldashanti.com/SA%20Exploration%20Hub/ or visit the AngloGold Ashanti LinkedIn page.

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Re-thinking gold operations for the future

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THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY

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BACKGROUND

The Southern African Institute of Mining and Metallurgy (SAIMM), the Canadian Institute of Mining, Metallurgy and Petroleum (CIM,) and the Australasian Institute of Mining and Metallurgy (AusIMM) will jointly convene a World Gold Conference every two years. In 2021 the conference will be held in Johannesburg, South Africa and hosted under the auspices of the SAIMM.

Several important aspects of the current mining environment will institute opportunities and threats for the industry in the foreseeable future.

These include:

- Environmental, safety, and health compliance
- Social license to operate
- Gold price volatility
- Lower grade resources
- Increasing refractoriness
- More energy-efficient mining and processing
- Maximizing long-term optionality

KEYNOTE SPEAKER

Eric Lilford
Professor
Curtin University

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visit www.saimm.co.za

KEYNOTE SPEAKER

John Antony Wates
Chairman
Fraser Alexander

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KEYNOTE SPEAKER

Megan Becker
Associate Professor
University of Cape Town

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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.

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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

mineral scene

Shigaite

This Mineral Scene is in part extracted from Cairncross and Beukes (2013).[1]

The rare mineral from the Kalahari manganese field, shigaite $[AlMn^{2+}_2(OH_6)]_3(SO_4)_2Na_2(H_2O)_6\{H_2O\}$, is the featured species for this *Mineral Scene*. At present, shigaite is reported from five countries, including the type-locality in Japan.[2] Without exception, the finest crystalline examples come from South Africa.

Shigaite crystallises in the hexagonal system, has perfect {0001} cleavage, a hardness of 2, and the tenacity is moderately flexible, with some crystals being sectile. Crystals have a micaceous habit.

From a historical standpoint, the first specimens that were collected from the Kalahari manganese field came from the Wessels mine in June 1993, when lustrous, amber-coloured crystals were found associated with small pink rhodochrosite crystals, leucophoenicite, gageite and caryopilite. Gageite and caryopilite formed the matrix to the shigaite. Most were micromount specimens, but some aggregates were half a centimetre to one centimetre, and, in some exceptional cases, crystals were two centimetres in diameter, although these are extraordinary for this particular find. At the same time, circa 1993, shigaite specimens with similar associations were collected at the adjacent N'Chwaning I mine, so some locality information for these 1993 shigaites may not relate entirely to Wessels mine. However, these early 1990s

Shigaite in situ in a 3.9 cm vug lined by rhodochrosite and sussexite. N'Chwaning I mine. (Specimen: Bruce Cairncross)

Shigaite crystal, 2.1 cm, on pale-pink rhodochrosite matrix, mined in May 2006. N'Chwaning I mine. (Specimen: Paul Balayer, photo: Bruce Cairncross)

specimens were superseded by those unearthed 13 years later.

During the first half of 2006, an area in the old N'Chwaning I mine produced some exceptional specimens of shigaite associated with rhodochrosite. This was the third time shigaite from the Kalahari Manganese Field entered the collector market, so the discovery was not new. The 2006 production of specimens comes from the same area of N'Chwaning I mine where there were still traces of the shigaite present in the old mine-face workings. However, these 2006 specimens differ from the previous ones in their general higher lustre and red–amber colour. The associated mineral assemblage consists of shigaite, barite, kutnahorite, manganocalcite, pyrochroite, rhodochrosite and fibrous sussexite, much of the sussexite being washed off the specimens.

Most of the vugs that contained the minerals were only a centimetre to a few centimetres in diameter—the largest pocket was about the size of a soccer ball. Most of the cavities were lined with drusy, pink rhodochrosite. One single cavity approximately 13 cm long yielded six specimens of light-pink kutnahorite and fluorescent manganocalcite. Interestingly, some of these loose specimens were 'floaters', consisting of small fragments of rock matrix completely coated by drusy rhodochrosite and, occasionally, containing scattered shigaite crystals.

Shigaite was the premier mineral discovered in some of the cavities. The crystals tend to be bright, lustrous dark amber to red and display a typically micaceous habit. Shigaite size varies from tiny 1 mm crystals, to some rare 2.5 cm crystals. The smallest crystals usually have the brightest orange colour and are transparent. The shigaite is commonly scattered over the rhodochrosite matrix. The smaller crystals are thin, but the larger crystals can be up to several millimetres thick and some even have a rosette-like, layered habit. They are hexagonal and are invariably found on the drusy rhodochrosite matrix. As a result of blasting, the larger crystals (over 1 cm) were often found lying loose on the bottom of the cavities, as they had popped off the matrix due to the shock of the explosions. Some, however, were found intact on the matrix and these are the premier specimens.

The Kalahari manganese field shigaite crystals are still the finest known to-date, and are unlikely to be surpassed anytime soon, from any of the other worldwide occurrences.

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

A complex, large shigaite crystal, 2.8 cm. (Specimen and photo: Bruce Cairncross)

References:

1. Cairncross, B. and Beukes, N.J. (2013). *The Kalahari Manganese Field: the adventure continues*. Random House Struik Publishers, Cape Town, 384 pages.
2. Mindat.org. https://www.mindat.org/min-3638.html, accessed May, 2021.

Multiple intergrowths of shigaite on drusy pink rhodochrosite, with a grey barite crystal. (Specimen and photo: Bruce Cairncross)

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!

Arusha National Park, Northern Tanzania: Mount Meru

THE GEOTRAVELLER

By Roger N Scoon*

Geology of the Arusha National Park, Northern Tanzania:
Mount Meru—a Giant Stratovolcano and Potential Geopark

The Arusha National Park, northern Tanzania, is dominated by Mount Meru, Africa's fourth highest summit. Meru is a giant stratovolcano located in the Gregory Rift (eastern branch) of the East African Rift System (EARS). Meru reveals evidence of multiple, catastrophic Plinian events and contains one of the largest volcanic-induced debris avalanche deposits (DADs) on Earth. The volcano is gazetted as active. Rejuvenation of volcanic activity within the large, horseshoe-shaped caldera has resulted in lava flows that may be as recent as 1877. The most prominent feature of the caldera is the Ash Cone that last erupted in 1910.

The Meru Volcano has a base diameter of 25 km and rises some 3 km above the regional town of Arusha (altitude of 1,400 m). The outer slopes are relatively gentle, but the upper slopes include bare, rocky ridges. Landforms are related to a combination of episodic volcanic activity interspersed with cycles of intense erosion during the Late Pleistocene and Early Holocene.[1,2,3] The near-vertical internal walls on the western side of the caldera are capped by a rocky ridge that leads to the summit dome and Socialist Peak (4,565 m). The km-high pyramid of poorly consolidated volcanic ash and cinder known as the Ash Cone (3,667 m) is located within the northwestern corner of the caldera.

The name "Meru" is derived from ancient Hindu and Buddhist religious scripts, in which a mythological mountain is described as a sacred place in the centre

The Ash Cone in the giant, horseshoe-shaped Meru Caldera.

View of the Meru Caldera and Ash Cone from the summit ridge overlooking Little Meru with the outer slopes of Kilimanjaro in the background.

of our universe, in both a physical and spiritual sense. The concept of a mountain with seven rings, separated by water, is central to the mythology of several ancient cultures.

The Arusha NP is situated approximately 35 km by road from the regional town of Arusha. Despite the relatively small size (137 km^2), the park has been described as one of the "hidden gems" of East Africa, having much to offer and yet receiving far fewer visitors than other parks in the region. The park was gazetted in 1960, in part to protect the Afromontane forests that girdle the lower and central slopes of Mount Meru. The caldera, which has internal dimensions of 8 km by 5 km, is accessed by a four-wheel drive track that offers visitors an opportunity to view the upper slopes. The track passes under an arch created by a strangler fig tree (*Ficus thonningi*) prior to reaching a viewpoint at the entrance of the caldera. The trek to the summit requires overnighting

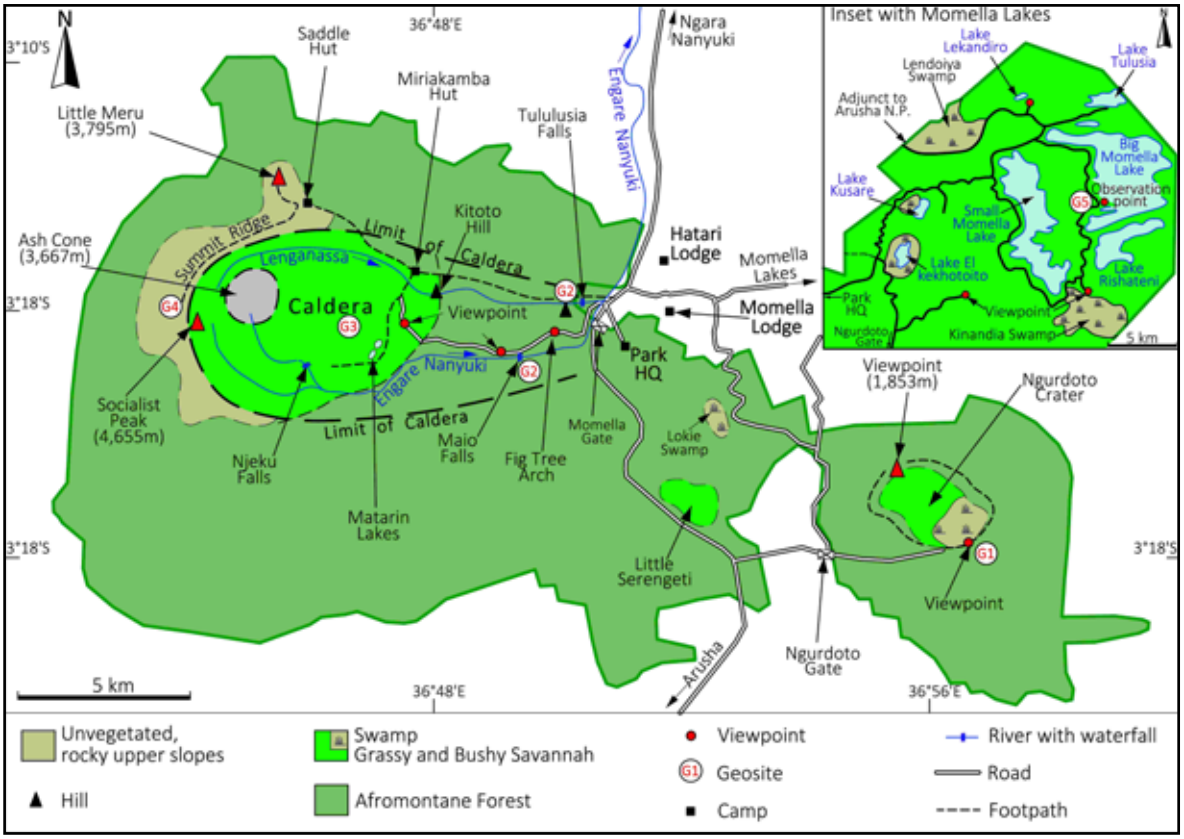
Socialist Peak (4,655 m), the fourth highest summit in Africa, sits atop a dome of resistant lavas

Image of the Arusha National Park. (Source: Google Earth Image 2017, DigitalGlobe, CNES/Airbus)

at mountain huts. This includes a final ascent on the rocky, upper slopes with some degrees of exposure that are not experienced on Kilimanjaro. Little Meru (3,795 m) is a subsidiary peak on the northeastern slopes of Meru. Additional features of interest are the Ngurdoto Crater and the Momella Lakes (an adjunct on the northeastern side of the park).

The Arusha NP is approached from the main road linking Arusha and Kilimanjaro International Airport. The turn-off at Usa River leads to a fork. The left branch leads to the park headquarters via the Momella Gate and the right branch accesses the Ngurdoto Gate. There is a range of accommodation in and around the national park, including Hatari

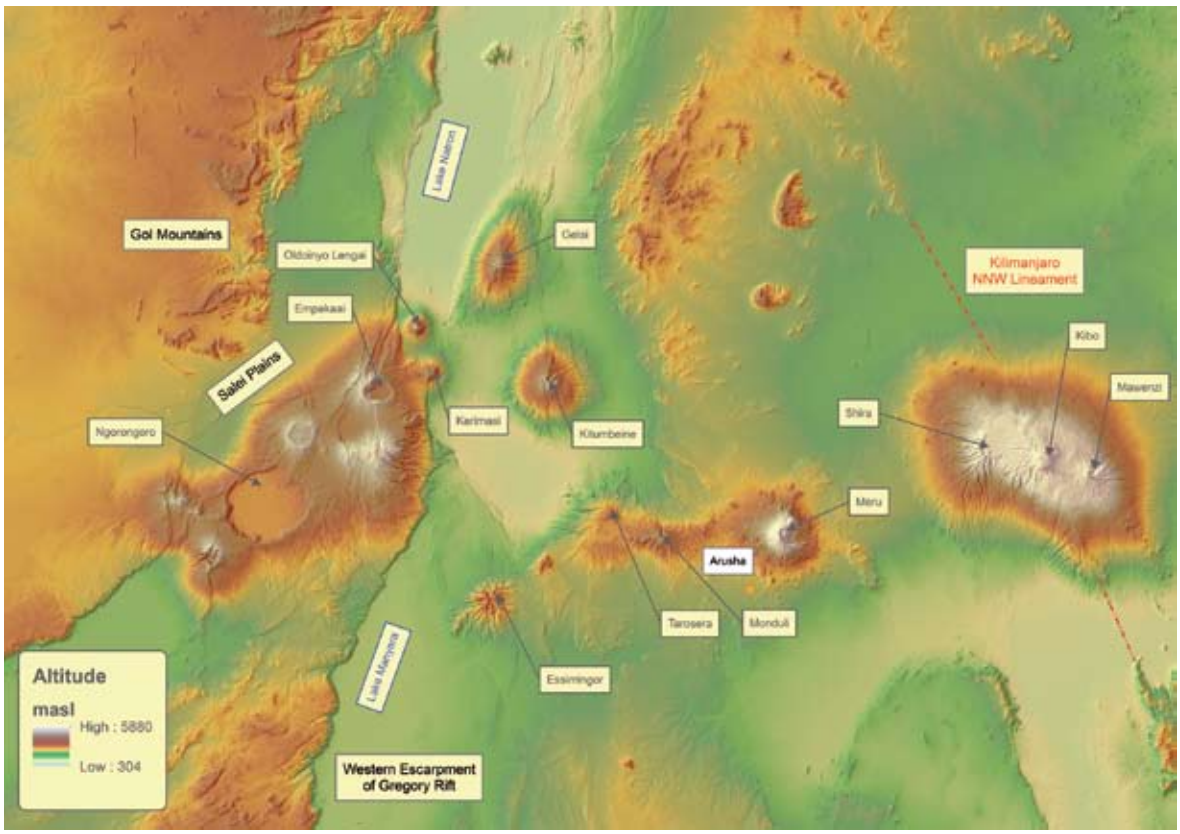
Afromontane forests clad the lower and central slopes of Mount Meru.



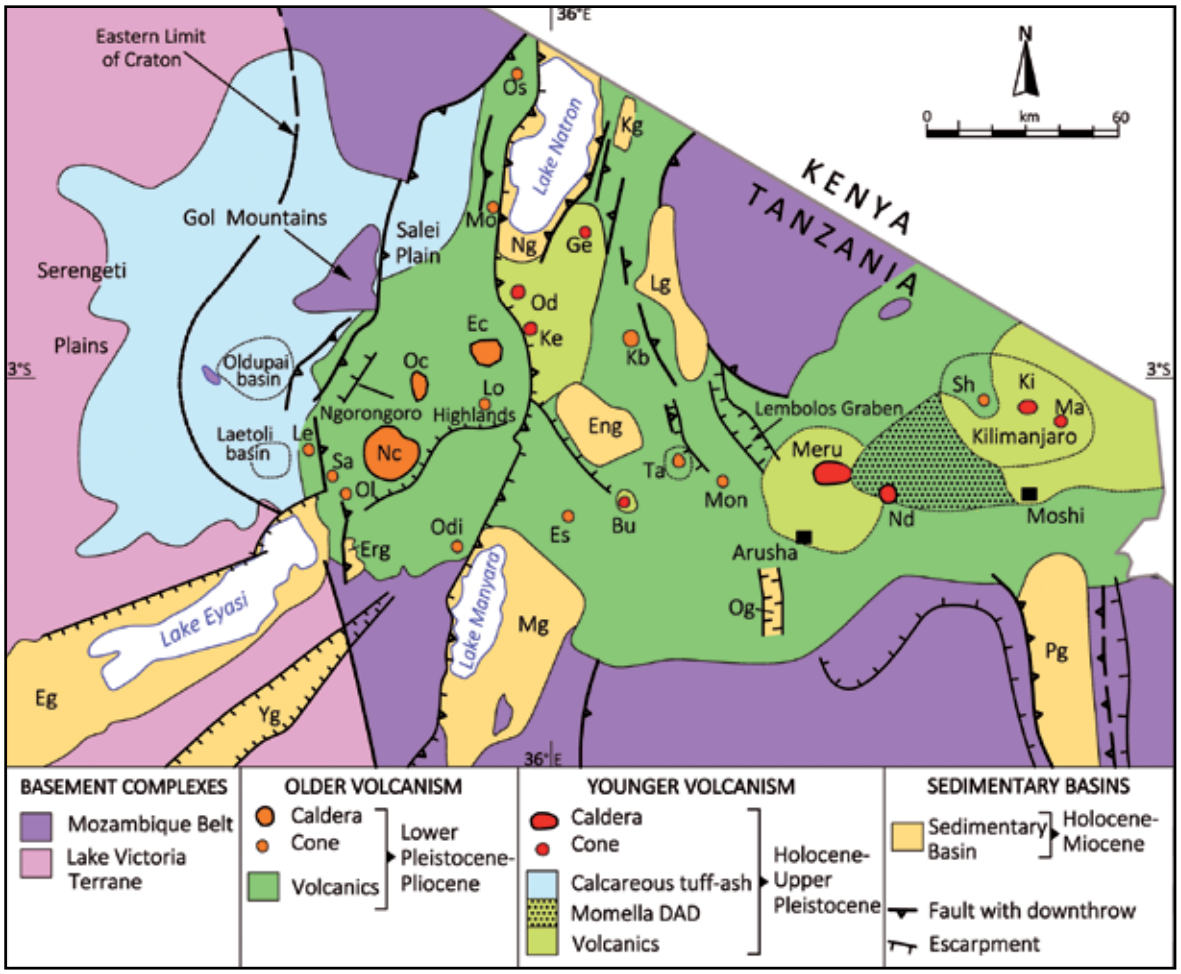
Map of the Arusha National Park showing the extent of the Afromontane forest and geosites referred to in the text. The Momella Lakes are protected in an adjunct to the park (inset).

Lodge (built for the 1962 film "Hatari", meaning danger, starring John Wayne), which has views of Meru and Kilimanjaro.

The region experiences a subtropical climate (tempered by the altitude) with biannual rainy seasons. The relatively high annual rainfall includes



Digital terrain image of the northern Tanzania divergence showing the profusion of giant volcanic cones. The region between Mount Meru and Shira is associated with the Momella DAD (pale brown).



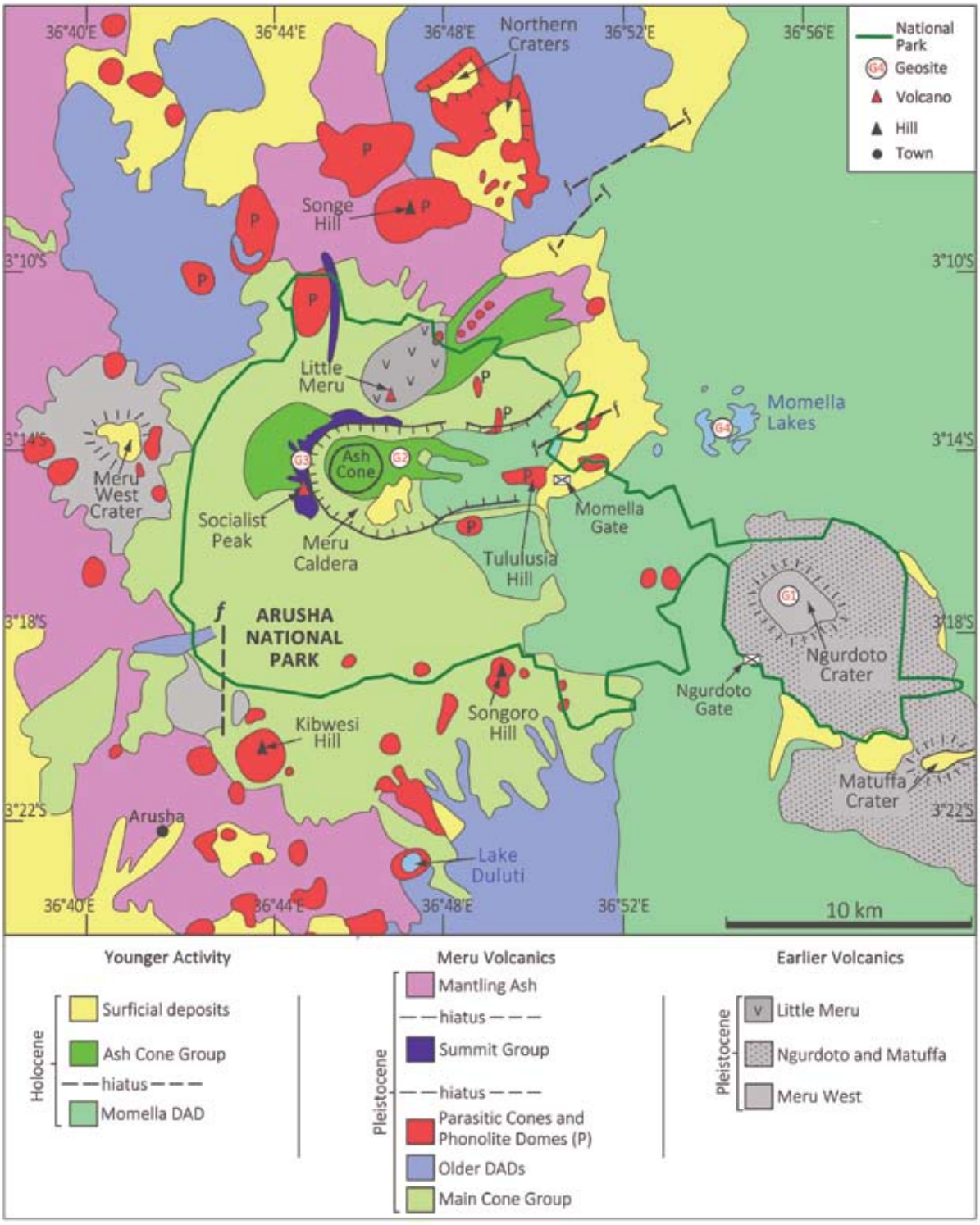
Simplified geological map of northern Tanzania (after Dawson[3]). This region of the EARS includes an older, faulted volcanic terrain, small grabens and giant volcanic cones (both "Older" and "Younger" groups). ***Volcanoes:*** *Burko (Bu); Essimingor (Es); Gelai (Ge); Kerimasi (Ke); Kibo (Ki); Ketumbeine (Kb); Lemagrut (Le); Loolmalasin (Lo); Mawenzi (Ma); Monduli (Mon); Mosonik (Mo); Ngurdoto (Nd); Oldeani (Ol); Oldoinyo Dili (Odi); Oldoinyo Lengai (Od); Oldoinyo Sambu (Os); Sadiman (Sa); Shira (Sh); Tarosera (Ta).* ***Calderas:*** *Empakaai (Ec); Ngorongoro (Nc); Olmoti (Oc).* ***Grabens:*** *Engaruka (Eng); Erumkoko (Erg); Eyasi (Eg); Manyara (Mg); Natron (Ng); Oljoro (Og); Pangani (Pg); Yaida (Yg).*

snow on the upper slopes. Mount Meru is drained by several rivers. The Engare Nanyuki flows eastward within the caldera, prior to turning abruptly northward near the Momella Gate. Headwaters include the Jekukumia River (on the southern side of the caldera) and the Lenganassa River (on the northern side of the caldera). The Momella Lakes are internal basins fed by groundwater.

Meru is situated in the "northern Tanzanian divergence", an area where the Gregory Rift splits into three branches.[3,4,5] The main phase of rifting in this branch of the EARS, which occurred in the Mid-Pleistocene at 1.2–1.15 Ma, was associated with intense volcanism.[6] Giant volcanic cones are a notable feature, e.g., Meru and the three centres of the Kilimanjaro edifice (Shira, Mawenzi and Kibo). Two groups of volcanic rocks are identified: "Older Volcanism" (Late Miocene, Pliocene and Early/Mid Pleistocene) and "Younger Volcanism" (typically younger than 1 Ma).[3] The Older Volcanism (characterised by alkali basalt and phonolite) includes both plateau-style outpourings (fed by graben faults) and free-standing cones. The Younger Volcanism (dominated by nephelinite, phonolite and carbonatite) is associated with giant cones fed by long-lived conduits.

Meru overlies a faulted volcanic plateau constructed of the older volcanic terrains.[2,3] This area is characterised by oblique rifting with an east–west extension. Two structural trends are identified. The Lembolos Graben, which contains thick sequences of olivine basalt (tentative age of 2.3 Ma), is aligned NW–SE. These rocks are exposed in the Matisiwi and Matuginigi Escarpments (northwest of Meru). The N–S-aligned Oljoro Graben (south of Meru) contains the Oljoro Lavas (2.49–2.3 Ma). Large volcanic cones in this region include Tarosero (2.4–1.9 Ma) and Monduli (2.15–2.09 Ma).[3,7]

The oldest of the small volcanic centres proximal to



Simplified geological map of the Arusha National Park and surrounding areas. The relative ages of the earlier volcanic rocks are uncertain and many of the products of Meru are undated. The parasitic cones are greatly simplified (there are multiple compositions and ages). The Momella DAD extends eastward as far as the lower slopes of Kilimanjaro.

Mount Meru is the Meru West Crater (located on the western slopes). This feature is associated with phonolite and nephelinite lavas (dated at 1.5 Ma).[6] Some of the parasitic cones on the lower, southern slopes of Meru, which form prominent hills, may be of a similar age, e.g., Kibwesi Hill (1,961 m) and Songoro Hill (1,717 m). The Ngurdoto and Matuffa Volcanoes have not been dated but probably predate Meru (they are severely eroded). Ngurdoto (1,853 m) includes a well-defined summit crater (internal diameter of 4 km by 3.5 km) with steep inner walls and a depth of 360 m. The identification of nephelinite and natrocarbonatite at Ngurdoto invites a comparison with Oldoinyo Lengai.[3,8] The subsidiary peak of Little Meru consists of explosive nephelinite breccias with subordinate nephelinite flows (0.40–0.30 Ma).[6] The breccias contain clasts of phonolite lava, possibly derived from Meru West.

The summit ridge of Meru reveals outcrops of gently dipping lavas and volcanic ashes. This is the view looking south with the summit dome visible in the background.

Graded layers of coarse-grained and fine-grained volcanic ash on the summit ridge.

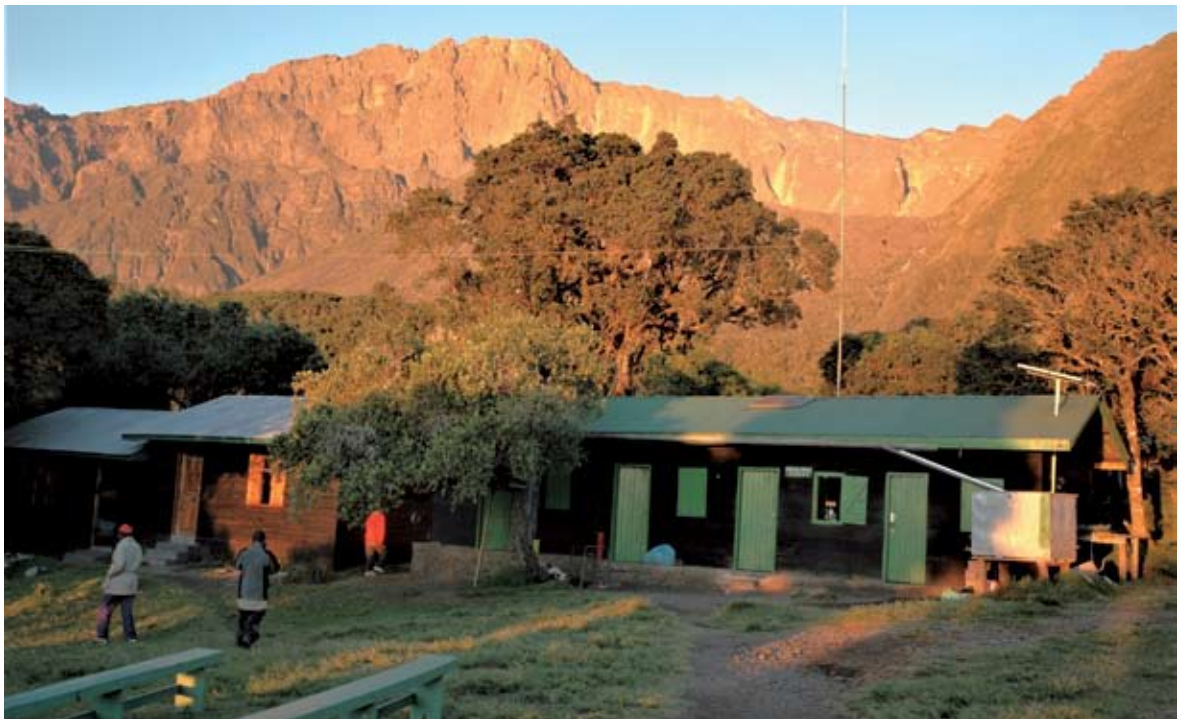
An eroded relict of resistant lava on the summit ridge.

The Main Cone Group of the Meru Volcano is related to multiple Plinian eruptions during a period estimated at 200,000–80,000 BP.[2] This coincided with the waning of activity in the Kibo Volcano (the youngest component of Kilimanjaro). The two giant volcanoes may share a common plumbing system. The oldest radiometric age available for Meru is 163,000 BP; the youngest is 59,000 BP.[6] The Main Cone Group has a broad stratigraphy: layers of pumice and tephra, including coarse-grained agglomerate, alternate with subordinate lava. Most of the pumice and tephra has a phonolite composition, but the lavas include phonolite and nephelinite. Thick deposits of pumice and tephra can be observed in the bed of the Engare Nanyuki near the Maio Falls. This activity included extrusion of phonolite domes on the northern and eastern flanks, e.g., Songe Hill (2,108 m) and Tululusia Hill (2,002 m). The dome-like morphology is ascribed to the viscous nature of the phonolite magma.[2] Extensive DADs have been recognised.[9] These features were originally mapped as lahars (multiple deposits and ages were recognised). They may be interbedded with sedimentary sequences. DADs of this age occur on the northern and southern flanks of Meru. One of these features may be linked to the Little Meru Volcano.

The first cycle of erosion recognised at Meru occurred during periods of quiescence associated with the Main Cone Group.[2] This cycle overlapped in part with the Main Ice Age. Meru was capped by a large ice cap in the Late Pleistocene. The first erosive cycle persisted after termination of the Main Cone Group until approximately 60,000 BP, when a second phase of eruptive activity resulted in the Summit Group. Thick sequences of phonolite and nephelinite lavas of this age cap the caldera rim and summit dome. The phonolite lavas contain phenocrysts of alkali feldspar. They are intercalated with fine- and coarse-grained ash deposits on the summit ridge.

The second cycle of erosion persisted from 60,000 BP into the Early Holocene.[2] This cycle was disrupted by bursts of volcanism, including the Summit Group, but also younger, renewed Plinian activity. This resulted in deposition of thick sequences of tephra on the outer slopes of Meru. The Mantling Ash blankets large areas of the volcano on the northern, western and southern slopes (deposits on the eastern slopes

The Meru Caldera glows in the early morning light with the Miriakamba Hut in the foreground.

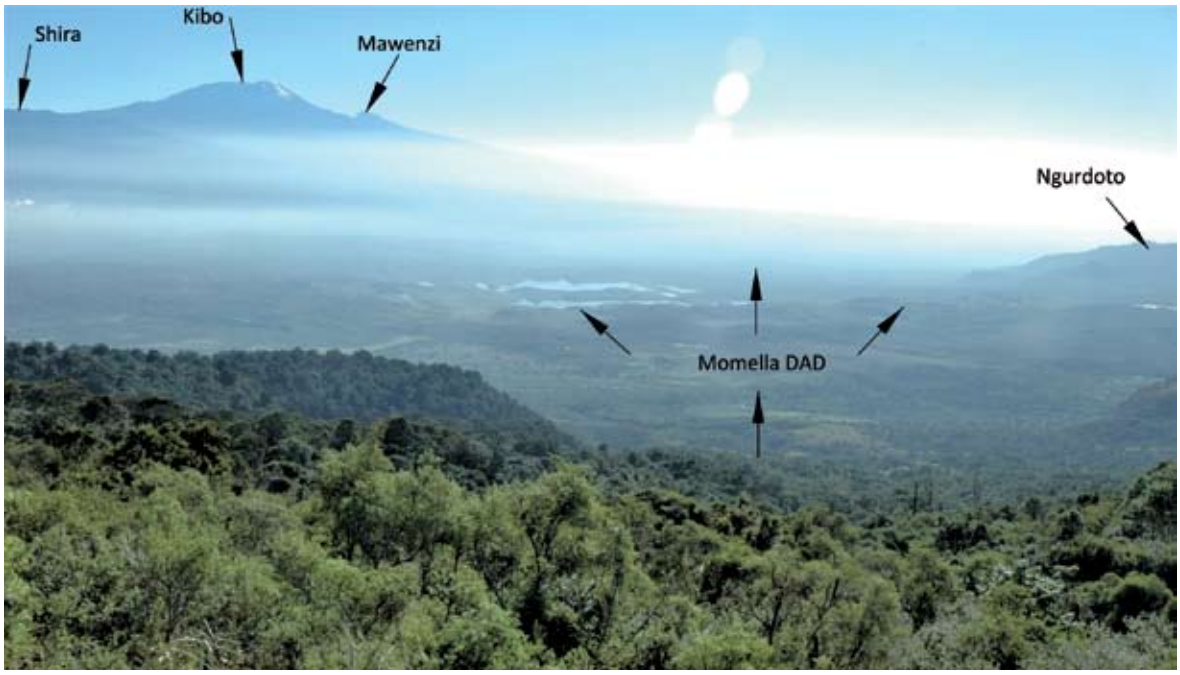


have been covered by younger events). The Mantling Ash may have formed in the Early Holocene but evidently predates the Momella DAD. The tephra accumulated from ash columns that attained heights of as much as 23 km, the abrupt collapse of which created pyroclastic deposits.[8,10] This activity included formation of a younger group of parasitic cones and craters on the lower, southern slopes of Meru.[2] Some of these craters are infilled by lakes and are a popular site for luxury lodges, e.g., the Duluti Crater. They are generally associated with phonolite lavas and ashes. The Northern Craters, a group of explosive craters, may have a similar age. The presence here of breccia and tuff rims reflects phreatomagmatic activity.

The Meru Caldera is probably associated with multiple Plinian events during the period between 60,000 BP and the Early Holocene.[2] There are no definitive ages or agreement on the processes involved. The occurrence of prominent scarps (and the horseshoe shape) may be indicative of a series of older tectonic events, e.g., the abrupt emptying of a shallow magma chamber. The most recent event, which occurred at approximately 8,000 BP, resulted in the eastern side of the caldera being blasted out.[2] The Plinian activity associated with formation of the caldera generated a group of younger DADs.

The western wall of the caldera is built up of layer-upon-layer of lava and volcanic ash, mostly associated with the Main Cone Group. Also visible are feeder dykes and faults.

The regional map depicts two or more of these "younger" DADs, but the approach here is to collate these features into a single deposit, the Momella DAD.[9] This deposit covers an area of 1,249 km^2 and has an estimated volume of 18 km^3. This is one of the largest volcanic-induced DADs known, having travelled 33–35 km prior to washing up on the lower slopes of Kilimanjaro. In comparison, the DAD associated with the 1980 eruption of Mount St Helens has a volume of 2.8 km^3.[11] The tectonism associated with the Momella DAD may be ascribed to either instability on the eastern side of the cone (or earlier-formed caldera), or repeated intrusion of magma at depth on a specific structural lineament.



View looking east from Meru overlooking the Momella Lakes and the DAD-, which extends as far as the southwestern slopes of Kilimanjaro.

The Momella DAD created the undulating or hummocky terrain on the eastern side of Mount Meru. The fast-travelling avalanche gouged out the land surface. The undulations are generally on the order of tens of metres with a maximum elevation differential of 100 m. House-sized boulders of phonolite derived from the Main Cone Group may be observed. Small lakes accumulated in the depressions. Radiocarbon dating of sediments from the lakes has provided a minimum age for the Momella DAD of 8,600 BP.[12] The hot and humid climatic regime of the Early/Mid Holocene caused the DAD to be partly redistributed by fluvial activity into fan and fluvio-volcanic sequences.

The Momella Lakes formed initially due to ponding of the Engare Nanyuki, but minor seismic activity at 1,800 BP caused the course of the river to change in a northerly direction. The largest and deepest of the lakes is the alkaline Big Momella Lake (depth of 10–30 m). Small Momella Lake is considerably shallower (depth of 4–10 m) and is alkaline and salty in the

Greater and Lesser Flamingos fringe Big Momella Lake. The lake is enclosed by hummocky ground associated with the Momella DAD.

centre, but the margin is freshwater. The Rishateni, Elkekhotoito, Jembamba and Tululusia Lakes are relatively small and alkaline. The Momella Lakes may contain sufficient cyanobacteria to sustain flocks of flamingos.[13] The Small Momella Lake remains part of an underground river system, but the other lakes are stagnant.

The Ash Cone Group is related to the rejuvenation of volcanic activity within the caldera. This occurred in the Mid-Late Holocene. The Ash Cone is one of the earliest components. A lava dome located between the northern perimeter of the Ash Cone and the caldera wall fed flows of nephelinite and phonolite. Flank eruptions of a similar age and composition produced lava flows (extents of up to 7 km) on the western and northeastern flanks of the main cone. Lava flows located near the Ash Cone form topographic highs. The unvegetated nature suggests some flows are relatively recent (e.g., late 1800s). The ejection of small amounts of ash from the Ash Cone over a few days in 1910 is the most recent record of activity at Meru.[14] Up until 1953 fumaroles were recorded in the Meru Caldera but since 1974 no activity has been reported.[2]

The Arusha NP contains extensive annular botanical zones that mimic those found on many of the free-standing mountains in East Africa. Grassy and bushy savannahs dominate the base of the mountain. The "Little Serengeti" is an open plain with an abundance of large grazers and browsers. This area also includes small lakes, e.g., Senato Pools, springs, and areas of permanent and seasonal swamp, e.g., Lokie Swamp. Large herds of Cape buffalo (*Syncerus caffer*) occur on grassy plains at the base of the forest, e.g., near the park headquarters, and in the caldera, and armed rangers are required for hikes. Over 400 species of birds have been recorded in the national park and the Momella Lakes are important stopovers for birds that migrate between Europe/East Africa and southern Africa.

The Afromontane forests that girdle Mount Meru above an altitude of approximately 1,600 m include extensive stands of giant Podocarpus (yellowwoods). The forest is the habitat of African elephant (*Loxodonta africanus*) and is noted for sightings of black-and-white colobus monkeys. The forest contains a diversity of bird species, including the colourful Hartlaub's turaco (*Tauraco hartlaubi*) and

Large herds of Cape buffalo occur on the lower slopes of Meru below the forest. Hills in the foreground are associated with either phonolite domes or resistant lava flows. The Meru Caldera is visible in the background.

The Ngurdoto Crater provides a glimpse into a verdant "Garden of Eden".

Narina trogon (*Apaloderma narina*). At altitudes of 2,500–3,000 m, the forest degenerates into ericaceous heathlands and moorlands.

The highlight of a visit to the Arusha NP is the trek to Socialist Peak. Nights are spent at the Miriakamba Hut (located in the caldera at 2,514 m) and at the Saddle Hut (on the caldera rim at 3,801 m). Most trekkers include the ascent of Little Meru as part of their acclimatisation. The ascent of the summit ridge and dome are on bare rock slopes with views to the base of the caldera. Sunrise from the summit is enhanced by the triangular shadow created by Kilimanjaro. The Ash Cone is relatively inaccessible and is reportedly exceedingly difficult to climb. Short hikes can be undertaken to the Tululusia Falls, where the river has carved a small gorge in the lava cliffs, and the Maio Falls, which include a small gorge carved out of deposits of ash and pumice. A short hike in the caldera accesses the Materin Lakes, internal pans rimmed by deposits of alluvium and salt (they are not volcanic craters), and the Njeku Falls where the Jekukumia River drops over a band of resistant lavas.

The Ngurdoto Crater is protected as a "park-within-a-park" (there is no access to tourists) and reveals a verdant "Garden of Eden".

The biodiversity conservation and equitable management of natural resources in the Arusha NP is hampered by the relatively large population within the rural community.[15] Mount Meru has a fundamental role in ensuring climate stability and water supply for a large area, including a rapidly growing urban population based in the regional centre of Arusha. A fundamental principal is protection of the Afromontane forests and the fertile foothills, large parts of which occur outside of the national park.

The Arusha NP has potential to include a **geopark**, i.e., a unified area that advances the protection and use of geological heritage in a sustainable way and to promote the economic well-being of the people who live in the region. The Ngorongoro-Lengai Geopark, northern Tanzania, is one of Africa's first geoparks, illustrating how existing protected areas

☞

(Ngorongoro Conservation Area and Lake Natron Wilderness Area) can be incorporated into a new structure.

Roger N. Scoon

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

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book review

'The Geotraveller – Geology of Famous Geosites and Areas of Historical Interest' by Roger N. Scoon

Published by Springer Nature, Switzerland AG in 2021
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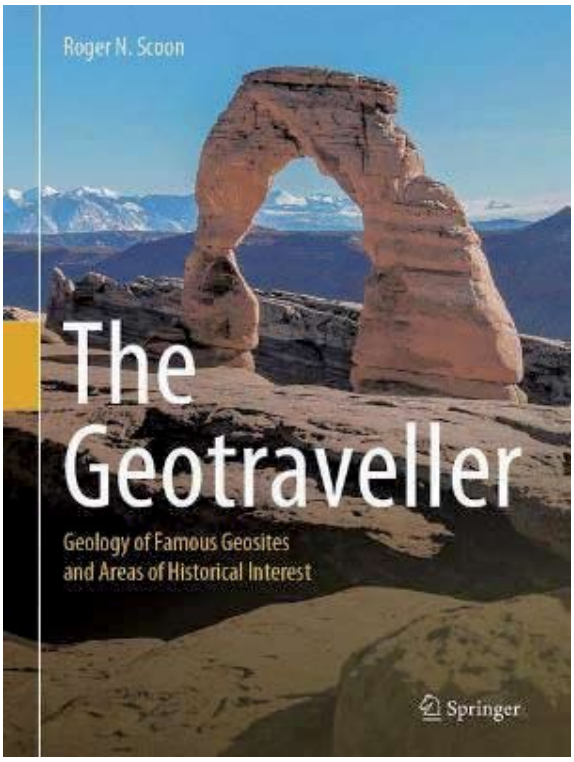

Members of the Geological Society of South Africa who receive the Society's Quarterly *Geobulletin* will be familiar with Roger Scoon's regular contribution entitled *The Geotraveller,* in which he provides lucid and well-illustrated accounts of places of geological and historical interest that he shares with like-minded lovers of the great outdoors. In his latest book, *The Geotraveller*, published by Springer Nature, he has presented a number of chapters (17 in all, see below) each dealing with the geology of famous geosites and areas of archaeological and historical interest from the USA, Europe, Asia and Africa. The places he describes he has visited personally and he was sufficiently entranced by what he saw that he felt the urge to communicate and share his experiences with other adventurous travellers. While there is a geological undertone to all that he presents, he has combined this with aspects of archaeological and historical interest, so adding to the value of the places described. The sites of interest are all geologically spectacular and famous tourist localities, many being protected in national parks and nature reserves. The often awe-inspiring scenic grandeur of the sites is invariably geologically controlled and not always recognised as such by visitors. The curious and thoughtful visitor may wish for an expansive explanation of the site and this is precisely where *The Geotraveller* becomes an invaluable companion. The book provides easily understandable explanations without being overpoweringly technical. The book is beautifully illustrated, with photographs and figure caption explanations that enhance the written text, and well-designed and superbly crafted maps and satellite images show precise localities and details of places discussed. Considerable thought has gone into making the book user-friendly and the presentation by the publisher is outstanding.

As the author explains in the Preface, the book is largely based on published geological articles that are not readily accessible to the non-specialist and the narrative is directed at both professional geologists and the educated layperson. I would go a step further and add that the work would be illuminating to an even broader audience including scholars and university undergraduates. I would guarantee that even well-rounded and experienced geologists would learn something from the book descriptions that they never knew or did not fully appreciate prior to reading what has been provided—I know this because I learnt a great deal myself as an initial reviewer of the book prior to its publication.

To provide the reader with an outline of the scope of *The Geotraveller*, a list of book chapters is given below:

United States of America and Canada

1. Canyonlands National Park and Monument Valley, Eastern and Southern Utah;
2. Arches National Park and Dinosaur National Monument, Eastern Utah;
3. Yosemite National Park, California;
4. Yellowstone National Park, Wyoming;
5. National Parks of the Canadian Rocky Mountains;

Africa

6. National Parks, Rivers and Lakes of Southern Uganda;
7. Lake Natron and the Ngorongoro Conservation Area, Northern Tanzania;

Europe and Western Asia

8. Mediterranean Basins and Italian Island Volcanoes;
9. Neapolitan Volcanoes, Southern Italy;
10. Antiquities and Archaeaological Sites of Southeast and Northwest Greece
11. Antiquities and Archaeological Sites of the Peloponnese and Zakynthos, Greece;
12. Volcanoes of the Hellenic Volcanic Arc, Greece;
13. Antiquities and Archaeological Sites of Western Turkey;
14. The Hierapolis-Pamukkale Archaeological and Geosite, Southwest Turkey;
15. Cappadocia, Central Turkey;

England

16. The Lake District, Northwest England;

Greenland and South Africa

17. Skaergaard Intrusion, Greenland and Eastern Bushveld Complex, South Africa.

As indicated earlier, the book is profusely illustrated with excellent photographs and maps. These would be useful for teaching purposes at all levels to illustrate a wide range of geological phenomena and localities.

Finally, some details about the book itself. It is A4 in size, is hard-covered and has 398 pages. It also includes 353 maps and photographs, most of which were taken by the author and are in full colour. Each chapter has a list of references, providing additional reading for the specialist. In addition there is a comprehensive Glossary of words and terms used in the book and a Subject Index. The book has to be ordered from Springer or international online book shops as it is not yet available in South African Bookstores. The eBook from Springer costs EUR 26.74 (R453) and the hard-cover version is priced at EUR 32.99 (R559). The price is inclusive of VAT. Already there has been wide interest in the book overseas and I would unequivocally recommend it as a useful reference work and field guide for tourists and persons interested in geology and the natural environment.

Reviewed by ***Carl R. Anhaeusser***
Professor Emeritus, School of Geosciences, University of the Witwatersrand

Springer

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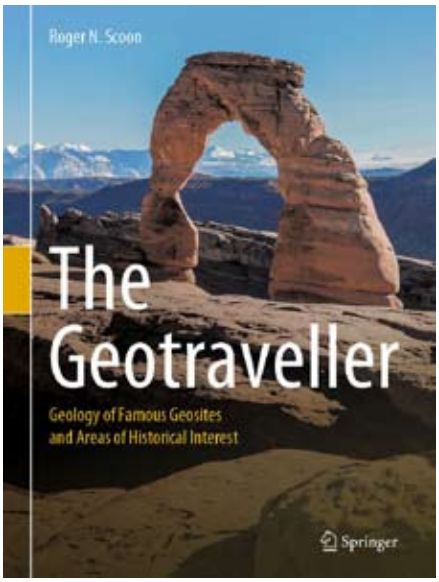

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Roger N. Scoon

The Geotraveller

Geology of Famous Geosites and Areas of Historical Interest

- Gives an illustrated overview of the geology of world-famous geosites
- Blends geology, archaeology, history and mythology
- Illustrates the relationship between geology and landforms that triggered historical events
- Includes photographs and simplified geological maps
- Promotes geotourism

This book describes famous geosites and historical localities in national parks and conservation areas from North America, East Africa, and Europe. The geosites include iconic landforms associated with active volcanoes, canyons, glaciated landscapes, natural rock monoliths, and rifts. The potential for geotourism in historical localities such as the famous Greco-Roman antiquities of Greece, Italy, and Turkey, is emphasised. Some of the geosites and historical localities provide evidence that previous civilizations coped with active geology and major climatic cycles, whilst others reveal evidence of famous geological events recognized in history and ancient mythology that helped shape our current civilization. The book assists tour guides and visitors (both geologists and non-specialists) interested in geotourism by providing an understanding of geological processes in the national parks and historical locations with the assistance of photographs and simplified geological maps.

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!

Northern Cape Branch
Geological Society of South Africa

RHENOSTERKOP EVENT

14 & 15 May 2021

'The Geology and mineralogy of the Rhenosterkop tin, tungsten and zinc deposit'

"I am still buzzing from the Rhenosterkop event and, still, many thanks for your efforts. I am truly humbled by the support and interest the branch and trip managed to garner amid the Covid19 challenges we faced to date.

As the Chair of our branch, I hope that we can only improve from this event. This improvement will still depend on the many members, sponsors, and other stakeholders who share the common desire to see the Northern Cape thriving.

Standing atop Rhenosterkop and observing all those passionate people talk geology and the need to do something similar, again, sooner rather than later made me feel like we formed a pact there. The pact was not written in stone but all our souls. We live for that adrenalin, those moments, and we will live still for each other." Masibulele Zintwana

DAY 1: LAKE GRAPPA












DAY 2: RHENOSTERKOP FIELD TRIP













Northern Cape Branch
Geological Society of South Africa

RHENOSTERKOP EVENT

14 & 15 May 2021

'The Geology and mineralogy of the Rhenosterkop tin, tungsten and zinc deposit'

HIGHLIGHTS

The first event of the Northern Cape branch in 2021 was held at the Lake Grappa in the town of Kakamas (coordinates: 28 42'13.8"S / 20 28'39.70"E).

Mr. Allan Saad presented a talk on Rhenosterkop, which is a significant tin, tungsten, and zinc deposit. It has a surface expression and is located between the R64 tarred road and the Orange River. Economic potential of the deposit was recognized firstly by the geologist Dr. Vaughn Armstrong in the late 1980s working for Rio Tinto, who discovered the deposit by means of geochemical sampling techniques.

The mineralization present is not visible in hand specimen. The deposit is hosted within a quartz, biotite, and topaz greisen. Typical greisen deposits contain muscovite and biotite, making Rhenosterkop unique in its mineralogical assemblage. The biotite greisen is believed to have formed by hydrothermal fluids altering the host granitic rock along thrust planes forming shallow-dipping sheet-like bodies, which merge to form a massive mineralized and greisenized body in the centre. The body is weather resistant compared to the surrounding granites and forms an outcropping ridge 1,500 m long and 300 m wide. The body has a dip of 15 degrees to the east. The deposit contains 29 million tonnes at a grade of 0.124% Sn, 0.583% Zn, and 0.016% WO3 with a stripping ratio of 0.27:1.

Dr. Hermann Praekelt presented a talk on a geological perspective of the Bushmanland covering detailed mapping, unravelling the structural geology of the Augrabies area.

The speakers did a fantastic job with informative presentations followed by an exciting and fascinating field trip on the Rhenosterkop.

Thank you to all our event attendees, sponsors and speakers for their interest – we look forward to enjoying future Northern Cape branch events with you.

For general enquiries, sponsorship and branch membership applications: admin.nc@gssa.org.za and lonigallant@icloud.com

MINROM CONSULTING

GSSA Geological Society of South Africa

PRACTICAL PROJECT MANAGEMENT FOR EXPLORATION GEOLOGISTS

31 AUGUST - 03 SEPTEMBER 2021

32 GSSA
4 SACNASP
CPD Points

Projects are where the action is - this is where strategies are implemented, plans generated, resources utilised and where "talk" is turned into "action". Project management involves everything from strategic planning through to project execution. This practical course will equip exploration geologists to properly scope, schedule, cost, execute, monitor, and control their projects.

This 4-day Practical Project Management training course is aligned with the Project Management Body of Knowledge (PMBOK) Guide of the Project Management Institute (PMI). MINROM Training has formed an association with Dr Anton Olivier, who has presented project management training for the past 15 years, to tailor an exploration project management training course specifically for exploration geologists. The course is up to date with the changed global industry and technological conditions, needs and standards.

COURSE INFO | **REGISTER** | **AGENDA**

Babanango
GAME RESERVE

WITS
UNIVERSITY

26th - 31st July 2021

EXPLORING EARTH & SOLAR SYSTEM

An introductory course in Earth Sciences at Babanango Game Reserve

All meals, tented accommodation and expert field-based instruction included.

EXPLORING EARTH AND THE SOLAR SYSTEM:

An introductory course in Earth Sciences at Babanango Game Reserve

Are you fascinated by rocks, the Earth, and our place in the Solar System, but wish you knew more of the underlying science? Experts from the School of Geosciences at Wits University have teamed up with Babanango Game Reserve to bring you a unique learning opportunity based in a region of southern Africa with a superlative rock record and open African skies.

This all expenses package includes a 6-day short course, held at the Babanango Game reserve which is part of the African Habitat Conservancy in KZN, will provide participants with knowledge of Earth sciences and astronomy in a region of South Africa with an unparalleled rock record. This offering will not only provide you with a basic theoretical knowledge of Earth sciences and astronomy but will allow you to get up close and personal with a wide variety of ~3-billion-year-old rocks while enjoying walks along the Wit Umfolozi River. This type of immersive experience, where you can investigate and touch the rocks you learn about during lectures, provide some of the most beneficial learning environments. Similarly, evenings will be spent around a campfire stargazing with a resident astronomer, providing you with a hands-on appreciation of the night's sky.

Treat yourself to a getaway in one of South Africa's pristine nature reserves, while learning about rock identification, stars and the processes that shape our Earth and neighbouring planets.

COURSE FEE

The course will run from 26 - 31 July 2021 and will combine daily, short theoretical lectures with many more practical learning opportunities among the unique rock record preserved in the Babanango Nature Conservancy. Each day will involve short lectures in camp accompanied with walks or drives to view important rock outcrops in the region. After dinner, evenings will be spent stargazing around the campfire with a resident astronomer. This accredited course will cover basic and intermediate-level geology and astronomy and all participants will receive certification for this course from the University of the Witwatersrand.

Three meals per day, daily conservation fees, safari-style tented accommodation, course content, as well as for instructions by experts in their respective fields, will be covered in the R8950 per person cost. Exclusions: Personal items, travel to the reserve, additional activities, beverages.

Accommodation in Safari Style Tents, guests to bring their own sleeping bag, pillow, and towel.

Please, ensure you have received PDF directions as google maps do not reflect correctly.

For more information or bookings please email to Dr Grant Bybee at Grant.Bybee@wits.ac.za

Course numbers are limited to 35 participants.

Please register for the course by completing your details here

Comprehensive Covid-protocols and practices will be in place and all group interaction, including meals and lectures, will be in open air lapa environment.

Participants will need to drive themselves to the Matatane Nature conservancy, ~75 km southeast of Vryheid, for arrival by 3 p.m. on 26 July.

A moderate level of fitness will be required for walks through the Matatane Nature Conservancy and along the Wit Umfolozi River.

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classifieds


GSSA
Geological Society of South Africa
GEOCONGRESS APPETISER SEMINAR SERIES
20 JULY - 5 AUGUST 2021
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.
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CPD points will be earned.
Register
info@gssa.org.za

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

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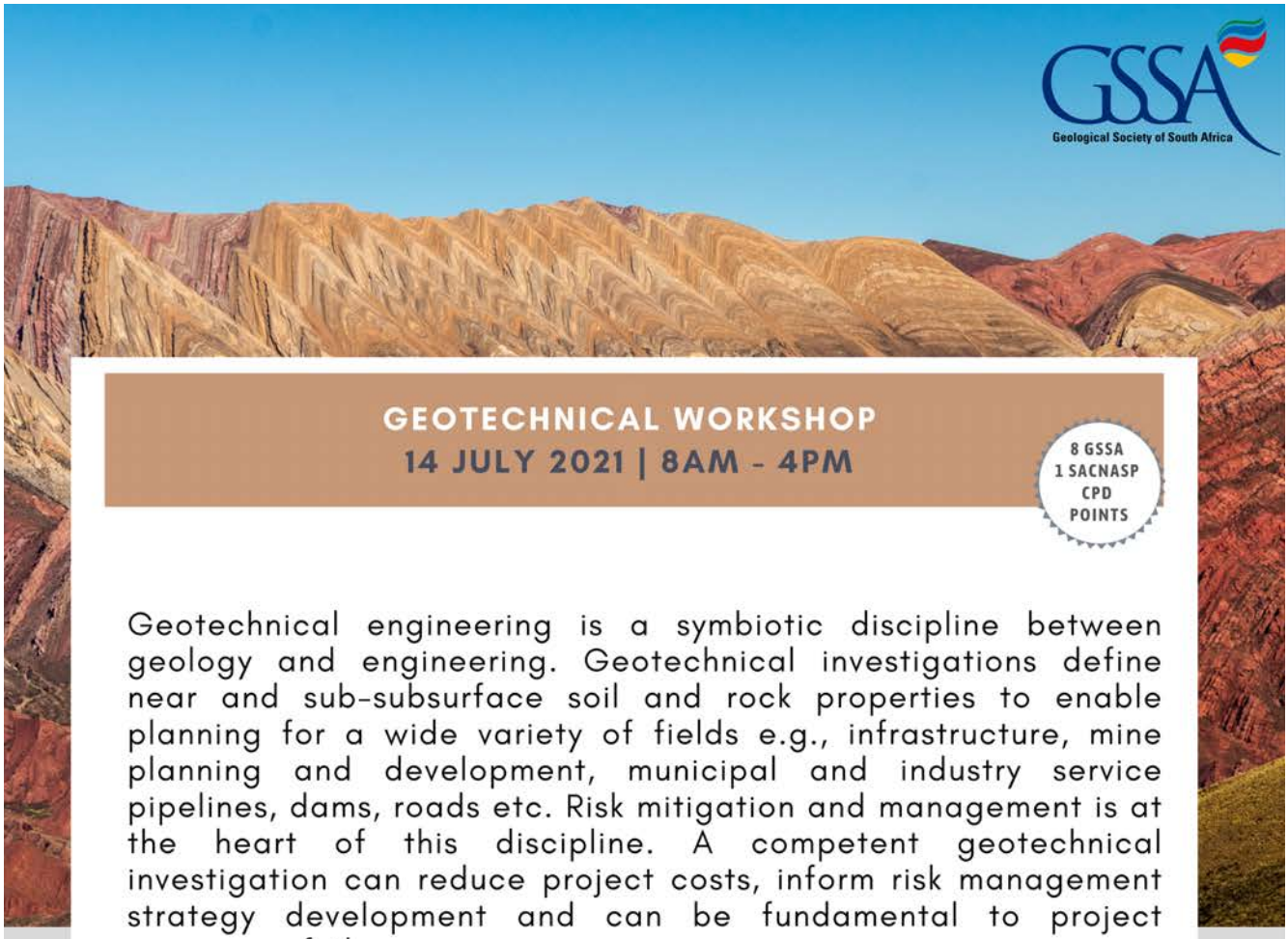

GEOTECHNICAL WORKSHOP
14 JULY 2021 | 8AM - 4PM

8 GSSA
1 SACNASP
CPD
POINTS

Geotechnical engineering is a symbiotic discipline between geology and engineering. Geotechnical investigations define near and sub-subsurface soil and rock properties to enable planning for a wide variety of fields e.g., infrastructure, mine planning and development, municipal and industry service pipelines, dams, roads etc. Risk mitigation and management is at the heart of this discipline. A competent geotechnical investigation can reduce project costs, inform risk management strategy development and can be fundamental to project success or failure.

This 1-day workshop is aimed at entry level geologists and geotechnical engineers as well as industry specialists. The programme will introduce the legal requirements of geotechnical investigations and reporting, the methodology of hard rock and soil profiling and 3D modelling of geotechnical data. A variety of case studies will be presented including dolomite stability investigations and the relationship between hydrogeological and geotechnical properties in hard rocks.

REGISTRATION FEES

Member - R1000 | **Non Member** - R1500 | **Student / Retired** - R500

Click here to **REGISTER**

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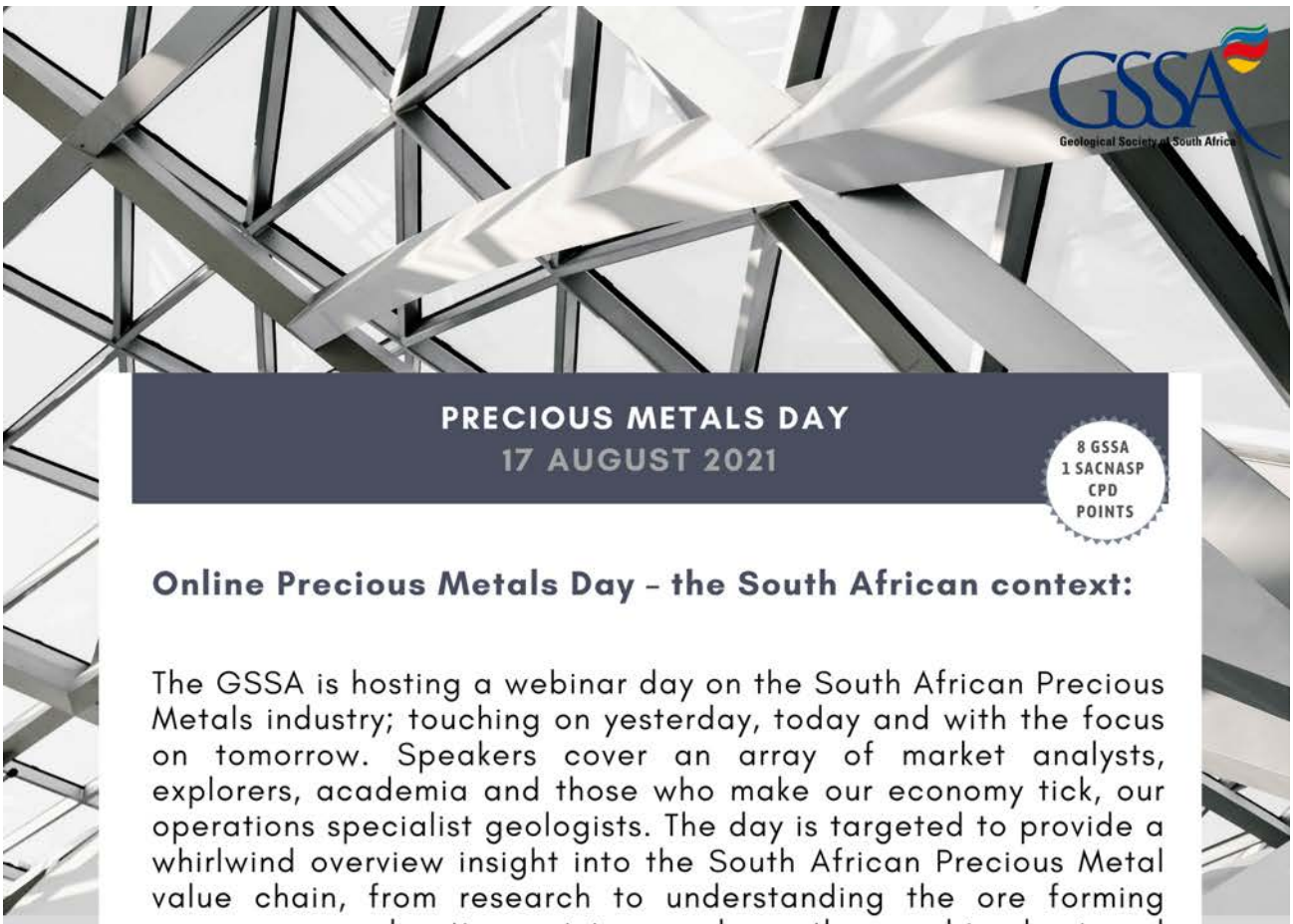

GSSA
Geological Society of South Africa

PRECIOUS METALS DAY
17 AUGUST 2021

8 GSSA
1 SACNASP
CPD
POINTS

Online Precious Metals Day – the South African context:

The GSSA is hosting a webinar day on the South African Precious Metals industry; touching on yesterday, today and with the focus on tomorrow. Speakers cover an array of market analysts, explorers, academia and those who make our economy tick, our operations specialist geologists. The day is targeted to provide a whirlwind overview insight into the South African Precious Metal value chain, from research to understanding the ore forming processes, exploration, mining geology, the combined mineral assets, aspects of processing to the down-stream supply and demand and future outlook. Included is a selection of on-mine geological talks which depart somewhat from the traditional main-stream PGM and Wits-Gold operations.

The talks will last about 8 hours which provides 8 CPD points on the GSSA system and 1 CPD on the SACNASP system.

REGISTRATION FEES

Member – R1000 | **Non Member** – R1500 | **Student / Retired** – R500

Click here to **REGISTER**

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Material:	CD or High resolution PDF in CMYK

3. PRINTING MATERIAL

Material to be supplied on CD as a FH MX/InDesign CS2 or PDF file. Accompanying images should be high resolution in CMYK format (NO RGB or Pantone colours). Any full page material to be trimmed to 297 x 210 mm must include a bleed of 5 mm all round. A COLOUR HARDCOPY MUST ACCOMPANY MATERIAL. Any modifications to incorrectly supplied material will be charged to the advertiser at R300.00 per hour.

4. LOOSE INSERTS

R7 680.00 Printed material to be supplied. Please ensure that the inserts do not exceed the trim size of 297 x 210 mm. All inserts must be e-mailed to the GB Editor.

5. DEADLINES FOR COPY AND ADVERTISING MATERIAL

March issue:	15 February 2021
June issue:	15 May 2021
September issue:	14 August 2021
December issue:	15 November 2021

6. CANCELLATIONS

At least 4 weeks prior to deadline

7. CIRCULATION

Geobulletin is issued in digital format to all members of the GSSA and its local and overseas exchange partners. A printed option is also available for those who opt for it, and the electronic version is available as an open access download on the GSSA website. **Circulation exceeds 3150 recipients plus website visitors, and reaches decision makers in the geoscience community including industry, academia, and government.**

8. ADVERTISING BOOKINGS AND SUBMISSION

Contact person: GSSA
e-mail: lully.govender@gssa.org.za
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9. ADDITIONAL CONTACT INFORMATION

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The design and layout of the adverts is the responsibility of the advertiser. If you wish to utilise the services of the GB graphics and layout supplier, please contact Belinda directly, well in advance of the advert submission deadline to make arrangements.


GSSA
Geological Society of South Africa