geobulletin

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New challenges associated with Covid-19
Historic impacts of pandemics on mining
Geoheritage and World Heritage

news

CENTREFOLD: pg 34 and 35

The seminal 1:10 000 000 geological map of a reconstructed Gondwana compiled by Maarten de Wit and colleagues—see article on pg. 36.

De Wit, M.J., Jeffery, M., Bergh, H. & Nicolaysen, L., 1988. Geological map of sectors of Gondwana reconstructed to their disposition ~150 Ma. American Association of Petroleum Geologists and University of the Witwatersrand.

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GSSA

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Geological Society of South Africa

Front Cover:

The summit crater of the Nyiragongo Volcano in the Democratic Republic of Congo contains a lava lake (left) and an active spatter cone (right). Lava fountains associated with the spatter cone attain a height of approximately 50 m. Nyiragongo is one of Africa's most active—and most hazardous—volcanoes. For more about Nyiragongo and the Virunga volcanic province, see Geotraveller on pg. 52.

guest editorial

Gillian
Drennan

COVID-19 and its effect on Geoscience Education in South Africa

The impact of COVID-19 on Geoscience Education at all levels (primary, secondary, tertiary, continuing adult education) is difficult to define in a few paragraphs and perhaps even impossible to measure right now. We

will all have to look back in years to come to begin to understand the impact that this will have on future generations of geoscientists. I can only speak from my experience of the Higher Education sector and from comments made by fellow Heads of Schools/ Departments from Universities around the country, that no one felt 'ready' for the shift away from traditional face-to-face learning towards online learning. Many educators had only days or a couple of weeks to convert their teaching materials to online modes of instruction. This was quite different to our experiences of #FeesMustFall in 2015–2017.

In some ways, #FeesMustFall forced us to rethink our approaches to teaching when we had to put existing face-to-face materials onto various student-learning platforms. However, that was different to actually going "fully online". During #FeesMustFall, students were advised to look at notes and reading lists that were posted on learning platforms and some educators made alternative arrangements, meeting students in local coffee shops or restaurants and even in private homes, just to maintain contact with their learners wherever possible. This form of "blended learning" (e.g. Czerniewicz, 2020) took shape relatively quickly because educators were still largely in contact with each other, often in a face-to-face environment with fellow educators. In essence, educators were able to share successes and failures in real-time and were there for each other when they needed to find solutions to problems as and when they arose. Likewise, students

quickly formed study groups, which served as peer support structures, and promoted a collective learning experience, sharing of resources and a sense of community. It is fair to say that "blended learning" in this context was more about managing protests and not about pedagogical innovations (Czerniewicz, 2020; Hodges et al., 2020).

The onset of the COVID-19 pandemic presented very different challenges to anything that South African educators had faced before. For the first time, both educators and students were forced into isolation because of social distancing. Both instructors and learners lost the sense of connectedness. For the first time, it was not possible to simply post lecture notes online and the uneven distribution of access to technology and reasonable connectivity became more noticeable. Many learners had no access to electricity at home, let alone to technology and internet connectivity, and some lecturers faced similar challenges. For the first time, long-term online engagement became a necessity, with no immediate end in sight. Lecturers and learners alike were forced into online modes of teaching and learning, when most had little or no real exposure to the online space.

Measures that were put in place (to bridge the digital divide), by institutions that could afford them, included provision of laptops to students and staff and securing data for students. Lecturers initiated WhatsApp and other online chat groups for their classes and, where possible, students were allocated to online tutors for small-group consultations. Institutions created online orientation sessions for learners, developed short 'how to' videos to assist learners with the transition to online learning and ran surveys of student needs in order to set up university support structures. Similarly, lecturers were assisted by Teaching and Learning practitioners with 'how to' videos offering guidance on ways of transforming their teaching materials into online

packages and tips on how to evaluate such courses. Individual Faculties assisted with basic support and individual disciplines established communities of practice to support each other.

Despite everyone's best efforts, it soon became abundantly clear that there were major issues and that what was being offered was not real "Online Learning". Typically, online learning is a product of many months of careful instructional design and planning by professional materials developers (Branch and Dousay, 2015), and these processes give full consideration to design decisions that influence the quality of instruction. Such careful design was not possible given the circumstances of the COVID-19 pandemic. What most institutions resorted to was a temporary shift of instructional delivery (Hodges et al., 2020), referred to as Emergency Remote Teaching and/or Learning (ERT/L). ERT/L provides access to instruction that is hurriedly set up, without detailed planning, which covers only the most essential content that learners need in order to progress from one level of learning to the next. Such instruction is difficult to support and can result in quality-control issues because some sections are left out. This makes it difficult to evaluate the quality of the materials developed by subject specialists, rather than materials developers, and it is even more difficult to evaluate the success of the student learning experience.

For the first time, subject experts, many with little or no pedagogic expertise, were faced with the need to very quickly convert their face-to-face materials into something that could be accessed electronically. Some younger, tech-savvy lecturers chose to use synchronous learning (Hrastinski, 2008), i.e. preparing instructional materials that could be delivered via live web streaming, with simultaneous engagement by students and the lecturer in real-time. This allowed for active student participation and interaction with the lecturer concerned. This delivery style, while providing students with a sense of connectedness, required large amounts of data. Students with limited data or poor connectivity were automatically disadvantaged

and generally, participation by students was minimal. The majority of lecturers preferred to follow a more asynchronous style of delivery (Hrastinski, 2008), providing recordings of lectures that accompanied traditional lecture presentation slides. Student engagement in asynchronous learning is limited to e-mail communication or discussion forums, with no real connection with the lecturer.

From a geoscience education perspective, whether a synchronous or asynchronous style of delivery was chosen, learning thus far has been limited to theory. Geosciences, by nature, relies on practical, hands-on experience working with various specimens, maps, models, instruments, etc., which cannot easily be simulated except in a face-to-face learning environment. More importantly, professional development skills that come from exposure to fieldwork and detailed geological and geophysical mapping and interpretation can only be partially addressed through virtual-reality video clips. Consequently, the potential exists for a major disconnect to develop between theoretical concepts and application. Travel restrictions, the need for social distancing, and other occupational health and safety requirements have resulted in some institutions cancelling field trips altogether, while others have tried to adapt virtual field experiences to suit their students. Yet other institutions are hoping to delay fieldwork until after lockdown conditions are lifted, but such delays may mean that theoretical concepts pertaining to a particular field excursion may have been forgotten by students or may not have been adequately understood because learning took place out of context.

Additional challenges faced by lecturers include production of online assessments that test students' critical thinking and problem-solving capabilities. It is difficult to design assessments that measure individual students' understanding and the larger the class size, the more exaggerated the problem. Marking online assessments is considerably more time consuming than in a face-to-face setting where general feedback

is provided in the classroom and common errors or misunderstandings can be corrected before an entire class. As a result, providing timely, meaningful feedback to students on online assessments puts lecturers under a lot of stress. In addition, the ease with which students can communicate via social media makes it very difficult to know how much sharing of information is occurring during any given assessment. There have been cases reported where entire classes copied from each other, rendering the assessment invalid.

Students, on the other hand, also have trouble with adjusting to this new learning space. Many have difficulty in keeping up and experience suggests that students can only cope with a portion of what the lecturers expect them to absorb. The learning pace is thus slower and students get behind, which causes anxiety and other stress-related issues. Many students do not have adequate learning environments in their homes under lockdown condition. Surveys conducted indicate that many students do not have a desk at home from which to work; many have no electricity; entire families are confined to small dwellings that are noisy and not conducive to deep learning. Although universities may have provided laptops and data, in remote areas students are unable to connect to the internet. Consequently, the digital divide results in poor learning experiences for many and the potential for students to lose focus on their studies becomes a reality.

In many ways, Higher Education is still dealing with the after effects of #FeesMustFall and now the COVID-19 pandemic has exacerbated conditions, enhancing inequalities, challenging resources, and increasing the stresses on both lecturers and students. At an institutional level, progression rules may well have to be modified to maintain standards if fieldwork components of courses cannot be satisfactorily completed.

As suggested by Hodges et al. (2020), once the COVID-19 pandemic is over, institutions will need

to “evaluate how well they were able to implement Emergency Remote Teaching to maintain continuity of instruction”. It will be incumbent on academics to critically analyse their efforts, giving recognition to successes and identifying shortfalls, listening to the student voice, so that they use this experience to better prepare themselves should education be called upon to implement ERT/L again. Employers of geoscience graduates and Professional Bodies such as the GSSA, METF and CGS need to engage with educators to assist in overcoming the obstacles that could potentially have long-lasting effects on the current cohort of students. Now is the time to reflect on what is important and to engage with curriculum reform to ensure the future of geoscience education. There is no way of knowing when another pandemic might occur, given the increasing pace of change in society at large.

Gillian Drennan

Head of School, Geosciences
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executive manager's

In the last issue of Geobulletin, I noted correctly the severe effects of the coronavirus pandemic on the world, but I also noted incorrectly that the meetings program for the second half of 2020 should be unaffected. I could not have been more wrong. It is now unlikely that we will be running traditional events until well into the third quarter, if then. But we have also taken this opportunity to experiment with remote meetings platforms, staging a series of free lunchtime lectures during April and May, using Zoom as the event platform. These have been highly successful, attracting between 30 and 100 delegates each lecture. Furthermore, these are attracting global participation from both presenters and delegates, which would simply not be possible with traditional events. These lectures are lodged on the [GSSA YouTube channel](#). Going forward, we will continue to offer the free lunchtime lectures, as well as a mix of half-day and full-day paid events at reduced rates compared to physical meeting costs. Beyond that, we will be endorsing and marketing the Colin Rice online drilling skills course. Keep track of the events schedule with our [GSSA Meetings Google Calendar](#).

Geocongress 2020 has now been postponed until 2021, but will still be held in Stellenbosch. We will stage it as a hybrid event—both a face-to-face and a remote-access meeting. We will decide on platforms and process in due course. There is software that will allow high degrees of networking, with chat and breakaway rooms possible, and we will be exploring options in the coming months. Electronic meetings look to be the future, and those among the membership who do not use computers are going to have to get used to the idea.

The financial model for events has to change considerably in the new digital world; meetings have been a traditional source of income for the GSSA, but are also expensive to stage, and need cash flow in advance. These costs are reduced in the digital format, but the organisational effort is not. Some platforms are expensive while others are not, but the adage of 'you get what you pay for' still holds. We are looking for

corner

Craig Smith

sponsorship to assist with remote meetings and lectures, and would appreciate any contributions.

The GSSA is very concerned about the effects of lockdown on its members. Members of the academic community are very busy converting courses to on-line formats; some are frantically busy. The mines are being re-opened slowly. The real worry is for the consulting people who need to travel across borders to projects, and cannot do so at the moment. Additionally, the near-term demand for resources looks poor, and that may force some of the more marginal projects to close. Sometime in early June we will be conducting a member survey to gauge the effects of the pandemic on members.

You will all be aware that Professor Maarten de Wit passed away in April. His obituary is published in this issue; he will be missed. Our sympathies go to his family and colleagues.

Craig Smith

president's column

Sifiso
Siwela

In the last Geobulletin contribution I incorporated some anecdotes on David Draper, who is the “founding father” of the GSSA (“the Society”), in order to celebrate our 125th birthday. I had also mentioned plans to carry on with a series of more historical extracts. However, we are currently dealing with a COVID-19 pandemic for the history books and this therefore necessitated the focus to shift to the predicament at hand. I also discussed the onset of the “future of work”, especially with regards to remote working and connectedness, but nobody imagined this pandemic being the catalyst to accelerate this significantly.

Some much-needed good news for the Society is that we had already implemented Zoom video conferencing for online events and meetings earlier in the year before the declaration of the pandemic as a national disaster. Therefore, by the time the hard lockdown was imposed from late March, we were ready to keep the members engaged during this lockdown period. Within two days of Council taking the decision, the GSSA mobilised a series of lunchtime lockdown lectures or talks for its members, as well as anyone interested in participating. This series entailed at least one talk per day from the first Monday of the

lockdown on 30th March, for the full 5-week duration of the Level 5 lockdown period into May. The popularity of the talks grew quickly and then included talks on Saturdays and some public holidays. We also saw the worldwide spread of these talks, with 15 talks from speakers as far afield as Ireland, United Kingdom, Australia, and USA. We have continued these lectures, albeit not at a daily frequency, through the Level 4 lockdown period and into the whole month of June. We are grateful to all speakers and participants for ensuring smooth running of the lectures. A total of 35 online talks were presented during the Level 5 lockdown period and these were attended by 1,200 participants, all in the comfort of their own homes. We are grateful to Meetings Portfolio, Council and the office staff for ensuring we provide our members with these talks and thereby contributing to knowledge sharing and continuing professional development (CPD). These talks have been well received to date.

The membership will also be pleased to know that we are implementing our flagship online course programme using a tested learning management system for the Drillings Skills course by Colin Rice. The GSSA has been running the Drilling Skills in conjunction with Colin Rice annually for the past 25 years. The online certificated programme can be completed remotely and will be assessed with credits.

Since safety and well-being are our highest priority, and based on guidelines from the World Health Organisation (WHO), we have had to postpone some planned and upcoming meetings, including our pop-up events, to dates that will be communicated soon. We will continue to monitor the situation and provide updates by e-mail and on the website. We have, however, implemented some of these as online events, such as the upcoming PGE workshop. There will be more such online events from our Meetings

calendar and we are planning for this year's AGM in July 2020 to be virtual. We were looking forward to another Geocongress, originally planned to be held at the University of Stellenbosch in June 2020, but unfortunately we had to postpone this event to mid-2021. We will continue to monitor the situation and make decisions that will benefit the Society. Hopefully we will soon be able to resume our contact events, which are important for networking and the global community of practice.

During this lockdown period we sadly lost three distinguished members of the Society; firstly, Prof. Willem Johannes van Biljon who was a Fellow and Past President of the GSSA (1972 to 1973), as well as the first HOD of the Department of Geology at UJ (then RAU); secondly, Prof. Maarten de Wit, who was a Fellow as well as an NRF A1-rated scientist and founding director of the African Earth Observation Network (AEON); and thirdly, Dr Tom Molyneux, who was a Retired Life Fellow and conducted work and research worldwide, including providing crucial understanding of the geology as well as exploration and mining potential of the Eastern Bushveld. We also sadly lost Margaret Wynne, who was a Retired Member. Our condolences go out to the families of the four members.

One of the inspirational qualities that resonates from Prof. Maarten de Wit's life and career was his advocacy for transformation in geosciences, including the mentoring of young members to follow in the footsteps of distinguished and experienced geoscientists. During my inauguration speech at last year's AGM, I appealed to our Retired Members and Fellows to get involved as mentors for our younger members, thereby keeping themselves relevant. I am happy to announce that the Society has started the process of implementing a mentorship programme, with the first initiative being done in co-operation with our statutory body SACNASP. I therefore continue to urge our senior members to impart their wisdom and knowledge while they are still able to do so, thereby harnessing some of the invaluable skills and

knowledge gathered during their long careers. As mentioned in one of our lockdown talks, mentorship is important in the journey to leadership. The Mentorship sub-committee is making great progress in this regard, as mentorship is one of the areas close to my heart, and also of importance based on our previous survey to the membership. We will send out another survey soon in order to assess the effect of the pandemic on the employment status of our members. We also acknowledge potential financial difficulties during this time and into the future, and the Membership Portfolio continues to look for ways to support the membership during this difficult period.

We had been seeing markets and the mining industry falling in this first quarter of the year, and this predicament was compounded by the pandemic. We as geologists and a Society will overcome this and therefore remain relevant in our place of employ as the new-age geologist who works in a multi-disciplinary team. This remote-working time is a good opportunity to fully embrace the future of work, big data and the 4th Industrial Revolution, as we can potentially upskill ourselves, re-invent ourselves, as well as re-look at and interpret data during this time. As historically exemplified by Daniel Draper and others, geoscientists are resilient, and I am confident we will overcome this challenge. The GSSA will continue to support initiatives that benefit the membership in this regard.

This year marks our 125th birthday and this is still some good news to celebrate, even in the face of adversity. We do hope that we will be able to hold some form of celebration later in the year. This will, of course, depend on how the pandemic evolves.

It is imperative to continue to remain relevant to and engaged with members and to use opportunities to broaden geoscientists' exposure to different disciplines, and therefore enabling geoscientists working in different parts of the world to connect with each other as part of the global community of practice. Hence, we have increased communication during this lockdown period, as visible leadership is important

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in the face of adversity and in the absence of face-to-face contact. The membership can rest assured that we will still continue on the path of outreach, except in a virtual way. As we continue to expedite innovative ways of connecting with the Society virtually and providing online events for CPD during this time, we also gladly welcome the members' innovative ideas and suggestions.

The GSSA office staff are all working, albeit from home, to provide support for the duration of the lockdown and are contactable by e-mail and mobile.

I hope all members stay safe, sane and sanitised during this lockdown period.

Yours in safety,
Sifiso Siwela

GSSA
Geological Society of South Africa

letters

To the Editor,

John Gurney and the history of the Mineral Services Group

Thanks for an excellent *Geobulletin* for December 2019. I particularly appreciated the obituaries of the prominent South African Earth Scientists that were featured. I picked up something in that of John Gurney which is not quite correct. It suggests that John's entrepreneurial bent only came to the fore in 1996 in the form of the Mineral Services Group. In fact it started long before, nearly 30 years earlier. In 1968 John and Mickey MacMillan, a recent PhD graduate from the Precambrian Research Unit at UCT, and the discoverer of the Rosh Pinah deposit, started the company Mineral Services. They had landed a job to provide geological consulting services to King Resources, the company of a Texas oilman, one John King, who had acquired options on all the prospects in Namaqualand and what is now Namibia held by George Swanson of Springbok. Mineral Services

was hired to assess these prospects. Chief amongst them was the Haib Copper prospect, which a King Resources geologist had recognised as a possible porphyry copper deposit. Exploration at the Haib was due to start in January 1969, and at that time Mineral Services consisted only of John and Mickey. In mid-December John contacted me, fresh out of Honours, and offered me a job with his company working at the Haib. Despite never having heard of porphyry copper deposits I accepted the job and although I stayed with the company for only one year I had the time of my life and have never regretted the decision.

Professor Goonie Marsh

Department of Geology
Rhodes University

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

regret to announce:

GEOCONGRESS ~~2020~~ 2021

Date to be confirmed

Stellenbosch - Western Cape

The next ~~125~~¹²⁶ years of Earth Sciences

EVENT POSTPONED

Dear Southern African Earth Sciences community,

As many of you by now well know, the current global Covid-19 pandemic, which grips the world in its virulent claws, has led the Geocongress Local Organising Committee (LOC) to make the difficult (but we believe correct) decision to postpone the 2020 Geocongress. The committee continues to monitor the local and international situations, and has as yet not made a definite decision regarding the exact dates over which the postponed Geocongress will be held. Our preliminary feeling is that the event will run in June/July 2021 and that it will comprise a significant component of online or remote-access functionality.

The LOC would like to apologise for any inconveniences that this postponement may have caused, and would like to thank each and every one of the session chairs for their efforts thus far. At this point, the theme and proposed sessions will carry over to next year, the website will remain live, and the abstract submission portal will continue to accept abstracts. The event website (<http://allevents.co.za/geocongress/>), the Geobulletin, and the GSSA mailing list will remain the primary vehicles for communication of updates related to the postponed Geocongress. As always, we will look forward to welcoming everyone to Stellenbosch once it is safe to do so.

who is the GSSA?

Who is the GSSA? Management, MANCO and Council

The Geological Society of South Africa (GSSA) is a not-for-profit scientific and professional society for earth scientists first established in February 1895, making it one of the oldest such societies in Africa (125 years old in 2020). The GSSA is both a Learned/Scientific Society and a Professional Body with over 2,500 members, fellows and student members.

As a **Learned/Scientific Society**, our objectives are to promote the study and awareness of geology and the broader earth sciences, in Africa and southern Africa in particular; to provide a scientific forum for the publication and dissemination of scientific research in African earth science; to disseminate geological and earth science information among our membership; to provide the general public with earth science information, as objectively as possible, and to promote the documentation and preservation of important geological sites for the benefit of broader society.

As a **Professional Body**, our goals are to promote the professional interests and professional development of our members; to provide professional forums and networks for the geological 'Community of Practice' in Africa; to inform and influence government policy and law-making regarding earth science issues; to assist and inform interested parties, including financial institutions, on practice and policy regarding the reporting of Mineral Resources and Mineral Reserves; to provide and safeguard a professional code of ethics and disciplinary procedures to improve professionalism and encourage the highest moral and ethical behaviour within the earth science disciplines; and to represent our members at the professional registration authority in South Africa, the South African Council of Natural and Scientific Professions (SACNASP).

The GSSA caters for everyone who is eligible for membership regardless of their level of professional

THE PROFESSIONAL (AFFAIRS) CORNER

development. The GSSA is opposed to any discrimination and a portfolio exists within its Council to transform the Society to one that is truly representative of all the people of southern Africa. The GSSA's members are drawn from professional sectors within academia, government, business and industry. Members are required to comply with the GSSA Code of Ethics, which is aligned with similar international codes to promote ethical and professional conduct of all practitioners.

The GSSA is governed by its Council, Management Committee (MANCO) and an Executive Office. Council, which comprises up to 30 Members/Fellows of the Society, meets bi-monthly to determine the direction and strategy of the Society and to ratify operational activities. MANCO, which comprises the Executive Manager, the President of the Society, the Immediate Past President and the eight portfolio VPs, meets monthly to flesh out strategy details and execute the decisions of the Council. Both MANCO and Council members serve as volunteers. The Executive unit of the GSSA comprises four full-time paid professional and administrative staff.

The GSSA has its offices at the Mandela Mining Precinct in Auckland Park, Johannesburg (cnr. Carlow and Rustenburg roads). The GSSA offices are staffed by Mrs Lully Govender (Office Manager), Mrs Sally Nienaber (Publications and Reception) and Mrs Marliese Olivier (Finance). In addition to managing the day-to-day activities of the office, the staff are also

involved in organising many of the Society's meetings and networking events.

The current (2019/2021) President of the GSSA is **Sifiso Siwela**. After graduation, he worked at the MSA Group for 13 years, from Exploration Project Geologist to Geology Operations Manager. He was involved in field exploration, project execution and supervision on various commodities and managed multi-disciplinary and multi-commodity exploration projects in Africa and Asia (including the Middle East) from early-stage exploration to advanced mining projects, for major and junior exploration and mining companies listed on various stock exchanges. He also conducted Mineral Resource estimation, minerals investment promotion, capacity building and business development. Since 2018, he has been at Deloitte Technical Mining Advisory, where he has been employed as a Manager and conducts Competent Persons reporting, Mineral Resource reviews and audits, due diligence reviews and valuation of mineral projects in Africa, Asia and Europe.

Sifiso Siwela is a Fellow of the GSSA and member of MANCO and Council. He became Vice-President of the Meetings Portfolio from 2015 to 2019. He is a registered professional scientist with SACNASP. He is also a member of the Southern African Institute of Mining and Metallurgy (SAIMM), Society of Economic Geologists (SEG) and Geostatistical Society of South Africa (GASA). He is also the GSSA committee member on the SAMCODES Standards Committee (SSC).

The Executive Manager of the GSSA is **Dr Craig Smith**. He obtained his BSc degree in geology from the University of Illinois, an MSc in geology from Colorado State University, and a PhD in isotope geophysics from the University of the Witwatersrand. He held postdoctoral positions with the University of Cape Town and the Max Planck Institute for Cosmochemistry. In 1987, he returned to South Africa to head the Hugh Allsopp Laboratory in the Bernard Price Institute

at Wits University. From Wits he moved to Anglo American Research Laboratories. At the end of 2006 he left De Beers and moved to a smaller consultancy, Mineral Services Laboratories in Cape Town, where he served as General Manager of the Mineral Services analytical arm, and also as director on several of the other Mineral Services Group companies.

In June 2009 Craig Smith took up the post of executive manager of the GSSA. He is a member of several local and global scientific organisations and is a SACNASP-accredited earth scientist.

GSSA Committees

As at 2020, the GSSA has eight portfolio committees, each headed by a Vice-President. These are:

- Membership and Transformation (Mr Dumi Sibaya)
- Meetings and DPP (Ms Noleen Pauls)
- Finance (Mr Thomas Molengoane)
- Networking and Communications (Dr George Henry)
- Branches and Divisions (TBC)
- Academic Affairs and SAJG (Prof. Steve McCourt)
- Professional Affairs (Dr Tania Marshall)
- Fellows Committee (Prof. Judith Kinnaird)

In addition, a number of committees and sub-committees are designed to facilitate various member requirements:

- Complaints Committee
- Ethics Committee
- CPD Committee
- Mentorship sub-committee
- REI Fund

The GSSA is also represented on the following external committees/organisations:

- SACNASP
- Council for Geoscience
- SAMCODES Standards Committee
- Geology Museum Committee

The Society supports a number of geographically diverse branches, specialist divisions and interest groups. Active branches include Egoli (Gauteng), Western Cape, Northern Cape, KwaZulu-Natal, Bushveld, Barberton and University of Venda. Specialist divisions or interest groups include the Ground Water Division (GWD), Mineralogical Association of South Africa (MINSA) and the Geoheritage Division. The Society also has strong links to the Overberg Interest Group and the Eastern Cape Interest Group, the South African Institute for Mining and Metallurgy (SAIMM), the Geophysical Association of South Africa (SAGA), the Geostatistical Association (GASA), and the Fossil Fuels Foundation (FFF).

Furthermore, the GSSA has solid relations with various international associations, including the American Association of Petroleum Geologists (AAPG), the Geological Society of America (GSA), the European Federation of Geoscientists (EFG), Geoscientists Canada and the Society of Economic Geologists (SEG).

The next articles in this series will deal with the different portfolios and how they serve your interests as members of the GSSA.

Compiled by **Tania Marshall** with contributions from **Craig Smith** and **Sifiso Siwela**.

all the news fit to print

Stellenbosch University

As with the rest of South Africa, the staff and students at Stellenbosch University have been following the social-distancing protocols set out for us. This means that we have not been allowed on campus and that most of our activities have been forced into the online

space. This means no physical contact time between staff and students, limited tangible data generation for research, and no national or international conferencing. Consequently, it also means no real news to report for a Geobulletin stub.

*Dr Martin Klausen
teaching igneous
petrography from his
home office.*

Dr Matthew Mayne enthusiastically brings metamorphic rocks into the online world for his students.

Perhaps the only noteworthy item to report from the Department is that we took the initiative to gauge our students' perceptions of the online teaching and learning offerings, implemented at short notice and in order to successfully complete the first semester. Overall, our students have been impressed by the efforts that the lecturers have put into ensuring that their learning can continue under the difficult global and national circumstances. These are highlighted in some of the survey feedback responses related to our online teaching and learning offerings:

"Overall, it feels like the department is well prepared and very competent at online lecturing."

– Student A

"I feel that more departments should adopt the way the Earth Science department has been handling the online curriculum."

– Student B

"I personally feel like I am learning and gaining knowledge every day, regardless of being at the university itself."

– Student C

Importantly, this has been a period of learning and adaptation for all of us. Words like Zoom and MS Teams have become part of our daily lives, and even the old professors in the department have had to find creative ways to replace their trusted overhead-projector transparencies (I joke of course).

As I wrap up this very brief and decidedly un-newsworthy stub, I gaze out across the mountains and winelands that majestically dominate my views. My biggest remorse is that at the end of June when Geocongress 2020 was due to proceed, I will not be sharing this view with the broader southern African geoscience community as was planned. Fortunately, I can take solace in the fact that the Geocongress will most likely proceed in 2021 at Stellenbosch University. We thank all session chairs and abstract submitters for the efforts that you have put in thus far, and look forward to welcoming the broader community to our spectacular campus once things have returned to some semblance of normality. My second biggest remorse, also related to the said majestic view, is that I have long since run out of wine with which to enjoy it!

Bjorn von der Heyden

the geological hot pot

The **Geological Hot Pot** is not to be confused with the geological hot spot, nor with the Sichuan hot pot. Most of us geoscientists should know what a hot spot is, but the hot pot requires the following Wikipedia definition, unless you are a serious foodie!

“Sichuan hot pot is a relatively standard thing. You get a big spicy hot pot of boiling broth, a bunch of fun things to cook in it, and an assortment of things to make your own dipping sauce. A hot pot experience is ultimately what you make of it.”

This new column, commissioned by our new Editor, cobbles together introductions to some of the latest research in our broad field of geoscience. They are garnered from trawling the internet—you should not be amazed at how much information is available out there to read free of charge. These are some that caught my attention in the past few weeks. I am sure that you all

have read articles that you think you should share, so instead of WhatsApping it to a friend, please email me the article so that I can include it in the column. You will be duly credited for the introduction if it is used.

Did you know that the Earth’s magnetic north pole has gone walkabouts in the past 180 years, with the pace quickening in the past 20 years? It has moved from northern Canada towards Russia, and the bottom line is that we have to reset the declination on our geological compasses to take this movement into account. Scientists have recently come up with an explanation for the pole’s behaviour that involves changes in flow in the Earth’s outer core, which is nicely explained in [this BBC article](#).

We are in the midst of a severe lockdown due to the corona virus pandemic. By the time you read this, we should hopefully be in the Level 3 stage. If not, you

The huge Kamoa-Kakula copper ore field in the DRC (source: Ivanhoe Mines Limited website).

can always read some of my links to keep up on Continuing Professional Development (CPD) points! But is there any upside to the pandemic? In the very short term, yes, with regards to the levels of carbon dioxide being emitted into the atmosphere, as [this BBC feature](#) outlines. Notwithstanding the transient upside, climate change remains a serious threat to Earth and all her inhabitants, and should be mitigated against.

Ivanhoe Mines Limited, under the leadership of Robert Friedland, recently made a world-class copper ore deposit discovery in the Democratic Republic of Congo. The Kakula mine is under development, and will be tapping into 119.7 million metric tonnes of probable mineral reserves at a grade of 5.48% copper. Wow! You can watch an excellent [presentation on YouTube](#) by George Gilchrist about the discovery and geology of the Kamoa-Kakula ore field. This presentation was arranged by Noleen Pauls (EMEA at Reflex, Vice-President of the Meetings Portfolio of the Geological Society of South Africa) as part of a series of lunchtime lectures for members during the Covid-19 lockdown, all of which are posted on YouTube.

Did you know that dinosaurs could swim? Neither did I until I came across this [article in National Geographic](#).

Palaeontologists in Morocco recently unearthed one of the most complete fossil specimens of *Spinosaurus* ever found, which shows an oar-like bone structure on its tail that helped to propel it through the water. The article makes fascinating reading and goes to show just how much chance (or luck) plays a part in scientific discoveries.

Leo Vonopartis is a doctoral candidate at the University of the Witwatersrand under the supervision of Professor Paul Nex. The team has just published their findings on the origin of the tin mineralisation in Bushveld granites of the Zaaipplaats Tin Field in Limpopo Province in this Open Access [article in Minerals](#). Which brings back memories of a visit to the Zaaipplaats mine in early September 1981 by my class of Masters in Exploration Geology (Minex) degree course at Rhodes University, run by Professor Bob Mason. It was a freezing day, and we heard on the news later that it snowed in Johannesburg, amongst other places. We went underground and saw how the complex tin-bearing pipes were being mined. Not a job for the faint-hearted! Now, many years later, we are beginning to get a better understanding on how these interesting tin deposits formed.

Simplified geology of the Zaaipplaats Tin Field from Vonopartis et al. (2020).

May 18 marked the 40th anniversary of the eruption of Mt St Helens in the USA. To commemorate this, Jane Palmer has written a *Nature Features* article about the science of volcanoes and eruption forecasting. This jogged another memory link in my brain about the Minex class of 1981 at Rhodes—one of my classmates (gang of seven!) was a pipe-smoking American named John Empsall who was in Grahamstown together with his wife Glenda. As we knew little about the eruption, John filled us in with some of the details he knew about, having been closer to the event, so to say.

Mt St Helens today.

<https://commons.wikimedia.org/w/index.php?curid=25095973>

We hope you have enjoyed our first Geological Hot Pot, and your feedback would be most welcome. Please email me at ghenry@uj.ac.za.

George Henry

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new challenges

Between a Rock and a Hard Place: The Ancient and New Challenges Associated with Covid-19

To date, more than 7 million people around the world have contracted Covid-19, leading to more than 400,000 deaths over the course of a few months, and severe disruption of social and economic life almost everywhere. The virus that causes the disease, Covid-19, is SARS-Cov2, a coronavirus.

By now most people are aware of the deceptively simple precautionary measures that can limit and slow the spread of Covid-19. Stay at least 1–2 metres away from other people, wash your hands, wear a face-

mask, and sanitise surfaces after people touch them. But practicing and implementing these measures is far from straightforward. Serious thought and sincere efforts are required, which include consideration of context, process, infection pathways, the organisation of workspaces, training needs, effective means to deliver training, and checking whether new ways of doing things work in practice. Then to top it all, for many people engaged in mining, construction and fieldwork, multiple levels of regulation are likely to apply—national and local public health law and rules, sector-specific rules or directives, and organisation-specific rules. And these may not be aligned!

What are we dealing with?

Scientists who study viral evolution find that coronaviruses, which are large RNA viruses, have been around for a long time, with a birthdate somewhere between 10,000 and 300 million years ago. They attack at cellular level and affect many species of mammals, including chickens, pigs, cats, dogs, pangolins, and human beings. Through a genomic mechanism, they are able to weed out mutations that could weaken them and have the ability to trade similar parts with their relatives, other coronaviruses, forming novel combinations that can infect new types of cells or jump species. Covid-19 is named for the year in which it was first identified. Recent studies suggest that SARS-Cov2 is closely related to the virus identified in the unfortunately blamed pangolin, but it probably branched away from this lineage over 140 years ago, where it most likely lingered in another animal before crossing over to humans¹. Although this virus, like most coronaviruses, causes respiratory infections, it is especially adept at penetrating cells and jumping from cell to cell to find its way deep into the lungs². However, the full extent of its effects on the human body are still being discovered, as doctors in the emergency sections of hospitals encounter new reactions to the virus among their patients, such as local inflammatory responses, and blood clots in large arteries and small veins^{3,4}. At the time of writing, it is unclear whether people who have recovered from Covid-19 become immune to further infection, and if they do so, for how long, or whether later infections will become milder as antibodies offer protection. The most likely outcome, according to a former head of the WHO's research programme⁵ is that the virus will infect most people in the world over the next two years and continue circulating 'forever', causing mainly minor infections of the upper respiratory tract. While the true mortality rate associated with the virus is uncertain, its ability to wreak havoc is apparent, albeit not absolutely predictable.

Pandemics, a global outbreak of a disease, are not new and have ravaged humankind several times in the past. The one that has the most significance for the current epidemic is of course the Flu H1N1 pandemic of 1918,

commonly and misleadingly known as the Spanish Flu Epidemic. Other flu pandemics occurred in 1957 (H2N2), 1968 (H3N2 or Hong Kong Flu), and 2009 (H1N2 or swine flu). Since these flu epidemics, many of which were associated with exposure to birds, were far less severe than the 1918 epidemic, it appeared that the occurrence of a high severity pandemic such as that of 1918 was unlikely. The key factor was that infections during the subsequent pandemics did not spread quickly and 'efficiently'. Lessons from the 1918 pandemic were that various factors amplified its virulence, such as the movement of, and close contact between, soldiers engaged in World War I, and the limited availability of health services. At the time diagnostic tests were not available, and vaccines, antiviral drugs, antibiotics, intensive care support and mechanical ventilators were not yet invented. Cities in which schools were closed, public gatherings were banned, and isolation or quarantine orders were issued fared better than others in terms of mortality⁶. The irony of the current situation is that advances made in medicine and technology are not in sufficient supply, not universally available or, in the case of a vaccine, not yet developed. So, the old remedies of a century ago are now largely in effect in a much more interdependent and densely populated world.

Not just health consequences

As protective public health measures have been imposed in country after country, the economic impacts of the pandemic have come into sharp focus. In a pre-industrial era, the separation of life, health and livelihood would be inconceivable. Today, however, the separation of workplace and home still largely defines modern working life and drives the spread of the virus.

Very few policy makers fail to recognise the interdependence of livelihood and welfare at individual level, and of social and economic wellbeing at societal level. An unrestrained pandemic and a crippled economy have alarmingly similar consequences. Only a few countries, such as Sweden, New Zealand, Australia, South Korea and possibly Canada, have avoided being menaced by high death rates and

disease alongside the spectre of hungry, desperate people needing to work. In some countries leaders have been more open than others have about the basis for new edicts and the adequacy of relief measures and mechanisms.

The Covid-19 pandemic has also given rise to a wave of speculation and blame about its origins. This is not a new phenomenon, as stigmatisation has accompanied many pandemics and epidemics⁷. The pandemic of 1918 was called Spanish Flu, not because it originated in Spain, but because the first cases were identified in Spain, a country that was not involved in World War I. While countries involved in the war suppressed information about the pandemic in order to avoid affecting morale, in Spain more data were available, and the press followed the epidemic very closely. Hence the label, Spanish Flu. Interestingly, in Spain the flu was called 'French Flu' because it was believed to have originated from France! In reality, the flu virus travelled with troops engaged in the war⁸. More seriously, a conference on social justice and influenza convened in Italy, which examined the problem of stigmatisation associated with epidemics and pandemics, recognised that disadvantaged groups were less likely to report illness for well-founded fear of reprisal and livelihood loss.⁷

Silver Linings?

The WHO, which was established in 1948 after World War II, followed initiatives taken since the late 19th Century to improve disease prevention and control⁹. By then, it had become very clear that society as a whole paid a heavy price when social conditions lead to the outbreak of epidemics and pandemics. Following the cholera epidemic in London in 1854, public water and sanitary infrastructure was built. The flu pandemic of 1918 led to improvements in housing and investment in public health care systems.

It is possible that the Covid-19 will similarly draw attention to the precariousness of many livelihoods and

the poor conditions in which millions of people live, and inspire a new generation to press for social and public investments, which not only benefit people who have been marginalised, but also society as a whole.

We can all do our bit by doing the smaller things that matter at work and at home, while keeping an eye out for opportunities to work with others for beneficial change at a larger scale.

May Hermanus

Centre for Sustainability in Mining and Industry
University of the Witwatersrand

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impacts of pandemics

Historic impacts of pandemics on mining

Pandemics have left their mark on mining, from medieval times to the first industrial revolution, the Spanish flu to Covid-19.

The world is considering the impact of the Covid-19 pandemic and resulting lockdowns, or curtailing of operations. This is, however, not the first time that epidemics and pandemics have had a profound impact on mining. Throughout history there have been events that were either directly recorded or recognised by historians.

The Black Death swept across Europe in the 14th century, resulting in the death of 25 million people, a third of the populations of all European countries. The Black Death was introduced to Europe by merchants coming from Asia. The Plague, as it was also known, is caused by the bacterium *Yersinia pestis*. Apart from the loss of life and of skilled workers such as blacksmiths, which led to a decline in the production of metal goods, the lead mining industry also came to a halt (Bressen, 2017). The halting of lead mining and related smelting of the ore had an impact on air quality across Europe. In medieval times, lead was used for roofing of large buildings such as cathedrals, water pipes, and especially for dishes and glazed pottery. By analysing a 236-foot ice core recovered from a glacier in the Swiss-Italian Alps, researchers from Harvard University were able to reconstruct the concentration of lead particles in the atmosphere over Europe for the last 2,000 years (Bressen, 2017). Atmospheric circulation transported the lead from the lowlands into the Alps, where it was precipitated from the atmosphere by rain and snow. The snow partially melts and changes

over the summer into ice, forming single layers, as found in glaciers. The team found one significant spike around 1349–1353 when the measured concentration of lead dropped far below the average value of 100 nanograms of lead per litres of air (Bressen, 2017).

The Spanish Flu of 1918 was the first truly global pandemic and that led to the deaths of 50 million people worldwide. In the United States, Tennessee shut its mines (Conis, 2020), as did southern Kentucky, with coal production dropping by fifty percent (Garrett, 2007). The mining town of Gunnison, Colorado, boasted zero mortality and almost no cases of infection over a lengthy time period. This was due to isolating the town from the outside world. The town is located high in the Rockies, so could barricade its roads and regulate its railways (Heymann, 2020).

In South Africa, the spread of the influenza was partly attributed to infected miners on their way to the mines or home (SAHO, 2020). A number of incidents have been recorded that relate specifically to the effect the influenza had on the mining community at that time.

The greatest tragedy occurred on ERPM Mines when a winding engine driver was [so] suddenly prostrated by a bout of flu that he crashed the cage he was lifting with 41 miners in it onto the shaft head, causing it to plummet down and kill 28;

The Spanish Flu in South Africa (source: SA History Online)

injuring another eight. A week after the pandemic was reported in Cape Town the first cases were recorded in the diamond capital of Kimberley. It hit the black workers in the De Beers mine compounds first, leading to the suspension of mining on September 30. By October 3, the pandemic hit the white side of the city, "like an avalanche fell on us", a reader told the town's Diamond Fields Advertiser.

Within days, four of the town's 10 doctors had fallen ill. The death rate in the first 12 days of October reached 600/1000. The town would have been wiped out in 16 months if the rate had continued. Everything closed, with banks opening only between 9 am and 10 am. A piece of red cloth in a window signified a case in the house which the other inhabitants were too sick to deal with. De Beers started burying workers at night in mass graves. But almost as suddenly as the epidemic hit, it passed. (Ritchie, 2020)

It was also notable that more miners died in Kimberley than miners on the Witwatersrand. It is suggested that this was due to an influenza-like illness in Natal Province some weeks prior to the main pandemic that may have given the gold miners some degree of immunity, whereas the more isolated diamond miners only experienced the second, more lethal, wave (Shanks et al., 2010).

The effect of the influenza on mining was also the topic of one of the first studies on the subject (in 1973), which

is titled: 'The "Spanish" influenza pandemic of 1918 and its impact on the Southern Rhodesian mining industry'. This paper covers the reaction of the authorities, the criticism from the industry and the socio-economic impact, and is a worthwhile read as a comparative study for the current situation.

More recently, the Ebola outbreaks in West Africa led to vast regions losing all interest from international companies involved in exploration in this region. A saving grace was the fact that the epidemic was largely contained in the rural areas, and did not spread to major cities or infect mining operations with a large fly-in-fly-out workforce or migrant workers.

Few industries are as aware of the impact that diseases have on their operations and are subject to such a wide range of legislation and regulations as the mining sector. Mining houses and companies are subject to occupational health and hygiene regulations and engage in ongoing awareness campaigns. The type of measures that South African mines have in place range from annual compulsory medicals for all employees and contractors, to awareness campaigns for AIDS and TB. South African mines are also geared to prolonged shut-down periods due to protracted strikes and go-slow actions. All of this is likely to contribute to the South African mining industry weathering this pandemic better than their global counterparts.

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Masked officers in New York in 1918
(source: New York Times)

Doctor's outfit during the Black Plague (source: National Geographic)

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geoheritage

Geoheritage and World Heritage

Geoheritage is about valuing rocks for reasons other than the commodities we can extract by mining them. These values may be simply aesthetic, or scientific and educational. Fewer places on Earth have greater aesthetic value than the Mpumalanga Escarpment. Standing on the escarpment above Blyde River Canyon, you look down on the world and can feel part of the mighty forces that carved this majestic gorge. Floating on the water below the escarpment, you look up and feel that only as part of this awesome creation can an individual feel significant. The powerful sense of place that geological forces created is part of the reason for the creation of the Blyde River Canyon Nature Reserve. Incorporation within a Nature Reserve means that here the rocks and their aesthetic value require no further protection. In neighbouring Limpopo is the Dwaars River National Monument, declared as a Provincial Heritage Site to provide protection to a magnificent outcrop of

chromitite layers. In their database, the South African Heritage Resources Agency (SAHRA) classifies this monument as a geological site of scientific value.

In addition to Nature Reserves and South African Heritage Sites, UNESCO World Heritage Sites also protect the rocks within their boundaries.

UNESCO has ten criteria for the recognition of World Heritage. Six of these are cultural (C i to C vi) and four natural (N vii to N x). The selection criteria are:

- i. to represent a masterpiece of human creative genius;
- ii. to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;

South Africa has **10 UNESCO World Heritage Sites**, shown above:

1. iSimangaliso Wetland Park, KZN (N vii)	6. Cape Floral Kingdom, Western Cape (N ix)
2. Robben Island, Western Cape (C iii)	7. Vredefort Dome, Free State (N viii)
3. Cradle of Humankind, Gauteng (C iii)	8. Richtersveld Cultural and Botanical Landscape, Northern Cape (C iv)
4. uKhahlamba Drakensberg Park, KZN (C i)	9. #Khomani Cultural Landscape, Northern Cape (C v)
5. Mapungubwe Cultural Landscape, Limpopo (C ii)	10. Barberton Makhonjwa Mountains, Mpumalanga (N viii)

- iii. to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization that is living or that has disappeared;
- iv. to be an outstanding example of a type of building, architectural or technological ensemble or landscape that illustrates (a) significant stage(s) in human history;
- v. to be an outstanding example of a traditional human settlement, land-use, or sea-use that is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;
- vi. to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria);
- vii. to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- viii. to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
- ix. to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
- x. to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Locations of Geological (G) and Palaeontological (P) sites in the SAHRA database.

Locations of all sites in the SAHRA database.

Criterion viii is geological, and of 1121 sites in the 2019 UNESCO list, only 30 qualify primarily on this basis. With only ten UNESCO World Heritage Sites in South Africa, the two sites recognised for their geological significance—the Vredefort Dome and the Barberton Makhonjawa Mountains—constitute a relatively high percentage of the total. This is probably a fair indication of South Africa's exceptional geological record.

Recognition of the Barberton Makhonjawa Mountains as a World Heritage Site has led to the declaration of 17 National Heritage Sites in that area. However, as yet the Vredefort Dome has no National Heritage Sites.

The SAHRA database is an appropriate central repository for Geoheritage sites, so the GSSA Geoheritage Division will be approaching members for recommendations of geosites that the Division will submit to SAHRA. The aim will be to fairly reflect the Geological Heritage of South Africa so that the

percentage of Geological and Palaeontological Heritage Sites in the SAHRA database increases from the current 2% (70 of 3000 sites) to 20%.

The economic benefits of geosites are in tourism and education. To reach these audiences, the record of the rocks must be woven into a story. Here South Africa has a rich tradition, exemplified by the publication in 2005 of the book *'The Story of Earth and Life'* by Spike McCarthy and Bruce Rubidge. To build on this foundation, the vision of the GSSA Geoheritage Division is 'Telling the Story of Earth and Life to all South Africans and to the world'. To accomplish this vision, the first step must be the compilation of all relevant geosites in South Africa. Accordingly I request that members submit site names with latitude and longitude (preferably in decimal degrees) and a comment to chatton@geoscience.org.za.

Chris Hatton

Call for Industry Participation

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

BTG invites all geosciences/mining related companies and industry professionals to "bridge the gap" between students and industry, and to act as positive role models by joining the BTG program as a mentor, sponsor or motivational speaker.

If you are interested in getting involved please complete the Google form by clicking on the following link:

<https://forms.gle/6PXQwpWtBromVb4T9>

For more information, please email
bridgethegap.wits@gmail.com

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".

new partnership

New partnership to develop geological field guides for South African Game Parks

South Africa has a rich geoheritage, and many spectacular rock formations are found in our game reserves. Tecoma Strategies has partnered with the [Field Guides Association](#) of Southern Africa (FGASA) to develop geological field guides and training material, and has initiated a pilot project at [Kariega game reserve](#) in the Eastern Cape, near Kenton on Sea.

The Field Guides Association of Southern Africa (FGASA)

FGASA is at the forefront of advancing ecotourism in South Africa and they have done tremendous work in training and accrediting field guides in various fields. After completing the FGASA Field Guide Certificate, and having accumulated at least 2 years of active guiding experience, a field guide may embark on attaining the FGASA Professional Field Guide Qualification. The specialist guiding areas currently include Biomes, Tracking, Birding and Wildflowers, and the process includes completion of a learner workbook

on conducting a guided experience. No geological FGASA specialist guide currently exists.

The new collaboration between FGASA, Tecoma, park officials, academics from Rhodes University, the Geological Society, and geological professionals in the Eastern Cape aims to create a park-specific geological field guide for the Kariega Game Reserve in the Eastern Cape, and a NQF-levelled FGASA course tailored towards training field guides in basic geology, so as to enable them to enrich their guiding experience with geological knowledge. The intention is that this will provide a template for other parks, in order to share the rich diversity of the geology that we have across the country.

The Pilot Project

On the 9th of September 2019, the Pilot Project to create the first field guide was launched at the Kariega Game Reserve. The launch signified a union between geology and tourism and a concerted effort to preserve the natural beauty of South Africa.

The meeting kicked off with opening remarks from

At one of the spectacular outcrops of folded Witteberg strata, with the Bushmans River in the foreground.

Game drive at the Kariega Game Reserve. From left to right: Annie Tumner, Michelle du Plessis, Chris Reynecke, Alan Weyer, Joseph van Scheltema.

Alan Weyer, general manager of Kariega Game Reserve and a renowned and respected Eastern Cape historian. Alan entertained the room with interesting historical accounts relating to the early settlers of the Eastern Cape and how these people interacted with, and utilised, their natural surroundings to survive. Chris Reynecke, conservation manager and ecologist at Kariega, then shared some insight on the importance of plants and animals to a working ecosystem. Michelle du Plessis, managing director of FGASA, also shared thoughts on the importance of tourism to South Africa's economy and how it can be used as a tool to conserve our natural environment. Geologist Joseph van Scheltema presented the project rationale and touched on the importance of conserving our geoheritage and what this project aims to achieve.

After the formal proceedings and a commitment to the success of the project from those present at the launch, the group went on a game drive around Kariega Game Reserve. How often do you get an experienced ecologist, the head of the Field Guide Association of South Africa, a formidable historian and a geologist on one game drive? The experience was nothing short of riveting. Chris conveyed fascinating facts and stories about animal and plant behaviour, while Alan shared historic accounts of the park. Joseph related interesting facts about the geology of the park and highlighted geological landforms and phenomena and how these relate to and interact with

the ecosystem of the reserve. There was not a dull moment. This experience encapsulated the essence of this project: to equip field guides with the knowledge of the geology of the game parks they are working in and to spread awareness of geology to enrich the tourism experience.

Over the next 12 weeks, Joseph, together with Chris and photographer Charles Pote, surveyed the Kariega Game Reserve, documenting and describing the geology of the park. This information was then used to create a detailed field guide, which includes a geological map, a geological history of South Africa, a geological history of Kariega Game Reserve and numerous photos and descriptions of rock types found in the park, geological landforms, interactions between biodiversity and geology, and a history of the use of geology by recent and prehistoric humans. A link to the full Field Guide [here](#).

If anyone would like to be part of this exciting initiative, please contact:

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knysna gold rush

Knysna Gold Rush

Knysna is probably best known from Dalene Matthee's books, notably 'Kringe in die bos' and 'Fiela se kind', where the world was introduced to the indigenous forest, timber industry and unique elephants.

Knysna was also the centre of a short-lived gold rush, leading to the establishment of the boomtown of Milkwood. According to the Knysna Museum, James Hooper of the farm Ruigtevlei found a gold nugget in the Karatara riverbed, at Karawater, while looking for grit to feed his ostriches in 1876. He took it to William Groom, the pharmacist, who confirmed it to indeed be gold and weighed it at around 26.4 grams. The nugget was in turn sent to Charles F. Osborne, a government engineer, who presented the find to the Cape Government, which awarded £100 for further prospecting. The pair sank a 50-foot shaft at the site of the find, but it yielded nothing. Osborne continued prospecting in the Karatara and Diep rivers until he was transferred to Port Nolloth, but returned in 1885 to continue the work.

As news of the prospecting became known, an increasing number of illegal prospectors started entering the Knysna forest. In 1880, Thomas Kitto and geologist E. J. Dunn discovered alluvial gold in the area of Jubilee Creek and wrote a favourable report on the potential of gold mining in this area. John Barrington was subsequently appointed as mining commissioner for Knysna.

The Diggers' Committee was established in 1883 by the nearly 200 prospectors operating in the area. The purpose of the Committee was to maintain law and order, and lobby for the proclamation of the diggings. At nearly the same time, in 1884, the historic first significant gold discoveries were made in the Witwatersrand. After Osborne's return to Knysna, he discovered a gold-bearing reef in an eastern tributary of the Karatara River. It is reported that his mining team was able to wash out at least half an ounce of gold on the first day.

By 1886, the prospectors' camp had become a village known as Millwood that boasted four hotels,

Gold sluicing in Knysna
(source: Knysna Museum)

six shops, a committee room, and an agent's office, and published three newspapers. However, the area had not been proclaimed as a recognised goldfield. The Cape government responded in 1886 by declaring that all diggings were illegal and that the miners were trespassing. The Millwood mining community reacted by calling a mass protest meeting at George on the Market Square. In response, the Cape government recanted its previous statement and indicated that no one was prohibited from digging, but that he did so at his own risk and secured no legal right until allotment was made under proclamation.

On 6 January 1887 the Millwood goldfield was proclaimed. There was some discontent as the Diggers' Committee previously managed all activities with a nominal licence fee of 1 shilling per claim per month, but the government exacted a 10 shilling fee. On the 20th of June 1887, Jubilee Creek was named in honour of the jubilee anniversary of the ascent to the throne of Queen Victoria of England.

In 1887, the gold production peaked and the official gold recovery at Millwood was 655 ounces (18,568.938 grams) of gold, mostly nuggets. Gold had been found in quartz veins on at least 40 of the registered claims. Famous diggings include the Bendigo Mine and Golden Gully that employed stamp batteries. In May 1888, it all came to an abrupt end when the shafts and alluvial workings were barely making any recoveries. The hard-rock recoveries were hampered by the increasing difficulty of following the veins in the highly folded rocks. The town of Millwood became a ghost town overnight and the goldfield was officially abandoned on 21 November 1924 by Government Proclamation No. 294/1924. It is estimated that, at the height of gold rush between 1886 and 1891, a total of 2 600 oz. of gold was recovered (Davenport, 2013).

Millwood House—on the corner of Queen and Clyde streets in Knysna—was moved to its present position from its original site in the Village of Millwood after the village was abandoned. It is now part of the

The entrance to Bendigo Mine

Millwood Mining Walk

Knysna Museum. Old mining equipment and items relating to the Millwood gold rush were recovered and restored, and are on view at Monk's Store or the Materolli Museum (a corruption of 'Mother Holly'), a walk of about 5.5 km from the remains of the mines, the ghost town, and cemetery.

The Millwood Mine Museum and tours unfortunately no longer exist. Visitors to the site can still visit the picnic site and the Dalene Matthee memorial. It is still possible to do the Jubilee Creek walk, past a small waterfall, with some signage indicating the site of some of the old shafts, but these cannot and should not be explored. The entry fee for South African citizens is reasonable, but extremely expensive for foreign tourists, and there are no maps or site brochures available. If you want to visit the site, from Knysna take the N2 towards George, and 8 km out take the Rheenendal turnoff to the right.

A restored portable steam engine

Follow this road for 12.6 km and take the Bibby's Hoek/Millwood Gold Fields turnoff to the right.

The Knysna Lagoon is fed by the Knysna River. The estuary opens to the ocean after passing between two large headlands. The Heads is a popular geo-tourism site and nearby is a formation known locally as "The Map Stones."

Geological Setting

The lode gold deposits of Millwood are hosted in narrow, discrete and discontinuous quartz veins, which are emplaced in structurally controlled zones (faults and shears) in the ferruginous brittle rocks (quartzites) of the Tchando Subgroup. Minor amounts of calcite, pyrite, arsenopyrite and other gangue minerals may be present. Gold mineralisation within the quartz veins is erratic, commonly occurring in small 'shoots' within the vein, according to van Berkel (s.a.). The mesothermal gold mineralisation is spatially associated with structures of the 330 Ma Cape Folding event. The hydrothermal

fluid dissolves trace amounts of metals (gold, arsenic, antimony, etc.) from the surrounding Kaaimans and Cape Supergroup sediments. It is suggested that the presence of iron in the Tchando Subgroup played a major role in the precipitation of the metallic gold from the chloride complexes (van Berkel, s.a.).

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ABOUT THE SYMPOSIUM

The South African Diamond Producers Organisation (SADPO) is pleased to announce that the 2020 Kimberley Diamond Symposium & Trade Show will take place in Kimberley, Northern Cape Province, RSA, in early September 2020. New technologies and geological interpretations have revived activity in mid-size and small-scale diamond mining in the Northern Cape and North West Provinces, and exciting technology advances are driving greater recoveries of large and exceptional diamonds in mines across Southern Africa and other parts of the world, and transforming the industry in its entirety.

Technical Presentations and Panel Sessions – will focus on large-stone diamond populations and their origin, recovery, and provenance (in the case of alluvial deposits), developments in local and international diamond exploration and mining, the unique alluvial diamond deposits of the Northern Cape (including the marine placers of the West Coast) and North West Provinces, new technology developments that are reshaping all facets of the diamond industry, synthetic or laboratory-grown diamonds, and the future of the international diamond industry.

There will be sessions on new geological and technological applications enhancing delineation and exploitation of ultra-low-grade alluvial deposits, back-to-basics geological modelling that has restated the origin and diamond resources of alluvial deposits in North West Province, RSA.

TRADE SHOW

This will accompany the Symposium at the same venue and provide delegates with a cross section of enhanced earth moving equipment, new approaches in design of diamond processing plant, and advanced recovery technologies, including single particle sorting developments. New entrants to the mining industry will be on hand to display their equipment ranges.

mineral scene

Sphalerite, Witwatersrand Goldfield

In 2016 this column featured giant baryte from the Witwatersrand goldfield, with perhaps the largest baryte crystal known coming from a Wits gold mine (Cairncross and Rademeyer, 2001; Cairncross, 2016). In this latest Mineral Scene, the theme of large crystals from the goldfield is continued, with sphalerite being the featured species. As an important zinc sulphide mineral, sphalerite is relatively common in several Pb–Zn deposits in South Africa, while museum-quality, aesthetic crystals are somewhat rare, exceptions being those found at the Pering mine, and the somewhat bizarre siderite–sphalerite pseudomorphs from the Broken Hill mine at Aggeneys (a future Mineral Scene topic). From across the border in Namibia, some noteworthy sphalerite crystals have come from Rosh Pinah mine and tiny, gemmy crystals, in the micromineral size, from the Aris quarry south of Windhoek. So how then do the Witwatersrand goldfield specimens fit into this scene?

The post-depositional history of the Witwatersrand strata attests to various episodes of structural deformation, dyke intrusion, metamorphism, plus the influence of the Vredefort impact, all of which have resulted in a suite of secondary minerals (and gold) that crystallised long after sedimentary processes ceased (for example, Kershaw et al., 2003). The mineralogy of the Witwatersrand goldfield has been studied by many and summarised in part by Feather and Koen (1975,) and Mindat.org currently lists 141 species. Sphalerite is one of these, including what might be the largest sphalerite crystals known—certainly from southern Africa, but perhaps also globally.

Three notable specimens are shown here, two of which were collected over 50 years ago.

Bruce Cairncross

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A cluster of sphalerite crystals associated with pale yellow baryte. Randfontein Estates Gold mine, 5.1 cm (photo: Bruce Cairncross).

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A single pseudo-hexagonal 3.2 cm sphalerite crystal, from the Free State Geduld No. 1 Shaft, 45 West 2, 27th cross-cut fault. This specimen, together with the one below, were collected in 1962 (sample: Ex Allan Edkins collection; photo: Bruce Cairncross).

A cluster of sphalerite crystals, 7.6 cm. Free State Geduld No. 1 Shaft, 45 West 2, 27th cross-cut fault (sample: Ex Allan Edkins collection; photo: Bruce Cairncross).

* AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS AND UNIVERSITY OF THE WITWATERSRAND — 1994

obituary

Maarten Johan de Wit

9 April 1947 to 15 April 2020

Maarten in the geology museum at the NMU, 2018.

Maarten Johan de Wit was born in The Hague, the Netherlands, in 1947 and was the second of four brothers. He completed his primary and part of his secondary schooling in Bilthoven (Netherlands) before the family moved to Ireland, where he attended the Drogheda Grammar school from 1961 to 1965. He completed his BA (Hons) geology degree at Trinity College, Dublin University in 1969, and also obtained his MA from the same University in 1992.

He enrolled to do his PhD degree at Cambridge University in 1969 and completed this in 1972 (De Wit, 1972) under the supervision of John Dewey, focussed on a mapping project in north-west Newfoundland. In 1993, he was awarded an Honorary Doctorate of Science degree from Queens University, Kingston, Canada.

Maarten Johan de Wit †

The Gondwana Connection

From 1972 until 1976 he held postdoctoral fellowships at the Lamont Doherty Earth Observatory, Columbia University (USA), and the University of Santiago in Chile, where he experienced the first taste of Gondwana reconstruction while exploring the connection between South America and Antarctica. He published several papers on this work with people like Ian Dalziel and Charles (Chuck) Stern, but his paper entitled '*Evolution of the Scotia Arc: key to the reconstruction of southwest Gondwanaland*' (De Wit, 1977) encapsulates his passion for this ancient continent. One of his favourite reads was Moorehead's '*Darwin and the Beagle*', which together with his south Atlantic experience changed the trajectory of his geological thinking, particularly with regard to the shaping of Gondwana.

Things got untenable in Chile in the 1970s, so he left and joined the UNDP in Ethiopia from 1976 until 1978. Here he worked along with the Ethiopian Institute of Geological Survey and British Technical Cooperation, with the objective to strengthen the Survey and compile an inventory of the mineral resources of that country, which was published in book form (Senbeto and De Wit, 1981). It is here that his social conscience emerged more openly. While he recognised that the

A happy 'selfie' taken during fieldwork in Newfoundland around 1970 (photo: MJ de Wit).

scientific and technological gap between the rich and poor countries continued to widen, he was critical of *"the irresponsibility of the academic who fails to realise his/her potential as a helping hand to the struggling sciences in the developing world"*. Like Chile, Ethiopia became a difficult country to work in after the coup d'état in 1974 that resulted in yet another curfew situation, this time in Addis Ababa, and put a stop to his fieldwork. He left the UNDP in 1978.

The first time he came to South Africa was in 1977 on a visit to act as best man to his brother's wedding. During this time, he met with Louis Nicolaysen of the Bernard Price Institute of Geophysical Research (BPI) at the University of the Witwatersrand to explore research opportunities. He accepted a position as Senior Research Fellow at the BPI from 1978 until 1988. During this tenure, he was also a Queen's Quest Scholar at Queen's University in Kingston, Canada (1981–1982), Research Fellow at the Royal School of Mines in London (1983–1984), and Resident Research Scientist at the Lunar and Planetary Institute in Houston USA (1983–1984).

Shortly after arriving in Johannesburg, he participated in the *Reunite Gondwana* workshop held at the BPI in 1979. Taking into account the enormous advances in earth sciences, data from the relatively new discipline of marine geoscience and modelling of seafloor spreading at mid-ocean ridges, and other major scientific developments, Maarten undertook the enormously ambitious and challenging task of

Fieldwork in southern Chile in 1974 (photo: C Stern).

Charles 'Chuck' Stern and Maarten (in front) in Patagonia, January 1974 (photo: I Dalziel).

Maarten along the Beagle Channel, Tierra del Fuego, in March 1974 (photo: C Stern).

Field season in Ethiopia, 1977 (photo: BPT de Wit).

The completed 1988
Gondwana Map.
(Also see centrefold of
this issue.)

compiling a detailed geological map of Gondwana at a scale of 1:10,000,000, as principal author.

Around 1979/1980, computer graphics were in their infancy, and GIS almost unheard of. Continental coastlines and geological data were therefore hand drawn after rotations were performed and plotted using a modified Hypermap program. The positions of the continents were charted on an equal-area projection of Gondwana with Africa fixed in its present-day position. Subsequently, the cartography was photographically reduced for production at the published scale of 1:10,000,000. During the 1980s, digital cartography advanced at break-neck speed and computer-generated maps were suddenly capable of producing fine geological detail. Maarten appreciated that transitioning in mid-compilation to a digital platform was essential. Without the capacity to interrogate data in the computer environment, a static printed map would be just that—static and soon outdated.

The 'Geological map of sectors of Gondwana reconstructed to their disposition ~150 Ma' (see centrefold - pgs 34 & 35) was published in 1988 by the American Association of Petroleum Geologists and the University of the Witwatersrand and was an

extraordinary testament to his vision and determination. This pioneering work and map, compiled with the able assistance of Margie Jeffrey, Hugh Berg and Louis Nicolaysen, became the foundation for a suite of GIS-based research projects still progressing today at institutions around the world, including the Gondwana Lab in Rio de Janeiro, Brazil.

Margie Jeffrey recalls Maarten saying, *"In summary, the break-up of Gondwana was a major event in the history of the planet, with profound consequences for its inhabitants and their future. Establishing the detailed kinematics and dynamics of the dispersal of Gondwana will provide the framework into which the dynamics of many past biogenic, geologic, geochemical and geophysical processes must be fitted. This would be an important step towards understanding the workings of planet Earth as a total system."*

Revisiting Greenstone Belts

In the early 1970s, when President Nixon slashed NASA's budget, effectively putting an end to the Apollo program, the Agency redirected some of its effort and expertise back towards Earth studies. In the early 1980s, the Lunar and Planetary Institute (LPI), where Lew Ashwal worked, started the Early Crustal

Genesis Project, aimed at understanding what the Earth's oldest rocks could tell us, relative to what we had already learned about the Moon's ancient history. In mid-1985, LPI Director Kevin Burke invited Maarten to spend six months in Houston, to work with Lew in organising a workshop on greenstone belts. Maarten stayed with Lew during this period, and they became good buddies. Lew recalls how Maarten had to endure the early days of Lew's band, The Bags, whose main distinguishing feature was volume.

What Lew learned first-hand about Maarten was his extraordinary and iconoclastic abilities in inducing variably sized groups of scientists to focus productively on addressing important scientific questions. For the greenstone belt workshop, it was decided to focus on tectonics, and one of its outcomes was the clarity it provided on a major polarity in viewpoint as to whether or not the very early Earth operated under the paradigm of plate tectonics.

The workshop, which took place in 1986, was attended by 86 invited delegates from all over the world, chosen mainly by Maarten. It included many students, as one of Maarten's most significant contributions to earth sciences was attracting and encouraging numerous students to pursue geology and related disciplines. The proceedings of the workshop were videotaped and captured, among other things, Kevin Burke standing up during one of the talks and banging his head against the wall. The results of the greenstone belt workshop were published as a comprehensive 809-page monograph in 1997 with contributions from more than 100 authors, entitled *Greenstone Belts*, and this still stands as the one of the definitive works on the subject.

Maarten was also responsible for Lew Ashwal and Sue Webb coming to South Africa in 1990. Lew took a position at the Rand Afrikaans University (RAU) as it was then known, and Sue at Gold Fields. Lew started working on anorthosites in Madagascar and convinced Maarten to join him in the field, and this developed into a decade-long research project on the island, also involving the training of several Malagasy students.

Maarten's structural and tectonic work in the Barberton greenstone belt, which started in the late 1970s and induced intense objections from the established geoscience communities, turned out to be prescient and paradigm shifting. When Richard Armstrong, who had moved from the BPI to the Australian National University, produced the first dates of Maarten's critical rocks from Barberton, it confirmed his field observations and provided a whole new view on the stratigraphy and tectonic history of the classic Barberton Belt. Although his interpretations are still contentious for some, he paved the way for a new generation of scholars to interrogate the earliest terrestrial rock record in terms of the ways in which the ancient world resembled the present-day Earth, and the ways in which it also differed. Lew's view of Maarten was *"that he was one of the most gifted field geologists I ever encountered, as he would almost always see things in outcrops that most others did not, and which then became obviously apparent, leading us to say, 'Why didn't I see that?'"*. Steve McCourt recalls several occasions when Maarten would interrupt a discussion in the field with *"but you don't know that"* or *"you need to keep it honest"*, as he believed in robust science and also felt strongly that research should focus on new ideas rather than reinforcing existing opinions.

His work in Barberton produced many publications, such as his benchmark paper in *Nature* entitled *'Formation of an Archaean continent'* (De Wit et al., 1992), and resulted among others in a new Paleoproterozoic bedrock map of the Makhonjwa (Barberton) Mountains published in 2018. His Barberton work also assisted in raising the profile of the area such that it was inscribed as a [UNESCO World Heritage Site](#), on 2 July 2018.

In 1985, he published his first book, *'Minerals and Mining in Antarctica; Science and Technology, Economics and Politics'*, which explores the viability of extracting certain precious and strategic minerals, such as platinum, for more than just economic criteria, and includes environmental and political reasons. He suggested, for instance, that the extraction of platinum could challenge the monopoly of South Africa's hold on the metal and hence weaken the then apartheid

regime. Consistent with his liberal views, he published 'Boycott of South African Science' with Johan Kruger, Rodger Hart, Marian Tredoux and Nick Lindsay (in Nature) where they, also highly critical of the regime, called for training of black scientists to be a key priority for the future of South Africa (De Wit et al., 1987). Dave Reid, one of his colleagues from UCT, reminded me of the following passage from this paper "In essence, ... if one sincerely opposes the system, there are only two moral options open to whites in South Africa: imprisonment or emigration. Willingly to choose imprisonment requires a degree of courage we do not profess to have, but, on the other hand, emigration can be (and often is) construed as a purely self-interested act by black and white alike ..."

African Cratons and Corridors

In 1989, Maarten moved to the University of Cape Town (UCT) where he held the Philipson-Stow Chair of Geology and Mineralogy for 22 years, and was Head of Department from 1989 to 1992. During his time at UCT he was awarded the Crosby Visiting Professor at the Massachusetts Institute of Technology (MIT) in the USA (1992–1993); was a visiting Research Scientist at the International Institute for Geo-Information Science and Earth Observation (ITC) in Delft, Netherlands (2006–2007); was a Research Professor at Geoforschungs Zentrum Potsdam (2006–2007), where he was awarded the GFZ-Potsdam Professorial Fellowship of Germany; and a visiting Professor at the Institute Physique du Globe (IPGP) in Paris (2009).

While at MIT, he was very interactive with Tim Grove, Sam Bowring, Kip Hodges and John Grotzinger, and convinced Tim to come to South Africa for a sabbatical to work on komatiites in Barberton. During that time, and together with Sam Bowring and Tom Jordan of MIT, and Rick Carlson and David James at the Carnegie Institution of Science (DTM), they collectively initiated the far-reaching Kaapvaal Craton Project, a multidisciplinary study of the processes that led to the formation of this Craton. This 1995 initiative saw the integration of extensive geology, petrology, geochemistry and geophysical studies for the Kaapvaal Craton, and involved at least 55 investigators from both academia and industry, from the US and southern Africa. A massive seismic deployment

comprising 85 transportable seismometers to map the geophysics of the craton was undertaken, the results of which were combined with petrological studies of komatiites, crustal rocks and kimberlite-derived mantle xenoliths. Maarten was the catalyst and facilitator in making this project happen. Funding was secured for this project from the US science funding agencies and mining companies in southern Africa. The project was hugely successful, with many scientists and students from southern Africa benefiting from their involvement.

He was founder and director of the Centre for Interactive Graphical Computing of Earth Systems (CIGGES) at UCT, which ran between 1992 and 2004. This was probably the first university-based GIS system in Africa, and Christien Thiart managed the Gondwana database (GO-GEOID). Strong links were built during this time with the French BRGM. Maarten also used this unit to teach his honours students the power of GIS, which he believed to be the future for any geologist. Many PhD students passed through this system, such as Joy Ghosh, Nadine Good, Daud Jamal, Justine Tinker, Jacek Stankiewicz, John Decker, and Tshifhiwa Mabidi, to name a few.

The Africa Alive corridors—autobiography of the continent told along 20 corridors.

From the time that Maarten organised the 10th 'International Gondwana Conference' in Cape Town in 1998, he had worked closely with John Anderson (National Botanical Institute, Pretoria) on an evolving intertwining triptych of projects titled 'Gondwana Alive', 'Earth Alive', and 'Africa Alive'. All, at heart, focus on the deep mutual concern that they both shared about the Sixth Global Extinction event, which in their words "we humans have set alight". Their first booklet, 'Towards Gondwana Alive', completed along with a number of other colleagues, was published the following year. This included a warm endorsement from Nelson Mandela, SA's President at the time, including the words, for "the children of today's world and the children of tomorrow's world".

From this interest and work arose their 'Gondwana Alive Corridors' (GAC) research work, which was initially presented concurrently by Maarten at the 11th International Gondwana Conference in New Zealand, and by John Anderson at the World Summit on Sustainable Development in Johannesburg, in 2002. Two books are now in progress as a follow-up to the GAC program: the 'Africa Alive Corridors', with a network of 20 Heritage Corridors across the continent; and the 'Homo Sapiens Corridor', an especially poignant set of corridors running along the southern Cape coast. Their 'Earth Alive; 101 strategies towards stemming the Sixth Extinction & global warming' initiative was launched at the 'International Year of Planet Earth' (IYPE) Congress in Tanzania, in 2008.

John has committed to completing the books they both began, and will forge ahead with their GA/EA/AA projects striving towards a new tomorrow, and a world in which all 7.7 billion of "us humans team proudly together as Earth stewards, recognising that we share this most exquisite of planets with tens of millions of other species"!

Professors Anusuya Chinsamy-Tyran and Christien Thiart fondly remember the many hearty discussions about 'African Origins' and Maarten's passionate ideas at the time to establish a centre for Earth Stewardship and Earth Systems Science, which materialised in the form of the Africa Earth Observatory Network

Collecting rock samples for geochronology in the Central African Republic, 2006 (photo: H Jelsma).

(AEON) in 2005, of which he was the founder. This was the realisation of his dream of bringing together researchers from different academic fields in the spirit of Earth Stewardship Science. AEON supported two collaborative bilateral Earth System Programs with Germany and France, Inkabaye Africa and !Khure Africa, which were active for 10 and 5 years, respectively. These were multidisciplinary and intercultural initiatives dove-tailing next-generation science and technology, with strong training and capacity-building components. Building on the experience of these two earth systems science programmes, a new initiative, IPHAKADE, was started with a focus on new integrated developments and consilient knowledge among earth and life sciences, engineering, resource economics and human sciences.

Nelson Mandela University Earth Stewardship Chair

In 2011, Maarten took up the Earth Stewardship Science Chair at the Nelson Mandela University (NMU) in Port Elizabeth. In addition to his ongoing research on the Cape Fold Belt, the Kango Group, the Karoo Supergroup and the question of shale gas, and AEON activities, he became the science director for the Earth Stewardship Science Research Institute (ESSRI) at NMU

Enjoying the locals
at a village south of
Bangassou, CAR, 2006
(photo: H Jelsma).

in 2013, and a Visiting Professor at the University of Southampton (UK).

Aside from his far-reaching interests and work in classic geological and earth science processes (including geodynamics, tectonics, early mantle processes and craton formation, Gondwana reconstruction, stratigraphy, etc.) he was equally concerned about the related social shortcomings (educational, agriculture, cultural), especially in the African context, and for some years had been working to define this transdisciplinary field of research as a new discipline, called 'Earth stewardship science'. In this respect, he had noted that *"As a planet, we are not on the right path"* and *"The question is how we get back on the right path. My vision is to get young people involved in this and drive*

it forward". The concept of Earth stewardship science originated in De Wit's AEON with links at universities across the country.

This institute was set up by 18 scientists from a range of disciplines, from social sciences to hard physics, with the aim of researching and solving the planet's future and emerging problems. This, according to Maarten, could only be done via a multi-disciplinary team approach, and he further asked the question *"How do we transform this into a sustainable society?"*.

Maarten regarded the Eastern Cape as a unique "laboratory" for Earth Stewardship Science; an area that had a range of problems to solve—scientific ones, including those affecting the coastline and wetlands, as

Celebrating his 66th
birthday at the CAG24
conference in Addis
Ababa in 2013 with
Colin and some of
his students. From
left to right: Maarten,
Colin Reeves, Taufeeq
Dhansay, Thakane
Ntholi, Naledi Chere
and Bastien Linol (photo:
MCJ de Wit).

well as social issues such as poverty, education, and rural development. He saw Nelson Mandela Bay as part of a microcosm of what was going on in the rest of the world. *"This can be an example of how it can be done elsewhere"* he would argue and was excited that it was already being tackled by, among others, the life sciences and engineering faculties at NMU.

As an example of his vision for this multidisciplinary approach to address local, African, and international challenges and legacies, Maarten worked closely with NMU's Professor Raymond Auerbach on agro-ecological programs resulting in new research activities for students such as organic food systems. Together with his NMU colleagues, he was actively refining and progressing the transdisciplinary field of research of Earth Stewardship, and in the process highlighting that solutions for the planet's future and its problems lay in the hands of young people. His thesis was that the younger generation, with an integrated approach and multidisciplinary team effort, had a fighting chance of providing solutions to challenges that prior traditional approaches had failed to address.

Publications, Awards, and Sporting Achievements

Maarten published his very first paper in 1970 (in *Nature*), on work the he did in Newfoundland for his PhD (De Wit, 1972). This was the first of what became a long list of publications of well over 250 papers in international refereed scientific journals. He wrote one book and edited five.

He was an Honorary Fellow of the Geological Society of London and the Geological Society of America; he received the Jubilee Medal from the Geological Society of South Africa for the best paper in 2003, 2004 and 2008, an Honours award in 2006, and was a Fellow of the Society; he received the South Africa Medal (Gold) from the Southern Africa Association for the Advancement of Science in 2013, awarded to recognise exceptional contributions to the advancement of science; sat on various scientific committees and editorial boards of scientific journals; supervised some 92 MSc and PhD theses; and organised numerous conferences, workshops, and technical courses. He was notably also a National Research Foundation A1

Maarten being honoured for his significant contribution to South Africa's geology by the CEO and the executive manager of corporate services of the Council for Geoscience (CGS), Mosa Mabuza (right) and Dr Jonty Tshipa, respectively, at the 2019 CGS conference (photo: CGS).

Maarten was also recognised for the inspiration he has been to students and those he led to postgraduate degrees at the 2019 CGS conference. From left to right: Thakane Ntholi, Maarten, Thomas Muedi, David Ngobeni and Refilwe Shelembe. Thakane and Thomas are ex-students of Maarten (photo: CGS).

rated scientist.

On the sporting front, he came second in the annual Belfast to Dublin walk (104 miles) in 1967 in 29 hours and 13 minutes. He received full colours for field hockey at Trinity College Dublin, and his Blue and Half-Blue for field hockey and ice-hockey, respectively, from Cambridge University, and was a member of the Hawks club at that University. He completed the Argus cycling race with his son Tjaart in 2000, and was an active ocean swimmer, taking his daily swim at King's Beach in Port Elizabeth up to recently.

His Legacy

Maarten was a unique multi-faceted person. His great strength was his ability to unravel, conceptualise, and integrate continental-scale geology with local detail, and then draw together leading scientists and experts

from diverse but related disciplines, postgraduates, and undergraduate students to undertake mapping, structural, geophysical, geochemical, isotope and geochronology work, reinterpret old theories, challenge the status quo, and collectively publish new models and ideas. These versatile skills likewise lead to him being able to transcend established scientific disciplines and create successful multidisciplinary structures in the form of AEON and ESSRI.

He was an outstanding field geologist, passionate about every aspect of his work and research, immensely supportive of his students, robust in his questioning and debate, gracious and generous but sometimes stubborn and cantankerous, called a spade a spade, did not suffer fools gladly, and was typically colourful in his use of language. His approach sometimes ruffled feathers among the 'establishment' and may have lost him a few followers along the way. However, his awards, publication list, and the unqualified respect and support demonstrated by his peers, politicians, students, and people from every walk of life that interacted with him, are testament to his remarkable scientific endeavour and achievements, leadership, and immense moral authority.

Wherever in the world he worked, Maarten always insisted on involving local scientists in research activities, so as to avoid the "colonialist" behaviour that is so commonly perpetrated by others in our field. Steve McCourt remembers Maarten for his advocacy of building capacity by creating opportunities for African students to undertake post-graduate studies and Lew Ashwal will tell you that more than anyone he knew, Maarten displayed a genuine commitment to the development of Africa, Africans, and African science. He had a profoundly positive effect on countless students and young scientists across the African continent, and everywhere else, and with his passing South Africa and the world has lost a scientific giant comparable in stature to Alex Du Toit.

Maarten is survived by his partner Lynne Ferguson, daughter Thandi (married to Matt Scriba) and

granddaughter Emma, and his son Tjaart (married to Amy Harington), all of whom shared his passion and love for his work, and he equally was committed to his family and their activities and careers.

RIP Maarten.

By **Mike de Wit**, with contributions from **Lew Ashwal, Tim Grove, Christien Thiar, Margaret Jeffrey, Anusuya Chinsamy-Tyran, Dave Reid, John Anderson, John Bristow, Raymond Auerbach, Richard Armstrong, Steve McCourt** and others.

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obituary

Willem Johannes van Biljon

16 February 1929 to 1 August 2019

The Afrikaans poet Jan F. Cilliers wrote a beautiful poem celebrating the Boer General Christiaan de Wet, the first few lines of which may equally apply to the late Professor Willem van Biljon.

*Stil, broers,
daar gaan 'n man verby,
hy groet,
en dis verlaas.
Daar's nog maar één soos hy;
bekyk hom goed.*

Freely translated:

*Silence brothers,
A man passes
He greets, for the last time
There is but one of his kind,
Observe him well.*

And so Willem van Biljon greeted us for the last time on 1 August 2019 after losing a battle with a malignant melanoma at the age of just over 90 years after a fruitful and most productive life.

I met Prof. Willem in 1968 when I enrolled as one of the first students at the newly established Rand Afrikaans University in Braamfontein, Johannesburg where he was appointed as the first Head of the Department of Geology, with his colleague Dr Wilhelm Verwoerd as senior lecturer. Thus started my career and life-long love of geology.

Over the next 51 years our paths were to cross frequently on various occasions and at various locations, to leave an indelible mark on my own life as he did in the lives of all he came across.

The italics in the resume below was taken from 'A Century of Geological Endeavour in Southern Africa 1895-1995', published by the Geological Society of

Willem Johannes van Biljon †

Prof. Willem van Biljon
(photo: Stephanus van Biljon)

South Africa and edited by Prof. Carl Anhaeusser, and interspersed with my own comments:

Willem Johannes VAN BILJON (1929–present) was born in Pretoria as the eldest son of the well-known geologist, Dr S van Biljon. He received his early schooling in Pretoria and matriculated at the Hoër Volksskool, Heidelberg, in 1945 with distinctions in science and mathematics. In 1946, he enrolled at the University of Pretoria, where he obtained a BSc degree with majors in petrology–mineralogy, paleontology–stratigraphy and physics in 1948. In 1950, he completed his Master's degree at the same university under the leadership of Professor B.V. Lombard and Dr H.J. Nel. His thesis dealt with the Bushveld Complex and its floor rocks at Steelpoort, Eastern Transvaal.

From 1952 to 1962 he was a member of staff at the University of the Witwatersrand, first as lecturer and

later as senior lecturer. During this period he was responsible for teaching mineralogy, petrology and crystal chemistry. He was an enthusiastic teacher who contributed substantially to equipping the department with X-ray diffraction and other modern facilities. He encouraged innovative thinking and urged students not to take anything for granted. Prof. van Biljon also believed in the practical application of geology and he organised many field camps and excursions to mines. From 1954 to 1964 he acted as a consultant to Cape Asbestos for whom he reported on asbestos occurrences in South Africa and on many other mineral deposits ranging from gold, diamonds, chromite, iron and copper to coal, andalusite, crocidolite, clay and salt.

He married Sophie Coetzee in 1953 and they had four children, Stephanus (Fanie), Willem, Erli and Lynette.

In 1963 Willem was appointed to the chair of geology and Head of the Department at the University of the Orange Free State, a post that he held for four and a half years. During this relatively short period he successfully campaigned for a new building for the Geology Department and laid the foundation for the department to become one of the largest post-graduate schools of geology in the country. In 1967 he was offered the chair of geology and the post of Head of the Department at the newly established Rand Afrikaans University in

Johannesburg. This was a great challenge and the new department was soon established specializing in applied mineralogy, metamorphic petrology, structural geology and sedimentology. With the aid of excellent staff it became one of the country's leading geology departments.

In 1967 he was awarded a travel grant by the Carnegie Corporation of New York to visit American Universities and in 1968 received a grant from the University of Strasbourg to carry out research on clay minerals in the Karoo Supergroup under the guidance of Professors Millot and Lucas. From 1968 to 1982 he acted as a part-time consultant on amphibole asbestos, first to Cape Asbestos Ltd and later to Rand Mines Ltd.

Prof. Van Biljon served on the Council of the Geological Society from 1960 to 1974 and from 1976 to 1981. He acted as honorary editor of the *Transactions* for 1961 and 1962 and for the *Quarterly News Bulletin* from 1968 to 1972. He was elected President of the Geological Society of South Africa in 1972 and President of the Associated Scientific and Technical Societies in 1982. In his presidential address to the Geological Society, with the title "Goud is nie waar dit gevind word nie!" (Gold is not where you find it!), he proposed that plate-tectonic processes played an important role in the formation of sedimentary basins, igneous complexes and ore deposits throughout geological time. In 1983, he received the Honours Award from the Geological Society of South Africa and in 1984, the Havenga Prize for Geology from the South African Academy of Science and Arts. Prof. Van Biljon acted as leader of the South African delegations to the International Geological Congresses in 1980 and 1988.

Apart from the above, he held several positions as consultant to various mining companies between 1954 and 1982, as well as a member of the advisory boards of various universities, statutory bodies and private enterprises.

Prof. van Biljon was awarded Honorary Membership of the Geological Society of South Africa in 1995 and won the prestigious Draper Memorial Award of the Geological Society in 2008.

Prof. Willem with colleagues at the Rand Afrikaans University in 1971. From left to right (back row): Prof. Nic Beukes, Prof. Willem van Biljon, Prof. Wilhelm Verwoerd; in front: Mr Koot Bensch.

Lecturers and final year students at Rand Afrikaans University, 1971. From left to right: Prof. Wilhelm Verwoerd, Manie Brynard, Prof. Dirk van Reenen, Piet Coetzee, Stephen Kloppers, Prof. Nic Beukes, Prof. van Biljon and Johan Wentzel.

In 1984 Prof. Van Biljon left the academic sphere to become Counsellor, Science and Technology at the South African Embassy in Bonn, West Germany—a post that he held for six years.

My wife and I had the opportunity to visit him and Aunt Sophie twice during his tenure in Bonn, during which we were treated to a road trip along the Rhine to enjoy the beautiful German countryside and savour German cuisine.

On his return to South Africa in 1990, he was offered the position of Director of Research at the University of Pretoria, a position he held until his official retirement in 1995. However, his restless nature would not allow him to remain inactive very long, as he took up the post of visiting professor and later acting Head of the Department of Geology at the University of Venda in Thohoyandou from 1996 until 1999.

In his lifetime, Prof. Willem experienced a great deal of sorrow. In 1973 I happened to meet him on the road to Cape Vidal in Kwa-Zulu Natal where his old Wolseley had broken down. Providence led us to the nearby camp where we traced a motor technician who

was able to sort out the Wolseley in no time. A few days after that encounter I received a call from Prof. van Biljon with the news that his thirteen-year-old son, Willem had died suddenly.

Some years later in 2005, he lost his beloved daughter Erli at the tender age of 43.

In April 2013, after a long period of illness during which Prof. Willem lovingly cared for her, he lost his beloved wife Sophie.

I have fond memories of geological excursions, where I probably learnt most of my knowledge of South African stratigraphy and rock identification. Prof. Willem's enthusiasm boiled over to his students, but we often battled to keep up with him while ascending a steep hill.

He was an extremely social person with a genuine interest in people regardless of their status. He regarded mine manager and shift boss on an equal footing. He used to carry with him a small notebook dedicated to each excursion where he jotted down the name of every person that he considered important and that he would likely meet again in future. He consulted his

Amongst friends and colleagues for the last time. In the photo are from left to right:

Mr. Fanie Kruger,
Prof. Carl Anhaeuser,
Prof. Dirk van Reenen,
Prof. Nic Beukes,
Dr. Manie Brynard,
Prof. Willem,
Dr. Johan Wentzel,
Prof. Morris Viljoen and
Mr. Charles Fourie.

Right:
Prof. Willem van Biljon
on the occasion of his
90th birthday celebration.

notebook prior to each excursion to familiarise himself with the names of people that he was likely to meet on the trip.

Prof. Willem's interest in geology never ceased after his retirement. His father, Dr. S van Biljon, was known for his controversial ideas on the origin of the Bushveld Complex as the result of the metamorphic transformation of the Transvaal Group sediments. However, in his later years Prof. Willem considered these ideas as being not too far-fetched and much of his personal research was centred on this topic.

In February 2019, Prof. Willem celebrated his 90th birthday, where some of his former colleagues and students were present. At this time his battle with cancer had already reached an advanced stage.

On 1 August, his battle ended. Prof. Willem will be surely be missed by friends and family alike, and all whose lives were touched by his amiable character and his love for his Creator.

By **Manie Brynard** with contributions from **Prof. Nic Beukes**, **Prof. Dirk van Reenen** and **Stephanus van Biljon**

obituary

Gerry Levine

23 July 1934 to 10 March 2020

Sadly, Gerry Levine—a good friend to many, an exuberant and entertaining character and a walking encyclopaedia on the South African geological fraternity, past and present—passed away on 10 March 2020. We extend our sincere condolences to Toni, his loving and always supportive wife and companion for over 40 years.

Gerry's diminutive stature belied a person with strong views and opinions. With his irrepressible disposition, he was passionate on matters related to geological

Gerry Levine †

history and personalities. He also had a deep interest in land survey and in property and deeds issues, particularly relating to prospecting and mining. Of special interest were books, maps, documents and newspaper articles of a geological nature, which he strived to preserve for future generations. He had built up a sizeable collection of geological memorabilia, as well as documents on aspects of survey. For many years he was archivist for the Geological Society and contributed interesting articles to *Geobulletin* under the pseudonym 'Willebees', a name by which Gerry

was affectionately known to his friends and of which he was proud. Sadly, his collection, including two treasured geological picks, seem to have 'disappeared' during Toni and Gerry's move a few years ago to the Sandringham Gardens Jewish Retirement Centre. His legacy, however, lives on through the numerous articles and biographical sketches he contributed to *Geobulletin* over the years, including accounts of some of South Africa's geological greats, such as Alex du Toit, A.L. Hall and, most recently, Percy Wagner. He also had an interest in Gold Fields' consulting geologist Leopold Reinecke, who came from Ceres and whose life story Gerry had documented. Reinecke was the Witwatersrand geologist who, together with geophysicist Rudolph Krahman and mining engineer Guy Carlton-Jones, discovered the West Wits or Carletonville Goldfield.

Gerry was born in Ceres of Jewish parents who, as Ashkenazi Jews from Eastern Europe, came to South Africa in the early nineteen thirties. His father owned the Ceres Hotel and Gerry attended the De Villiers Graaff High School in Villiersdorp. He had no siblings and there are no other known members of his family.

He commenced his geological studies at UCT, but moved to Wits in his 2nd year, where he enrolled for the Mining Geology course and, being the character he was, became well known and well liked on the Wits campus. He lived close by in Braamfontein, across Jan Smuts Avenue and the then main entrance to the campus, in an apartment above the well-known and frequented "Pops" Café. Here he made life-long friends with geologists such as Pat Ryan, who affectionately called him "Aki" (Akkedis). Gerry accompanied Morris Viljoen to Pat's memorial service in the Waterberg in 2012. Gerry was also friendly with several of the Wits Geology staff and mentors such as John McIver, John Ferguson and Willem van Biljon. He had a particularly good relationship with Prof. Edgar Mendelsohn, with whom he shared his passion for geological history and heritage, and had many long discussions.

Gerry often reminisced about his university experiences, in particular about a memorable Geology and

Mining Engineering student tour to South West Africa (Namibia) in 1962. Carl Anhaeusser, Richard and Morris Viljoen and Faan Steyn, among others, were also on this unforgettable five-week excursion by train from Park Station, Johannesburg, to as far north as the Tsumeb Mine in SWA. The group was accommodated on the train for much of the journey and hosted by many of the mines and towns, playing rugby against a number of the local teams. Gerry was at the forefront of the activities and kept everyone well entertained with his antics, humorous storytelling and reciting of the full unabridged version of 'Eskimo Nel'.

An example of one of the stories, jokes, etc. that Gerry would recount on many occasions, and which many might recall, goes as follows:

Two gents are discussing their favourite English writers/poets. Just then, a bandy-legged old codger comes walking along the road. 'So how would Wordsworth have described the scene?' one asked. 'He would probably have described it as follows,' said the other:

*Over the hill and down the road,
There comes a man with legs abowed.*

'And how would Shakespeare have described it?'

*Forsooth, what manner of man is this,
Who walks with his balls in parenthesis?*

Another favourite was:

*To crib from one person is plagiarism
To crib from many is research*

Being fully bilingual, Gerry often expressed himself in Afrikaans, and another saying when he saw a pretty girl was:

Sy het lekker lippe vir vlakwater suip.

In the early 1960s, during a Wits Geology honours tour to the Western Cape, we visited a new road-cutting to view exposures of trilobite fossils some 10 kilometres outside of Ceres and, on Gerry's recommendation, a stop was made at his father's hotel in the town where we were privileged to see Gerry's excellent trilobite collection, which was displayed on the pelmet around the bar.

After graduating, Gerry was employed by Selection Trust, carrying out prospecting activities in Central and Southern Africa. He then spent a few years working in Australia, obtaining an Australian passport, but returned to South Africa to be with his ailing parents in Ceres. Following the passing of his parents, religious family memorabilia belonging to Gerry's father, Joseph Levine, were left to the Ceres Museum, where they are on display. In 1978 Gerry married Toni Meyer, who always supported him in all his activities and was a perfect companion until his passing.

During the mid-1970s, Gerry worked for Whites Cement, where his passion for geology put him, from time to time, in conflict with his superior. After the latter had retired, he had a somewhat 'love-hate' relationship with the new Managing Director of the company, who also had a geological background. Gerry firmly believed that the role and status of geologists was not fully recognised, valued and utilised. For many years after he left the Cement Company, Gerry was active in providing specialised deeds searches and associated advice in a consultative capacity.

With his interest in survey and survey history, Gerry loved scrutinising and commenting on historical maps. He enjoyed pointing out that the border of the then South West Africa had two different positions a small distance apart—one surveyed by the British from the east and measured in feet, and the other border determined by the Germans from the west, surveyed in metres. Metal survey plaques marked the unfenced border line between South Africa and Namibia. They were inscribed with "South Africa" on one side and "South West Africa" on the other. Gerry had obtained one of these metal beacons on a visit to this isolated area and it became one of his prized possessions. Sadly, this also went missing in the last move of Gerry and Toni. Whenever Gerry encountered an old map, he could not resist the temptation of constructing a metric scale bar next to the existing one, which was frequently in Imperial measures, Cape Roods, or a similar exotic system.

For many years Gerry was an active member, and later a Fellow, of the GSSA, serving on the Geoheritage committee and acting as the Society's archivist. Later in his life he requested the GSSA to cease sending him his copy of the journals, as he felt that much of the modern and latest research had become too mathematical and statistical for him to keep abreast of and to comprehend. However, he remained until the end always interested in things geological and 'geohistorical'. Gerry was until recently a regular member and often organiser of the GSSA "old boys" lunch club, which met in the pub at the Wanderers Club. He always had amusing anecdotes to relate on these occasions. He had definite views on the new Minerals Act when it was initially being drafted. Gerry seemed to strongly favour a more gradual and phased approach and felt that practitioners who had to implement the Act should be fully trained, qualified and experienced in all the aspects of the job that they would have to manage before taking over their appointed leadership portfolios.

Towards the end of last year, Gerry underwent a hip operation from which he never really recovered and went into frail care, his state of health deteriorating rapidly until his passing at the Sandringham Gardens Retirement Centre. Once again, from the whole geological community, we express our sincerest condolences to Toni for the sad loss of Gerry.

Having grown up in the Winelands of the Cape, Gerry professed to be something of a connoisseur of wines, particularly as he would put it, those of the red hue. A toast to Gerry's life with a "glassie rooi wyn" would be in order.

We will all miss his exuberant presence. Rest well, our friend.

Frank Schie, Morris Viljoen and Richard Viljoen

With contributions by **Toni Levine, Carl Anhaeusser and Peter Ringdahl**

12TH INTERNATIONAL
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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!

*The Nyiragongo
Volcano,
DRC*

THE GEOTRAVELLER

By Roger N Scoon¹

The Nyiragongo Volcano, Democratic Republic of Congo: *Active Summit Crater with a Semi-permanent Lava Lake*

The active summit crater of the Nyiragongo Volcano contains a lava lake (left) and an active spatter cone (right). Lava fountains associated with the spatter cone attain a height of approximately 50 m.

Nyiragongo in the Democratic Republic of Congo (DRC) is one of Africa's most active volcanoes. The steep-sided volcanic cone rises to a height of 3,470 m, approximately 20 km NNE of the regional city of Goma. Nyiragongo is one of eight large volcanoes in the Virunga volcanic province in the Albertine Rift, the western branch of the East African Rift System. Nyiragongo is capped by a vertical-walled summit crater (diameter of 1.2 km), which contains a semi-permanent, and relatively large, lava lake. Two catastrophic eruptions have occurred in recent years. In 1977, the lava lake drained entirely, and in 2002, streams of lava emitted from fissures on the southern flanks of the cone entered Goma and partially destroyed the airport. The lava reached as far as Lake Kivu, one of the large freshwater finger-lakes in the Albertine Rift. Nyiragongo and the adjacent Nyamulagira Volcano

(3,056 m) are unusually hazardous, as eruptions include anomalously fast-flowing lava flows with large volumes of toxic gas. The two volcanoes may account for almost half of the eruptions in Africa.

The Nyiragongo Volcano has been more-or-less continuously active since the earliest reports were submitted in 1882. The lava lake—the most fascinating component of the volcano—was probably present in the summit crater throughout the period leading up to the 1977 eruption. The altitude and depth of the lake show considerable variation. The lava lake occurred at a relatively high elevation (3,250 m) prior to the 1977 event. The eruption caused the lava to drain in less than an hour. The lava lake has mostly likely experienced numerous overflows, although the historical activity

is poorly known. The lava lake re-formed in 1982/3. Between 1982/3 and 2002, the lava lake was partially obscured from the crater rim by several terraces; the crater was considerably deeper than currently observed. The 2002 eruption did not drain the lava lake, but the crater was lowered by approximately 250 m. Since 2002, the summit crater has remained intact. The crater is currently 250–400 m deep.

The Virunga volcanic province is the principal manifestation of volcanism in the Albertine Rift (Woolley, 2001). The crater fields in the vicinity of Lake Edward (Uganda) are distinctly subordinate. The rift propagated from north to south; spreading rates decrease from 6.5 mm/yr in the north of the rift to 1.5 mm/yr in the south of the rift (Chorowicz, 2005; Ebinger, 2005; Stamps et al., 2008). The spreading rate in the vicinity of Lake Kivu is estimated at 2.8 cm/yr. The rift valley in this part of eastern DRC occurs at a considerably higher elevation than farther north. Lake Kivu occurs at an elevation of 1,460 m, whereas Lake Edward, on the border with the DRC and Uganda, is situated at an elevation of 912 m.

The Albertine Rift in the vicinity of Lake Kivu trends approximately NNE. The rift is a half-graben (characteristic of the Albertine Rift), with a normal fault located on the western side. There is no evidence of a fault on the Rwandan side. The Virunga Mountains are

View of Goma airport, partly covered by the 2002 lava flow, looking south over the city, which is situated next to Lake Kivu (source: Guido Potters: <http://www.gnu.org/copyleft/fdl.html>).

unusual in that they are aligned E–W, i.e., at right angles to the rift. The easternmost chain of peaks is located on the regional plateau, and only the active volcanoes of Nyiragongo and Nyamulagira occur within the rift. The eastern peaks are interpreted as dormant; there are few

The rim of the near vertical-walled summit crater is capped by lava from the major eruption of 1977.

(a) The lava lake (left) and active vent (right) in the summit crater of the Nyiragongo Volcano are a spectacular sight in the twilight.

(b) A night-time view of the lava lake shows the occurrence of cracks and segments with magma flares.

A

B

Location of Nyiragongo in the Albertine Rift (source: Wauthier et al., 2012).

reliable age dates but most of the volcanism is younger than 100,000 BP (review of Woolley, 2001). Mounts Muhabura (4,127 m) and Mgahinga (3,474 m) occur on the border of Rwanda and Uganda. Mount Sabinyo (3,634 m) defines the position where the three countries meet. Mounts Visoke (3,711 m) and Karisimbi (4,507 m) are on the border of Rwanda and the DRC. The deeply eroded peak of Mikenno (4,437 m), which is situated entirely within the DRC, is extinct (the main activity occurred at 2.5–0.8 Ma) and may be unrelated to the Virunga volcanic province.

The Virunga volcanic province is related to a localised hot spot, rather than the rift-related lineaments (e.g., Sahama, 1973; Tazieff, 1977). The hot spot is currently located beneath Nyiragongo and Nyamulagira. Nyiragongo is a stratovolcano characterised by a steep-sided cone. This feature is in part an indication of the fluid nature of the lava and in part the youthfulness (there has been minimal erosion). Nyamulagira is a gentle-sided shield volcano, which erupts on average every 2–4 years. There may have been as many as 40 eruptions since 1885. The most recent eruptions occurred on 2 January 2010 (when lava flows covered extensive areas to the north and south of the volcano) and on 5 November 2011 (which produced a 400 m-high column of lava). In 2014, a new lava lake

Part of a tourist map of the Virunga Mountains showing the volcanic peaks.

formed in the crater (the previous lake had drained in 1984), the formation of which caused considerable air pollution in the region. By 2018, the Nyamulagira lava lake had cooled and developed a surface crust.

The Nyiragongo and Nyamulagira volcanoes are contained within the southwestern sector of the **Virunga National Park**. This is Africa's oldest national park—and one of the largest with an area of 7,844 km²—having been established by the Belgian government in 1925. The Virunga NP is a world heritage site and is of international significance (Languy and de Merode, 2009). The park protects an unusually diverse range of ecosystems that

include lowland and tropical forest, savannah grassland, swamps, lava plains and active volcanoes. The icefields and glaciers of the Rwenzori occur in the northerly section of the park. More than 2,000 plant species have been identified, of which approximately 10% are endemic to the Albertine Rift. The Virunga NP probably contains the greatest number of mammal, reptile, and bird species of any national park. The southwestern section of the park is well known for mountain gorillas (*Gorilla beringei*). The hike from the Bukima gate to view one of the habituated family groups is a highlight of an excursion. The gorillas occur in the dense, Afromontane forests on the slopes of the dormant and extinct volcanic peaks.

The steep-sided and rugged Nyiragongo cone (foreground), as compared with the smoother and gentler slopes of Nyamulagira (background).

Rugged peaks of the dormant volcanic cones of the Virunga Mountains, viewed from Rwanda.

The hike to the summit of Nyiragongo ascends the southeastern flanks of the cone and starts at the Kibati gate (altitude of 1,984 m). The hike is led by experienced park rangers and includes regular stops (to avoid altitude sickness). The overnight huts, which are located on the rim of the crater, make the experience enjoyable, rather than overly strenuous. The forested lower slopes of the cone do not exhibit the mature Afromontane forests that are found on the slopes of the easternmost peaks of the Virunga. Almost the entire cone was flooded by lava flows during the 1977 eruption. The central section of the ascent follows a mostly unvegetated tongue of lava derived from the 2002 eruption. A linear depression

located approximately half way up the cone, on the western side of the path, is part of the fissure system that opened in 2002. Above here, the trail passes close to the subsidiary (and older) Shaheru Volcano, which includes a large central crater. The short and steep final ascent of the cone is located almost entirely on barren lava from the 1977 eruption. Many of these features are apparent on the detailed geological map, part of which is shown here.

The two catastrophic eruptions of Nyiragongo, on 10 January 1977 and 17 January 2002, have been studied in great detail. The 1977 eruption was triggered

Image showing location of the Nyiragongo Volcano relative to Goma and Lake Kivu (source: Google Earth).

by fracturing of the crater walls (e.g., Tazieff, 1977; Tedesco, 1995). The older terraces collapsed (although new terraces developed once the lava lake re-formed). Lava raced down the mountain (at speeds >60 km/h) and overwhelmed villages to the NNE of Goma. There are no reliable estimates, but there may have been several thousand fatalities. The danger of such fast-moving lava flows with anomalously low viscosity is unique to the volcanoes of the Virunga volcanic province. The 2002 eruption was preceded by increased seismic and fumarolic activity (e.g., Tedesco et al., 2007; Wauthier et al., 2012). Large volumes of lava were emitted from a series of fissures that opened over 20 km on the southern flanks of the cone. Three lava streams were formed. The lava spread from a maximum height of 2,800 m and one of the streams reached Lake Kivu in a few hours. Whereas the 1977 eruption was restricted to degassed magma from the lava lake and upper conduit, the 2002 event resulted in eruption of magma derived from deeper sources (Tedesco et al., 2007). This may indicate a transition from a central lava lake to rifting as the dominant eruption pattern.

The 2002 eruption was recorded by InSAR data from the ERS-2 and RADARSAT-1 satellites. Modelling of the data indicates the presence of two sub-vertical dykes—a shallow dyke (2 km in height) associated with the

Image showing details of the eruption of 2002 (source: Wauthier et al., 2012).

Map showing distribution of mountain gorillas, Virunga National Park (DRC).

Mountain gorillas, part of the Rugendo Family Group, Virunga NP.

The 2002 eruption resulted in an estimated 45 fatalities, with approximately 15% of Goma destroyed by the lava flows that streamed into the city. The 2002 eruption was the most destructive effusive volcanic eruption in recent history and piles of lava from this event can still be observed in the city. The semi-permanent nature of the lava lake in the summit crater of Nyiragongo remains a major hazard to the inhabitants of Goma and surrounding villages. The active nature of the crater is, however, a major attraction to tourists. The volcano is monitored from a research observatory based in Goma.

The hiking trail in the lower section of the Nyiragongo cone (near the Kibati gate) is located on lava from the 1977 eruption. The forest has regenerated since the eruption, but is far less luxuriant and does not contain the giant trees characteristic of the Afromontane forests on the extinct or dormant cones of the Virunga Mountains.

eruptive fissure, and a second, deeper dyke (6 km in height and 40 km in length) located approximately 3 km beneath the city of Goma (Wauthier et al., 2012). The deeper dyke extends laterally for 20 km beneath Lake Kivu. The dyke directions are probably not controlled by stresses but rather by a reduced tensile strength, inherited from previous rift intrusions. The cones and eruptive fissures associated with Nyiragongo and Nyamulagira are generally aligned with the NNE rift system, but a secondary NNW-trending fracture system is also significant. The two volcanoes are located at the intersection of these trends.

The existence of two different plumbing systems at Nyiragongo is a key finding. The volcano is thought to be underlain by a shallow magma chamber, at a depth of 1–4 km, with a deeper reservoir occurring at 10–14 km (Wauthier et al., 2012). Both the 1977 and 2002 eruptions may be ascribed to collapse of the roofs of the reservoirs, as indicated by seismic activity. Typical magmatic gases have been sampled from the 2002 lava flows, with carbon dioxide gas emanating from fractures in the city (Sawyer et al., 2008).

Samples of melt from the Nyiragongo lava lake collected in the 1950s demonstrated that the magma had a composition equivalent to nephelinite and was saturated in nepheline, melilite, magnetite and apatite (Sahama, 1978). The temperature measured at the lake surface was 980 °C; the liquidus temperature of the magma was estimated at 1100 °C. The current lava lake has a diameter of approximately 400 m and area of 46,500 m² (Burgi et al., 2014). The lava lake is modelled as having a funnel or inverted-cone shape, fed by a vertical conduit. The conduit is fed by a shallow magma chamber with a flow rate of 0.6–3.5 m³/s necessary to maintain the volume of lava in the lake.

The spatter cone located in the Nyiragongo crater on the eastern side of the lava lake started to form on 29 February 2016 (Burgi et al., 2018). The volume of erupted lava from the spatter cone was estimated in this report as 20,000,000 m³. The magma is fed from a dyke or conduit from the shallow magma chamber (rather than the juxtaposed lava lake). The shallow reservoir has an estimated volume of 10 km³. Both the lava lake and the new spatter cone are related to a “buoyancy-driven, bidirectional magma flow model”, and the magma

Ropy-textured lava resembling pillow structures from the 1977 eruption. Locality: Next to beach for the crossing to Tchegeira Island.

Chill textures in blocky lava from the 2002 eruption. Locality: Footpath on lower slopes of Nyiragongo.

The lavas of the 1977 eruption form the steep, unvegetated upper slopes of the cone. The prominent cone and crater of Shaheru is visible in the background.

The summit crater is built up from numerous historical eruptions of lavas and tephra.

overpressure at the level of the shallow reservoir is estimated as 12–16 MPa, i.e., sufficient to initiate a new eruption (Burgi et al., 2018). The magma has among the lowest known viscosity of any terrestrial magma and a very low phenocryst charge.

In March 2020, the spatter cone was extremely active and erupted at regular intervals of 5–10 minutes. The lava fountain attained a height of approximately 50 m and formed glowing blocks of scoria as it collapsed onto the flanks of the cone. There was a constant noise associated with movement of magma from depth and the heat associated with eruptions could be felt on the crater rim. There did not seem to be a periodicity between the spatter cone and the lava lake. The latter experienced more irregular periods of activity (every 30 minutes to 1 hour), during which time the surface cracks reformed and changed shape, with flares (most notably) on the eastern margin attaining heights of a few metres.

Nyiragongo partially overlaps two older volcanoes, Baratu (northwest flank) and Shaheru (southern flank), and includes hundreds of subsidiary cinder cones on the flanks of the main cone (Sahama, 1973; Tedesco et al., 2007). Tuff cones occur in a radial pattern to the crater and

extend mostly to the south and southwest. Mount Goma is an example of a tuff cone located adjacent to Lake Kivu. Some of the tuff and cinder cones in the vicinity of Goma are quarried for the manufacture of bricks. The floor of the rift valley is dominated by volcanic deposits, many of which are associated with the two active volcanoes, but also include earlier events. Tchegeza Island in Lake Kivu—where a luxury camp has been established by the Virunga NP—is a crescent-shaped island associated with a partially submerged volcanic cone and crater. The island offers the opportunity of spectacular nighttime views of Nyiragongo.

Nyiragongo is primarily associated with potassium-rich foidite magma, or nephelinite, which has an extremely low SiO₂ content (Sahama, 1973). In comparison, Nyamulagira, despite its proximity, is dominated by potassium-rich tephrite and phonolite. The strongly potassic nature of the magmas is a regional feature of the volcanism associated with the Albertine Rift (e.g., Woolley, 2001). The alkali-rich nature and low silica contents are key factors in the fluidity of the Nyiragongo lava. The Nyiragongo lavas are interpreted as of mantle origin, without significant crustal contamination. The lavas range in composition from olivine melilitite to

Part of the geological map of the Nyiragongo Volcano (Key: brown, orange, and red is the southern part of Nyamulagira; pale grey the 1977 lava flows; pale blue the 2002 lava flows that were fed from fissures on the southern flanks, with 3 distinct streams depicted; green line is the boundary of the Virunga NP). Source: Volcanological Map of Nyamulagira (2010) in the Virunga Volcanic Province, North Kivu (Royal Museum of Central Africa, Belgium, provisional version).

Cinder cones in the vicinity of Lake Kivu are quarried for making bricks. Locality: Next to road between Goma and the beach for the crossing to Tchegeza Island.

nephelinite, with minor alkali olivine basalt (Andersen et al., 2012). The peralkaline nephelinite is unusual and the mineralogy includes Ti-magnetite, perovskite, Ti-rich clinopyroxene and götzenite. The latter is a rare silicate discovered in the region (Sahama and Hytönen, 1957). The 1977 and 2002 lavas and the lava erupted from the spatter cone have been described as melilitite–nephelinite (Minissale et al., 2019). This indicates that broadly the same cotectic magma composition has been fed from the uppermost of the magma reservoirs.

An additional problem associated with the alkali basaltic magmas typical of the Albertine Rift (and of activity in Cameroon) is release of gas when the lava reaches water. Lake Kivu contains a large resource of methane gas (together with CO₂) and similarities with the devastating eruption at Lake Nyos, Cameroon (in 1986), are apparent. This did not materialise during the 2002 eruption, but the fact that the deep water in Lake Kivu is saturated in both methane and CO₂ (and contains the highest dissolved methane content of any known lake) presents a potential hazard. The methane resource in Lake Kivu is shared by the DRC and Rwanda, and small quantities are exploited for generating electricity supplied to Gisenyi, Rwanda. The methane occurs at a depth of >260 m (maximum depth of the lake is 485 m and the surface area is 2,370 m²) and does not rise naturally to surface, as the water pressure currently exceeds the gas pressure. Information boards located next to the lake in Gisenyi explain that extracting the gas will benefit the local economy and lower the gas pressure (which could increase during new volcanic activity).

The problem of asphyxiating gases associated with the Virunga volcanism is well known in the DRC. The occurrence of natural gas chambers (“makuzu”) on surface was discovered in the Virunga NP in 1958. The gas pockets were initially found near the Molindi River, a

tributary of the Rutshuru River. Large rocky ditches (with lengths of up to 50 m) and depressions, with blocks of lava, were found to contain a concentration of carcasses of large mammals, including elephants, hippos, lions and monkeys (Languy and de Merode, 2009). The ditches and depressions were infilled by toxic gas. The gas contains approximately 60–65% CO₂ (Vaselli et al., 2002).

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

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View of the active Nyiragongo Volcano from Tchegeza Island (Lake Kivu). This is not an eruption but a reflection from the lava lake.

Photograph by Alice Kamonyo (Virunga NP).

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online course

The GSSA proudly endorses “Drilling Skills for Geologists” online course, presented by Colin Rice Exploration Drilling Advisory

A bit of history:

Colin Rice presented the first drilling methods course, called “An introduction to drilling”, for the GSSA in 1993! This course was offered annually and by 1998 an “Advanced diamond drilling” course was added to bolster the original training offering. Colin and the GSSA recognised the importance of geologists having a well-rounded knowledge of a drilling operation and therefore in 2007 combined the two courses into the current “Drilling Methods and Techniques in Resource Delineation”. To date, these courses have been attended by hundreds of geologists from southern Africa and many other countries, including Russia, China, Argentina, Brazil and the UK.

Over the years of developing training programs for the drilling industry, Colin identified the need for these programs to be presented online in order to reach a more geographically diverse target audience and in 2018 launched a suite of five online certificate programs. These programs were developed around the key roles on a drill site, namely the geologist, the supervisor and the safety officer. The program aimed at geologists has become one of the most popular and is aptly called “Drilling Skills for Geologists”.

About the “Drilling Skills for Geologists” online certificate program:

After much discussion, the GSSA has recognised the importance of this learning program and the relevance

of its availability online and have made the decision to endorse the program. This means that once candidates have completed the program, they will receive a certificate endorsed by the GSSA.

The online program is built around the objective of every exploration project, which is to obtain representative samples of as high a quality as possible, safely and efficiently. The key concepts here are quality, safety and efficiency and so the program is designed to provide candidates with the necessary knowledge and skills to effectively manage these three key aspects.

The “Drilling Skills for Geologists” program is made up of nine courses, which cover the fundamental technical, economic and safety aspects of a drilling operation. The strong focus on the safety and legal aspects of exploration drilling sets this program apart.

Although the program is primarily aimed at geologists, it is suitable for geological technicians, safety personnel, project managers and engineers who need a deeper understanding of the principles and processes involved in drilling boreholes.

The online program allows candidates to work at their own pace and on average it takes 6–8 months to complete.

Online learning offers several benefits, including the ability to work at one’s own pace, a substantially reduced total cost of learning (no accommodation and travel), as well as a reduced amount of time away from the workplace.

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How long is the program?	6–10 months of online learning depending on individuals’ available time to commit to the program.	3 days in a classroom setting.
What is the program content?	The program is designed to provide candidates with the knowledge and skills to enable the geologist to effectively manage production and safety aspects of an exploration drilling operation.	The program provides candidates with a fundamental understanding of selected aspects of a drilling operation.
Is the program assessed?	Candidates complete self-assessments and course assessments at the end of each course. Successful candidates are awarded a Certificate of Completion endorsed by the GSSA.	No, candidates are awarded a Certificate of Attendance.
What courses are included in the programs?	The program comprises 9 courses: 1. Drilling Fundamentals 2. Introduction to Drilling Methods 3. Common Drilling Calculations 4. The Use of Drilling Fluids and Foams in Exploration Drilling 5. Fundamentals of Borehole Surveying 6. Economic Aspects of Exploration Drilling 7. Fundamentals of Hazard Identification 8. Fundamentals of Risk Assessment 9. Legal Aspects of Exploration Drilling (SA Law)	This program is made up of elements of the first 6 courses in the online program only.

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Size: 45 x 90 mm wide

Advertorial rate per column per cm

Full column, ± 500 words:	R3 560.00	R3 560.00
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2. MECHANICAL DETAILS

Trim Size:	297 mm x 210 mm
Full Bleed	297 mm x 210 mm +5mm all round
Type Area: Full Page:	275 mm x 190 mm
Half Page:	275 mm x 95 mm (Vertical ad) 135 mm x 190 mm wide (Horizontal ad)
Quarter Page:	135 mm x 95 mm (Vertical ad)
Screen:	300 dpi or more
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 delivered to the GB Editor (see Society Office).

5. DEADLINES FOR COPY AND ADVERTISING MATERIAL

March issue:	15 February 2020
June issue:	15 May 2020
September issue:	15 August 2020
December issue:	15 November 2020

6. CANCELLATIONS

Four 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

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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.