GSSA
Geological Society of South Africa

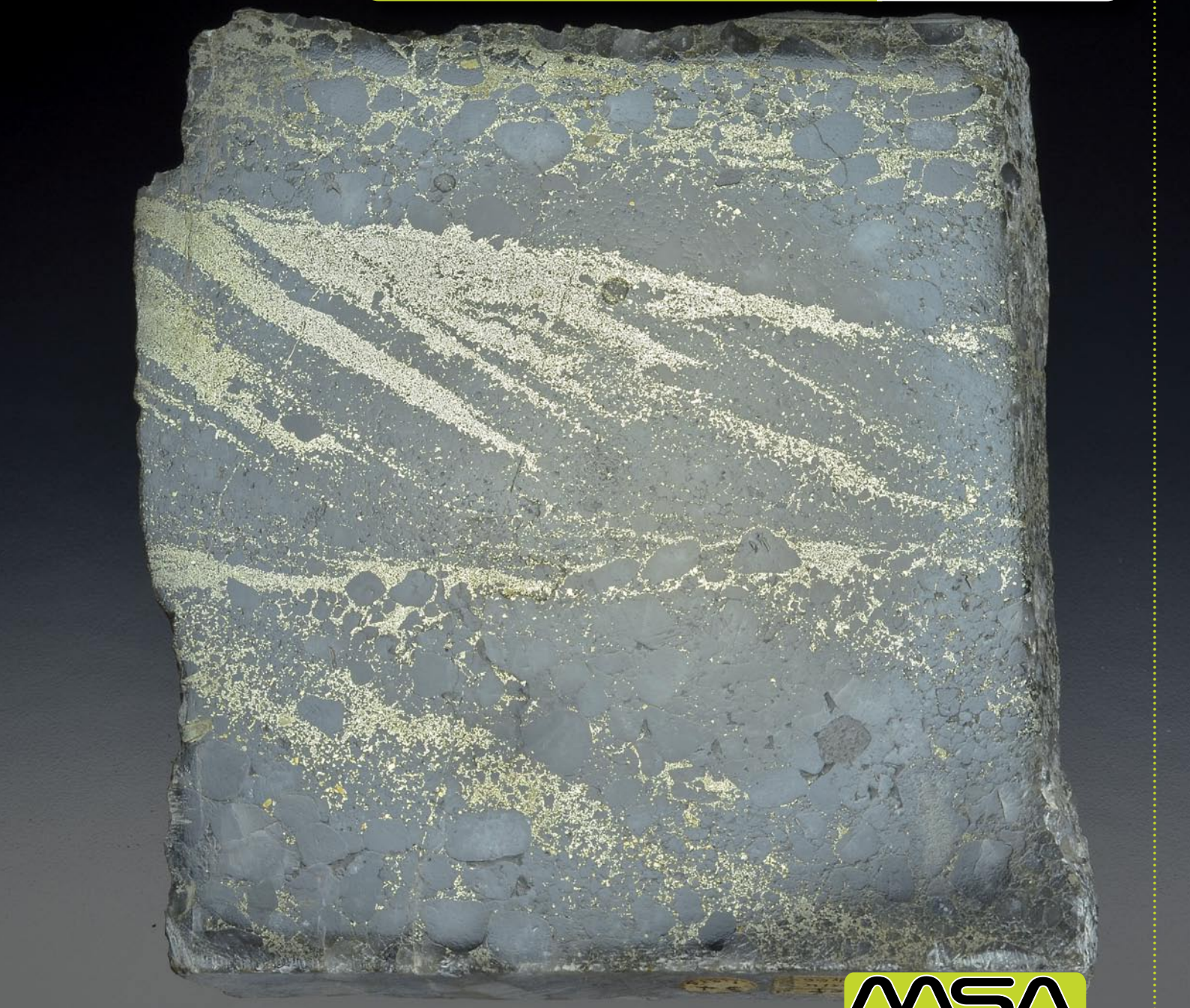
# geobulletin

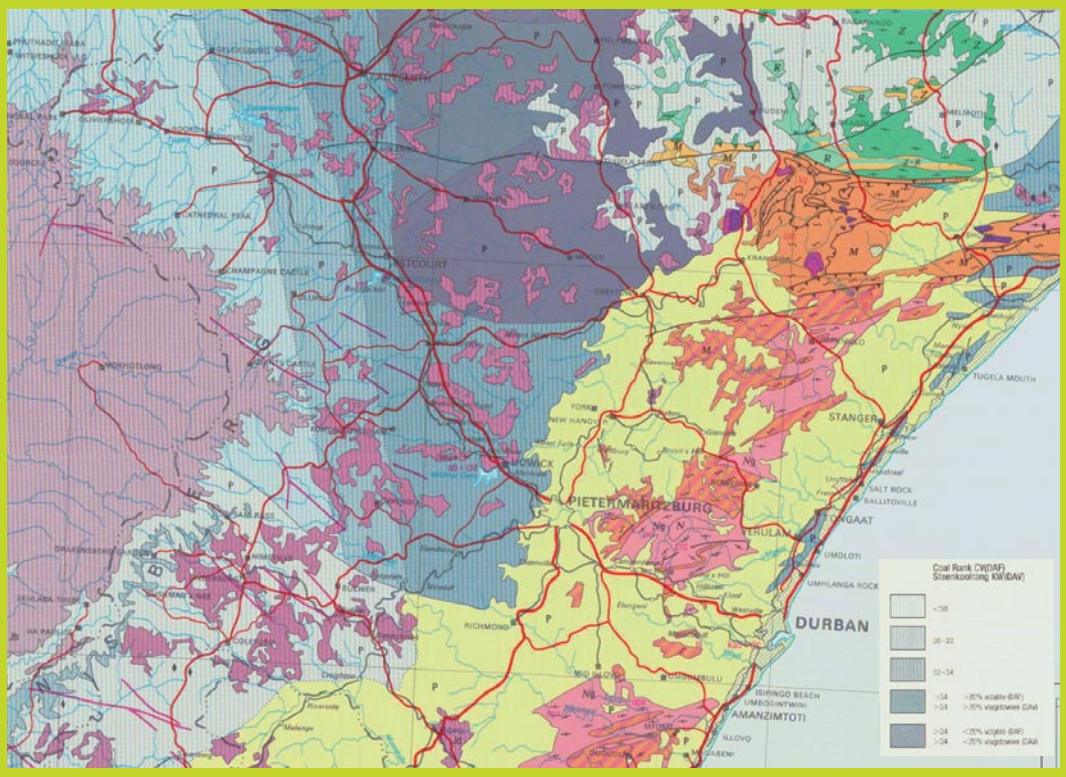
QUARTERLY NEWS BULLETIN ~ MARCH 2019

VOLUME 62 NO. 1

CDD for GSSA
The Sea Point Contact – GeoHeritage Site
Stellenbosch Earth Science students excel

news






**CENTREFOLD:**

Extracts from the Council for Geoscience 1 : 1000 000 Metamorphic Map of South Africa compiled by Ted Saggerson and Leslie Turner. See obituary of Ted Saggerson on p. 28.

Saggerson, E.P. & Turner, L.M (1992). Metamorphic Map of the Republics of South Africa, Transkei, Bophuthatswana, Venda and Ciskei and the Kingdoms of Lesotho and Swaziland. Department of Mineral and Energy Affairs, Geological Survey of South Africa.

GSSA
Geological Society of South Africa

# contents



**Front Cover:**

*Layers of pyrite in the quartz pebble conglomerate reef from the Vaal Reefs gold mine, Witwatersrand goldfield. The pyrite is present as inclined layers of detrital pyrite on the foresets of cross-bedding. The 13.5 X 12 cm specimen is polished and photographed in direct reflected light to highlight the pyrite layers. Bruce Cairncross specimen and photo.*


GSSA
Geological Society of South Africa

**GSSA**
CSIR MINING PRECINCT (FORMERLY CSIR MININGTEK),
CORNER RUSTENBURG & CARLOW ROADS,
MELVILLE, SOUTH AFRICA.

P.O. Box 91230
Auckland Park 2006
Johannesburg, South Africa

Tel: +27 11 358 0028
e-mail: info@gssa.org.za
Web: www.gssa.org.za

**COMMITTEE**

Convener & Editor: Chris Hatton ..... 082 562 1517
Advertising: Jann Otto ..... 082 568 0432

Design & Layout: Belinda Boyes-Varley ..... 079 129 7748

Printing: Seriti Printing (Pty) Ltd ..... 012 43 7632

All submissions to (in order of preference):
email attachments (in Word .doc) to: chatton@geoscience.org.za
disc/hard copy to: Chris Hatton
Postal Address: Council for Geoscience
Private Bag X112
Pretoria
South Africa 0001
Tel : + 27 (0) 12 841 1149
General Fax: 086 679 8591

Contributions for the next issue should be submitted by:
***15th May, 2019.***

Geobulletin is provided free to members of the GSSA. Non-member subscriptions per four issue volume are R350.00 for South Africa. Overseas and rest of Africa, R350 plus postage. Surface mail, R200.00. Airmail, R300.00. The views expressed in this magazine are not necessarily those of the GSSA, its editor or the publishers.

ADVERTISING RATES (Excl. VAT & Agency Commission): Geobulletin is published by the Geological Society of South Africa (GSSA) and appears quarterly during March, June, September and December each year.

**2019 RATES:** Jann Otto 082 568 0432

For detailed prices, mechanical and digital submission requirements, please contact the GB advertising co-ordinator, editor (see Contents Page for contact information) to obtain an up-to-date Rates Card or other information.

***DEADLINES FOR COPY AND ADVERTISING MATERIAL*** are 15th February (March 2019 issue), 15th May (June 2019 issue), 15th August (September 2019 issue) and 15th November (December 2019 issue).

Please note that the design and layout of adverts and inserts is entirely the responsibility of the advertiser. If you wish to contract the services of the GB graphics and layout supplier for this service, please contact Belinda Boyes-Varley directly, well in advance of the advert submission deadline to make arrangements.

# from the editor's desk

Chris Hatton

Can excessive modesty be considered a crime? Given the increasing polarization around the climate change debate, one can imagine the day when the climate change lobby holds the climate change denialists to account in the 21st century equivalent of the Nuremberg trials. On that day the usual plea of uncertainty about the exact effects of burning fossil fuels is unlikely to be sympathetically heard. Geologists are generally in awe of the immense forces that shape our planet, and the notion that we humans could significantly affect the workings of nature strikes some of us as mildly arrogant. How can a creature that has been around for at most a few hundred thousand years significantly affect the workings of a planet that is four and a half thousand million years old? Surely we are over-estimating our own importance; surely even the idea that we should name a geological epoch, marked by the onset of climate change, after ourselves is not to be taken too seriously?

Well, in 1988 the late Manfred Schidlowski maintained that as far back into the geological record as he could see, biological activity modified the carbon cycle. Even in the Archean, back at nearly four thousand million years ago, carbon isotopes fell into three groups, mantle carbon with a $\delta^{13}C$ value of around -5 parts per thousand, carbonate with the reference value of 0, and organic carbon with a $\delta^{13}C$ value of -25 parts per thousand. Schidlowski concluded from this that organisms living in the oceans consumed about a fifth of the available carbon and because these values haven't changed much with time, living things have always modified the carbon cycle. In 2002 the late Peter Deines reviewed the carbon isotope signatures of diamonds, and although he did not favour a biological origin, he found the same isotopic groupings. Deines appealed to 'as yet unexplored thermodynamic or kinetic isotope effects' to explain the light isotopic signature of -25 parts per thousand, but since then exploration has not revealed any such effects. In the absence of a less astonishing explanation, light carbon must be accepted as the signature of life. Fossil fuels preserve this signature of the living organisms they were derived from.

For most of the last ten thousand years there wasn't much contribution from light carbon to the carbon isotope signature preserved in glacial ice; according to a review published in Science at the beginning of 2016 this was sitting slightly above a $\delta^{13}C$ value of -6.5 parts per thousand, not much removed from the carbon isotope value of the mantle, but about 1770 CE the $\delta^{13}C$ value started to drop. At this time steam engines, powered by burning coal were being used to deepen coal mines, setting in motion a feedback loop which greatly increased the consumption of coal. By 1965 CE the $\delta^{13}C$ value in glacial ice had dropped to -7.3 parts per thousand. Considering that the value varied by less than 0.2 parts per thousand for more than seven thousand years, a drop by 0.8 parts per thousand over two hundred years points quite convincingly to the burning of coal as the main contributor to the drop in the carbon isotope value from 1770 CE to 1965 CE. After 1965 the drop accelerated even further so that by 2010 the carbon isotope ratio preserved in glacial ice was -8.2 parts per thousand. This drop of 0.9 parts per thousand in less than forty years is even harder to attribute to anything other than the increasing impact of humans on the carbon cycle.

Accepting that humans today are as capable as micro-organisms in the Archean of influencing the carbon cycle, then maybe it's not too arrogant to name a geological epoch after ourselves. This Anthropocene Epoch would follow the Holocene Epoch. While we're at it we might as well consider emulating the division of the Holocene Epoch into three ages. The earliest age of the Anthropocene would begin when the $\delta^{13}C$ of the atmosphere dropped below -6.5 parts per thousand, at the beginning of the Industrial Revolution. The middle age would begin when the drop in carbon isotope ratios accelerated, at the time the baby boomers were beginning to make their impact felt. The latest age of the Anthropocene would be the time when the carbon isotope ratio stops dropping and begins its return to the pristine value at the end of the Holocene. This late age might never come, in which case the human race would probably be late anyway; but knowing that you're going to be late if you don't hurry up, just means you have to hurry up.

**Chris Hatton**

# executive managers corner

Craig Smith

Welcome to 2019 – which looks to be as unpredictable and as interesting as 2018 was. Just consider the optimistic mood of the Mining Indaba, shortly followed by the catastrophe of Eskom introducing a week of load-shedding. This about as mixed as a message can be, insofar as attracting foreign investment is concerned.

The annual Mining Indaba was staged in Cape Town in early February, and it was a successful event attracting 6000 delegates. There are some key messages coming out, though what goes on in the private meetings can only be guessed. First, everyone tells me that the mood is upbeat. There is increased investor appetite to support projects in Africa compared to the last two or three years – though whether this translates to job opportunities for geologists remain to be seen. Second, there is at least discussion under way as to how to 'kickstart' exploration in South Africa – which should be attracting a lot more than one percent of global exploration spend. And there seems to be a realization that investment in greenfields efforts is desperately needed. If exploration spend increases (and this will be etermined by the regulatory framework), geologists will be hired.

A third theme is best illustrated by Cyril Ramaphosa's comments in his address. He listed 10 action points that stakeholders (read industry!) need to commit to, namely:

- Inclusive growth for local communities
- Engagement with local government
- Investment in and improvement of staff living quarters
- Investment in education and training
- Partnerships with training colleges and universities
- Local beneficiation
- Health and safety
- Training and internship programs
- Employment of more women
- Making boards more representative of affected stakeholder groups

For the most part, the President was preaching to the converted, and his comments were reportedly well received. But note the lack of emphasis on technical expertise that our graduates spend most of their university careers learning. The above list has everything to do with social upliftment and very little to do with the science and engineering backbone of the exploration and mining industries. The message is clear; the 21st century geologist needs to come out of the education mills with more than technical expertise. Maybe it is time for the various university departments to examine just what is being taught, and maybe the registration bodies such as SACNASP and ECSA need to re-look at the current focus on technical knowledge and experience to assess qualification. Should sociology courses be included in a geology curriculum, for example?

But it does not end there. Regarding technical skills alone, will a traditional geological education remain relevant for a world in which technology changes rapidly, partly in response to the need to access deeper, smaller and/or more complex ores? Future mines are liable to employ fewer people and more technology. Robotics and AI are coming fast, and will impact many different aspects of the earth sciences. Scientists in general may have to become more adept at managing and organizing data rather than generating or interpreting it. The future is blurry – and a deep question is whether we are preparing students to not just cope but to thrive in it. We may need to hit the reset button.

I would like to end this column by recognizing the contributions of Professor Jackson M (Jay) Barton to the GSSA, over his career. Most of our readers will be aware that he passed away in January, and a full obituary will be published in a future issue. He was a Past President of the Society (2004), and for many years was co-editor of the South African Journal of Geology. He was one of the people instrumental in transitioning the Journal into the modern era. He will be missed.

**Craig Smith**

Geological Society of South Africa

# president's column

Ed Swindell

One of the issues we are grappling with at the GSSA is the question of Open Access. This impacts us directly and has the potential to undermine our very existence. Open Access sounds wonderful as an ideal and at first glance it holds the promise of free access to all published research but there is a sting in the tail. The concept is built around a number of assumptions driven largely by privilege. The proponents of Open Access all enjoy hugely privileged positions as regards being able to afford it. Yes, Open Access is not free, it merely shifts the costs of the publication of research to the researcher and to the researcher's funder, away from the current situation whereby the consumer of research part pays and contributes to the cost of publication. Every time a paper is published it attracts costs called Article Processing Charges (APC). The role of the not for profit scientific society, such as ours has been to assist both the researcher and the consumer of research by part subsidising the

cost of the publication by firstly providing a platform for the publication and then supporting the cost of publication using membership fess and subscriptions. Hence the long life of and continuing existence of your South African Journal of Geology. This is now under threat.

To give you some of the background to this issue, you should be aware there is a move, called Plan S coming out of Europe to force the publication of public funded scientific research in an Open Access format. This has been the source of much publicity and debate since the latter part of 2018. Plan S has its origins in the European Commission and its key principle is summarised in the following statement;

*"After 1 January 2020 scientific publications on the results from research funded by public grants provided by national and European research councils and funding bodies, must be published in compliant Open Access Journals or on compliant Open Access Platforms"*

A coalition of European research funders that have committed to implement Plan S, known as cOAlition S, therefore call for a definitive shift towards new models of academic publishing. This coalition represents about 13 funding organisations with a net research budget of Euro8.8 Bn. This is an enormous amount of money and it becomes immediately evident that the entire concept of Plan S open Access is predicated upon the massive financial resources available from the European Commission and national states within Europe. Plan S is in short a Euro-centric concept that does not recognise the limitations of public funding resources elsewhere in the world. As you will know funding for research and scientific publication from the NRF in South Africa has been cut back dramatically. Members have regularly reported to us that they face increasing difficulties in securing funds to publish and sometimes have to self-fund the APC costs of publication. In sum South African research scientists such the Geological and Earth scientists that we represent have to rely on either self-funding publication or on the services provided by the membership based scientific societies such as the GSSA.

Plan S is based upon 10 principles. Look at the link https://www.coalition-s.org/. to see these principles. One of the critical principles potentially most damaging to us is the one whereby the Hybrid Model followed by many societies is rejected. (Hybrid journals are those, in which authors can pay for open access if they (or funding agencies) desire but can also select an option for non–open access). There is also a cap to be set on publishing costs which may prove to be impractical if it is not realistic and presumes Euro-centric levels of funding.

In order to deal with some of the objections that have been raised to Plan S, Plan-S states that the journal/platform must provide automatic APC waivers for authors from low-income countries and discounts for authors from middle-income countries. This may however result in South African scientists ceasing to be able to publish in South African journals and moving the publication of their research to European based Journals; this has the potential to severely undermine South African science and research.

The GSSA is a not-for-profit membership based association that represents about 3000 geologists and earth scientists. The GSSA receives absolutely no public funds and draws on no funds from the tax payer. The core business of the GSSA is to serve the best interests of its members by means of organising conferences and scientific meetings, by representing the professional needs of its members, and by means of providing a publication service for its members. To this end the GSSA publishes a range of publications including the standard text book of South African Geology, various special publications and most importantly the South Africa Journal of Geology. A journal such as the South African Journal of Geology (SAJG) receives no public funding at all. It is paid for by means of GSSA membership fees, subscription fees and by the researcher who contributes to special publishing requirements such as the use of colour. The SAJG is a peer reviewed scientific journal of the first order. It is one of Africa's longest continually published scientific journals having been first published in the late 1890's.

Plan S is the source of much debate around the world and a morning spent googling it throws up an enormous amount of stuff mostly dated late 2018. A great deal of opinion exists but you will find that the plight of Scientific Societies is the same all around the world and across disciplines. The issues facing the GSSA are being highlighted by many other societies. How far will Plan S spread and will it impact us directly? Well as you all know we are part of a global village and I think you can assume it will directly impact us quickly and directly. Plan S is a real and fundamental threat to the both the SAJG and to the GSSA. We are going to have our work cut out for us trying to navigate our way through this difficult challenge. The question facing your Council is how do we deal with this going forward?

**Ed Swindell**

# CPD for GSSA



SACNASP
South African Council for Natural Scientific Professions

Register to be Recognised!

## THE PROFESSIONAL (AFFAIRS) CORNER

**The PROFESSIONAL AFFAIRS portfolio of the GSSA**

The Professional Affairs portfolio exists to advance, promote and protect the professional status of all GSSA members through:

- v Identifying the professional needs of all members;
- v Ensuring that appropriate educational, registration, CPD, professional indemnity insurance and reciprocity needs are addressed; and
- v Supporting the concept and training of Competent Persons.

In order to accomplish these objectives, the GSSA:

- Maintains and enforces a Code of Ethics which includes a robust Complaints and Disciplinary system;
- As the primary voluntary association for Earth and Geological Sciences, represents the interests of the membership on the South African Council for Natural Scientific Professions ("SACNASP"), where it retains a seat on the SACNASP Council and participates in such committees as are needed and provides input on policy
- Is represented on several committees of the Council for Geosciences;
- Maintains MOAs and co-operative agreements with several international organizations, including the Society of Economic Geologists, Geoscientists Canada, Geological Society of America, American Association of Petroleum Geologists, European Federation of Geologists as well as local societies including SAIMM, SAGA, FFF, GASA, and SAIEG;
- Along with the SAIMM, is a co-patron and co-funder of the SAMCODES Standards Committee ("SSC") and through the SSC, maintains a presence on CRIRSCO and IMVAL, ensuring reciprocity across various countries and continents;
- Has developed a Continuing Professional Development ("CPD") system that is specific to the needs of geoscientists and which is bench-marked against CPD systems in use across similar organisations in Australia, North America and Europe;
- Maintains representation on various international statutory and professional bodies, such as the Scientific, Engineering and Technological Societies and Allied Professions

Group (SETAG, operating under the umbrella of the National Science and Technology Forum (NSTF), and the International Union of Geological Services (IUGS) Task Group on Global Geoscience Professionalism ("IUGS TG-GGP").

But who are "professional" geoscientists that we are trying to assist? Are they just the individuals who work in "industry" or as consultants? Are academic (teachers and/or researchers) geoscientists also professionals? And what about those in Public Service or who work in laboratories?

**Science vs Profession**

Back in 1997, the Geological Society of London referred to "serving science and profession", giving equal importance to these branches of geoscience practice. Does this mean that these are separate communities or tribes within geoscience and that certain facets of geoscience professionalism are more, or less, applicable to one group than to another?

A communication from Geoscientists Canada (26 July 2012) noted that "In general, the majority of those who define themselves as professional geoscientists work in industrial / applied sectors, but professionalism is just as important in the academic and teaching arenas ….".

Although the geoscience community might be comprised of several different groups (e.g. geoscience researchers, geoscience educators, applied geoscientists in public service/industry, geoscience regulators and standards setters, early-career geoscience graduates, geoscience students, learned & professional geoscience organisations), dislocation and separation within the diverse geoscience communities is clearly not in the interest of anyone – least of all the public. Although each might do highly specialised work, if geoscientific endeavour is truly to serve Society – we, as a community, will not have the impact to which we perhaps aspire, simply by sticking within our own 'tribe' or 'comfort zone'.

Geoscientists serve Society by, inter alia,

- Undertaking research,
- Advancing knowledge,
- Teaching and training,
- Applying geological skills and technology to problem solving,
- Providing expertise, interpretations and opinions on which others rely for key decision making and
- Communicating geoscience to the public and policy makers.

The first two are primarily considered the preserve of academia and public sector bodies such as geological surveys or specialist research institutions. The last three typically involve applied geoscientists (consultants, company geologists), academic and public sector organisations as well as and professional and scientific geoscience organisations. As one works down the list, the extent of interdisciplinary collaboration and the need for working in the fuzzy interfaces between disciplines increases.

In reality, the number of applied or "industry" geoscientists outnumber those in education or research. Consequently, most of the geoscience students who pass through university departments and who work in geoscience work in non-academic careers. Hence the imperative of more connectedness between the 'tribes', not least so that students have a fighting chance of identifying a career path that suits them and employers recruit graduates who are more prepared for non-academic work in the outside world.

The complex interrelationships between the "academic scientists" and the "industry practitioners" can, perhaps, be summarised in these three propositions:

- Without understanding societal needs, how can researchers design research which is truly relevant to those needs?
- Without understanding the skills and expertise needed by "industry", how can educators prepare students for the workplace?
- Without access to high quality graduates and excellent underpinning fundamental and applied research, how can geoscientists in "industry" or public service deliver their expertise effectively?

As in other aspects of life, "tribalism" is unhelpful. Science and Profession are two sides of the same coin

and neither can progress at the expense of the other. As such, professionalism across the board is fundamental and must be embraced by all geoscientists.

One definition of a professional geoscientist holding themselves out to be competent notes the requirement of:

- Sound geoscience knowledge and application of theory;
- Exceptional ethics; and
- Good judgement; providing services and opinions only in the areas of geoscience in which they are both appropriately qualified and suitably experienced.

It's perhaps easier to see how this applies to a person taking responsibility for informing investors about mineral resources and their prospects for economic recovery (for example) than to an academic geoscientist. However, if the final bullet point were to read "Good judgement; delivering teaching, training and research only in the areas of geoscience in which they are both appropriately qualified and suitably experienced." then the application to academic geoscientists is clear.

Does there need to be two definitions applying to two different geoscience "tribes" – as if no academic scientist ever provides a service outside of teaching or research, or no applied geoscientist ever becomes involved in teaching or research? Should not all definitions regarding professional activities of geoscientists be combined into a single phrase, such that "Good judgement; delivering teaching, training and research as well as providing services and opinions only in the areas of geoscience in which they are both appropriately qualified and suitably experienced." unifies, rather than divides?

It is for this very reason that several global groups have emerged as leaders in identifying and promoting standards of excellence throughout the international geoscientific community. The most active of these organisations is the IUGS TG-GGP (on which the GSSA maintains a committed presence).

**International Union of Geological Services (IUGS) Task Group on Global Geoscience Professionalism (TG-GGP) (https://tg-ggp.org/)**

The TG-GGP was formed in 2012 with the purpose of providing an international forum under the auspices of IUGS for discussion of matters of common concern and interest among geoscientists and geoscientific organizations involved in professionalism, at the local, national and international level. It is the purpose of the TG-GGP to ensure that geoscientists, engaged in all areas of geoscience, are fully engaged in the transformation of their profession; a profession that is increasingly relied upon by the public to provide expert opinion and service, and to safe-guard the public interest.

The broad objectives of the Task Group are:

- To act as a resource to IUGS on professionalism in the geosciences as they may influence and impact "Earth Science for the Global Community" in general – both now and in the future;
- To engage and seek participation from geoscience communities in all countries globally;
- To offer and provide leadership and knowledge transfer services to countries and geoscientist communities around the world seeking to introduce systems of professional governance and self-regulation in the Earth sciences;
- To facilitate a more 'joined up' geoscience community fostering better appreciation by academics and teachers of the professional skills that geoscientists need in the workplace, and facilitate better communication between academic and applied communities leading to more effective application of research findings and technology to applied practitioners and development of research programmes that truly address urgent issues;
- To provide geoscientists in all areas of professional practice and at all stages of their careers with practical guidance and support on professional matters, including (but not restricted to):

o Registration and licensing requirements associated with working abroad, either permanently or temporarily;
o Access to information about accredited educational pathways acceptable to licensing and registration authorities;
o Opportunities for continuing professional development to support career progression and

maintain competence;

- Guidance for early career geoscientists and students as to the range of geoscience career opportunities and their educational and training requirements.
- To continue and increase over time the provision of symposia and technical sessions to allow for exchange and knowledge transfer at IGCs and other events for those involved in, and impacted by, the evolution of professionalism in the geosciences.
- To act as a resource to members of IUGS, and others, of material and speakers to present to geoscience groups – in particular, young Earth scientists – around the world on professional practice and registration matters (including geoscience practice standards and guidelines, and reporting standards, codes of ethics and conduct, and professional registration.)

Participation is open to, and encouraged from, all national or international professional geoscience organisations worldwide. Current member organisations include:

- European Federation of Geologists (EFG)
- Geoscientists Canada
- American Institute of Professional Geologists (AIPG)
- Australian Institute of Geoscientists (AIG)
- Colegio de Geólogos de Bolivia (CGB)
- Geological Society of South Africa (GSSA)
- South African Council for the Natural Scientific Profession (SACNASP)
- Masyarakat Geologi Ekonomi Indonesia (MGEI)
- Colegio de Geologos de Chile
- National Association of State Boards of Geology (ASBOG), USA

And collaborating organisations include:

- African Association of Women in Geosciences (AAWG)
- Committee for Mineral Reserves International Reporting Standards (CRIRSCO)
- Young Earth Scientists Network (YES Network)
- International Association for Promoting Geoethics (IAPG)
- International Association for Geoethics (IAGETH)

The strategic plan for the continued work of the IUGS Task Group on Global Geoscience Professionalism ("TG-GGP") covers the three-year period 2019 to 2021 to promote the principles and practice of professionalism in the geological sciences and to offer tangible professional practice support across the IUGS and beyond to all parts of the geoscience community.

Reference Presentations by IUGS (TG-GGP)
Much of the commentary is taken directly/indirectly from various presentations (see reference list below) by Ruth Allington, Isobel Fernandez and Barbara Murphy from the IUGS (TG-GGP), with permission.

Allington, R (2016): Breaching the boundaries between Science and Profession – an imperative for geoscience in the service of society (35IGC, Cape Town).

Allington, R and Murphy, B (2018): The essential elements of professionalism and the importance of the acquisition of appropriate skills.

Allington, R and Fernandez, I (2015): Abiding by Codes of Ethics and Codes of Conduct – a tiresome formality or a win-win for professional integrity and protection of the public.

Allington, R (2013): The importance of professional skills alongside scientific and technical excellence to underpin ethical geoscience practice.

Allington R (2012): The need for a task group on strengthening communication between fundamental and applied geosciences. (34IGC, Brisbane

**Tania R Marshall**

# all the news fit to print

## STELLENBOSCH UNIVERSITY

### Stellenbosch Earth Science students continue to excel

Stellenbosch University was well represented at the recent Igneous and Metamorphic Studies group meeting held in the Vredefort impact structure between 13 -16 January. The SU contingency comprised four students and three staff, with Post-Doctoral student **Matthew Mayne** collecting the accolade for the best Ph.D. presentation for his work on phase equilibrium modelling during melting.

Ph.D. student **Ismael Kangueehi** attended the 2nd International Symposium on Medical Geology in Africa which took place in Johannesburg from the 5th to 7th of November 2018. The symposium focussed on the most recent findings on the relationship between the impacts of geological processes, toxic metals, trace elements, natural dust and minerals, on environmental quality and public health. The symposium provided a platform to discuss and engage international scientists about the new developments in the field of medical geology. Ismael presented about air quality assessment and potential health impacts at Saldanha Bay (Western Cape, South Africa) and won the prize for best oral presentation.

Ismael's success complements a host of student publication outputs originating from his colleagues in the Centre for Trace and Experimental Biogeochemistry (TracEx) research group. Ph.D. students **Ryan Cloete** and **Johan Viljoen** both celebrated 2018 first author papers in international journals for their respective research into seasonal Cu, Zn and Ni cycling in the Southern Ocean, and into predicted phytoplankton response to global change.

### Collaborative SUN-UP sampling of Mesozoic dykes along South Africa's West Coast

After the IMSG, postdoc Dr Cole Kingsbury (UP), Dr Martin Klausen (SUN) and an MSc-student from UJ (Mr Johan O'Kennedy) drove down the west coast, in search for Mesozoic dykes. Apart from several Google Earth targeted 'red herrings' and a roughly coeval, but more felsic and alkaline, Kugelfontein Complex, the team managed to collect 10 samples from mafic dyke outcrops. Apart from standard petrography and geochemistry, Dr Kingsbury will use UP's SELFRAG in a pioneering attempt to separate bigger baddeleyites for U-Pb dating, and most dykes were certainly thick and coarse grained enough for that (e.g., the 40 m-thick dyke in figure).

*Current PhD student Ismael Kangueehi and Stellenbosch Earth Sciences alumnus Conchita Kamanzi (credit: Patrick Gevera, UJ)*

*West Coast dyke outcrop. Top: overview of a NW-SE trending and 40 m-thick mafic dyke.*

*Bottom: Close-up of the dyke's south-western margin, with several host rock slivers and dyke apophyses. Cole provides a scale for lower photo, to the right.*

**Staff member receives award for teaching excellence**

In the 2018 edition of the annual Stellenbosch University Teaching Excellence Awards, lecturer Dr Bjorn von der Heyden received the accolade of being selected as one of 11 recipients of the Teaching Excellence Awards in the 'Developing Teacher' category. The award acknowledges his creative, yet scholarly approach towards designing teaching interventions that facilitate the students' learning about his field of economic geology.

*Economic geology lecturer Bjorn von der Heyden receives his Teaching Excellence Award from Prof. Arnold Schoonwinkel, Vice-Rector: Learning and Teaching at SU.*

**New Fluid Inclusion Microthermometry Laboratory**

The Economic Geology research group at SU is pleased to announce the completion of a new petrography laboratory which is dedicated to ore geology research. The lab is equipped with a Zeiss Primotech and camera for ore microscopy, and with an Olympus BX53 microscope coupled with a Linkam THMSG600 geological heating stage. The research group looks forward to providing new and exciting scientific contributions related to the fluids responsible for forming ore deposits.

**Bjorn von der Heyden**

*M.Sc. level students Christina Comuso and Stephan Dunn looking excited about their new laboratory.*

## UNIVERSITY OF JOHANNESBURG

### General News

*UJ representation at the AGU, from left to right: Casey Luskin, Jeremie Lehmann, Anika Solanki, Trish Owen-Smith, Cedric Djeutchou and Herve Wabo. Sebastian Tappe not in photo.*

UJ had a good representation at the American Geophysical Union Fall Meeting in Washington in December 2018; Jeremie Lehmann, Herve Wabo, Trishya Owen-Smith, Cedric Djeutchou, Casey Luskin, Anika Solanki and Sebastian Tappe all attended the meeting.

UJ Students featured prominently at the annual Igneous and Metamorphic Studies Group (IMSG) meeting in January 2019. at the: Lizzie Tau, won the prize for Best MSc Student Presentation, and Juliet Akoh, won for the Best Poster presentation. She gave the first report on the unusual occurrence of a peralkaline ignimbrite in the Pilanesberg Complex. One of the overseas attendants at this meeting was MSc student Marie Solem, from the University of Oslo (Norway), who is co-supervised by Marlina Elburg. Marie is also working on the Pilanesberg Complex. After the IMSG meeting, Marlina and Juliet took Marie to visit her field area for the first time. Close encounters of the elephantine kind did not stop them from searching for the elusive alkali granite and sampling the dolerites and ignimbrites – with a ranger carrying a rather big shotgun keeping watch. While still on student accolades, Nikki Wagner's PhD student Charlotte Badenhorst won the 'UJ Visualise Your Thesis Competition' held in August 2018 and furthermore, her 60-second video entry made it to the global showcase of winners in Australia.

Marlina Elburg is celebrating one year as editor of South African Journal of Geology, during which she dealt with more than 40 contributions. Although dependent on both the quality of the submission and the speed of the reviewers, the time between submission of a manuscript and final acceptance can now be as short as two months. Thanks to the system of electronic publication prior to the print issue, it is possible to have a paper published on-line no more than three months

*UJ student IMSG 2019 prizewinners with John Clements, IMSG President. Juliet Akoh (left) and Lizzie Tau (right).*

after submission. Admittedly, it is also possible to have your paper rejected within several hours of submission, so quality is still the key ingredient.

Some of the UJ staff applied for NRF re-evaluation and these applications were assessed during 2018. Three staff were successful in getting 'upgraded': Marlina Elburg (B2), Bertus Smith (Y1) and Bruce Cairncross (C1). Still on staffing matters, during the latter half of 2018, Hassina Mouri was promoted to Professor and Clarisa Vorster to Senior Lecturer.

The multifaceted PPM (Palaeoproterozoic Mineralisation) Research Centre has been thriving for many years at UJ. First headed up by Jens Gutzmer, then Nic Beukes, and then followed in recent years by Jan Kramers. The group focuses on a wide range of economic topics and is populated by both staff and post-graduate students. As of 2019, Bertus Smith will be taking over the helm as Director from Jan, and PPM will no doubt continue to produce outstanding results.

*Bertus Smith, the new Director of the PPM Research Centre.*

*High school learners from schools in Soweto and Johannesburg South listening to talks on mantle geology during the Geocongress Messengers of the Mantle exhibition.*

Each year the UJ Department of Geology conducts several activities for community engagement. Here we highlight presentations and exhibitions that involved school learners in 2018 and the annual Christmas charity drive. Prof Michiel de Kock (HoD) participated at the career day for pre-school learners of the Deutsche Internationale Schule Johannesburg. At this occasion, he gave a presentation and displayed specimens of minerals and rocks as well as fossil skulls of a gorgonopsian dinosaur and the Taung child hominin.

Three staff members (Prof de Kock, Dr Marvin Moroeng and Ms Caroline Hlongwane) gave presentations to grade 6 and 7 learners at the career day of the Asteri Primary School in the Hillbrow-Houghton area. During the Geocongress meeting, the department in association with the UJ Library, the Geological Society of South Africa and the University of Cape Town Department of Geology hosted 60 high school learners from schools in Soweto and Johannesburg South. The learners were

*Some of the staff and postgraduate students of the UJ Department of Geology with their donations for the Christmas drive.*

treated to a series of talks on mantle geology before viewing the Messengers from the Mantle exhibition of mantle rocks. Finally, at the end of each year, staff and postgraduate students in the department make donations to the Christmas charity drive organized by The Work Space Organisation. Items such of toiletries, toys and educational content are donated for delivery to organisations and shelters around Johannesburg for children, elderly women, abused women and abandoned animals.

**DST-NRF CIMERA**

DST-NRF CIMERA is proud to announce that Prof Nikki Wagner (see biography below) has been appointed as its new Director from the 1st January 2019. She was selected after due processes were followed by the University of Johannesburg (UJ) and the National Research Foundation (NRF), on the retirement from the post by Prof Nic Beukes, our Founding Director. We heartily thank Prof Beukes for successfully running our Centre of Excellence together with Prof Judith Kinnaird (Co-Director at Wits) for the past five years and wish him all the best in his research activities at UJ. We will certainly still call on Prof Beukes for his sound advice and know-how on matters geological. Prof Kinnaird will continue to be the Co-Director at Wits.


*Professor Nikki Wagner, the new CIMERA Director.*

*RIGHT: Prof Willem van Biljon (ex-Head of the Department of Geology at RAU/UJ) and Prof Nic Beukes at the DST-NRF stand at Geocongress 2018. Professor van Biljon is celebrating his 90th birthday this year!*

Prof Nikki (Nicola) Wagner is an Associate Professor in the Geology Department at the University of Johannesburg (UJ). Her research areas include organic petrology, coal petrography, trace elements in coal, coal geology, carbon dioxide capture and storage, coal oxidation, underground coal gasification, coal conversion, conversion ash, and so on. She completed her PhD in 1998 (University of the Witwatersrand (Wits), and shortly thereafter worked for Sasol in their Coal to Syngas Research Group, as the in-house coal petrographer for six years. She then joined the School of Chemical and Metallurgical Engineering at Wits in the Coal Research Group for eight years before moving back to geology at UJ in 2014. Prof Wagner has over 45 peer-reviewed publications and supervises a number of MSc and PhD candidates at UJ and other institutions. She is an active peer reviewer for over 10 research journals, is accredited in all three of the International Committee for Organic Petrology (ICCP) accreditation programs, and is the elected editor of the ICCP News, where she also serves on the Council. As well as being a council member of the Fossil Fuel Foundation (FFF), Prof Wagner is a member of the Geological Society of South Africa (GSSA) and is registered with SACNASP. She has a National Research Foundation C1 rating and is the mother of three children.

In August 2018, CIMERA underwent a 5-Year Cycle Review by an independent Review Panel appointed by the NRF to ascertain our progress to date, and to recommend as to the way forward. We are happy to state that, after the stringent review, the NRF is highly satisfied with our achievements in all our key performance areas, especially in knowledge generation and student training. We thank all our collaborating researchers and supervisors for the efforts they have put in for us to achieve our targets and hope that they will continue to do so in our next 5-Year cycle.

DST-NRF CIMERA affiliated researchers were involved in the Geocongress 2018 event of the Geological Society of South Africa, both as organisers and as presenters of talks and posters. This took place from the

*Attendees at the DST-NRF CIMERA Annual Colloquium at the PDH at Wits.*

17th – 20th July 2018 at UJ and was highly successful. Once again, our collaborators and students deserve a pat on the back for their contributions.

Prof Willem van Biljon (ex-Head of the Department of Geology at RAU/UJ) and Prof Nic Beukes at the DST-NRF stand at Geocongress 2018. Professor van Biljon is celebrating his 90th birthday this year!

Our Annual Colloquium took place at the Professional Development Hub at Wits on the 13th November 2018. Twenty-one excellent talks were presented, of which 18 were by our students. We extend an especial thanks for the students and supervisors who travelled from far afield – Fort Hare, Stellenbosch and Venda – to attend our colloquium and help to make it a success.

Dr Nikki Wagner (UJ), Dr Nandi Malumbazo (CGS), and Professor Rosemary Falcon (recently retired from Wits) held a book launch hosted by the UJ Library. The production of the book titled 'Southern African Coals and Carbons' was made possible by funding support from Coaltech (printing costs), the NRF (DST-NRF SARCHi Chair in Clean Coal technology, and other NRF incentive rants), Wits, UJ and the CGS. The book includes four reference chapters and two detailed photographic chapters of coals and carbons. The target audience includes students working on coal and carbon related projects, the coal industry, academics, and the public wishing to gain an understanding about organic petrology. For further information, please contact Dr Wagner: nwagner@uj.ac.za


*The launch of the new coal book held at the UJ Library.*
*From left to right: P rofessor Rosemary Falcon, Dr Nikki Wagner, Mrs Pavlinka Kovatcheva (UJ Library), and Dr Nandi Malumbazo.*

**International Symposium on Medical Geology in Africa (ISMGAf2)**

The University of Johannesburg hosted the 2nd International Symposium on Medical Geology in Africa (ISMGAf2) from 5th-7th/11/2018- organized by Hassina Mouri and the medical geology group. The event consisted of 2 days short course and one day oral/posters presentations. The total number of delegates attracted by this event was up to 70 including 20 Postgraduate students from various universities in South Africa (UJ, UNIV, UCT, Wits, Stellenbosch, UP, NMMU) and 10 Honours students from NW University. The rest of delegates are researchers, academics and private consultants representing various organisations including UJ (Faculty of Health, College of Business and Economics, Departments of Geography and Geology), UCT (Department of Environmental Sciences), NWU (Department of Geology), Council for Geoscience and Anglo American, Harmony Gold. The guest speakers and short course presenters are from various national and international institutions including public health sector in South Africa (Flora Hospital and Poortview Clinic) and Faculty of Health at NMMU, University of Montana, Missoula and University of Nevada, Las Vegas, USA, Federation University Australia, University of Jos, Nigeria and the British Geological Survey, UK. The presentations by guest speakers and delegates covered a wide range of topics related to medical geology including microbiology, biochemistry, environmental toxicology, immunotoxicology, environmental health, primary health care as well as psychiatry. The sponsors of the event include the National Research Foundation (NRF), ISC-Regional Office Africa (former ICSU office), International Union of Geological Science (IUGS), British Geological Survey and Faculty of Science, University of Johannesburg, which are thanked for their financial support and the Geological Society of South African for marketing the event.

In August 2018, Sebastian Tappe was appointed as an Associate Editor for the multidisciplinary geosciences journal Gondwana Research published by Elsevier. Gondwana Research has an Impact Factor of 7.2 and ranks number 6 (out of 190) in the multidisciplinary geosciences journal category.

In September 2018, a small group of mantle research students from UJ and Wits (Anika Solanki, Malcolm Massuyeau, Sara Burness, David Greyling) were guided by Sebastian Tappe to the Petra Diamonds Ltd owned Finsch Mine in the Northern Cape. On site, an underground tour down to 700 m depths was organized by Finsch Diamond Mine Geology Manager Kopano Maisela. Finsch Diamond Mine uses the Sub-Level Caving method to retrieve kimberlite ore (actually 'orangeite' ore), which requires an impressive amount of coordination and precision, as respectfully witnessed by the Johannesburg students. The trip ended with a visit to the Big Hole Museum in Kimberley, where the

*Delegates attending the 2nd International Symposium on Medical Geology in Africa (ISMGAf2).*

*The 2018 UJ Honours class, with staff and other students, at the Big Hole in Kimberley (picture taken using a drone).*

UJ Geology Honours Class traditionally finishes their three week long Northern Cape field school.

The DEEP Research Group at UJ welcomes two new post-graduate students: Mr. Ntando Ngwenya, who is embarking on an MSc degree (joining from Wits), and Ms. Thendo Netshidzivhe, who is embarking on a PhD degree (joining from Stellenbosch).

**Bruce Cairncross**

# cgs conference

**Council for Geoscience Annual Conference 2019, 11–12 February 2019**

The recent conference held on 11 and 12 February 2019 by the Council for Geoscience brought together national and international scientists to discuss aspects of the new "integrated and multidisciplinary geoscience mapping programme 2018–2021" of the organisation. The event took place at the CSIR International Convention Centre (ICC) in Pretoria.

Within the broad geological mandate of the organisation, special emphasis was placed on geoscience for minerals and energy, geoscience for infrastructure and land use, geoscience for health, groundwater and the environment, geoscience innovation and geoscience diplomacy.

The technical organising committee received nearly twice as many abstract submissions as in previous years, necessitating presentations to be held in parallel sessions. The conference had eleven invited national and international experts presenting on issues relevant to the conference subthemes. The keynote presenters were Dr Bob Thomas, Dr David Khoza, Dr Emmanuel Sakala, Dr Jeanine Engelbrecht, Mr Stephen Hine, Prof. Louis van Rooy, Prof. Laurence Robb, Prof. Patrick Vrancken, Prof. Richard Ernst and Prof. Ronald Cohen. With this conference, the CGS hoped to provide to its stakeholders with insight into all the nationally funded research projects it is undertaking and to show, via the invited speakers, new areas of enterprise that its scientists could pursue.

*The team who compiled the newly released digital one million scale map of the geology of South Africa.*

The conference was fully subscribed (equal to the maximum capacity of the main auditorium), but unfortunately a number of registrants did not show up. This did not, however, dampen the scientific interest and subject diversity of the conference. Judging from the numerous commendations received from the audience, the conference was well appreciated. The catering by the CSIR ICC was outstanding and enjoyed by all.

A highlight of the conference was the honouring of Prof. Maarten de Wit for his significant contribution to South Africa's geology and the inspiration he has been to students and those he led to postgraduate degrees. Another highlight was the official launch of the new digital 1:1 000 000-scale geological map of South Africa compiled under the leadership of Coenie de Beer.

In the closing remarks to the conference by Ms Refilwe Shelembe, she thanked the invited speakers, the presenters, the technical and local organising committees and the adjudication committee for their evaluation of the presentations and posters. The work done by the adjudication committee culminated in two awards being made, i.e. "The best poster presentation" that went to Ndivhuwo Mukosi and her team (T. Radzuma, S. Doggart, M. Motheta, J. Mathebula, K. Mogowe, D. Ngobeni, M. Bensid, R. Netshitungulwana and S. Hlatshwayo) and the best "Young scientist presentation" awarded to Marcelene Voigt and her team (J. Miller, L. Bbosa, R.A. Govender, D. Bradshaw, A. Mainza and M. Becker).

Two post conference workshops were held on the 13 February at the CGS head office, entitled "Passive treatment systems - The Good, The Bad and The Complicated" and "Global Landmarks in SA stratigraphic record". The passive treatment workshop was led by Drs Henk Coetzee and Thakane Ntholi (both of the CGS) in conjunction with Prof Ron Cohen (Colorado School of Mines) and Prof Christian Wolkersdorfer (TUT) water. The workshop was fully booked and dealt

*Delegates attending a Keynote presentation by Dr David Khoza on aspects of innovation in the geosciences.*

with passive treatment systems for contaminated mine water, focusing on acid mine drainage.

The "Global Landmarks in the South African Stratigraphic Record" workshop was co-hosted by Drs Chris Hatton and Cameron Penn-Clarke of the CGS in conjunction with Prof Richard Ernst (Carleton University, Ottawa, Canada). This well-attended workshop discussed major global events that manifest in the South African stratigraphic record, as well as where major events may be preserved, but have not yet been discovered. Also presented were new methods and age constraints for various stratigraphic units. This fruitful workshop opened up ideas for new exciting research, avenues for collaboration between the CGS and academia, and areas for the CGS to target for mapping and research.

"The technical organising committee received nearly twice as many abstract submissions as in previous years, necessitating presentations to be held in parallel sessions. The conference had eleven invited national and international experts presenting on issues relevant to the conference subthemes. The keynote presenters were Dr Bob Thomas, Dr David Khoza, Dr Emmanuel Sakala, Dr Jeanine Engelbrecht, Mr

*Prof. Maarten de Wit was honoured for his contribution to the geology of South Africa.*

Stephen Hine, Prof. Louis van Rooy, Prof. Laurence Robb, Prof. Patrick Vrancken, Prof. Richard Ernst, Prof. Olugbenga Okunlola, and Prof. Ronald Cohen. With this conference, the CGS hoped to provide to its stakeholders with insight into all the nationally funded research projects it is undertaking and to show, via the invited speakers, new areas of enterprise that its scientists could pursue.

**Thinus Cloete**

# dolerite

**Dolerite intrusion interaction with various lithologies and settings in the greater Waterberg area**

The Waterberg region, with Nylstroom as base, offers the opportunity to study the effect of late-stage intrusions, mostly dolerite, into a variety of lithologies. A number of factors determine the manner of intrusion, the size of the intrusion and the reaction of the intrusion with the country host rock. This article only presents a high level review of some of these factors that is observed.

Sills and dykes are concordant sheet-like bodies of magma that can range in composition from mafic to felsic. The sills and dykes could also have a layered appearance that would indicate it to have been fed by multiple pulses of magma, each with a unique geochemical signature. It is also possible that variations in the geochemical signature are due to interaction with the country rock at depth or at the level of emplacement. The contact between the intrusion and the country rock is mostly sharp, but in some cases has been noted to be highly irregular.

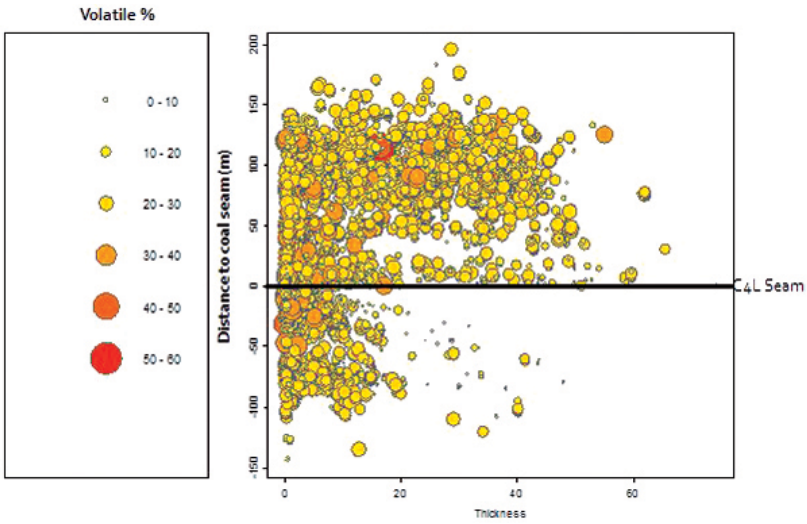
In the more resistant quartzite of the Transvaal Supergroup and the sandstone of the Waterberg Group, the contact between the dolerite intrusions and the country rock is sharp with very little indication of any interaction between them. At most it will exhibit a thin chill zone along the contact, small vein-like

☞


*Dolerite intrusion in Greenstone Belt schist*

intrusions into the country rock or micro-xenoliths. The large dolerite hill associated with the Nylstroom syncline, visible from the N1 highway, falls into this category. The contact of dolerite pipes within shale country rock further north tends to be the same sharp type, but with a hornfels halo of irregular development thickness. Since the dolerite intrusion is more susceptible to weathering, relative to this type of country rock, the dolerite is weathered and eroded preferentially. This is demonstrated clearly in a number of road cuts along the N1 and R101, the most notable on the Ysterberg roadside.

To the north of Potgietersrus, the dolomite of the Malmani Group outcrops with a couple of intrusions that have been noted. The formation of a distrinctive skarn halo around the intrusion is visible in most cases. In the location of the larger Northern Limb of the Bushveld Igneous Complex, that partially intruded the dolomite, the reaction product of para-pyroxenite is very pronounced. Para-pyroxenite, or CaTs-clinopyroxene, in short is a Ca and Al-rich pyroxene found in thermally metamorphosed dolomite and limestone. This mineral is characterised by the presence of Al in the octahedral sites in the crystal lattice. These para-pyroxenite grains in thin section can also be easily identified as micro-xenoliths in the intrusions as it is refractory and tend to be more resistant to secondary alteration relative to any of the primary magmatic clinopyroxene grains that may be present.

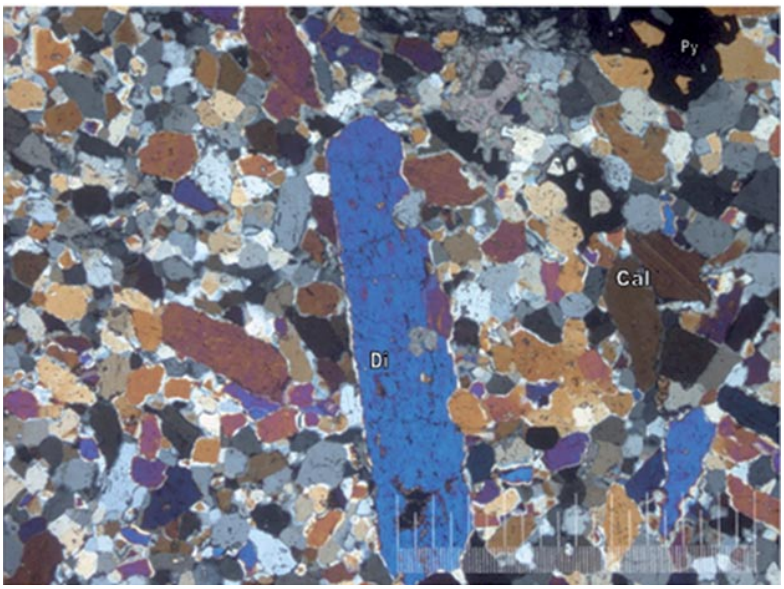



*Volatile % of teh C4L seam, indicated relative of the distance of the dolerite intrusion and intrusion thickness (After Bussio, 2011).*

Slightly further north, dolerite sills and dykes also intruded the Pietersburg Greenstone Belt. One of the larger dolerite intrusions, approximately 5 meters in diameter, would seem to indicate that it was able to scavenge additional sulphur and gold from the country rock at depth. At the position of the sampled intersection, the host schist fire assay results indicated the gold content to below detection level. Two samples from the dolerite that showed visible small specks of disseminated sulphides returned fire assay results of 0.1 g/t and 0.24 g/t gold respectively.

The size of the intrusion has conventionally been thought to influence the extent of the thermal metamorphic influence. However, in the Springbok Flats coalfields, no such relationship could be identified to date. In a larger study of the relationship between the size of an intrusion and the area of devolatization of coal throughout South Africa, Bussio (2011) found no apparent correlation between dolerite volume, distance and devolatization effect. The same effect was noted where dolerite dykes and sills intruded partially or unconsolidated clastic sediments. In these types of settings, it is noted that

the contacts tend to be more irregular. This is suggested to be the result of the difference in interaction with the country rock in both settings due to either laminar or turbulent flow conditions in the dyke or sill at the time of emplacement. According to Canon-Tapia and Merle (2006) the Reynolds number of dolerite intrusions is usually in the order of 28 for the transition from laminar to turbulent flow conditions.




*Parapyroxenite in cross polarised light*

Based on these observations the provisional conclusion would suggest the metamorphic effect of a dolerite sill or dyke will be unique, depending on the emplacement position. The type and extent of the metamorphic effect is determined primarily by the physical and chemical characteristics of the country rock at the level of emplacement. The reactiveness and thermally affected thickness of the country rock decreases, as the silica content increases. Provisional results also indicate that the geochemical signature can be influenced by entrainment of assimilated elements from depth that only settle at a higher emplacement position. The contact is primarily also determined by the country rock type and the structure(s) that were exploited by the intruding sill or dyke. The secondary influence will be the magmatic flow conditions, either laminar or turbulent, at the time of emplacement. This will also have a bearing on the presence or absence of preserved xenoliths of more refractory rock types.

The results of various field observations suggest that sill emplacement is primarily the result of stress rotation at contacts between layers of contrasting mechanical properties. These intrusions suggest upward, fracture-controlled, magma passage with local bedding control from an array of feeding centres whose location was determined by basement structures and regional stresses associated with the Waterberg basin. The orientation of the maximum principal compressive stress σ1 is horizontal. It has been suggested (Burchardt, 2008) that such contacts can represent interfaces along which sill emplacement is encouraged. After a sill has been emplaced, it extends the stress field with a horizontal orientation of σ1. As a result inclined sheets and dykes injected near the sill will be deflected into sills. The injection frequency of further sill units controls if the sill can grow into a larger magma body by mixing of the newly supplied with the initially injected magma (Burchardt, 2008), such as the dolerite sill of the Nylstroom syncline.

**Acknowledgement**

This article forms part of a study of late stage intrusive and related activities in the larger Waterberg (Nylstroom) area and is partially supported by the Kent Trust Fund of the GSSA.

**References**

Burchardt, S. (2008). New insights into the mechanics of sill emplacement provided by field observations of the Njardvik Sill, Northeast Iceland. Journal of volcanology and geothermal research, 173, no3-4, p. 280-288.

Bussio, J. (2011). Sill metamorphic effect: relation to flow dynanics and origin. 23rd Congress of African Geology, January 2011, Johannesburg, South Africa. Abstract booklet (unpaginated).

Canon-Tapai, E. and Merle, O. (2006). Dyke nucleation and early growth from pressurized magma chambers: insights from analogue models. Journal of volcanology and geothermal research, 158 (3-4) p. 207 – 220.

**Nicolaas C. Steenkamp**

# sea point contact

*The Sea Point Contact*

**The Sea Point Contact – GeoHeritage Site**

The Sea Point Contact is one of the must see geoheritage sites in Cape Town, not only as an easily accessible impressive outcrop, but also due to the historical significance it holds. The Sea Point contact can be reached by parking off Beach Road south of the President Hotel and going down towards the beach, where a plaque marks the spot. This is latest in a series of plaques erected at the site, following the theft of and vandalised previous plaques. Here the two dramatically different rock types can be clearly seen, on the viewer's left is the dark, banded Malmesbury sediments and to the right the coarsely grained crystalline Cape Granite which intruded them. The relationship here illustrates the process of slow granite intrusion. The xenoliths of Malmesbury sediments in the granite are very popular in photographs. The Cape Granite is also known for the large twinned plagioclase crystals that can be up to several centimetres across. These rocks can also be seen at Cape Point.

The steeply dipping dark grey slate and sandstone of the Malmesbury Group underlies much of the Cape Town city centre. It was intruded approximately 540 Ma by the coarse grained Cape Granite, visible on most beaches. The horizontal overlying Table Mountain Group consists of about 50 m of reddish sandstone and shale of the Graafwater Formation, followed by a 500 m thick sequence of light grey sandstone of the Peninsula Formamation that makes up Table Mountain. Until about 25 Ma ago, the mountain existed as an island (Norman and Witfield, 2006).

**The Darwin Controversy**

During the 1800's, there was a debate raging around the origin of granite: did it come up from the depths or was it formed in situ as a precipitate of sea water? 'Neptunists' believed that granite, as well as sedimentary rocks such as sandstone, shale, and limestone, was precipitated from a primordial ocean. Popular myth has it that Charles Darwin went to Sea Point with the intent of disproving this view of his contemporaries.

Charles Darwin is reported to have become aware of the existence of the Sea Point contact after a paper read to the Royal Society in 1813, based on the observations of Royal Navy captain Basil Hall. Up until that point the opinion was held that the granite formed as a result of

*Close-up of the contact*

the conversion of the schist, but Hall postulated that the granite had in fact intruded in to the sedimentary roof rocks. Darwin set off on his world voyage aboard the Beagle and visited Cape Town in 1836. Darwin visited the Sea Point contact and was credited with solving the dispute on the formation of the granite, but Master (2012) scrutinised various sources and made a number of critical findings.

The first is that it was Captain Basil Hall who saw outcrops of granite veins intruding into schists at the foot of Table Mountain in Platteklip Gorge and not at Sea Point some 5.2 km south-east of there. It was also Hall who wrote to his friend John Playfair regarding this in 1812 and not Charles Darwin. Playfair and Hall then published this discovery in 1813 in the Transactions of the Royal Society of Edinburgh (Master, 2012). The second is that Clarke Abel had made geological observations at the Cape in 1816 and 1817, on his way to and from China, and in 1818 it was he who first recorded the granite–schist contact on the coast at Sea Point in Cape Town (Master, 2012).

Regarding Darwin, Master (2012) was able to establish that Darwin in his writings referred to the 'Green Point Contact' and not the 'Sea Point Contact'. In addition, Darwin did not suggest that the schist enclaves in the granite were detached fragments or xenoliths, rather he suggested that they were interconnected pendant slivers of infolded suprapositional schists that were intruded parallel to their schistosity by thin fingers of granite, and then eroded to reveal apparently detached schist fragments in the granite (Master, 2012).

Today a short summary of the formation of the Sea Point Contact is written on the plaque that is currently displayed at the site, along with the updated version of its discovery. It also features a quote from Darwin's The Origin of Species.

**References**

Master, S. (2012). Darwin as a geologist in Africa – dispelling the myths and unravelling a confused knot. South African Journal of Science, 108(9/10), p. 1- 5.

Norman, N. and Witfield, G. (2006). Greater Cape Town and environs. Geological Journeys, Random House Struik publishers, p. 62 – 68.

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

# malawi gold rush

**Malawi Gold Rush**

Malawi is seeing the sixth gold rush in 2018 and this time it is just outside the capital city Lilongwe. In the last four months of the year there have been extensive artisanal diggings along the riverbanks of the Nathenje River. Workers, mostly women, are digging trenches and deep holes along the river, hauling out the sediments to dry high ground. Here the sediments are poured onto a sieve to wash away sediment and examine the remains for signs of gold.

There have been mixed fortunes, with diggers paying up to USD7 for a plot of 5 x 10 meters. The recovered gold is then mostly sold to foreign buyers who take it out of the country. Initially diggers could get up to 25 000 kwacha (about USD 34) per gram, but this dropped to 20 000 kwacha. The quality of the gold being recovered however remains uncertain. However, the artisanal miner's fortunes are to be short lived as the Malawian government is s in the process of formalising illegal mining. This would mean licensing would be introduced and illegal miners evicted from all these sites.

Primary gold has been previously mined in the Kirk Range-Lisungwe in Neno/Mwanza area at a small-scale. Traces of alluvial gold are found in numerous rivers throughout the country. Areas like Kirk-Range Lisungwe valley, Dwangwa in Nkhotakota, Malindi-Makanjira in Mangochi, Nathenje in Lilongwe and Chitipa-Kameme.The gold is hosted in decimetre-scale quartz lobes and stringers zones and enhanced residual concentrations occur in the overlying regolith. This gold rush again highlighted the value of old colonial era geological mapping and surveying. Reportedly the deposit was found by an Indian national who obtained some historic reports. He was able to successfully locate the deposit, but fled after the Malawian police became aware of the illegal mining operation. The British undertook a geological survey in 1960, shortly before Nyasaland, as it was then known, became independent Malawi, but little surveying has been done since.

Nicolaas C. Steenkamp

*Malawi Gold-rush*

UNIVERSITY of the WESTERN CAPE

The University of the Western Cape's Faculty of Natural Sciences offers education and research in a wide range of scientific disciplines. As one of the recognised leaders in Natural Sciences in South Africa and on the African continent, the Faculty, with a strong focus on both undergraduate and postgraduate learning and teaching, has, in the past decade, witnessed an unprecedented investment in science infrastructure with commensurate growth in undergraduate and postgraduate numbers and research productivity.

The Faculty's Department of Earth Sciences hosts the Environmental and Water Science (EWS) and Applied Geology (APG) programmes, and occupies state-of-the-art facilities in both of the new Life Sciences and Chemical Sciences buildings. The campus of the University of the Western Cape is located in the vicinity of Cape Town International Airport.

The Department of Earth Sciences seeks to employ an

## Associate Professor in Hydrogeology

This position offers a leadership opportunity for a highly motivated, dynamic individual who has the potential to emerge as one of the future leaders in Hydrogeology in Southern Africa. Applications are invited from passionate researchers and teachers, with in-depth knowledge of Hydrogeology, who can lead research as well as teaching and learning activities in Hydrogeology and multidisciplinary, ground water-related topics. This position requires a strong team player with a research and teaching track record, commensurate with appointment at the level of Associate Professor. In addition applicants must have excellent communication and networking skills, be willing to focus on achieving research and education targets, and provide leadership in the acquisition of funding for Hydrogeology research and advanced new equipment necessary to further research in this field.

**Key roles and responsibilities will include:**

- Academic leadership in Hydrogeology and groundwater related topics;
- Participation in Departmental academic governance and curriculum development;
- Development of sustainable research and innovation programmes in Hydrogeology and groundwater related topics;
- Undergraduate & postgraduate teaching and supervision;
- Acquisition of external research funds; and Publication of high quality research outputs in accredited journals relevant to the research field.

**Minimum Requirements**

- A PhD in Hydrogeology or closely related field;
- Hydrogeology teaching experience at both the undergraduate and postgraduate level;
- Post-graduate supervision experience;
- A track record of high quality Hydrogeology research outputs in accredited journals;
- A proven track record of acquiring research funding.

In your application, you are encouraged to highlight your strengths and also include anything else that you feel may be pertinent to the selection panel. Please attach your covering letter, a detailed curriculum vitae (that provides evidence for your teaching, post-graduate supervision, funding and publication track record, as well as the names and addresses of at least three referees) and highest qualification to your online profile. You are expected to be proficient in English. This is a full-time permanent appointment in the EWS Programme of the Earth Science Department of the Faculty of Natural Sciences. To be considered for this vacancy, you must click on the Apply for this Job link below or apply directly via UWC Careers at https://uwc.hua.hrsmart.com/hr/ats/Posting/view/688.

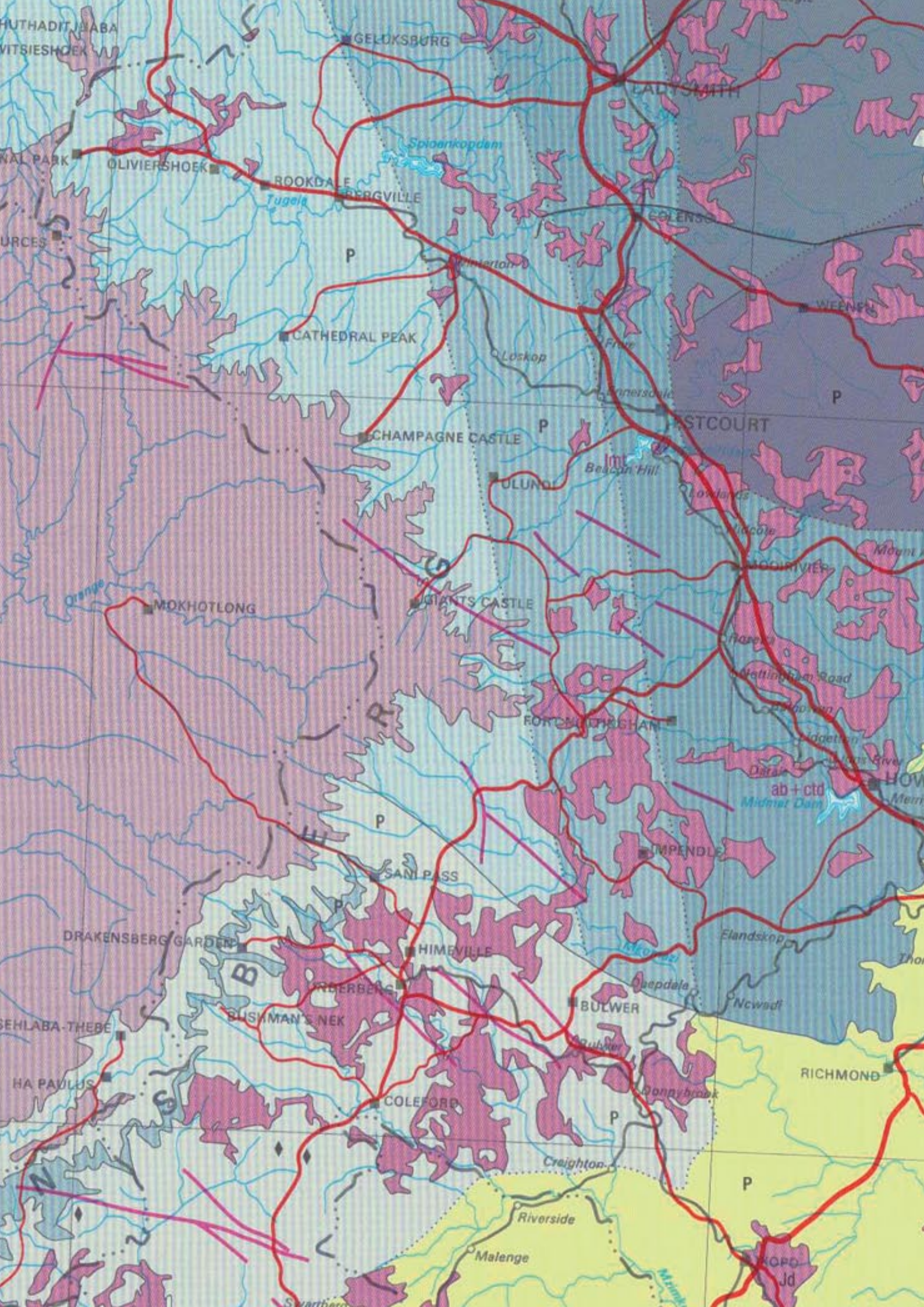
**Closing date for applications: 17. March 2019**

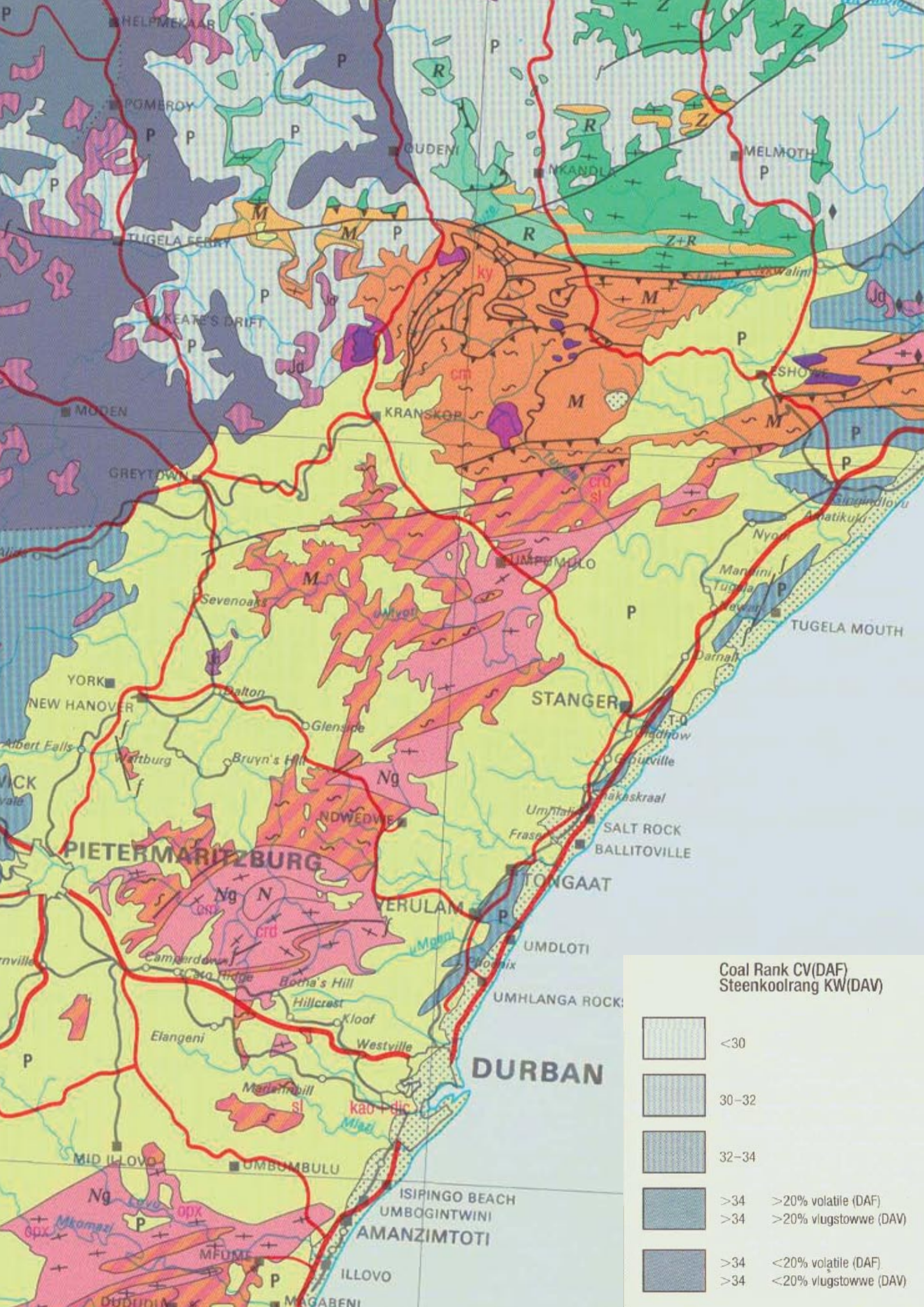
**Enquiries regarding this post:** Prof Dirk Frei, Head of Department, at +27 21 959 3881 or at dfrei@uwc.ac.za

For any other enquiries: please contact the Human Resources Department at +27 21 959 4063/9763/9708/3551/3756.

**Apply online at: https://uwc.hua.hrsmart.com/hr/ats/Posting/view/688**

**EQUITY DISCLAIMER:** In line with the University's commitment to diversifying its workforce, preference will be given to suitably qualified applicants in line with Employment Targets of the University. The University reserves the right to not make an appointment, make an appointment at a different level, seek additional candidates and may conduct competency assessments.


GELUKSBURG
OLIVIERSHOEK
ROOKDALE
BERGVILLE
Tugela
Spioenkopdam
CATHEDRAL PEAK
Loskop
CHAMPAGNE CASTLE
Beacon Hill
MOKHOTLONG
GIANTS CASTLE
Orange
IMPENDLE
SANI PASS
DRAKENSBERG GARDEN
HIMEVILLE
BUSHMAN'S NEK
BULWER
Elandskop
Ncwadi
RICHMOND
COLEFORD
Creighton
Riverside
Malenge
Mzimkulu
Nettingham Road
Midmar Dam
ab + ctd
P
R
B
S
N


HELPMEKAAR
POMEROY
GUDENI
NKANDLA
MELMOTH
TUGELA FERRY
KEATE'S DRIFT
MODEN
KRANSKOP
GREYTOWN
ESHOWE
UMPUMULO
Sevenoaks
YORK
NEW HANOVER
Dalton
Glenside
Albert Falls
Wartburg
Bruyn's Hill
NDWEDWE
PIETERMARITZBURG
Camperdown
Boma's Hill
Hillcrest
Kloof
Elangeni
Westville
DURBAN
Merebank
MID ILLOVO
UMBUMBULU
ISIPINGO BEACH
UMBOGINTWINI
AMANZIMTOTI
MFUME
ILLOVO
MAGABENI
TUGELA MOUTH
STANGER
Darnah
SALT ROCK
BALLITOVILLE
TONGAAT
VERULAM
UMDLOTI
UMHLANGA ROCKS
Nyoni
Mandini
Amatikulu
Coal Rank CV(DAF)
Steenkoolrang KW(DAV)
<30
30–32
32–34
>34 >20% volatile (DAF)
>34 >20% vlugstowwe (DAV)
>34 <20% volatile (DAF)
>34 <20% vlugstowwe (DAV)

# obituary

## Edward (Ted) Phillips Saggerson: 18-10-1924 – 03-02-2019 †

**EDWARD (TED) PHILLIPS SAGGERSON:**
**18-10-1924 – 03-02-2019**

It is with a deep sense of loss and gratitude that I pay tribute to the professional career of my late mentor, colleague and dear friend, Ted Saggerson: One of the finest gentlemen in Geology. An eminent academic and internationally renowned geologist, who was held in high regard by his peers, students, philatelists and anyone else who came across him. He had a remarkable career with many notable contributions to the geological sciences to his credit. He was elected as a Fellow of the Geological Society of London, a Life Fellow of the Geological Society of South Africa, and a Member of the Royal Society of South Africa.

Born in Newcastle-upon-Tyne in England, Ted's undergraduate studies were interrupted by the advent of war. He attended the Royal Military College (RMC) Sandhurst before joining in active service in Italy from 1943 to 1945 as an officer. His platoon was one of the first to cross the Arno River in Florence. As a budding scientist he recalled how he appreciated visiting the same cathedral where Galileo had his revelation that the earth moved around the sun.

**KENYA:** At the end of the war, he went on to complete (1949) his B. Sc. Honours degree at Kings College, Durham University, married Hilda and set off to Africa, aged 25, to take up a position in the British Colonial Office as a field geologist with the Geological Survey of Kenya. As one of a team of professional geologists he spent the next 14 years involved in the fundamental mapping of portions of the regional geology of Kenya, despite the Mau Mau rebellion.

In those days, before Landsat images, GPS, GIS and remote sensing techniques, only a few aerial photographs were available and geological survey work involved spending six months of the year geologically surveying a quarter degree sheet, an area of about 3 200 square kilometres, and living in a

tented field camp, with six field staff. A day in the field would include 20 – 30 kilometres of traversing, often on foot, taking notes, photographs and samples then writing up the results of that day's observations. This was followed by six months in the office preparing the map and writing up an illustrated report for publication before starting on the next sheet. He was frequently the first person to recognise and describe the geological features of Kenya and so provided the ground work for many later investigations.

He had to learn Swahili and had a number of encounters with remote tribal communities; and wild animals including the Big 5 which he describes vividly in his brief memoir left for his family.

"In Amboseli Reserve, near Kilimanjaro at 3 a.m. on a bright moonlight night, I was awakened by the approach of 50 elephants. They came into the camp to eat leaves from the giant acacias over our tents. I issued instructions for everyone to be totally quiet and remain

in their tents. My heart missed a beat when a huge bull stood at the entrance to my open tent, its scimitar-like tusks reaching the ground, unconcerned eating. The leviathan monsters eventually moved off. A survey the following morning revealed that the elephants had wandered through the camp but never once stepping on a guy rope."

Hyenas and leopards lurked in the dark beyond the thorny camp hedge, attracted by the scent of fresh game killed for the pot. And while mapping in an area which at that time boasted the highest population of black rhino in the world (no longer), he was charged twice a day for six weeks and became very adept at climbing/flying into a tree - and waiting until the rhino wandered off. On one occasion he and a staff member parted some bushes in search of a rock outcrop and found themselves face to face with a black-maned Masai lion, three metres away, sitting quietly and watching them, but having fed very well earlier that morning didn't think that they were worth bothering about. They retreated very gingerly.

Ted authored and co-authored eight regional geological maps with descriptions that included areas in the Great Rift Valley, the far NE corner of Kenya near the Somali border and the Nairobi area. Later he was responsible for compiling Geological Maps of Kenya, and of East Africa, and his pioneering work is still recognised and revered by the Kenyan Geological Survey.

In 1952 he was awarded his Ph. D. by UNISA based on the work carried out in the Kisumu area. In 1959 he and a colleague Brian Baker, added to the geological lexicon by identifying and describing a group of significantly different alkaline dykes which they named "Ngurumanite" after the Nguruman escarpment where they intruded Rift valley lavas.

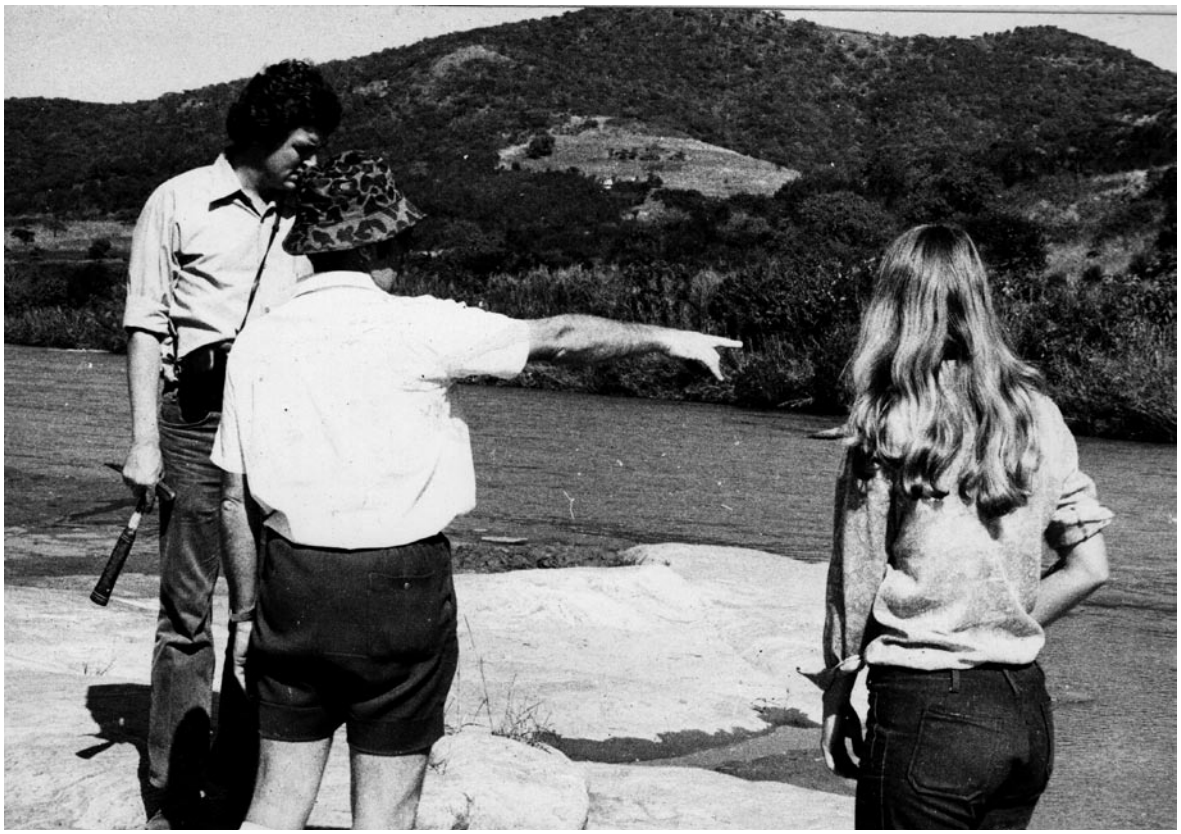
He completed his years of service in Kenya as Chief Geologist and Acting Commissioner of Mines and Geology in 1963, and at the age of 39, he moved with Hilda and their young family to Durban to take up a post as Senior Lecturer in the Department of Geology at the UNIVERSITY OF NATAL, DURBAN (UND) now the University of KwaZulu-Natal.

These early years as a classical field geologist laid a solid foundation for his credibility as a lecturer, supervisor and mentor and his subsequent illustrious research career. In 1965 he was awarded a D.Sc. by the University of Newcastle-upon-Tyne.

At UND, former students will remember that Ted's office with his nameplate on the door was opposite that of Professor Peter Matthews marking the main entrance of the imposing Memorial Tower Building. Together with John McCarthy they were the stalwarts of the Geology Department at UND for many years.

When I first met Ted in 1966 as a second year undergraduate, I was a rather intimidated by his steady sometimes stern blue gaze and brisk no nonsense demeanour. As our mineralogy and petrology lecturer he set a high standard; but at the same time he imbued his students with his enthusiasm and passion for geology. He taught by example the importance of correctly recording even the most mundane detail in the field and under the microscope as part of a bigger picture. His meticulous treatment of collected data was

☞



*Prof Ted Saggerson in The Valley of 1000 Hills Geology Field trip 1973 with Tony Cain and Wendy Edmonds (Photo from John Bristow)*

uncompromising and it paid off. From 1963 to 1975 he took students on the 2nd year field excursions and from 1976 to 1989 was involved in the 3rd year mapping programme.

He cared very deeply about his students, who referred to him affectionately as "Sag" (although they addressed him as "Prof") and keenly followed their progress. He was often a trusted advisor and supporter and enjoyed extremely good relationships with them, in particular the honours classes and post graduate students from the early 1970s and 1980s who participated in the National CSIR Geodynamics and NUCOR field mapping and research programmes which included projects south of the Tugela River, and from The Valley of 1000 Hills to Umzinto; and the Lebombo Mountains (Karoo Volcanics) from Empangeni to the Swaziland Border, and subsequently to the north end of the Kruger National Park and the Limpopo River.

Igneous petrology was a major research field in which Ted took a particular interest by virtue of his earlier work in the Rift valley. A number of students under his guidance made significant contributions to the understanding of Karoo vulcanicity in the Lebombo Mountains. In 1986 he published his popular textbook – "A Handbook of Minerals under the Microscope"which is still a useful aid to this day.

Many of his students went on to great achievements in their own careers and Ted took enormous pride in their successes. Several have themselves become professors of geology, world class researchers, leaders in the mining world and sought after consulting geologists working all around the world.

Three fossils bear his name - Gervillia saggersoni, a bivalve fossil, and Quenstedtia saggersoni, a gastropod fossil, both found in Kenya and named in 1965 by Dr Leslie Reginald Cox* a British scientist whom Ted never met. The third fossil is Megatrigonia saggersoni, a local fossil identified in the Makhatini Formation and named in 1993 by Dr M.R (Mike) Cooper**, a grateful student, and renowned palaeontologist.

**Cox, L.R., 1965. "Jurassic Bivalvia and Gastropoda from Tanganyika and Kenya", Bulletin of the British Museum (Natural History) Geology, Suppl. 1.*

***Cooper, M R, 2018. Cretaceous Fossils of South-Central Africa –An Illustrated Guide. E-book, CRC Press, London, 168 pages*

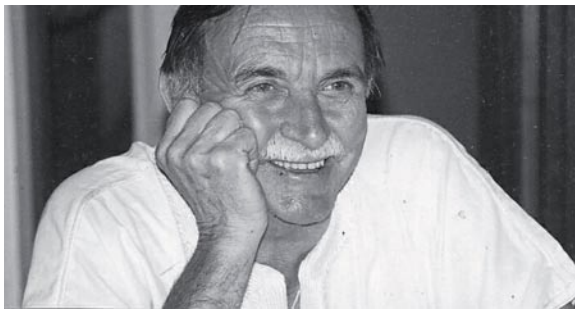
**RESEARCH PROGRAMMES:** From 1960 the nuclear age and space race were gathering momentum, and the geological world was caught up in great debates about the theory of Plate Tectonics as the unifying mechanism for mountain building, volcanic eruptions and earthquakes. New analytical technologies such as the radiometric dating of rocks were being refined. It was an exciting time to be participating in geological research.

Ted was essentially a petrologist with wide experience in both igneous and metamorphic rocks. He was also an experienced map maker so in 1967 he was invited by to be the Co-ordinator for Africa on the International Sub-Commission for the Cartography of the Metamorphic Belts of the World. When he asked me if I would like to be his research assistant little did I know then just how much that would impact my life for the next 20 years. It was an extraordinary experience. His knowledge, experience, prolific energy and relentless work ethic was impressive as we set to work, scouring the literature and contacting every source for geological information on each country, interacting with dozens of geologists from all over the world. Then we built up the map like a giant jigsaw puzzle, rigorously plotting the data and checking references. Ted was an exacting editor.

One image that sticks in my memory is of Ted with Prof Akiho Myashiro, the Japanese member of the Sub-Commission who visited Durban one year and joined Ted and his students on a field trip to the South Coast. Ted took off walking down the rocks on the beach at his usual brisk pace while Prof Myashiro struggled to follow him and kept muttering , "Datsun, datsun, datsun". I later discovered that "Datsun" in Japanese means "too fast".

The Metamorphic Map of Africa 1:5 000 000 was published by UNESCO in 1978 as a contribution to the Commission for the Geological Map of the World. From 1980-1986 we were contracted by for the Geological Survey of South Africa to compile an updated more detailed Metamorphic Map of South Africa 1:1 000 000 (1995). Also during this time Ted was invited to join the International Working Group 9 on Geodynamics and the International Atomic Energy Agency (Vienna) Working Group to study the distribution of uranium in South America and Africa. Maps were compiled and drawn, and the resulting volume of contributions from several members of the group was edited and published in 1986. He later undertook supervising the compilation of the Metamorphic Map of Namibia published in 1994. Bear in mind that these maps were largely compiled and drawn by hand with several colour overlays and without the aid of computer mapping programmes, GPS, GIS or Google maps.

These international research programmes required Ted to travel extensively to conferences, Sub-Commission and Working Group meetings in Europe, Russia, Canada, Australia, Brazil, Argentina and Africa. His extensive publications list includes 28 peer reviewed



papers plus several maps, books, chapters in books, articles, abstracts, guidebooks, and reviews.

Ted retired from UND in 1989 having also served as Acting Head of Department and Assistant Dean (Students) in the Faculty of Science. He continued to give lectures in metamorphic petrology to 2nd, 3rd year and Honours classes at the University of Durban Westville until 1994.

**HIS LEGACY:** A man with wide interests, he had a great appreciation of the natural world, the Arts and classical music and left behind far more than just his geological publications and the numerous successful geologists who have in turn left their imprint on society. He was a highly knowledgeable philatelist and earned international awards for his stamp exhibits in 2004 and 2010 and was recognised as a world authority on Bushire (in Iran) forgeries. He was also a fine sportsman, playing cricket as a capable bowler for the Kenyan Kongonis. A highlight of his cricketing years was when his team played against a combined South Africa-Rhodesian eleven including several test players, and the Kongonis won!. During retirement Ted was a member of a formidable bowls team in Durban.

Ted was a unique, multi-facetted person, a highly disciplined professional scientist, courageous explorer and classical field geologist, but also a considerate, generous, enthusiastic and knowledgeable gentleman, dedicated to Hilda and their family, his students, his community and his career. He had a calm positive attitude to life, a deep sense of service and great integrity. He took on every project and duty whole-heartedly, determined to excel at whatever he put his mind to. His rich legacy will endure in his publications but more importantly in the many geologists that he trained.

Sadly Hilda passed away in May 2018 after almost 70 years together and Ted missed her very much. To his daughters Veronica and Vivien and their families may we offer our heartfelt condolences. They were a great support to him and I doubt he could have achieved what he did without them and his great faith in the goodness and bounty of God. I would like to end with a quotation that Ted also liked.

***Shaping your stone*****

***Shaping your stone means quietly doing your job as well as you can. Your identity will soon be lost to history, but your stone, if well shaped and polished will fit into the structure we call civilisation and hold its weight as time sweeps past us, and others build upon us. History is full of greed, horror and the worst of mankind - but our humanness is built of well-shaped loving lives. What we do matters and if there is beauty in this world it is because many quiet souls have shaped their stones well and the cathedral of life is beautiful after all.***

*** Thomas R McGetchin (1936-1979), co-leader of the Basaltic Volcanism Study Project.*

With regards and appreciation, **Lesley Turner** with contributions from **John Bristow, Wendy Edwards, Phillip Paige Green, Ferdi da Silva-Perreria, Mark Lawless, Russell Sweeney, Stuart Comline, Richard Armstrong, Jock Harmer, Guy Charlesworth, Andy Duncan, Roger Gibson, Nick Norman, Bruce Eglington, Tony Tankard, Marco Andreoli, Tom Mason, Bob Thomas, Mike Cooper, Debbie Abel, Steve McCourt, Mike Watkeys, John Dunlevey** and many more.

Cretaceous Fossils of South-Central Africa
An Illustrated Guide
By Michael Robert Cooper
Edition 1st Edition
eBook Published 20 September 2018
Pub. location London
Imprint CRC Press
DOIhttps://doi.org/10.1201/9780429442971
Pages 168 pages
eBook ISBN 9780429810695
Subjects Bioscience, Earth Sciences

**DIRK KOTZÉ TOERIEN**
**15 October 1924 – 4 February 2019**

# Dirk Kotzé Toerien
# 15-10-1924 – 04-02-2019 †

I have written a number of obituaries through the years – sometimes of a colleague, sometimes of a relative, but this one touches me to the core, because the deceased was more than an acquaintance. To me he was a personal friend and my role model of a devout Christian and dedicated, brilliant but humble earth scientist. The pertinent dates and events of his life can be summarised as follows:
Born 15 October 1924 in Piketberg, Western Cape.
Matriculated from Piketberg High School in 1941 ("Cape Senior Certificate").

While working as a laboratory technician for the Roads Department in Grahamstown he met Audrey Avondale De Villiers and they got married on 20 December 1947. Four children, six grandchildren and 12 great-grandchildren (the 12th one on the 12th of February 2019) were eventually born from this happy marriage that lasted for 65 years:
Jeanette (25 January 1949 in Grahamstown)
Dawid (9 July 1953 in Lamberts Bay))
Dirk (30 April 1955 in Koekenaap)
Pierre (30 July 1959 in Windhoek).

Not long after Jeanette was born, he was transferred but his father-in-law, unwilling to part with his little granddaughter so soon, offered to pay for his Tertiary education at Rhodes University. This explains why a Piketberg boy ended up with BSc and BSc-Hons degrees from Rhodes.

D K Toerien (as he was known in the geological fraternity of the RSA and Namibia), was fondly called "Oom Toerien" by many of his friends and colleagues. He worked for the Geological Survey (GSSA) throughout his post-graduate career life, and wrote or co-authored many scientific papers. A number of these addressing the geology and mineralogy of the Western Cape became standard reference sources.

While based on the West Coast he conducted the field work that led to the publication of the 1:125 000 scale Geological map titled "3118C Doringbaai". Shortly after Dirk was born in 1955 he was transferred to Windhoek where he contributed immensely to our current knowledge of the geology of Namibia. I remember that while working as a student at the Geological Survey in Windhoek (the summer holidays of 1964, 1965 and 1966), I saw a copy of the treatise he compiled on the salt pans that occur along the West Coast – it compared favourably to any MSc thesis. About circa 1962 (I cannot recall the exact year) and while involved with geological mapping of the Kunene River valley and going on a leisurely stroll with his friend and colleague the legendary Dr Henno Martin on a Sunday afternoon, he discovered the world famous Swartbooisdrift sodalite deposit. Vehicle access to the deposit did not exist, and between the two of them they carried/dragged maybe 100kg or more of sodalite samples in an old skin they found, for a couple of kilometres over very rugged terrain. By the time they reached the camp (with vehicle access only from the other side) they were partly dehydrated and thoroughly exhausted; with dry white foam around their lips they simply plunged headlong into the Kunene and only after they recuperated somewhat they remembered

☞

that the river was infested with crocodiles, so they hastily made their way back to dry land again.

For the duration of 1963 he enjoyed a year's study leave to go to UCT to make and study thin sections in order to write up the geology of this world class sodalite deposit. He did the research diligently and meticulously, the hall mark of all his scientific endeavours. In the light of his experience and outstanding track record, UCT allowed him to enrol directly for a PhD. However, returning to Windhoek with stacks of interesting results, he was inundated by a huge backlog of work. His wife once complained to me that her husband was too honest – he just could not get himself so far as to work on his thesis while there were urgent tasks to attend to. Eventually he donated all his samples, thin sections, analyses and notes to a younger colleague who had the support of his office manager that allowed him to officially work on this information during office hours, enabling him to write the first geological account of this remarkable deposit.

The following contribution was received from emeritus professor I W Hälbich with whom the deceased worked for a number of years at the Geological Survey offices in Windhoek:

*"I met D K Toerien as my senior at the Geological Survey in Windhoek. He was a quiet, considerate, hardworking person with an unwavering faith in God.*

*Two aspects from that era come to mind:*
*It was his unenviable task to introduce me as an inexperienced Sedimentologist to the oldest meta-sediments and gneisses (pre-Damaran Age) in the Rehoboth District. At another occasion the two of us spent a couple of days in a chartered small double decker aircraft criss-crossing the table top Berseba landscape north of Keetmanshoop taking oblique aerial photographs (no good aerial photographs available in the market place those days) in an effort to identify significant master joint systems, contacts, cracks, dykes and faults which could subsequently be ground-truthed in the search for suitable drill sites to assist with the exploitation of ground water for the development of this vast region. Every 3 – 4 hours we had to extend the east-west survey and descend to a farmhouse with landing strip down at the foot of the escarpment for refuelling. The escarpment in that region comprised formidable vertical cliffs. At one stage, as the pilot negotiated the difference in altitude between the high plateau and the landing strip on the plain below, a sudden up draught from the cliffs hurdled us back and upwards to a position high above the plateau – a hair raising experience after we've just spent a couple of hours experiencing sharp turns and tilting, trying to get the best camera exposures with the available sunlight".*

D K Toerien was transferred from Windhoek to Grahamstown in July 1966, then to Mossel Bay in March/April 1973. Six years later he was transferred to Port Elizabeth where he retired late in 1984. During his time in the Eastern Cape he made huge contributions to our knowledge of the regional geology of that region. Among other duties he revised and updated the 1:250 000 Geological sheets of Port Elizabeth and Oudtshoorn, including re-writing the Explanations for these sheets. He also wrote a special report on the geology of the Addo Park that was published in Kudu, the bulletin of the National Parks Board.

Robbie Hill, who succeeded the deceased as head of the Port Elizabeth office of the Geological Survey at the beginning of 1985 reminisced: *"His last task was to take me on a two-week field excursion in order to acquaint me with the area. For the first night he had booked us in at a hotel, but that night at the dinner table it came to light that he did it on my behalf, while both of us actually preferred the field life. The rest of the trip we enjoyed the nightly camp life and wonderful conversations – he with his customary bedtime drink, jelly powder dissolved in hot water. As for his career, we must bear in mind that he hailed from an era when geologists were not so specialized; as "Jack of all Trades" in the geological arena he conducted many investigations for the State, including economic investigations, studies germane to the structural geology of areas where new dams were to be constructed, regional geology etc. This comprised many detailed investigations meticulously recorded on maps and in text that were never published, but used internally by different Government departments and their consultants. Therefore a list of publications cannot even remotely do justice to his contribution towards the geological endeavours of his generation".*

After his retirement they moved to Jeffrey's Bay until November 1995, when they relocated to Mossel Bay. In 2012 his wife passed away and two years later he moved to Nelspruit where he stayed with his eldest son, pathologist Dawid and daughter-in-law Susan. They were all together on a holiday visit in Mossel Bay when he suffered a stroke on 30 January 2019, and passed away 5 days later. His memorial service (6 February 2019 in Mossel Bay) was conducted by his youngest son, Pastor Pierre Toerien.

Having had the privilege of knowing this remarkable man personally made an indelible imprint on my mind. In the late 1950'ies when I was still a teenager he explained in a few words to me why there is no real abyss between the Bible and science, and his impeccable life and career inspired me to become a geologist. Due to the close friendship between my late parents and the Toeriens I was often asked in my teens to go and stay with his family during his extended periods of field work (especially the Kaokoveld) in the service of the Geological Survey.

One incident in particular emphasized his integrity and character: They had a very accomplished and reliable domestic servant who, with her husband stayed in a flatlet at the back of the house. From time to time this woman's husband physically assaulted her. One day, upon his returning home "Oom Toerien" was informed that Johannes had once again maltreated his wife very badly. He walked around to the flatlet and finding Johannes reclining on the bed, said to him: *"I understand that you have the habit of beating your wife? Today I'm going to do some beating, and you will feel what it is to be beaten. I am going to teach you a lesson that you will never forget; but get up onto your feet, for I do not hit a man that is lying down!".* Johannes was wise enough to stay down, but as far as I know he never assaulted his wife again.

In the church pastored by my late father in Windhoek (February 1957 to October 1961) D K Toerien was a real pillar of strength and Godly wisdom, and at the Geological Survey he received a number of citations for outstanding work.

While closing the curtain on the life and work of Dirk Kotzé Toerien, I am reminded of two aspects:

1. I was born in 1942 and after WW2 my aunt visited us from Johannesburg while we were living in the Karoo town of Graaff Reinet; she brought with her something that we have never seen or heard of before: a gramophone and a couple of records. As children we marvelled at this gadget that could bring forth the voices of people that sang in places far away. On each record was a picture of a Fox Terrier sitting on his haunches listening intensely to a gramophone recording, and the subscript became the Trade Name of the organisation that sold the records, namely "His master's voice".
2. In his letter to the Colossians (Col. 3:23) the apostle Paul instructed the Christian church – among other – as follows: "And whatsoever ye do, do it heartily, as to the Lord, and not unto men".

If I am to summarise the life and work of Dirk Kotzé Toerien, I only need to say: "He conducted his work and personal life as if he did it for the Lord, while paying close attention to his Master's voice".

A man among us men has departed, but his legacy will continue to serve the economic and regional geology of southern Africa, and his example will continue to guide us in our daily lives.

We honour his remembrance and with his children, grandchildren and great-grandchildren, as friend and colleague we will miss him dearly. And I just know that, had he been in a position to respond to this Obituary, it would have been with that characteristic shy, humble smile together with the words: "Soli Deo Gloria!".

**Assie Van der Westhuizen**

(With gratitude for contributions from his children and colleagues, especially **George Olivier**, Snr Technical Officer, Department of Earth Sciences, Stellenbosch University who travelled from the campus to Uniepark to collect Professor (emeritus) I W Hälbich's contribution and mail it to me, saving me the +70km drive from Pringle Bay to Stellenbosch).

# mineral scene

## Pyrite, Witwatersrand goldfield South Africa

**Bruce Cairncross**
Department of Geology
University of Johannesburg
PO Box 524
Auckland Park 2006
brucec@uj.ac.za

### Introduction

Pyrite $FeS_2$ is one of the most common sulphides and occurs in a variety of economic deposits as well as a disseminated mineral in many rock types, such as sandstones and black shales. Pyrite has long been known as 'fool's gold' due to its superficial resemblance to gold, although the latter might also crystallize in the cubic system, gold is denser, malleable and exhibits a different lustre to that of pyrite. Even so, sporadic reports surface of new 'gold' deposits being found triggering a frenzy of activity, such as the recent one in 2018 near Harding in KwaZulu-Natal, which, as is often the case, turned out to be worthless pyrite. But not all pyrite is valueless, a case in point being the pyrite associated with the gold mineralization in the Witwatersrand goldfield and the mineral has been the focus of numerous studies as to its origin and formation.

### Mineralogy

Pyrite crystallizes in the cubic system, with simple cubes and dodecahedrons being the most common forms. A world-famous specimen-producing pyrite locality is the Ampliación a Victoria mine, Navajún, La Rioja in Spain (Moore, 2016). This deposit hosts what are arguably the finest cubic pyrite crystals known, with individual cubes up 20 cm on edge and weighing almost 20 kg (https://www.mindat.org/loc-7116.html ). An example of one of these pyrite crystals is shown here (figure 1).

The Witwatersrand goldfield pyrite is far less spectacular with respect to form and size. Euhedral crystals are only ever found in secondary features such as dykes, faults or veins (figure 2), while the bulk occurs within the gold-bearing conglomerates. One of the forms is so-called 'buckshot' pyrite (figure 3), rounded to subrounded smooth pyrite grains that are sedimentary reworked pyrite and dispersed in the matrix of conglomerate (see for example Guy et al., 2014). Individual buckshot pyrite grains can be up to a few centimetres in diameter although most tend to be smaller. One of the direct lines of evidence for a detrital origin of the Witwatersrand pyrite is the rare occurrence of preserved pyrite cascading down and preserved on the prograding foresets of cross-bedding. One such example is shown on the cover of this issue (figure 4).

References

Guy, B.M., Onon, S., Gutzmer, J., Lin, Y. and Beukes, N.J. (2014). Sulfur sources of sedimentary "buckshot" pyrite in the auriferous conglomerates of the Mesoarchean Witwatersrand and Ventersdorp Supergroups, Kaapvaal Craton, South Africa. Mineralium Deposita, 49:751-775.

Moore, T.P. (2016). Moore's compendium of mineral discoveries 1960-2015. Mineralogical Record Inc., Tucson Arizona, USA, 813 pages.

*Figure 1. A perfect 3.5 cm cube of pyrite from the famous deposit in Rioja, Spain. The crystals nucleate in grey-green marl and are easily freed from the matrix. Bruce Cairncross specimen and photo.*

*Figure 2.*
*An 8.5 cm cluster of secondary (hydrothermal) pyrite from Free State Geduld gold mine, Witwatersrand goldfield. Bruce Cairncross specimen and photo.*

*Figure 3.*
*Close-up of a layer of rounded 'buckshot' pyrite from the 'B' Reef, No. 7 shaft, Freddies gold mine, Free State Province. The largest grain is 1.8 cm in length. Bruce Cairncross specimen and photo.*

*Figure 4.*
*Layers of pyrite in the quartz pebble conglomerate reef from the Vaal Reefs gold mine, Witwatersrand goldfield. The pyrite is present as inclined layers of detrital pyrite on the foresets of cross-bedding. The 13.5 X 12 cm specimen is polished and photographed in direct reflected light to highlight the pyrite layers.*
*Bruce Cairncross specimen and photo.*

Methana Peninsula, Greece

# THE GEOTRAVELLER

**By Roger N Scoon**

## Geology of the Methana Peninsula, Greece:
*Volcanism in the Peloponnese*

*The town of Methana nestles on the lower slopes of rugged volcanic hills, typical of the western shores of the Saronic Gulf. Discolouration in the harbour is related to hot water with gas bubbles discharged from geothermal springs.*

*Methana is located on the east coast of the Peloponnese, in the southern part of Greece. The Methana Peninsula projects northward into the Saronic Gulf, connected to the Peloponnese by a narrow gooseneck. The Peloponnese is also a peninsula, separated from the central part of Greece by the Isthmus of Corinth. The Peloponnese has a rugged, mountainous interior and deeply indented coast. Methana has a similar topography, but the geology reveals an active or dormant volcanic complex, rather than Mesozoic metasediments. Geothermal activity includes hot springs and gas exhalations.*

*The Methana Volcanic Complex is dominated by a series of discrete lava domes, with subordinate flows and volcaniclastics. A historic eruption was observed during Roman times from Athens, which is located on the eastern shores of the Saronic Gulf. Methana and the Sousaki Volcano located near Corinth are the principal manifestations of the Hellenic Volcanic Arc on the mainland of Greece. This curvilinear feature also incorporates the active and dormant volcanism on the islands of Santorini and Milos in the Cycladic archipelago. Two islands in the Saronic Gulf, Aegina and Poros, reveal extinct volcanism associated with the arc.*

*The Saronic Gulf (also known as the Saronikos Gulf) is a large embayment of the Aegean Sea. Quaternary volcanism in the Aegean and associated areas results from subduction of the African Plate beneath the Aegean microplate (Le Pichon and Angelier, 1979). The volcanism has migrated southward since the Miocene, from northern Greece to the southern Aegean, as described by Fytikas et al. (1984).*

*Methana can be reached from Corinth by a winding road with sections of spectacular corniche following*

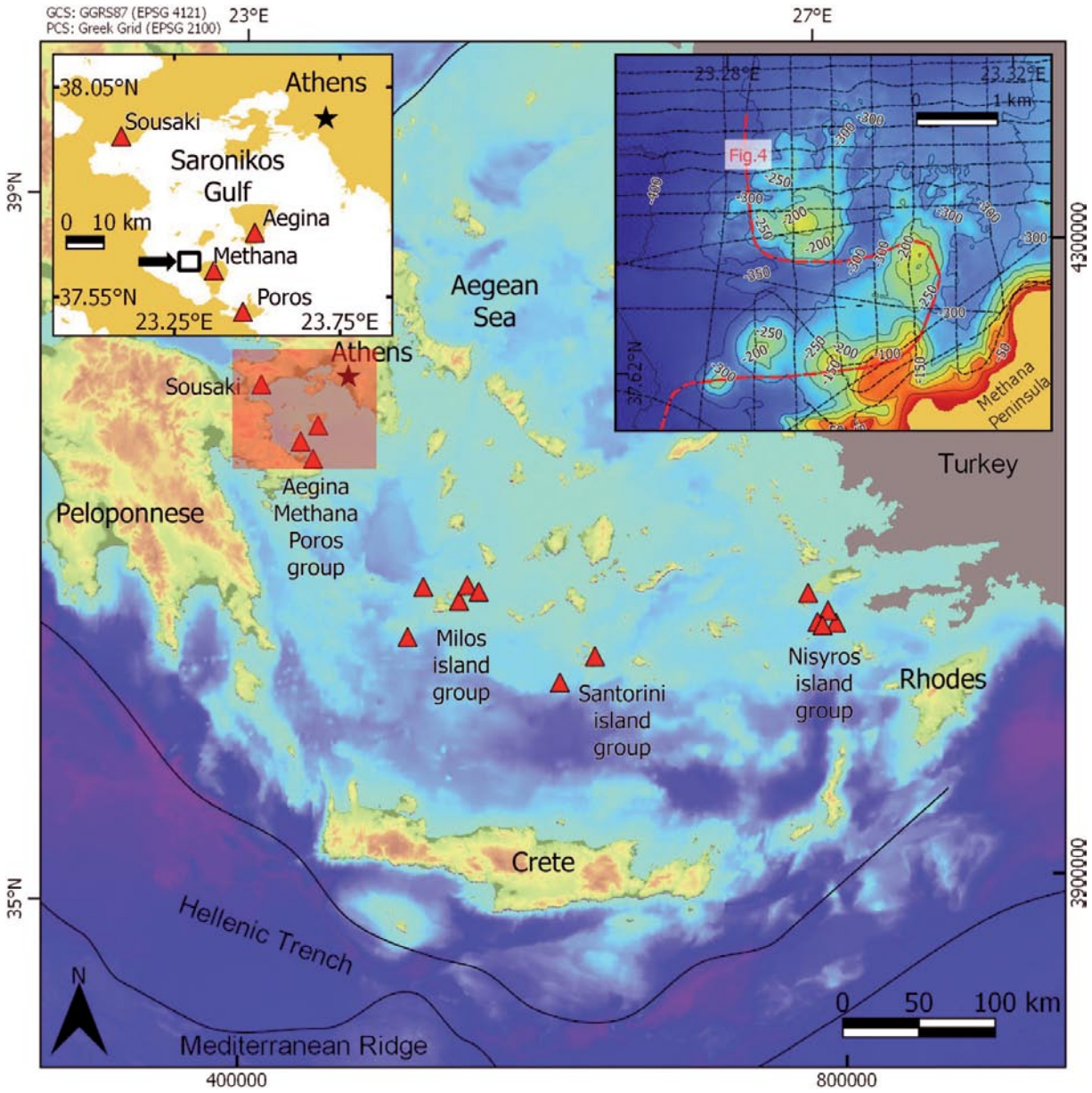
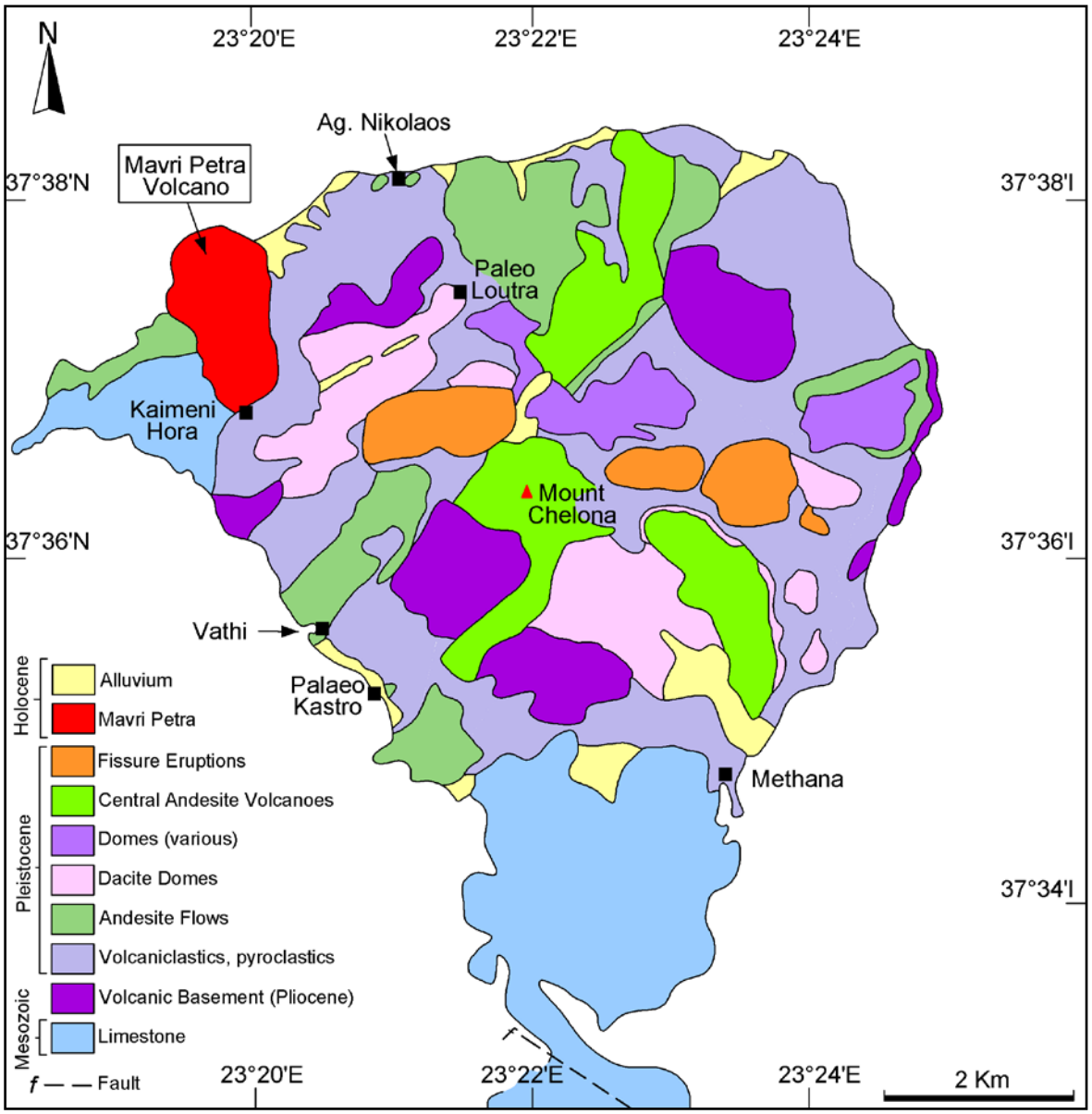



*Image from Foutrakis and Anastasakis (2018) showing the principal volcanic centres of the Hellenic Volcanic Arc. Inset (left) shows location of the volcanic centres of Methana, Poros, and Aegina. Inset (right) shows bathy-morphological setting of the submarine Pausanias volcanic field on the northwestern coast of the Methana Peninsula (near the village of Vathi).*

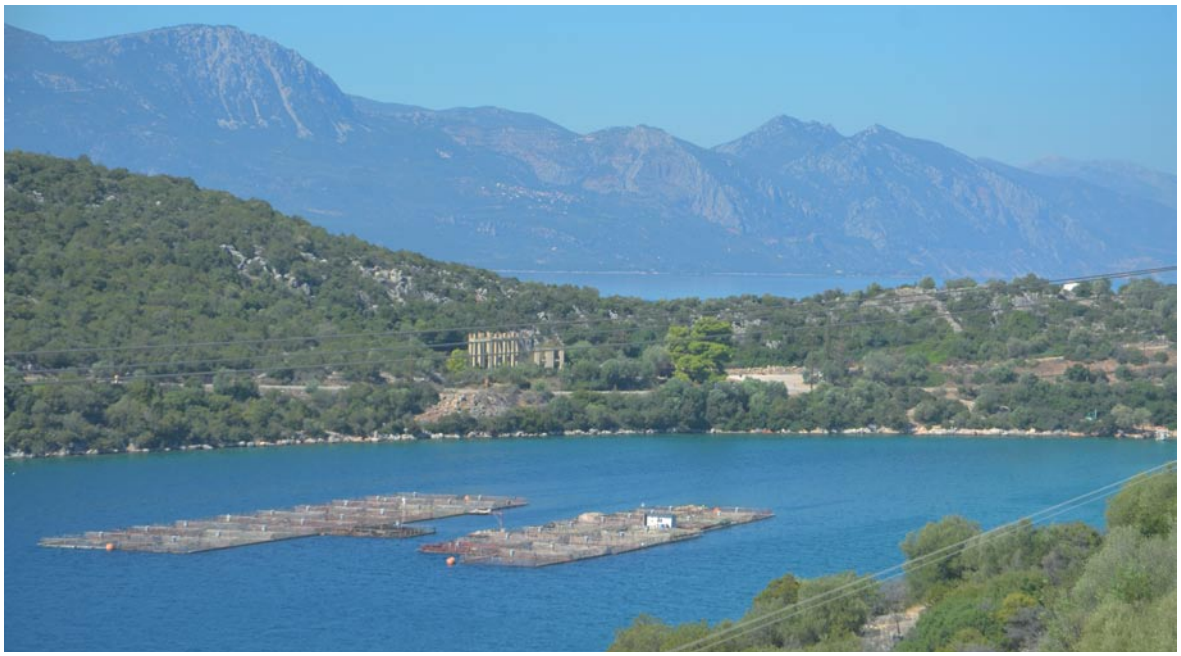


*the precipitous coastline on the western shores of the Saronic Gulf. This route is immortalised in mythology by the six labours that Theseus faced on his epic journey from Troezen to Athens. Troezen is the birthplace of Theseus, located a few kilometres inland from Methana. The rock Theseus was required to lift prior to starting his journey can be observed here. The historical site is spread over several square kilometres at the foot of a rugged mountain range comprised of Mesozoic limestone with belts of marble and schist. This area is part of the NW-SE aligned Parnassus tectonic zone which is linked to the mountains of northern Greece. Located above the historical site of Troezen is the "Devils' Bridge, a natural spur of limestone spanning a narrow gorge. The gorge has developed on the contact between limestone and schist; the latter contains boudinaged bodies of marble.*


*The limestone rock at Troezen that Theseus lifted prior to commencing his epic journey to Athens.*




*Geological map of the Methana Peninsula simplified from Pe-Piper and Piper (2013), which in turn was based on mapping of Gaitanakis and Dietrich (1995).*



*View looking west over the Isthmus of Methane towards the mountainous terrane (mostly Mesozoic limestone) typical of the Peloponnese.*

*Sub-horizontally layered dacitic ashes and pyroclastics are exposed in the southwestern part of the Methana Peninsula.*

*A simplified map illustrates the principal geological features of the Methana Peninsula. The narrow, 300 m-wide isthmus is comprised of Cretaceous-age limestone with minor conglomerate. Triassic- and Jurassic-age limestones occur in the northwestern part of the peninsula. The volcanic complex is situated above an older volcanic basement. The complex is comprised of more than thirty discrete volcanic centres, including a group of large lava domes, together with subordinate flows. The domes and flows are enclosed by an extensive belt of volcanic ash with pyroclastics and volcaniclastics. The ash and pyroclastic deposits unconformably overlie the limestone basement. This feature is clearly exposed in the southwestern part of the peninsula, in a road cutting south of Palaeo Kastro. A thick sequence of sub-horizontally bedded dacitic ashes, with a distinct brick-red colouration can be observed here.*

*Most of the volcanic activity at Methana occurred during the past 1-2 Ma, although the volcanic basement is a Pliocene feature (Pe, 1974; Fytikas et al., 1988; D'Alessandro et al., 2008). The map legend depicts the relative ages of some of the volcanic products identified by Pe-Piper and Piper (2013). Magmas are thought to have propagated on faults sea, forming the graben related to the Saronic Gulf (Pe, 1974). The Pleistocene experienced intense, bimodal activity with eruption of andesitic and dacitic magmas, i.e. typical of the arc-related setting (Pe, 1974). Lava domes and andesite flows reveal diameters and lengths of a few kilometres. The domes are generally*

*View of the rugged western side of the Methana Peninsula typical of the volcanic complex.*

*associated with high relief, including the rugged landforms on the western side of the peninsula. The highest point of the Methana Peninsula is Mount Chelona (742 m), a large Pleistocene-age lava dome. The village of Paleo Loutra in the northeastern part of the peninsula hangs on the precipitous slopes of a particularly large lava dome. The mantling deposits of ash and pyroclastics, however, are generally associated with areas of low relief.*

*According to Pe-Piper and Piper (2013), the Pliocene volcanics were emplaced along N-S striking listric faults during E-W extension. The initiation of NE-SW crustal scale strike-slip faults in the Early Pleistocene, the peak of the collision between the Aegean microplate and the African Plate, triggered more intense, explosive volcanism. The volcanism of the Late Pleistocene and Holocene is controlled by E-W striking faults.*

*The scenic village of Agios Nikolaos occurs at the foot of a large lava dome in the northern part of the Methana Peninsula. The resilient nature of the andesite and dacite lavas makes them suitable for building purposes and many of the dry stone walls are built of blocks of dark green-grey andesite and red dacite. The andesite and dacite contain phenocrysts of white or pale grey plagioclase. The harbour wall at Agios Nikolaos is constructed of blocks of both lava-types, together with blocks of andesitic agglomerate.*

*The village of Agios Nikolaos in the northeastern part of the Methana Peninsula is located at the base of thickly vegetated hills associated with Pleistocene-age lava domes.*

*Boulders of andesite (dark grey-green) and dacite (red) can be examined in the seawall at Agios Nikolaos.*

*Blocks of andesitic agglomerate at Agios Nikolaos reveal plagioclase laths (white) and small volcanic bombs.*



*The most recent evidence of volcanism in the Methana Peninsula occurs in the northwestern part, near the village of Kaimeni Hora ("Burnt Village"). The village is situated at the foot of the Mavri Petra Volcano, which includes a prominent andesitic dome and lava flow (Pe, 1974). The main eruptive phase is dated at 0.2 Ma (Pe-Piper and Piper, 2013). Initial activity was centred on a near-surface lava dome which collapsed to form a crater (Hurni et al., 1993). The crater overflowed to produce a lava flow with a length of 2 km, width of 1 km, and thickness of up to 150 m. The lava spread down the eastern slopes of the dome towards the sea, forming a dark swathe on the slopes above the village. The historic eruption at Mavri Petra was described by Strabo as occurring between 276 and 239 BC (Strothers and Rampino, 1983). An age of 260 BC with an error of 30 years has been determined for this activity. This eruption may be correlated with Greenland ice cores with anomalous contents of sulphuric acid. Higgins and Higgins (1996) have suggested there may be a correlation with the unusually cold winter of 270-269 BC experienced in Rome.*

*Andesitic lava flow associated with the historical eruption of the Mavri Petra Volcano forms a dark swathe on the hill slopes above the village of Kaimeni Hora.*


*The trail to the summit of the Mavri Petra Volcano is well signposted.*

*The bulk of the lava dome and flow at Mavri Petra ("The Volcano") which is now a popular tourist destination, is poorly vegetated, indicative of the recent nature of this activity. A well-defined trail can be followed to the upper slopes of the lava dome. The lower slopes are dominated by andesitic lava and agglomerate, with the upper slopes comprised largely of agglomerate and cinder. Some of the agglomerate and cinder blocks near the summit are sufficiently large, and loosely assembled as to enclose sizeable caves.*

*The andesitic dome is poorly vegetated.*

*The upper slopes of the Mavri Petra Volcano are dominated by large blocks of agglomerate and cinder.*

*Recent deposits of alluvium (right) and volcaniclastics, the latter containing large boulders (left), occur on coastal cliffs north of the town of Methana.*

*The small tourist village of Vathi on the west coast of the Methana Peninsula lies adjacent to an anomalously deep section of the Saronic Gulf. The seabed drops steeply close to the harbour. High-resolution imagery, part of a survey of the Saronic Gulf (inset to the location map) reveals the bathy-morphological setting of the Pausanias submarine volcanic field (Foutrakis and Anastasakis, 2018). The seabed in this area has a rugged morphology with cone-shaped features (lava domes?), similar to the onshore topography. There may have been a small, offshore eruption in this area at approximately 1700 AD.*

*The town of Methana is situated in the southeastern part of the peninsula near the contact between limestone bedrock and the younger volcanics. Recent deposits of volcaniclastics and alluvium occur on sea-cliffs to the north of the town. Methana is named for the gas emissions and hot springs. A tourist centre with open-air pools has been developed on the largest spring. A strong odour permeates the seafront and hot spring waters discolour parts of the harbour. Post volcanic activity, as manifested by geothermal springs, also occurs in the northern part of the peninsular (D'Alessandro et al., 2008).*

*The town of Poros is situated on a volcanic peninsula separated from the mainland by a narrow strait.*

*The island of Poros to the south of the Methana Peninsula is separated from the Peloponnese by a narrow channel. Despite catering to mass tourism the principal town of Poros is very scenic as it is situated on a peninsula of volcanic lava. The bulk of the island consists of Mesozoic-age limestone. The volcanics at Poros Town have been dated at 3 Ma. They have a similar age to the more extensive volcanism on the island of Aegina (Fytikas et al., 1988). The dominant lithology of the volcanism at both Aegina and Poros is andesitic lava with phenocrysts of plagioclase.*

*Methana and surrounding areas are well known tourist destinations and there is increasing awareness of the potential for geotourism. The peninsula includes archaeological and historical sites. The area was settled at approximately 6,000 BC, although inhabitation may date to 10,000 BC. Mycenaean-age settlements (1500-1200 BC) have been excavated near the town of Methana. The ancient acropolis of Palaeo Kastro is constructed of blocks of andesitic lava. Many of the steep mountain slopes on the peninsula host a diversity of flora, including endemic species related to the volcanic soils. Some plants were historically significant for medicinal usage and there is specialized tourism in this regard.*

***All photographs by the author***

*The archaeological site of Palaeo Kastro occurs on a prominent outcrop of andesite.*

**References**


1. *D'Alessandro, W., Brusca, L., Kyriakopoulos, K., Michas, G., and Papadakis, G. (2008). Methana, the westernmost active volcanic system of the south Aegean Arc (Greece): Insight from fluids geochemistry. Journal of Volcanology and Geothermal Research, 178(4), 818–828.*
2. *Foutrakis, P.M. and Anastasakis, G. (2018) Bathy-morphological setting of the Submarine Pausanias Volcanic Field, South Aegean Active Volcanic Arc, Journal of Maps, 14:2, 341-347.*
3. *Fytikas, M., Innocenti, F., Manetti, P., Peccerillo, A., Mazzuoli, R., & Villari, L. (1984). Tertiary to Quaternary evolution of volcanism in the Aegean region. Geological Society, London, Special Publications, 17(1), 687–699.*
4. *Fytikas, M., Innocenti, F., and Kolios, N. (1986). The Plio-Quaternary volcanism of Saronikos area (western part of the active Aegean volcanic arc). Annales Geologiques Des Pays Helleniques, 33, 23–45.*
5. *Gaitanakis, P. and Dietrich, V. (1995). Geological map of Methana Peninsula, 1:25 000. Zurich: Swiss Federal Institute of Technology.*
6. *Higgins, M.D. and Higgins, R. (1996). A geological companion to Greece and the Aegean. Cornell University Press, New York, 240 p.*
7. *Hurni, L., Dietrich, V.J., and Gaitanakis, P. (1993). Computer-aided geological cartography: 3-dimenisonal modelling of the Methana Volcanoes. Bulletin of the Geological Society of Greece 2893), 515-518.*
8. *Le Pichon, X. and Angelier, J. (1979). The Hellenic arc and trench system: a key to the neotectonic evolution of the Eastern Mediterranean area. Tectonophysics 60, 1–42.*
9. *Pe, G.G. (1974). Volcanic rocks of Methana, South Aegean Arc, Greece. Bulletin Volcanologique 38, 270-290.*
10. *Pe-Piper, G. and Piper, D.J.W. (2013). The effect of changing regional tectonics on an arc volcano: Methana, Greece. Journal of Volcanology and Geothermal Research, 260, 146–163.*
11. *Strothers, R.B. and Rampino, M.R. (1983). Volcanic eruptions in the Mediterranean before AD 630 from written and archaeological sources. Journal of Geophysical Research 88, 6357-6371*

# GSSA events 2019

**GSSA Events from January 2019 – November 2019**

| Date | Event | Venue |
|---|---|---|
| 25 January | CPD Workshop | Mandela Mining Precinct, JHB |
| 20 – 22 February | Drilling Methods in Johannesburg | Mandela Mining Precinct, JHB |
| 28 March | SAMOG Compliance | NH The Lord Charles Hotel, Cape Town |
| 12 April | Geophysics Workshop | Mandela Mining Precinct, JHB |
| 25 – 26 April | Coal Day Evaluation of Coal Data | Glenhove Conference Centre |
| 09 May | Core Logging | Mandela Mining Precinct, JHB |
| 16 - 17 May | SAMREC Compliance and Reporting | Glenhove Conference Centre, JHB |
| 27–29 May | Economic Evaluation of Mineral Deposits | Glenhove Conference Centre, JHB |
| 13 June | Critical Metals | Glenhove Conference Centre, JHB |
| 18 July | The Internet of Things and Data AGM | Glenhove Conference Centre, JHB |
| 14 – 16 August | Geoskills | Glenhove Conference Centre, JHB |
| 22 – 23 August | Structural Geology for the Mine Geologist and Structural Modeling | Glenhove Conference Centre, JHB |
| 18 - 20 September | Drilling Methods | Avianto Muldersdrift / Rustenburg |
| 10 – 11 October | Iron and Manganese Day | Northern Cape |
| 20 – 23 October | 16th Groundwater Division Conference and Exhibition | Port Elizabeth |
| 31 October – 01 November | Geochemistry in Exploration | Glenhove Conference Centre, JHB |
| 13 November | Fellows Dinner | Johannesburg Country Club, Woodmead |
| 14 -15 November | Technology Day African Exploration Showcase | Glenhove Conference Centre, JHB |

Sponsorship Opportunities

For those wishing to benefit from this opportunity to increase your visibility and gain access to your target markets please click on the following link: https://www.gssa.org.za/wp-content/uploads/2019%20Event%20Sponsorship%20Prospectus.pdf which will take you to our Sponsorship Prospectus which lists the various sponsorship opportunities. If you wish to confirm a sponsorship selection please click here https://www.cognitoforms.com/GeologicalSocietyOfSouthAfrica/_2019EventSponsorshipCommitmentForm

# classifieds

# classifieds

# classifieds

# ECONOMIC EVALUATION OF MINERAL DEPOSITS

**27th - 29th May 2019**
**THE WANDERERS CLUB, JHB**

> "I especially liked that the application of the course went beyond the Mining industry. Matt is attentive and passionate. It gets a participant eager to learn and participate -Past Delegate"

## MATT MULLINS

Matt Mullins is currently Head of Business Excellence & Capital Allocation for ArcelorMittal, based in London. He has +35 years' experience in the Minerals industry, including as an entrepreneur, as Vice President for Mineral Resource Development for BHP, as Consulting Geologist for Randgold, as a mine and exploration geologist for Goldfields, and as a mining analyst on the JSE. He has worked throughout the globe on most major commodities, from exploration to production.

This Workshop has been sponsored by ArcelorMittal Mining UK

## ABOUT THE COURSE

The Geological Society of South Africa is pleased to announce that Matt Mullins, Head of Business Excellence and Capital Allocation for ArcelorMittal, will be presenting his highly successful Economic Evaluation of Mineral Deposits Workshop. By request, this Workshop will be held over three days, from the 27th to the 29th May, 2019. This short course will be of interest to Geologists, Mining Engineers, Project Managers and Students who would like to understand financial modelling.

## KEY TOPICS

Day 1 - Introduction to Financial Modelling, hands-on model construction and development of financial metrics.
Days 2 and 3 will be more advanced, and will include detailed spreadsheet analyses of practical gold, platinum, coal and iron ore examples.
Delegates will be requested to submit and discuss burning valuation questions.

**Registration fee per day:**
**Members - R2200.00**
**Non-members - R2500.00**
**Academics/Registered students: R1500.00**

*Numbers will be limited on a first come first served basis.

Tecoma STRATEGIES

GSSA Geological Society of South Africa

ArcelorMittal

**CPD POINTS APPROVED**
**FOR MORE INFORMATION CONTACT:**
**info@tecomastrategies.com**


# 20-23 OCT 2019
# GROUNDWATER CONFERENCE

16th GWD Groundwater Conference & Exhibition

## Port Elizabeth, Eastern Cape, South Africa

The Ground Water Division of South Africa and its Eastern Cape Branch invite **businesses, universities, municipalities, water authorities and the private groundwater users** to join us in discussing and addressing these critical issues. Come and share your knowledge, your products, and your experience; or come and gain vital exposure and knowledge that you can take back to your clients or your business partners to be more water prepared!

**Groundwater** has proven to be a reliable **source** for decades, within the agricultural sector as well as the municipal sector, but the recent droughts in South Africa have prompted an explosion of private drilling in residential erven. Private groundwater usage has therefore increased beyond the point where it can be managed by the water authorities or even the private users themselves. Water quality, availability and sustainability are therefore key issues to consider when trying to protect this vulnerable and limited resource.

**Conservation** has become a key word where water scarcity is experienced. Cities/ towns throughout South Africa had to impose water restrictions, but also made progress in making people aware of the need to use less water. Educational programs have been put in place to educate the water user to adjust usage of water according to the availability thereof. Gone are the days where increasing water demands are being met with increased source development, as there are simply no more sources to develop. We simply need to use less water and use it more efficiently.

**Surety of water** supply is suddenly not a given. Large-scale developments for housing, hospitals, clinics, etc. must now first consider the long-term availability of water and surety of supply before they can implement their planned developments. This places tremendous pressure on water service providers and water authorities as groundwater is a complex, hidden source and requires intense scientific research, management and monitoring to fully understand.

## MAJOR THEMES

### Fundamentals of **Groundwater Drilling**

site selection, borehole construction and depths, pump testing, water quality testing.

### Fundamentals of **Groundwater Management**

Recharge versus abstraction, groundwater monitoring, co-operation between private groundwater users and the water services providers/ authorities.

### Fundamentals in **Water Conservation**

Bridging the gap between water availability and water use, efficient water usage (hardware and user education), addressing user expectations versus water availability.

### Fundamentals in **Water Surety/ Security**

Key aspects to be aware of when your business, enterprise or institution absolutely depends on the constant availability of water; in-depth look at current shortfalls in scientific research into water surety.

# rates card 2019

excl VAT & commission

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

Geobulletin is published by the Geological Society of South Africa (GSSA) and appears quarterly during March, June, September and December each year.

**Black & White**

| Size | Casual 1-3 insertions | 4+ Insertions |
|---|---|---|
| Full Page | R10 730.00 | R9 910.00 |
| Half Page | R 7 135.00 | R6 415.00 |
| Quarter Page | R 4 720.00 | R4 050.00 |

**Colour**

Full-colour (F/C): B&W page rate plus R4 400.00
Standard Spot Colour R2 160.00 extra per colour

| | | |
|---|---|---|
| FPF/C | R16 000.00 | R15 285.00 |
| Half Pg F/C | R12 480.00 | R11 800.00 |
| Quarter Pg F/C | R 9 860.00 | R 9 440.00 |

**Special Positions**

| Inside Front/Back | Outer Cover B/C only |
|---|---|
| R23 990.00 | R23 035.00 |

**Professional Directory: (Black & white only)**

| | | |
|---|---|---|
| Company: | R965.00 | R960.00 |
| Individual: | R720.00 | R710.00 |

Size: 45 x 90 mm wide

**Advertorial rate per column per cm**

Full column, ± 500 words:

| | |
|---|---|
| R3 390.00 | R3 390.00 |

## 2. MECHANICAL DETAILS

| | |
|---|---|
| Trim Size: | 297 mm x 210 mm |
| Full Bleed | 297 mm x210 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 315.00. 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 2019 |
| June issue: | 15 May 2019 |
| September issue: | 15 August 2019 |
| December issue: | 15 November 2019 |

## 6. CANCELLATIONS

Four weeks prior to deadline

## 7. ADVERTISING AGENCY COMMISSION

Excluded

## 8. CIRCULATION

Geobulletin is issued and dispatched at no additional charge to all of the various members of the Society and its local and overseas exchange partners. **The circulation list exceeds 2,800 (this is not a reflection of readership as it is read by a far wider audience - students in libraries, all geologists in a single company)** and reaches all of the decision-makers in the geoscience and mining community; the geological consultants and leaders in the Mining Groups, the Mining Industry and Government Institutions, universities, private, public and state libraries. Electronic versions of the GB are freely distributed through the society's web page.

## 9. ADVERTISING BOOKINGS AND SUBMISSION

| | |
|---|---|
| contact person: | Jann Otto |
| telephone: | 082 568 0432 |
| e-mail: | Jann.Otto@mweb.co.za |

## 10. ADDITIONAL CONTACT INFORMATION

### EDITORIAL OFFICE

Dr. C. Hatton
Council for Geoscience
(physical address: 280 Pretoria Street, Silverton)
Private Bag X112
Pretoria 0001
tel: +27 12 841 1149 fax: +27 86 679 8591
e-mail: chatton@geoscience.org.za

### DESIGN & LAYOUT

Belinda Boyes-Varley
cell: 079 129 7748
e-mail: bvmac@icon.co.za

### SOCIETY OFFICE

**GSSA**
Mandela Mining Precinct (formerly CSIR MININGTEK),
Corner Rustenburg & Carlow Roads,
Melville, Johannesburg, SOUTH AFRICA.

P.O. Box 91230
Auckland Park 2006
Johannesburg, South Africa
Tel: +27 11 358 0028
e-mail: info@gssa.org.za Web: www.gssa.org.za

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.

2019

GSSA
Geological Society of South Africa