

geobulletin

QUARTERLY NEWS BULLETIN ~ JUNE 2018

VOLUME 61 NO. 2

Agromining and Phytomining

Hout Bay Manganese Mine – Geoheritage site

Hemimorphite from Leeuwenkloof lead mine

news

COVER PHOTO:

Specimen JJG-1424, a garnet websterite xenolith from the Thaba Putsoa kimberlite in Lesotho, is composed of pyrope garnet (pink), diopside clinopyroxene (dark green) and enstatite orthopyroxene (yellow-green). These minerals are similar in composition to those in mantle peridotite (the main rock type in the upper mantle), but the fact that this specimen lacks the mineral olivine suggests that it has experienced metasomatism by a melt, such as basaltic magma, that is rich in calcium and aluminum.

Photo credit: Preston Thomas



CENTREFOLD:

Unusually fresh heavy mineral concentrate from a southern African kimberlite. The purple and orange minerals are peridotitic and eclogitic garnet, respectively. The bright green mineral is diopside, the yellow-green minerals are olivine (peridot) and enstatite and the dark silver-gray mineral is ilmenite. The compositions of these minerals (especially garnet) preserve pressure-temperature information and are correlated with diamond grade. Because of this, they are used extensively in diamond exploration.

Photo credit: David Swart

Close-up of kyanite eclogite specimen JJG-6392 from the Roberts Victor kimberlite, Free State. The bright blue mineral is kyanite, the dark mineral is garnet and the white material is a mixture of alteration minerals after clinopyroxene. This unusual specimen contains layers of bimineralic eclogite (garnet and clinopyroxene only) alternating with kyanite eclogite, possibly representing compositional layering in the basaltic material it originally formed from.

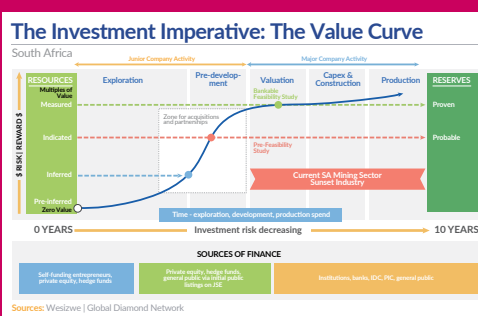
Photo credit: David Swart

Erratum - Page 22 March Geobulletin 2018

Reviving and transforming South Africa's minerals industry

Correct graph for pg 22.

See page 43 for larger version.



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Contributions for the next issue should be submitted by:
15th August, 2018.

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.

2018 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 2018 issue), 15th May (June 2018 issue), 15th August (September 2018 issue) and 15th November (December 2018 issue).

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from the editor's desk

Chris Hatton



While the recent rains in the Cape have somewhat softened the bleak image of the Theewaterskloof dam that was painted in the last issue of *Geobulletin*, it seems that although the winter rain figures are showing an improvement, the Cape is still a long way from the end of the drought. To avoid Day Zero in 2019 rainfall needs to rise well above this long term average. So for a while to come the most welcome gift that a resident of the east can offer to a Cape Town visitor will remain a five minute shower, or even more indulgently, a guilt free soak in the bath.

There are no records of Albert Einstein watching which way the water drained from his bath and he may have known that there were too many variables to use this as a clear demonstration of the Coriolis effect. Instead his lucid thoughts on the Coriolis force were based on observations of his morning cup of tea. After stirring the cup Einstein pointed out that the frictional force between the tea and the cup would slow the circular inward current at the bottom of the cup, so that the currents driving the tea leaves would weaken as they rose, allowing the tea leaves to settle in the centre of the cup, as observed. Einstein then used this observation to explain why meandering rivers in the northern hemisphere cut into their right bank, whilst meandering rivers in the southern hemisphere preferentially erode their left bank. Einstein's 1926 paper goes on to the pithy conclusion that the larger the river, the longer the meander wave length will be. Those flying to and fro from Cape Town to Johannesburg have the opportunity to see the kilometer scale meanders that the Vaal river

incised into the landscape in and around the Vredefort dome. Quantification of the relation between river size and meander wave length makes it clear that the current Vaal river is entirely incapable of carving such large meanders so that the incised meanders must be a record of much wetter times a million and more years ago when the then mightier Vaal river cut its way into the Vredefort Dome. The drying trend that is encapsulated in last issues' image of the Theewaterskloof dam could then be seen as part of the long term desiccation at the tail end of the Neogene. In drawing our attention to a recent letter, <https://www.thegwpf.com/an-open-letter-to-the-geological-society/>, John Bristow emphasizes that natural changes in climate which are obvious in the geological, archeological, and related natural systems (e.g. Boababs) need to be considered far more closely in the climate change debate.

Einstein was justly criticized for overlooking the earlier analysis of winding rivers by James Thomson (Alpher & Herman, 1960); as elder brother to the extraordinary Lord Kelvin, he of absolute zero fame, being overlooked might have been something James was used to. However as a geologist James probably fares better than younger brother William. William Thomson, 1st Baron Kelvin notoriously concluded that the earth could be no older than 20 to 40 million years, squeezing Darwin into an uncomfortably brief time for the origin of species. Whilst William Thomson was to be proven wrong about the age of the earth, James Thomson's analysis of winding rivers has stood the test of time. Einstein's ignorance of James Thomson's contributions was excused in 1960 on the grounds that it is "difficult to ensure that one has seen all the literature on a given problem". Today, despite the overwhelming expansion of the literature, Google searches allow anybody and everybody to find everything that is on the web. And there's the rub. These days if literature is not on the web it is as if it doesn't exist. In the President's Column Ed Swindell rightly rails against the uselessness of Compact Discs which probably couldn't be read even if one still had a CD reader. But a Compact Disc will probably come to be seen as one of those extinct transitional creations in the evolution from Gutenberg to Google. Conversion of paper to pdf is

now an essential part of the dissemination of information and is a fundamental part of 21st century research. The SAJG, which welcomes new editor Marlina Elburg on p. 6-7 of this issue, is committed to an electronic future; but what of the paper past? For keeping the GSSA moving forward into the post Gutenberg age one has to thank George Henry and Mike Knoper who enlisted the ongoing and much appreciated assistance of Sabinet in converting back issues of the Transactions of the Geological Society of South Africa to electronic format. As sadly recorded on pp. 12-13 Mike has relocated to the USA but in the electronic age the GSSA hopes that his valuable assistance will continue from afar.

For as long as the magazine format, reliant on pretty pictures, survives, Geobulletin will continue to be appear

in both paper and electronic format. The pretty pictures in this issue are all from the Messengers from the Mantle exhibition. Of course pictures are never as good as the real things, which will be on display during this year's Geocongress (p. 21). And as example of the monetary value of the real thing, Einstein's handwritten note "A calm and modest life brings more happiness than the pursuit of success combined with constant restlessness" sold last year for \$1.56 million, probably a little more than a Capetonian would pay for a nice long bath.

Alpher R A & Herman R 1960. *Tea Leaves, Baer's Law, and Albert Einstein*. American Journal of Physics 28(8), 748-748.

Chris Hatton

executive managers



I am sure all of our members are aware of the General Data Protection Regulation (GDPR) just introduced in the European Union. The intent is to better protect personal data from digital 'pirates' – who do not necessarily have your best interests at heart. How this plays out over the next year or so will be interesting, but the regulations strike at the core business models of some of the world's largest and most successful companies. Revenue models based on personalized advertising are likely to undergo significant change as the world beyond the borders of the EU also begins to regulate. The GSSA is not immune to regulatory effects outside of South Africa, and further has to be compliant with the South African Protection of Personal Information

Act (POPI). While we are reasonably confident that we have sufficient protections in place, along with policies prohibiting the sale or distribution of data to other parties, we will be reviewing practices in the coming months. If anyone has any concerns, please contact info@gsssa.org.za.

Of greater interest to most geologists is the ongoing saga of the Kilauea eruption in Hawaii (see <https://volcanoes.usgs.gov/volcanoes/kilauea/>). We are treated to nightly news stories of the event – sometimes accompanied by fantastic imagery – and as of writing no end is in sight. A great deal of property has been destroyed or abandoned; this is a pertinent reminder that infrastructure should not be constructed on geologically hazardous sites. In South Africa we are most unlikely to be affected by volcanoes spewing lava, but housing development on dolomitic terrain, or retirement villages constructed on 50 and 100 year floodplains should be guarded against (for example). Sadly, it seems that too many zoning committees may not be getting the right information. How should geological information be communicated to local levels of government? In my opinion, local authorities need to do a better job of seeking geological input into project planning and execution.

corner

Craig Smith



Congratulations and thanks are due to Professor Lew Ashwal, selected by the Fellows Committee as the 2018 AL Du Toit Lecturer. The lecture is titled "Wandering Continents of the Indian Ocean", with the first delivery set for the opening of Geocongress on July 17 at the University of Johannesburg. We will be in contact with GSSA branches and divisions about hosting the lecture at other venues in southern Africa in the latter half of the year.

The plans for Geocongress are progressing well (see <http://www.gssaconferences.co.za/>). There will be about 160 talks and 100 posters presented from the 18th to the 20th of July. A number of workshops and field excursions are on offer. On Saturday morning following Geocongress, Wits will be hosting a careers event, and students from other parts of the country may well wish to participate.

The Geocongress Organizing Committee has secured the UCT Mantle Exhibition to be set up at UJ during Geocongress. The exhibition showcases the collection of southern African kimberlite and mantle-derived xenoliths built up by Professor John Gurney and students over a life long career. It will be open to the

public for a few days prior to Geocongress, as well as during the event. It is a spectacular exhibition, highly recommended for those who want to know what the South African upper mantle is composed of. This is the first time it will be presented in Johannesburg.

Other GSSA events for the second half of the year are being planned, the next being 'SAMREC/SAMVAL Compliance and JSE Reporting' scheduled for June 28-29. The Annual General Meeting will be held on July 26. In addition to the other offerings on the calendar (Drilling Methods, Technology Day, Exploration Projects), the Meetings Committee will likely be repeating the highly popular Economic Evaluation course, and staging a new event dealing with core logging. We will keep members informed by mail drops, newsletter, facebook and the website. For the Fellows of the GSSA, diarize November 14 for the Fellows Dinner.

I am pleased to note that it is finally raining in Cape Town. It is cold, wet and miserable. But fantastic! It is way too early in the season to know if the drought is broken – but it's a start.

Craig Smith

president's column

Ed Swindell

As we approach the time for Geocongress 2018 I found myself turning to my bookshelves and browsing through my copies of the various abstract volumes for all the Geocongress' I attended over the years. I am going to indulge myself and use my prerogative to take you down through my personal memory lane triggered by the enduring value of those abstract volumes.

The first Geocongress I attended was in 1975 during my Honours year at UCT when our class went across to Stellenbosch and attended Geocongress 75. I do have the 230 page abstract volume for that event which had the theme of Mineralisation in Metamorphic Terranes but the only true memories I have of the event include wine and beer. I became a member of the GSSA that year because of Geocongress and remained set on a path that endures to today. The



1970's were a boom period for exploration in South Africa. Those of us lucky enough to graduate during that decade found all sorts of exploration projects and a booming mining industry to join and all of that activity fed the Geokongress themes. Geokongres 77 was held at RAU (now called UJ) and the Abstract volume is 166 pages long and 50 papers were given. The Congress was entitled "Sedimentary Basins and Associated Ore Deposits". Most of the papers I attended were on the Transvaal Supergroup and the Wits but I note quite a few on the oil and gas potential of the Karoo. I suspect that reflects the Soekor oil exploration activities of the time.

Geokongres 79 (the 18th Congress) was a much grander affair with more than one volume. Part 1 was a very grand 462 page volume covering four parallel sessions dedicated to "Recent Developments in SA Geology". Part 2 was dedicated to a "Uranium in the Karoo" and a "Karoo Basin Symposium" that was held in Beaufort West. I attended this after taking the train down to Beaufort West in the company of several colleagues. This symposium reflected the exploration activities of the time when so many of us were in the field throughout SA and Namibia looking for (and finding!) Uranium. This was the first time many of us were to get sight of the sandstone hosted uranium deposits that a group of American geologists had found a few years before. I remember sitting in the dining car with my boss and another passenger who we met and who turned out to be a doctor practising in the district and who was fascinated to hear about the presence of all the uranium in the district. His fascination stemmed from the cluster of cancer patients he had from the surrounding farms. It turns out sandstone rich in uranium (coffinite) was being used in the construction of houses and fireplaces and this led to speculation about cause - an early example of some Medical Geology discussion and speculation on the Trans Karoo train.

Geocongress 81 (the 19th Geocongress) is the next group of volumes on my bookshelf. It was held at the University of Pretoria and included the Third International Platinum Symposium but the main focus was "The South African Geodynamics Project". The

Geodynamics Symposium is 237 pages long and I know was major milestone in our understanding of South African Geology. It covered virtually every major component of our geology. CF Vermaak in his introduction to the Congress programme described it as "the largest geological gathering ever to be held in South Africa". It included both SEG and IUGS participation. I must have been bit better off that year as I went on the field trip through the Limpopo Belt and have a battered copy of the excursion guidebook to prove it.

The only evidence I have on my bookshelf of Geocongress 86 held in Johannesburg is the very excellent one day Witwatersrand excursions guidebook. (9 tours in one volume). But I do have evidence of having attended Geocongress 88 (the 22nd Congress) at the University of Natal. This is a 838 page volume of what are now called "Extended Abstracts". No specific theme was chosen for this congress "so that all of the geological Community could feel comfortable airing the pet theories and latest earth-shaking views" (TR Mason).

The volume of Abstracts for Geocongress 90 held in Cape Town is equally weighty and 768 pages long. Noteworthy is an extra volume, 42 pages long of "Late Abstracts". Perhaps this was a sign of things to come. It is interesting to note that this entire congress was organised by the Western province Branch of the GSSA, UCT, Soekor and the Geological Survey at Bellville.

The next set of volumes on my bookshelf are those from the momentous Centennial Geocongress in 1995 held at RAU. I have 2 volumes (1212 pages) of what are, yet again called "Extended Abstracts". Compiled by JM Barton and YE Copperthwaite, these cover a number of themes and include as a highlight the Du Toit Memorial lecture. Theme 1 was Economic Geology with a strongly African wide focus, Theme 2 was Tectonism focusing on Archaean Terranes and on Crustal Growth in Gondwana. Theme 3 was Crustal process in High Grade Metamorphic Terranes. Theme 4 covered Depositional Basin, Sedimentology, Sequence Stratigraphy, Tectonics and Climate, Theme 5 covered Tertiary Education



and Research, while Theme 6 covered Mineralogy and Chemistry in health and the environment. Remote sensing was given a place as theme 7 and Fossil Fuels were Theme 8. There was of course the ubiquitous open session as well. The list of Authors reads like a Who's Who of South African Geology.

The next volume on my shelf is Geocongress 98. Again a volume of Extended Abstracts this congress reflected a collaboration with the Council for Geoscience. The congress was entitled "Past Achievements / Future Challenges".

GEO2005 is the final volume on my bookshelf that I am going to mention. Held at the University of KwaZulu-Natal in 2005. This reflected a change in style. No longer called Geocongress but undoubtedly following a traditional Geocongress format it offered the South African Geo-community an opportunity to present research and findings in the best tradition. It is a thin volume but because of a 3 column format is entirely respectable. Noteworthy is the fact that the Abstracts are described as "Reduced Versions" with the following note "The abstracts reproduced here do not contain figures or references. For complete abstract versions and for citing abstracts (incl. page numbers) please refer to GEO2005 Abstract CD". I still have the volume on my shelf but I have absolutely

no idea what happened to the CD which is probably in a format that can no longer be read anyway, even if my laptop had a CD ROM reader.

Geo2005 was the start of a new phase in the publication of Congress proceedings. Now days you get given a Flash Drive and the argument is that this is more cost effective, which it probably is. But now for my pet gripe. Paper remains eternal and real while digital is transient, ethereal and unreliable. I am able to find and read abstracts to Geocongress papers I listened to more than 40 years ago but I can't find anything for any meeting I attended in this decade since 2005. Nowadays we get given CD's and Flash drives that end up in a drawer and are so easily lost. Computers, operating systems software, formats and technology get changed every few years and data gets lost or becomes unreadable as you transfer from one system to another. Digital Publications get forgotten about as they are just not visible anymore. You can browse, as I have just done, through a volume of abstracts but you cannot do the same with a flash drive. Search engines and such like are just not the same. We really seem to have lost something valuable with the emergence of the digital age.

Ed Swindell

SAJG

SAJG: News from the Editor's Desk

After nearly 20 years of service Lew Ashwal (School of Geosciences, Wits) has stepped aside as a Scientific Editor at the South African Journal of Geology (SAJG). Lew was co-Editor with Jay Barton from 1999 to early 2015 and has supported Steve McCourt since then. As an Editor Lew was passionate about maintaining a high academic standard for the SAJG and providing a professional service to prospective authors. Lew's success as an Editor was underpinned by his extensive network of international researchers, a resource he used to ensure that all manuscripts were subjected to rigorous peer-review. In addition Lew was able to call on his own

expertise across a range of fields in the geosciences to provide objective feedback and guidance to authors faced with manuscript revision. Lew was a valuable resource to the SAJG and will be missed. Fortunately he has agreed to serve in an advisory capacity when needed. Marlina Elburg (Department of Geology, UJ) has been appointed as the new Scientific Editor.

Marlina was born in the Netherlands, and did her undergraduate degree at Utrecht University, during which her interest in igneous rocks and isotope geochemistry developed. Considering the severe lack of igneous rocks in her home country, she did her granite-focussed PhD at Monash University in Australia. She



Marlina Elburg

divided 6 years of post-doc appointments between Adelaide and Monash University, but returned to Europe in 2002, to take up an EU Marie Curie Fellowship at the Max Planck Institute for Chemistry in Mainz, Germany, working on melt inclusions with Alex Sobolev and Dima Kamenetsky. She did a short stint at the Free University of Amsterdam, developing the capacities of the multi-collector ICP-MS there. In 2005, she was appointed at Ghent University in Belgium, but decided for a change of scene in 2011 when she took up a position at the University of KwaZulu-Natal. The year 2014 saw her move to the University of Johannesburg, where she now holds a position as a full professor, where she is again involved in MC-ICPMS development to support her research on igneous processes and geochronology.

Early Publications

As a service to authors, from volume 121 (2018) the SAJG has introduced a new format, Early Publications, for manuscripts that have been accepted for publication following peer-review and revision. These manuscripts will be published, in corrected proof format, as self-standing articles online at GeoScienceWorld (GSW) ahead of the issue to which they have been allocated. When an Early Publication article is incorporated into a full issue of the SAJG it will be allocated a volume number and page numbers in that issue and the Early Publication version will be removed from the online

platform. The year an article was first published online will be carried over to the final volume and issue.

Although Early Publications do not have final bibliographic details (volume/issue/page numbers must be added), they can be cited using the year of online publication and the DOI (digital object identifier). The correct format would thus be: Author(s), Title, Year of Online Publication and DOI.

Copyright for articles published as Early Publications of the SAJG is vested in the Geological Society of South Africa (GSSA).

Breaking News: The initial batch of 3 Early Publications were published online at GSW on April 17, 2018 and is available to Fellows/Members in PDF format.

Mike Knoper has relocated back to the USA but will continue to serve as the Technical Editor for the SAJG. Mike has been the Technical Editor since 2002 and is responsible for the processing of accepted manuscripts for publication on the GSW platform as part of the Millennium Collection (2000 to present). Mike also manages the Open Access SAJG Heritage Collection (1896-1999) on Sabinet and the online Supplemental Data Repository.

Steve McCourt

all the news fit to print

Wits Geosciences News



A productive start to 2018 in the School of Geosciences has seen exciting new developments in our analytical labs and a marked increase in PhD and MSc graduations. The latter will be joined in the July graduation by the first cohort of the Economic Geology MSc graduates and the third group of the Hydrogeology

MSc graduates. In January the School welcomed Glen Nwaila as a new Lecturer in Economic Geology. Glen received his PhD (*magna cum laude*) from the Julius-Maximilians-University Würzburg (Germany) in November. Congratulations are in order to Lew Ashwal on the re-awarding of his NRF A-rating. Rosalind Crossley, a new postdoctoral fellow who will be working with Judith Kinnaird, joined us in April.

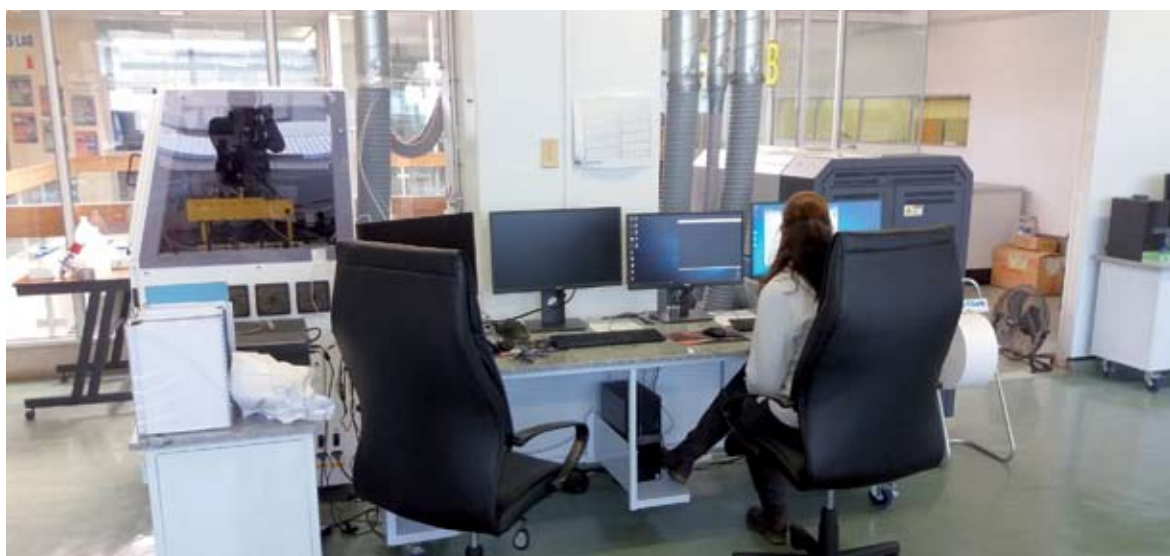
A state-of-the art laser ablation (LA) facility was recently installed at the School's EarthLab. The instrument system consists of an Australian Scientific Instruments 193 nm excimer laser (SE 155), a Thermo Fisher quadrupole ICPMS with reaction/collision cell capability (iCAP RQ C2) and a Thermo Fisher high sensitivity single collector, sector field ICPMS (Element

XR), equipped with a Faraday cup. The LA-ICPMS system will serve as a training platform for experienced scientists but also students, and will greatly enhance geochemical and geochronological research in the School and in CIMERA. Apart from U-Pb dating of zircon, baddeleyite, apatite, rutile, titanite, monazite and carbonate, the facility will be used to measure and image elemental concentrations and isotope ratios in a variety of geological, environmental, archaeological and organic/biogenic materials at micrometre-scale spatial resolution.

Linda Iaccheri has overseen the processing of the first samples in the WIGL. Matrix separation is achieved using ion exchange column chemistry allowing excellent precision on separated elements destined for high-precision isotope measurements. Before the end of 2018, the Lab aims to have calibrated and tested cosmogenic Be and Al isotopes for cave development and landscape evolution studies, Pb-U-Th on biological sample as tracers for Pb poisoning, and separation of Ca-Sr-Fe isotope compositions for paleontological applications.

Lewis Ashwal was awarded a generous grant of R500,000 by the Oppenheimer Memorial Trust to

The new laser ablation instrument at Wits





Linda Iaccheri at the WIGL

support his project on “Origin of the Earth’s largest volcanic eruptions from a southern African perspective”. He intends to complement the enormous geochemical and isotopic database that already exists for the Karoo Large Igneous Province (LIP) with new Sr-Nd-Hf isotope measurements for samples of the Ventersdorp, Bushveld and Umkondo LIPs. Over 500 combined Sr-Nd analyses exist for Karoo rocks, but only 15 are available for Umkondo, 25 for Bushveld, and none for Ventersdorp. This glaring imbalance will hopefully be partly addressed in the project. With colleagues and students, Lew hopes to constrain mantle sources, the role of crustal contamination, and the petrogenesis of southern African LIPs.



Masters student, Sibusiso Khonyana (from UJ), at work in the WIGL, collecting 1ml elute increments for the calibration of Be and Al chromatographic separation (photo courtesy of Tebogo Makhubela)

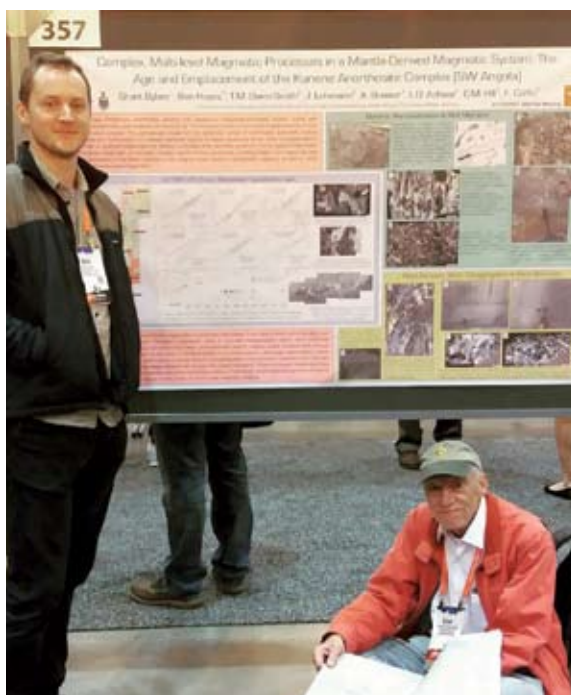
Rais Latypov and co-authors celebrated the publication



Rais Latypov at Dwars River in the eastern Bushveld



Ben Hayes and Lew Ashwal presenting research from the Kunene Anorthosite Complex at AGU



Musa Manzi, Shalene Selkirk, Ray Durrheim and Ranto Raveloson at EGU in Vienna



Wits Geophysics postgraduate, Kutlwano Mooketsi, at Lambert's Bay, Western Cape



of their work in Nature Communications. Rais provided an innovative model for the formation of the economically important chromitite layers in the Bushveld Complex.

After a successful introduction in 2017, Bridge the Gap has continued into 2018. This postgraduate student led initiative is providing excellent teaching and mentoring assistance to undergraduates in the School of Geosciences.

Wits geoscientists have been proactive at recent local and international conferences. At the end of 2017, Lew Ashwal, Susan Webb, Stephanie Scheiber-Enslin and Ben Hayes all presented research at the AGU Fall Meeting hosted in New Orleans. At the beginning of 2018, a strong contingent from Wits attended IMSG, this year hosted at the University of the Western Cape. Most recently, Ray Durrheim and Musa Manzi led a group from Wits to the EGU General Assembly in Vienna. We had 10 papers presented in total: 4 on ICDP DSeis project, 1 on Vredefort, 3 on Wits gold, and 2 on Africa Array.

A group of geophysics postgraduates (Kutlwano Mooketsi, Wesley Harrison, Ofentse Sebidi and Brandon Dias) helped to survey an archaeology site at Lambert's Bay in the Western Cape. The aim of this work was to assist with depth estimation to bedrock and provide high-resolution geophysical data in a cave.

They conducted both 3D DC resistivity and magnetic surveys.

Compiled by **Ben Hayes**

Stellenbosch



Two Earth Science staff recently received their latest NRF research ratings. Prof. Alex Kisters (Head of Department) is now rated B2 (up from B3) and Prof. Gary Stevens (SARCHI Chair in Experimental Petrology) maintained his B2 rating. This continues the upward trend for the Department, which now hosts one B1 staff member, three B2s, a B3 and a C1.

In January, Prof. Stevens also received the excellent news that his SARCHI chair had been renewed for a third funding cycle. This is quite an important endorsement of his performance in the position.

John Clemens

UJ



Perhaps the biggest organizational event on the UJ Geology Department calendar is the 2018 Geocongress. With more than 270 abstracts submitted,

the UJ Geocongress 2018 organisers have been kept very busy over the past weeks. The somewhat unexpected influx of abstracts left Bertus Smith and Marlina Elburg pondering how to accommodate a third parallel oral session, while Trishya Owen-Smith, who is in charge of the student financial support, is still sorting out the 75 applications she has to distribute to her committee. Jeremie Lehmann is dealing with the field trips, although there are some challenges regarding the costs thereof. Although there have been a few glitches with the abstract uploads and the internal communications for their review, the committee is proud to report that they are still (more or less) on schedule, despite an extension to the abstract submission deadline. A sincere vote of thanks should go to the session conveners who are busy assessing the quality of every abstract submitted – an especially arduous task for George Henry, who volunteered to be in charge of the open session, with close to 50 abstracts!

It is hard to believe that DST-NRF CIMERA, the only Department of Science and Technology-National Research Foundation Centre of Excellence hosted by UJ, is currently undergoing a 5-Year Cycle Review by the NRF. It seems like only yesterday that we moved into



The DST-NRF CIMERA team at our booth at the NRF CoE Directors' Forum held at Nelson Mandela University in Port Elizabeth in 2017. From left to right: Dr George Henry (Administration Manager - UJ), Ms Caroline Hlongwani (MSc student - UJ), Prof. Judith Kinnaird (Co-Director - Wits), Prof. Nic Beukes (Director - UJ), Mr Marvin Moroeng (Lecturer - UJ) and Dr Desh Chetty (Steering Committee Member - MINTEK).



our newly revamped offices on the 3rd Floor of C1 Lab in 2015, having been the guests of the Department of Geology on the 4th Floor for the second half of 2014. The review documentation was collated by Professor Nic Beukes, Director of DST-NRF CIMERA, with input from all our institutional collaborators around the country. We are confident that we have fulfilled our two main mandates of post-graduate student training and new knowledge generation successfully, and look forward to our next five years. We owe all our supervisors and post graduate students who have conducted and are conducting research under our umbrella a big THANK YOU for all your efforts.

Eight Postgraduate students from the Medical Geology Group at UJ together with Hassina Mouri attended the European Geosciences Union Meeting 2018 (EGU), which took place in Vienna, April 8th to 13th/2018. The group presented their on-going research in a session dedicated to the discipline of Medical Geology, under the theme: Medical Geology: an interdisciplinary field of science for the benefit of the society, which is organised for the 1st time at EGU. This event attracted 15,075 participants from 112 countries, 17,323 presentations given in 666 sessions, 68 short courses and 294 side events.

The group was sponsored mainly by the International Office of the University of Johannesburg and the

National Research foundation with a contribution from the Geological Society of South Africa (GSSA) and the International Council of Scientific Union –Regional Office Africa (ICSU-ROA).

Sebastian Tappe has been awarded a small research grant from the European Research Council within the Europlanet Horizon 2020 program to conduct a reconnaissance study on the isotope systematics of several moderately siderophile elements in diamondiferous mantle-derived rocks. The research aims at better understanding the early accretion history of planet Earth and to resolve the mantle dynamics beneath southern Africa since Gondwana breakup. This study is hosted by Prof Thorsten Kleine of the Institute of Planetology at Münster University in Germany. S. Tappe spent the majority of February in the Münster ultra-clean laboratories to setup his first high-precision isotope ratio measurements. Follow-up visits are planned over the next 2 years, which will also include postgraduate geosciences students from South Africa.

On a more somber note, the UJ Geology department bade farewell to Mike Knoper in May. After 29 years in South Africa, working first at the University of Natal, then UP and finally at RAU / UJ, Mike is returning to the USA. He will be missed, especially for his enthusiasm in the department and in the field. We wish him all the

Professor Mouri and her post-graduate delegation at the EGU meeting.





Mike Knoper in the field educating students on the complexities of field work.

best.
Bertus Smith attended the European Geosciences Union Conference in Vienna in April, where he presented a paper on evidence for free oxygen in Mesoarchean oceans. Also part of his trip to Europe was a research visit to the Department of Earth Sciences at Eberhard Karls University in Tübingen, Germany, to present a seminar and continue research collaboration with Prof. Ronny Schoenberg and his geochemistry research group. Thereafter he visited the Marine Geosciences Laboratory of the European Institute for Marine Studies in Brest, France to present a seminar and conduct laboratory work and geochemical analyses on iron ores in collaboration with Dr. Stefan Lalonde.

Compiled by **Bruce Cairncross**

agromining & phytomining

Agromining and Phytomining

The increasing demand for critical elements challenges conventional methods of resource extraction. Agromining involves the use of plants to absorb valuable metals from soils that have naturally high metal concentrations. Phytomining on the other hand refers to the cultivation of plants on mined-out areas or dumps. These plants are natural hyper-accumulators of metals from soils and are also called "metal crops". The process involves farming such crops on sub-economic deposits or industrial or mineral wastes. The plant material is then harvested, dried and the biomass incinerated. This bio-ore can then be processed through hydrometallurgical or pyrometallurgical processes to obtain high-value products to deliver metal ore. The

idea of argomining or phytomining of metals emerged in the 1990's and the goal was to cultivate plants able to accumulate trace metals from metal-rich soils and transport it to the shoots. Hyper-accumulator plants have been identified for Arsenic, Selenium, Cadmium, Cobalt, Manganese, Nickel, Thallium and Zinc.

The criteria for selection of a hyper-accumulator plant depends on the biomass yield, i.e. 1% to 2 % metal contained in the biomass, may translate into 10% to 25% metal in the in ash, referred to as bio-ore. The success of agromining is also closely related to available resources of the target elements and the ability of plants to grow and extract these elements from the



resources. The extent of the bio-availability of the target elements in the soil is a major factor that determines the yield potential of a site. It has been recommended that agromining should as far as possible utilise local, or indigenous, hyper-accumulator species which are adapted to local climatic conditions.

To date several hundred hyper-accumulator plants have been identified. Research into these plants has been intensified in recent years using advanced X-Ray Fluorescence (XRF) methods for the mass screening of herbarium collections, adding 120 species to the list since 2015. This has led to the identification of species adapted to a wide range of environmental and climatic conditions. In the Democratic Republic of Congo and Zambia more than 30 copper and cobalt hyper-accumulator plants have been identified.

The major focus of agromining to date has been on nickel. In Europe nickel-rich serpentine outcrops, a weathered form of ultramafic rocks is found. Generally these outcrop areas have a low-fertility and low-productivity. A number of nickel-accumulator species have been planted in mined-out nickel belts to absorb the remaining nickel in the soil that is beyond modern metallurgical capability of recovery. Ultramafic soils typically contain 1 000 to 5 000 parts per million (ppm) nickel, while cut-off grades for conventional mining projects are generally 10 000 ppm, or 1%, nickel. Ultramafic soils with a nickel content as low as 0.1% can be agromined. The amount of nickel contained in the ultramafic soil also depends on the type of deposit and climate. Nickel in lateritic serpentinite, e.g. New Caledonia, has very high nickel content as opposed to nickel in sulphide deposits, such as moderate to low levels at Kilembe in Uganda. Tropic lateritic nickel deposits also have notably higher yield potential.

There are currently programs underway in Australia to utilise Eucalyptus trees to absorb gold in mined-out parts of Kalgoorlie, Western Australia. Eucalyptus trees preferentially concentrate gold in the leaves and bark. The Eucalyptus trees are also being tested as a geobotanical indicator throughout Australia to locate potential gold deposits.



Eucalyptus trees

In South Africa, MINTEK is undertaking studies to recover the trace amounts of gold still present in the fines residue and tailings dumps associated with the Witwatersrand, using wheat. It is estimated that up to 17.7-million tons of gold is contained in these waste dumps. Gold is absorbed by all parts of the wheat plant except the grains. This allows for harvesting of the cereal as a traditional food crop followed by processing the discarded biomass.



Wheat

The limitation however is that most plants do not naturally accumulate gold in high quantities. Some plants do exude natural lixiviants that can mobilise gold in soil. Gold agromining therefore necessitates the use of thiocyanate to liberate gold from the tailings so that plants can absorb it. Laboratory and greenhouse research undertaken has shown that the uptake of gold can be induced by treating the soil or tailings with lixiviants such as cyanide and thiocyanate. This approach is therefore only suitable for enclosed environments where strict controls can be implemented to avoid pollution.



Gold dump

Currently the agromining and phytomining niche is limited to low-grade surface deposits associated with ultramafic soils and as part of the rehabilitation strategy after mining has taken place. A large-scale pilot project will be needed to identify operational risks and provide evidence of profitability of such an undertaking. Argomining trials are also being conducted in Malaysia, Greece, Spain and Albania. Current research include experimental work with *Berkheya coddii* for extraction of Platinum Group Elements (PGEs) in South Africa from rock dumps, the extraction of Thallium from Zinc-Lead-Copper tailings in Australia, and Rare Earth Elements (REE) from minerals wastes in China

The economic viability of such projects is dependent on a number of factors that include, but is not limited to: commodity market price, the annual yield per unit area

and the availability of surface areas enriched in the target element. Phytomining and agromining will also deplete the soils in essential elements and change the pH of the soils and will need to be managed to maintain optimal growth and yield. These considerations will all have an influence on the life of project period.

An added advantage to phytomining is that it aids in the rehabilitation and initial stabilisation of mined-out areas, mine dumps and dust suppression. In the case of gold mine dumps, hazardous elements mobilised along with gold could potentially be reduced by absorption in wheat.

In contrast to agromining or phytomining, geobotany is used only to identify areas of potential mineralisation. The most famous examples relate to the delineation of copper deposits in Sweden by looking for the pink flowers of the *Lychnis alpina* and later in the Congo Copperbelt, using the Zaïrean "copper flower", *Haumaniastrum katangense*. In Liberia (West Africa), the *Pandanus candelabrum*, has been used in locating diamond-bearing kimberlite pipes, as the spiny palm-like plant seems to have an affinity for growing on kimberlite residual soil (see *Geobulletin*, December 2016). As a side note, it could be mentioned that similar methods have been used in the development of phyto-archaeology to locate buried structures and metallic artefacts.

Nicolaas C. Steenkamp

geological signage

Geological signage at the lower cable station Table Mountain

In October, 2017, geological signage was installed in front of the Waiting Area of the Lower Cable Station of the Table Mountain Aerial Cableway.

In November 2016, John Rogers of the Geoheritage Subcommittee of the Western Cape Branch (WCB) of

the Geological Society of South Africa (GSSA) visited Ms Collette van Aswegen, the Marketing Manager of the Table Mountain Aerial Cableway. After discussing the optimum siting of the two existing GSSA plaques in the Waiting Area, the concept of additional geological signage there was suggested by Collette. She then drove the project and asked Ms Sian Croome of Graphic Ballroom to draft the new signage, which the Subcommittee later approved after minor modifications.



The new signage in the Waiting Area of the Lower Cable Station looking towards the Western Table of Table Mountain. Photograph: Bevan Jeacocks.



Geological Society of South Africa plaque interpreting the geology of Table Mountain, on the wall of the Waiting Area in the Lower Cable Station. Photograph by John Rogers.

The signage will be seen by up to one million visitors a year from all over the world, including South Africa, as well as by numerous groups of local schoolchildren.

John Rogers

Close-up of the geological signage. Photograph by Fazielah Williams.

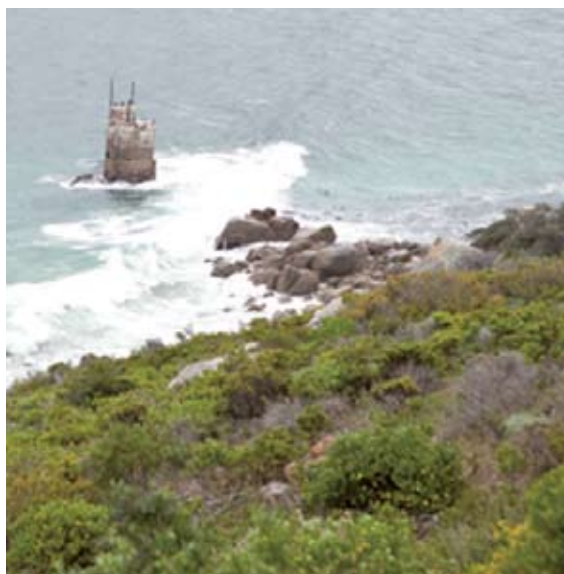


geoheritage site

Hout Bay Manganese Mine – Geoheritage site

Few visitors to Table Mountain are aware of the number of small scale mines that have been in operation there over the centuries. One of these is the Hout Bay Manganese Mine. The adits of the abandoned Hout Bay Manganese Mine can be reached, on preferably a warm dry day, with the help of a guide familiar with the area, as there are no trail markers to the site. The mine is located on the slopes of the mountain just above Chapman's Peak Drive.

Exploitable manganese was known to exist in the Cape from 1676. The Peninsula deposits were known and worked on at Constantiaberg as early as 1880. Written historical records suggest that manganese was first discovered in the vicinity of Hout Bay in November 1873. The deposit was deemed to be of inferior quality, having a low grade and being associated with



Houtbay Manganese Jetty

sandstone. The demand for manganese was also very low at that time.

A decade later, everything changed following Sir Robert Hadfield's metallurgical invention of manganese steel, an alloy of exceptional durability that made the deposit a more attractive proposition. An assay of the deposit was undertaken by a metallurgist in the employ of the South African College in the mid-1880's. The results of the assay were positive, indicating the ore contained between 76% and 83% manganese dioxide. The ore comprised mainly of weathered psilomelane and minor pyrolusite.

Mining only started in 1909 when Hout Bay Manganese Ltd was formed by A.J. Parker and a Mr Prior who worked the deposit, shipping the ore to Belgium. Operations started in 1910 and the deposit was mined from May 1910 to May 1911. The manganese ore occurred in a relatively narrow vein running vertically up the side of the mountain. A set of eight adits was developed into the mountainside. These adits varied from 20 metres to 85 metres in length and a few metres in width. After hand sorting the ore according to grade, it was stacked in one metre high piles adjacent to the vein running up the mountain to await transportation.



Houtbay Manganese adit entrance



Houtbay Manganese
lower adit



(Right) Houtbay
Manganese mine
inside view



A long cylindrical corrugated-iron ore chute was constructed that ran downhill at nearly 45 degrees, extending 750 metres from the mine, down to the beach below. The ore would slide down the chute from the mine into a sump where it would be transferred by a hoisting crane to cocopans that railed it to the jetty where the ore was loaded onto barges. From there the barge would be towed to Table Bay and the ore transferred to ships for the final leg of the journey to Belgium. The amount of ore that was mined is not certain, but records indicate that by 1911, roughly 130 tons was produced, fetching a price of £179. After only two years of operation, the mine closed down due a combination of the poor ratio of manganese to iron and high phosphorous content of the mined ore and the transportation problems that plagued the operation. Constant problems arose from ore overheating in its downward passage through the chute and getting stuck. This meant sections of the chute had to be taken apart and the ore dynamited loose.

The mine lay abandoned until 1929, when an attempt was made to restart the operation. The Wall Street Crash shortly afterward led to a collapse in demand for commodities such as manganese. Three years earlier the world-class manganese deposits near Postmasburg,

in the Northern Cape was also discovered. The attempt to mine the small and low-grade Hout Bay manganese deposit was thus quickly abandoned.

Popular legend has it that on one occasion the miners were drunk and send down too much ore in an avalanche that sank a barge. This was impossible as the barge was never docked anywhere near the bottom of the chute.

Of the eight adits, most of them are filled in or very shallow. One is still accessible and leads about 70 meters horizontally into the mountain. The entrance of adit number 7 is the most impressive, at 15 metres tall and 3 metres wide, but only 20 metres deep. Most of the ore piles are still preserved on the side of the mountain after nearly a century. The remains of old timbers and corrugated iron from the chute are still visible among an overgrowth of ferns. The pillars of the ore jetty are also still visible just off shore at the start of Chapman's Peak. At the Hout Bay Museum in Andrews Road there are enlarged historic photographs of the Hout Bay Manganese Mine.

Nicolaas C. Steenkamp

harding “gold” rush

Harding “Gold” Rush

South Africa experienced a small gold rush the last week of May 2018 after workers at a road gravel quarry excavation found yellow metallic rocks near Mubuthumeni, outside Harding in Kwa-Zulu Natal. Visual inspection of the material suggested the “gold” to be pyrite, but some samples were sent to Pretoria for analyses none the less. Despite numerous people from the local government pointing out the dangers of excavating the highwall face and trying to stop the local residents from entering the quarry, the digging continued unabated. Some of the diggers sold material they had collected for a couple of hundred rand. The local hardware store and shebeens also saw a massive increase in clientele. The police later closed the site and patrolled the area to keep out the diggers.

According to the geological map 3028 KOKSTAD the project area is underlain by dark-grey shale, medium grained buff sandstone, siltstone and mudstone of

the Eccca Group that is part of the Karoo Supergroup sequence of rocks. Dolerite sills have intruded the horizontally orientated sedimentary rocks in the region. Quaternary deposits (Alluvium) are associated with the Mzimkhulwana River.

The general area of the digging activity is covered by a layer of hillwash material that is composed of sandy silt to sandy clay that exhibits a firm consistency and a micro-shattered soil structure. The transported hillwash material is underlain by ferruginised residual siltstone that is composed of sandy clay with scattered to abundant ferricrete nodules and siltstone gravel with a firm consistency and an intact to micro-shattered structure. This is in turn underlain by slate or siltstone bedrock material. Dendritic precipitation is visible in the well jointed Eccca formation.

The Eccca Group hosts significant coal deposits in Southern Africa. Pyrite is commonly associated with these coal beds and their hanging and footwall rocks.





In the Early Permian Period the Southern African region and adjacent parts of South America were covered by the extensive but shallow Ecca Sea. Initially seawater was saline, but gradually became brackish and then freshwater due to input from river systems into the restricted basin. Deposits offshore of fine muds in the Ecca Sea are dark in colour and very rich in fine carbon particles (up to 14%). Extensive blooms of freshwater algae, promoted by high rates of nutrient influx from surrounding continental areas, are indicated as the source of the carbon. The constant deposition of dead algal material onto the seafloor exhausted all the available oxygen at the sediment/water interface and below. The bottom waters became anoxic (oxygen-poor) and the sediments are rich in iron pyrite that only forms in the absence of oxygen.

There are a number of small gold occurrences in Kwa-Zulu Natal with total gold production, from 1989 to 1991 amounting to over 824 kg. These deposits are found in Archaean and Phanerozoic placers, quartz lodes, Proterozoic intrusion related deposits (disseminated and skarn) and a Proterozoic auriferous volcanogenic sulphide-rich occurrence (Bullen et al., 1994). A single occurrence of gold in Ecca Group sediments in Kwa-Zulu Natal has been reported (Barath and Dunlevey, 2011) in heavy-mineral-rich sandstone bed placer deposits of the Permian Vryheid Formation near Muden in the midlands area. The heavy-minerals take the form of both individual mineral grains and inclusions in quartz and feldspar with gold occurring only as inclusions. It is suggested that most of the sand grains were reworked from the then unlithified glaciogenic Dwyka Group sediments, the primary source of which was the Transvaal Supergroup and

the gold-bearing granite - greenstone belts located in northern and eastern South Africa. This deposit is not economical to develop.

Harding has historically also attracted some interest due to the natural release of CO₂. It was the site of a commercial bottling plant established in 1922, located on the Bongwan gas fault south of Harding. The CO₂ gas issues from a ~20 m wide fault gouge along the banks of the river at a bridge over the Umzimkulwana River. The area is underlain by Dwyka Group tillite which is offset vertically by the fault zone and it is presumed that Marble Delta Formation (Natal Metamorphic Province) carbonate lithologies are present at depth, forming the source of the CO₂ gas. Samples obtained in 1922 returned carbon dioxide percentages of 98.3 % and 97.6 % for two samples, each with an O₂ content of 0.2 %, and nitrogen (by difference) of 1.5 % and 2.2 % respectively (Council for Geoscience, 2016).

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Nicolaas C. Steenkamp





MESSENGERS FROM THE MANTLE

Diamonds and Craton Roots

The Messengers from the Mantle: Diamonds and Craton Roots Exhibition was developed by the Kimberlite Research Group at the University of Cape Town to highlight scientific advances in the study of the Earth's interior and to showcase a selection of the roughly 14 000 unique rock specimens from the Earth's upper mantle currently held in the John J. Gurney Upper Mantle Research Collection at the University of Cape Town. The Exhibition was developed from 2014-2016 and was first exhibited at the 35th International Geological Congress in Cape Town in August, 2016. Since then, it has been on temporary display at the 11th International Kimberlite Conference in Gaborone, Botswana (in September, 2017) and at a private venue in Cape Town.

The Exhibition will be on display from 12 to 21 July 2018 at the Auckland Park Library of the University of Johannesburg for the occasion of the 2018 GeoCongress scientific conference, but it will be accessible to the public, including school groups and interested individuals, during this time.

About The Exhibition

The Messengers from the Mantle: Diamonds and Craton Roots exhibition consists of 13 sections covering the Structure of the Earth, Kimberlites, Peridotites, Eclogites, Metasomatism, Megacrysts, Diamonds, Exploration, Alluvial Diamonds, Marine Diamonds, History of Diamond Mining, History of the Mantle Room and Unsolved Mysteries. The Exhibition contains ten exhibit cases, each containing backlit large format thin sections of specimens on display, allowing the unusual colours and textures of these unique rock specimens to be shown clearly.

It highlights the specimens and science behind a unique research collection of mantle rocks delivered to South Africa's surface over a long period of geologic time in episodes of explosive kimberlite volcanism. The exhibition has been put together by a team of scientists from the University of Cape Town and the Mineral Services Group under the leadership of Prof. John J. Gurney and A/Prof. Phil Janney. Development of the Exhibition was funded through generous donations from individuals and companies.

The exhibit features rocks that have been collected mainly from kimberlite mining operations all over southern Africa, now archived for scientific research in the John J. Gurney Upper Mantle Research Collection at the University of Cape Town (previously called the "Mantle Room"), which is the most extensive collection of deep Earth samples from southern Africa in the world. It contains over 14,000 mantle and deep crustal xenolith specimens sourced from more than a hundred localities. The Collection has been, and remains, a destination for mantle researchers worldwide. They have used these specimens to provide insight about the timing and processes involved in the generation of the earliest continental nuclei, the Earth's Archaean cratons.

Also key to the story behind Messengers from the Mantle are the diamonds brought to the surface in kimberlites. This mineral acts as a time capsule uniquely preserving evidence of ancient and ultra-deep Earth processes, as well as providing information on the timing and nature of diamond formation itself.



The University of Johannesburg Library
From 12 – 21 July 2018
Entrance is Free
Open To The Public





GEO CONGRESS

18 - 20 July 2018

University of Johannesburg | South Africa

The Local Organizing Committee (LOC), the University of Johannesburg (UJ) and the Geological Society of South Africa (GSSA) would like to invite you to attend Geocongress 2018 to be held 18 to 20 July 2018 at the University of Johannesburg's Auckland Park Kingsway Campus, South Africa. The theme of this conference is **"Bringing the Geosciences Together"**, with the aim to provide a platform for southern Africa-based and –associated geoscientists to present their latest research.

The Geocongress is pleased to offer seven field trips, six one-day trip on a vast range of topics and a two-day trip to the Vredefort Impact Structure. Registration is now open and will close on Friday, 22 June.

Field Trip	Date	Cost
Jo'burg Geoheritage	Sun 22 July	R600.00
Cradle of Humankind	Sat 21 July	R700.00
Mafic Volcanic Rocks of the Central Kaapvaal Craton	Sun 22 July	R600.00
Geology of the Vredefort Impact Structure	Sat & Sun 21 & 22 July	R1 600.00
The Johannesburg Dome, a window of Archaean crust in the centre of the Kaapvaal Craton	Sat 21 July	R500.00
Geology of Johannesburg	Sun 22 July	R450.00
A transect of Archean Witwatersrand-Paleoproterozoic Transvaal Depositional Systems and the Great Oxidation Event	Sat 21 July	R550.00

WORKSHOPS

Geocongress 2018 will be complementing its exciting and diverse range of scientific sessions with a series of pre-meeting workshops on Monday 16th and Tuesday 17th of July. Geocongress delegates (*including students, academics and industry representatives*) will have the opportunity to partake in a selection of these pre-meeting workshops and learn new skills using the latest software, technologies and methods. Workshop topics include detrital zircons, geophysical methods, hyperspectral drillcore imaging, micro X-ray computed tomography, continuing professional development and SAMCODES. Workshops will be advertised and available for registration on the Geocongress website from 7th June (*for registered delegates only*).

18 - 20 JULY 2018 | UNIVERSITY OF JOHANNESBURG

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Standard **R1000-00**

There are various sponsorship and exhibition opportunities available, for more information contact **Charne Millett-Clay | 011 463 5085 | charne@soafrica.com**

For more information contact -

Scatterlings Conference & Events

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Registration – Lyntina Benjamin | 011 463 5085 | lyntina@soafrica.com

Abstracts & Speakers – Marija Spasveski | 011 463 5085 | marija@soafrica.com

Geocongress

Workshops – Ben Hayes | geocongress2018workshops@gmail.com

Field Trips - Jeremie Lehmann | geocongress2018fieldtrip@gmail.com

WWW.GSSACONFERENCES.CO.ZA





obituary

Brian Ronald Turner: 1941 – 2018

Brian was born in the UK in 1941 during the Second World War. Showing his industrious nature early, his first job was to help his mother stuff mattresses at the bedding shop - and he never looked back. He showed his talents as an allrounder when at Armley Park School in Leeds, he played in their football and cricket teams, as well as learning to play both the piano and trumpet. He received a scholarship to Leeds Central High School where he did his A-Levels and there he played in a brass band to earn pocket money.

Brian did a BSc Hons degree at Hull University and developed his culinary skills at Ringways Restaurant as a Chef during holidays, progressing to a restaurant in Leeds. He was evidently multi-talented, industrious, and a born academic. His geniality made him a pleasure to work with.

Brian's geological career began in South Africa at the Geological Survey in Pretoria, from 1964 to 1969. He was engaged in coal deposit research and produced 10 publications on the subject. While at the Survey he also undertook sundry geological services at the Oxbow Dam water scheme in Lesotho.

From 1969 to 1979 Brian was employed by the Bernard Price Institute, working in the Karoo with James Kitching of palaeontology fame, particularly on the Molteno Formation. Brian's primary forte was sedimentology. He published 10 discourses on his Molteno work and was awarded a PhD by the University of the Witwatersrand in 1975. Subsequent research on sedimentary rocks in the Karoo resulted in 46 publications, which included uranium-bearing sediments in the Beaufort Group.

Brian's academic bent saw him travel widely, teaching in Universities at Cape Town, Durham, Newcastle, and Jordan. He also contributed academically by examining geological theses (10 MSc and 4 PhD) at various institutions. Brian became a member of 13

Brian Ronald Turner: 1941 – 2018 †



international geological societies and branched out into the consulting business, where he served 23 firms. My last encounter with Brian's industriousness to see a job through, and his determination to contribute whatever he could to science, was on a gold exploration venture of Roraima Formations in the Amazon Basin. This expedition ended prematurely when the unwelcome results of a compulsory malaria test showed infection by both vivax and falciparum malaria, and saw him being sent back to London. There it transpired he also had a Bot Fly maggot infestation – the hazards of an exploration geologist's lifestyle! Generous as always, Brian donated his maggot to the Tropical Diseases Museum of London.

Brian was a loving husband to his wife Veronica, whom he fell in love with and married in 1974, after first falling in love with the Karoo Formations. Brian's culinary skills were put to good use in the family kitchen and he also kept up his trumpeting prowess, playing over weekends.

Brian was diagnosed with prostate cancer in 2012, and in 2013 suffered a bad stroke that left him paralysed down his right side. He soldiered on, learning to write with his left hand, but he finally succumbed to the cancer at home in 2018, after a painful battle, surrounded by family. We, the geological fraternity, his wife Veronica, his sister Charmian, sons Jason, Zeff, and daughter-in-law Celine, and numerous friends worldwide feel bereft, but appreciative of the huge understanding of earth's history he shared with us.

Lawrence Minter.

H.B.S. (Basil) Cooke

Herbert Basil Sutton Cooke, a geoscientist of international repute, passed away peacefully on Thursday, May 3, 2018 at 102 years of age. Born in Johannesburg on 17 October 1915 Basil Cooke was the last surviving member of a group of pioneering African palaeontologists, which included Robert Broom, Raymond Dart, John Robinson and Phillip Tobias in South Africa, as well as Louis Leakey in East Africa. Educated at King Edward VII School, Johannesburg, Cambridge University (B.A. [Hons] Geology and M.A., 1936-1940), and the University of the Witwatersrand (M.Sc and D.Sc, 1940-1947), he went on to teach first as a junior lecturer and then as a lecturer in Geology at the University of the Witwatersrand (Wits) from 1938-1947. From 1941-1945 he also served with the South African Air Force during the Second World War as observer and meteorologist in South Africa, North Africa and Italy, where his duties included instruction of observer/navigators, weather forecasting and meteorological research. He held the rank of Captain.

In 1953, following a stint as a private Consulting Geologist, he returned to Wits University as a Senior Lecturer, and between 1958 and 1961 held the title of Reader in Stratigraphic Geology and was responsible for the administration of the Geology Department and the organisation of research.

In 1961 he moved to Halifax, Nova Scotia, Canada, where he was professor of Geology at Dalhousie University, holding the Carnegie Professorship from 1969 onwards and acting as Dean of the Faculty of Arts and Science for five years. He retired in 1981 and, together with his wife Dorette, moved to White Rock, British Columbia, which became the base for his future activities.

While Basil's formal education was as a geologist, academic communities around the world knew him best as one of the pioneering African palaeontologists. He took a keen interest in Hominid Evolution and played a significant role in understanding the geology of the famous Sterkfontein Caves site (Maropeng) rich

Basil Cooke 1915-2018 †

in hominid and animal fossils. Although he was a geological 'all-rounder' his personal specialty was with Quaternary Geology and he made notable contributions in a series of papers on the alluvial terraces of the lower Vaal River, famous for the Stone Age artefacts and vertebrate fossils revealed in pits excavated by scores of diamond diggers, and collaborating at times with the pioneer archaeologist Clarence (Peter) van Riet Lowe. His studies of Quaternary Geology were not restricted to South Africa alone as much of his work in this field was carried out elsewhere throughout Africa, but particularly in East and southern Africa. He made major research contributions working on fossil African pigs, which were unusually abundant and diversifying rapidly during the late Tertiary and early Quaternary. Another notable contribution was made in 2006 and included a contribution on Hominin environments in the East African Pliocene.

In later years Basil was drawn into the work of the International Union for Quaternary Research (INQUA) where, as a member of INQUA's most important

Wadi Hiton, in the Egyptian desert, about 150 km southwest of Cairo, taken in 1989. Basil Cooke visited this site 40 years earlier while participating in a University of California Expedition in 1947 when he was 32 year old (inset photograph). The site is famous for the treasure trove of archaic fossil remains of whales (*Basilosaurus*, presumably named after Basil Cooke) and sea cows (*Sirenia*).



Basil Cooke was a geologist-palaeontologist and was interested in Human Evolution. He undertook geological investigations at the Sterkfontein Cave site north of Krugersdorp together with Dr Robert Broom. Here he is seen examining fossil skulls housed at the University of the Witwatersrand.



policy-setting body - the Commission on Stratigraphy- he made telling inputs which led to the defining of the present geological boundary between the Pliocene and Pleistocene epochs.

Cooke's interest in teaching was not a late development as his many publications (well over 100) included a university text book (*Geology for South African Students: An Introductory Textbook* - Hamilton & Cooke, 1939), which ran to five editions. He also published, together with Vincent Maglio, a benchmark volume (*Evolution of African Mammals* - Harvard University Press, 1979). Basil Cooke was also a regular broadcaster of scientific talks and from time to time took part in a popular SABC radio programme known as *The Three Wise Men* (together with other radio personalities, including Eric Rosenthal, Prof. Arthur Bleksley and Grant Loudon).

This year (2018) Basil Cooke celebrated the 68th anniversary of his election, at an exceptionally young age, to Fellowship of the Royal Society of South Africa



Basil Cooke taken when he was 91 years old.

in 1948, of which he was subsequently made a Life Fellow. The Royal Society published a Festschrift to him in 2006. He is also a Life Fellow of the Geological Society of South Africa, an Honorary Life Member of the Palaeontological Society of Southern Africa, Past President and Life Member of both the South African Geographical Society and the South African Archaeological Society, and a Past Vice-president of the South African Association for the Advancement of

Science. In Canada he was made an Honorary Life Member of the Nova Scotian Institute of Science and the Canadian Association for Physical Anthropology. He was awarded the Canadian Centennial Medal (1967) and the Queen's Golden Jubilee Medal (2002) for his contributions to education.

His awards over the years have been many and varied, these achievements including the award of an LL.D. *honoris causa* by Dalhousie University in 1982 and a D.Sc. *honoris causa* by his *alma mater*, the University of the Witwatersrand, in 1998.

Basil's move to Canada was an enormous loss to both the University of the Witwatersrand and to the scientific community of South Africa. However, his strong links with South Africa and the Quaternary Geology of the African continent as a whole were never severed.

As stated by Margaret Avery (2006) in a biographical note published in the Transactions of the Royal Society of South Africa (vol. 61, 2, 31-32) *"It may therefore seem surprising that so deserving a person has not received the recognition that has come the way of many of his peers, and even juniors. The reason for this is almost certainly that, in spite of his major scientific contribution, Basil has remained a quiet person who got on with the job without self-advertisement. In common with other great people he also has the humanity to remember the 'little' people; I personally can attest to this, having benefited from his friendship and support for a great many years."*

These words I, together with a few remaining colleagues, including Richard and Morris Viljoen and Dick Welch, who were students of Basil Cooke in the years 1958-1961 at Wits, can endorse. He was an enthusiastic teacher and inspired students immeasurably in the subject of Geology and his early mentorship made telling contributions to our future careers. From initial modest accommodation in the present day Biology Building at Wits he reportedly had significant input into the design of the new Geosciences Building on the campus. Regrettably, Basil left South Africa before it was officially opened on 7 June 1962.

Basil was predeceased by Dorette, his wife of more than 60 years. He leaves behind two sons, Christopher (Sharron) and Patrick (Phyllis), and three grandsons, Brandon, Christian, and Justin.

I encourage all who read this tribute to Basil Cooke to join me in celebrating the career (in the words of Margaret Avery), of an "often under-praised 'Great Man of Africa'".

Carl R. Anhaeusser. Professor Emeritus, Economic Geology Research Institute, School of Geosciences, University of the Witwatersrand, Johannesburg.



GSSA calendar 2018

Geological Society of South Africa

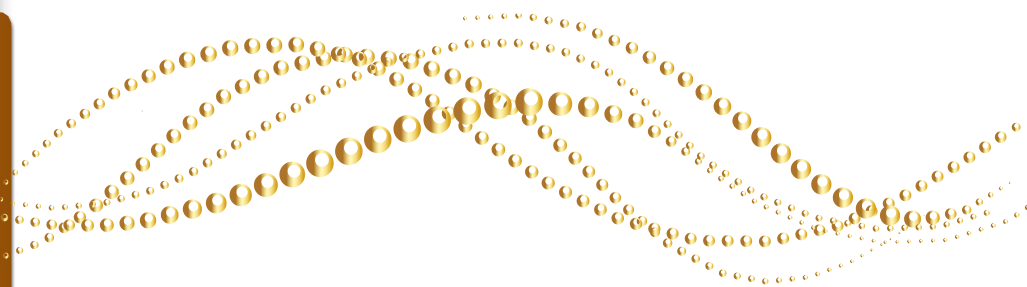
DATE	EVENT
Postponed till later in 2018 2 February	Introduction to SAMREC/SAMVAL Compliance – Cape Town
21 – 23 February	Drilling Methods and Techniques in Resource Exploration
8-10 March	Foundations for a Geological Career
24 - 25 May	Economic Analysis for Mining Investments
26 - 28 June	Workshop on SAMREC/SAMVAL Compliance and JSE Reporting for CP/CVs
18 – 20 July	Geocongress
26 July	AGM
Date TBC 31 August	Excursion to Hartebeesthoek Radio Astronomy Observatory
26 - 28 September	Drilling Methods and Techniques in Resource Exploration
4 - 7 November	AAPG ICE Meeting – Cape Town
15 November Date TBC	Fellows Dinner (tbc)
15 - 16 November Date TBC	Technology Day and African Exploration Showcase





CGS ANNUAL CONFERENCE 2019

11–12 February



‘Merging maps for an emerging future’

The Council for Geoscience would like to invite you to its annual two day conference at the CSIR International Conference Centre, Pretoria

The CGS Conference will bring together national and international scientists to discuss aspects of its new “Integrated and multidisciplinary geoscience mapping programme 2018 – 2021”. Within the CGS’s broad geological mandate special emphasis will be placed on: geoscience for minerals and energy; geoscience for infrastructure and land use; geoscience for health, groundwater and environment; geoscience innovation; and geoscience diplomacy. Internationally renowned experts will participate as keynote presenters and scientists from the CGS will be presenting research undertaken for this national programme. With this annual conference the CGS hopes to provide to its stakeholders an insight into all the nationally funded research projects it is undertaking. A call for abstracts will be made shortly with the emphasis on the use of multidisciplinary data sets and how societal needs are best served.

Kindly respond to this invitation via the mentioned website.

We look forward to confirming your participation and presence at the conference.

Follow the website for new developments:
<http://geoscience.org.za/cgs/>



Council for Geoscience

SAMREC/SAMVAL COMPLIANCE & JSE REPORTING

Glenhove Conference Centre
28th - 29th JUNE 2018



This two-day Workshop (28th and 29th June 2018) comprises an introduction to the SAMREC and SAMVAL Codes, and to JSE Public Reporting.

This course is aimed at geologists, mining engineers and other technical specialists, who include or wish to include sign-off as a Competent Person ("CP") or as a Competent Valuator ("CV") in their job description.

Day one focuses on the SAMREC and SAMVAL Codes, and on the requirements for CPs and CVs who compile Public Reports, specifically Competent Persons Reports and Integrated Annual Reports, for companies listed on or who would like to list on the Johannesburg Stock Exchange (applicable primarily to Solid Minerals).

Day two focuses on the Section 12 Listing rules applicable to both the Main Board and the Alt-X as well as the requirements of SAMREC and SAMVAL. The talks will highlight some of the issues experienced by CPs and CVs over the years as well as some of the updated requirements as a result of the implementation of the 2016 SAMREC/SAMVAL Codes.

There will be an introduction to the JSE Readers Panel and a discussion of some of the on-going compliance issues identified by the panel.

With the increasing focus on junior mining, we are pleased to have Ryan Gibson who will speak on Junior Mining: Venture Capital and Crowdfunding.

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mineral scene

HEMIMORPHITE FROM LEEUWENKLOOF LEAD MINE, GAUTENG

Geology

Introduction

Hemimorphite is a hydrated zinc silicate $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$. It crystallizes in the orthorhombic crystal system and its name alludes to the hemimorphic morphology of the crystals. It is typically colourless to pale brown. It forms as a secondary mineral in some Pb-Zn deposits. From a South African standpoint, hemimorphite is a rare mineral and known only as small crystals, usually a few millimeters in size. Mindat.org lists only seven localities in the country and the specimens found at Leeuwenkloof, shown here, are amongst the best known.

Leeuwenkloof lead mine is situated approximately 30 km west of Pretoria and a few kilometres west of Pelindaba. It is an old, abandoned lead mine that operated on the farm Leeuwenkloof 97 (now 480 JQ) which today is the site of the Leeuwenkloof Environmental Facility.

A basic description of the geology and old workings can be found in Willemse *et al.*, (1944), a somewhat old publication but nonetheless highly informative mineral-wise. In fact, this publication still provides a great deal of information about the lead deposits of not only South Africa but also Namibia. The main ore mineral exploited at Leeuwenkloof was galena that occurred in quartz veins that cross-cut dolomite of the Eccles Formation, Malmani Subgroup of the Transvaal Supergroup (du Toit, 1988). As with many of the lead deposits formed in the Malmani dolomite, weathering and oxidation produced a suite of secondary minerals that contain not only lead, but also zinc and copper, and Leeuwenkloof is a good example of this type of deposit. It was relatively small, with sporadic sulphide mineralization and did not yield a huge amount of ore but Willemse *et al.* (1944) record that 1,272 tons of lead ore, averaging 75% Pb was mined from 1907-1908 and again during the period 1914-1925 when production





ceased. Mindat.org reports that 77 kg of silver was produced as a by-product.

Although there are two historic sites where mining took place, the main activity was via an opencast operation plus a vertical shaft. The open pit still exists today, as do scattered dumps of waste material and it is the latter that contains the suite of primary and secondary microminerals. One of the most interesting species is hemimorphite, a hydrated zinc silicate hydroxide.

Leeuwnkloof hemimorphite occurs as crystals 4-5 mm that are very characteristically clustered together into radiating, stellate groups. The individual crystals are colourless, transparent and well terminated and when found in groups, are very attractive. The mineral occurs in small vugs and dissolution cavities in the host dolomite where it lines the walls, with clusters of hemimorphite protruding inwards into the cavity. A second habit also exists. Flattened rosettes (in form resembling the well-known Illinois marcasite "sun" specimens) are found on some flat dolomite surfaces. These crystals must have formed on joint planes or small fault surfaces where

mineralized fluids percolated along the confined rock surfaces and the hemimorphite could only nucleate and grow parallel to the surface.

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South-western Uganda



THE GEOTRAVELLER

By Roger Scoon

Geology of National Parks of South-western Uganda: Basement Terranes and Volcanism in the Albertine Rift.

South-western Uganda is situated between the savannahs of the East African plateau and the low-lying, tropical rainforests of central Africa. This is reflected by a great diversity of ecosystems and wildlife. The plateau has an elevation of 1,000-1,400 m, resulting in a mild climate in comparison to the hot, humid lowlands. The Albertine Rift reports an elevation of between 913 m (Lake Edward) and 615 m (Lake Albert) and includes sections of tropical forest. Many of the most well known parks and reserves in south-western Uganda are located either in, or proximal to the rift.

The Queen Elizabeth National Park includes extensive grassy and woody savannahs (they support large herds of grazers) in the vicinity of Lakes Edward and George. Some parks have been established to protect the wide range of primates for which East Africa is so renowned. Chimpanzee occurs in the extensive forests

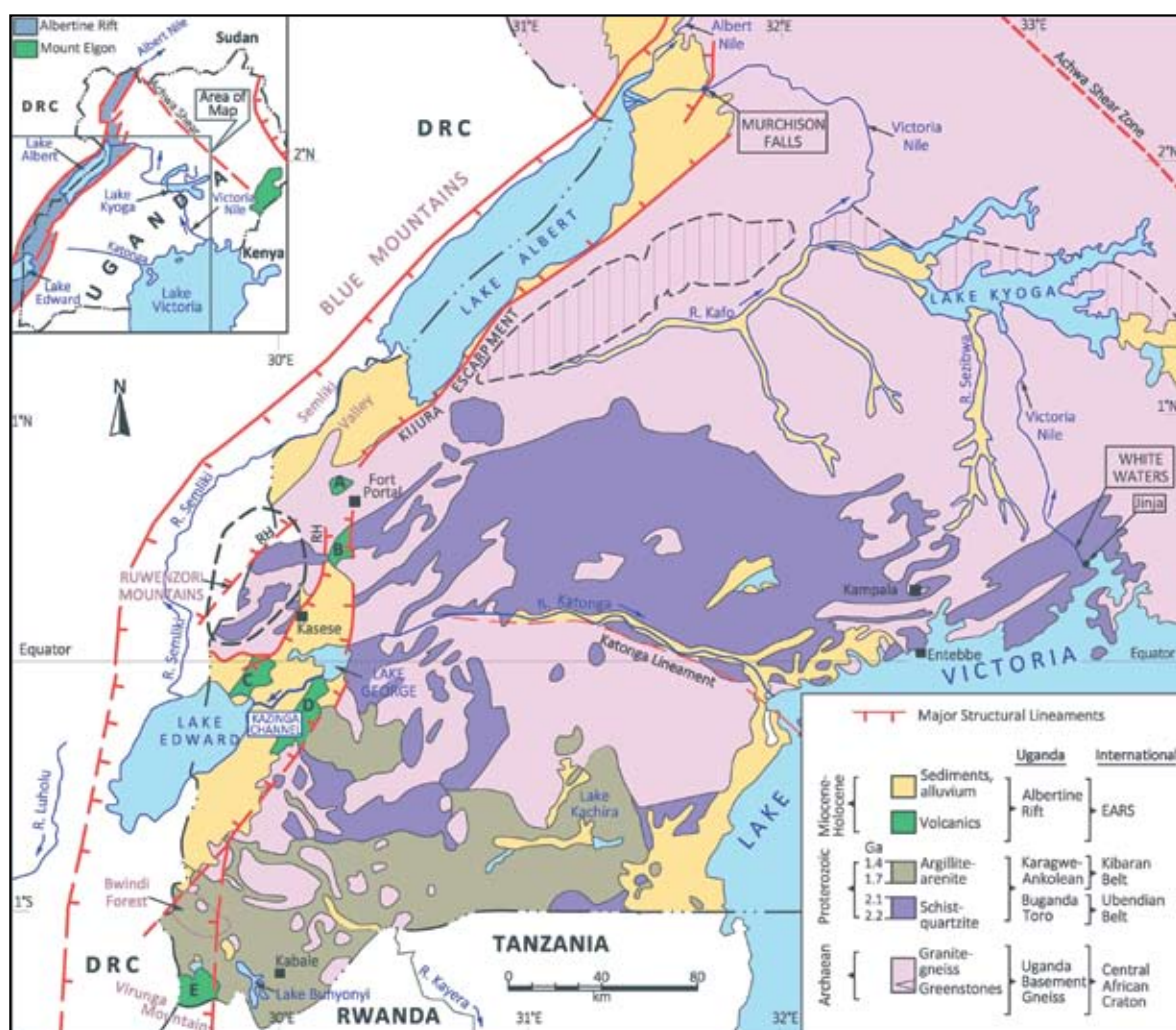
of Kibale National Park, located on basement terranes on the margin of the rift. Basement rocks are also exposed in the Lake Mburo National Park. The highly endangered mountain gorilla occurs in two parks, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. Bwindi is comprised of uplifted basement terranes on the edge of the rift, and Mgahinga is in the volcanically-active Virunga Mountains.

The regional plateau of south-western Uganda is underlain by crystalline basement complexes which were subjected to repeated phases of uplift and erosion during the Late Mesozoic break-up of the super-continent of Gondwana. The Archaean-age Uganda Gneiss Complex is the dominant component. Two metamorphic belts are recognised, the Buganda-Toro (Palaeoproterozoic) and the Karagwe-Ankolean (Mesoproterozoic). Outcrop of the basement complexes is sparse as they are covered

Lush vegetation covers large parts of Uganda, including rolling hills of the Ndali-Kasenda crater field.



Geological map of part of Uganda simplified from the 1:1,500,000 scale map compiled by MacDonald, R., and published by the Department of Geological Survey and Mines, Uganda (1966). Volcanic terranes of the Albertine Rift, Uganda: A: Fort Portal-Kasese; B: Ndali-Kasenda; C: Katwe-Kikorongo; D: Bunyaraguru; E: Virunga.



The Lake Mburo National Park includes monoliths of the Uganda Gneiss Complex.





The Kazinga Channel connects Lakes George and Edward, Queen Elizabeth National Park.

Rift are associated with the alkali volcanism which is characteristic of the entire EARS (Woolley, 2001).

Despite the Holocene being a relative quiescent epoch with modest seismic activity and volcanism, in recent years there have been several large earthquakes in the Albertine Rift (Maasha, 1975). The Albertine Rift has a higher than average heat flow. In 1966, a magnitude 7 event resulted in 157 fatalities in the Semliki Valley. In 1995, a magnitude 6 event caused a 20 km long crack to appear in the Fort Portal region (Roberts, 2007). Earthquakes in the region are deep-seated (27-40 km).

The Lake Mburo National Park is the smallest of Uganda's savannah parks with an area of 260 km². The park was formerly far larger but was reduced after being partially reclaimed by local pastoralists in the early 1980's. Mburo occurs on the regional plateau and is situated at an elevation of 1,220-1,828 m in an area of considerably less than average rainfall. Some 20% of the park is wetlands which are associated with a group of fourteen lakes fed by the Ruizi River. Mburo is mostly underlain by basement rocks, with localised areas of recent sediments in the river and lake basins. The latter may have formed due to Cenozoic warping, e.g. associated with the uplift



Tranquil setting of Lake Edward from the Uganda shoreline.



The Kikeronga Salt Pan, Katwe-Kikorongo volcanic field.



which caused the reversing of the flow of the Katonga River system (see below). Mburo includes large monoliths of the Uganda Gneiss Complex (estimated age of 2.75-2.55 Ga).

The Queen Elizabeth National Park has an area of 1,978 km² and is located wholly within the Albertine Rift. The park includes sections of Lakes Edward and George. This is the most widely visited of the Ugandan parks, in part as it includes a wide range of ecosystems, e.g., grassy savannahs, forests and wetlands. Maramagambo Forest in the eastern part of the park is located at the foot of the eastern escarpment. Several sections of the park include extensive crater fields. The Ishasha Plains are open savannahs located in the southern part of the park, south of Lake Edward. The Ishasha River is bordered by extensive riverine forest.

Lake Edward (area of 2,325 km²) has a length of 77 km and width of 40 km. The maximum depth is 112 m.

The lake is fed by several rivers, including the Ishasha. There is one major outlet, the Semliki River which flows northward into Lake Albert. This section of the rift is a half-graben; the escarpment is restricted to the Ugandan side. Lake George is the smaller of the two lakes (area of 250 km²), but has a similar elevation (914 m). The rounded shape and shallow depth (average of 2.4 m) are notable features. Lakes Edward and George were once part of the Katonga River system. Prior to the Cenozoic rifting, the Katonga was one of the palaeo-rivers that flowed westward towards the Atlantic Ocean. Until approximately 30,000 BP, the Katonga was the main outlet of the then newly-formed Lake Victoria i.e. part of the headwaters of the Nile system. The system reversed at approximately 13,000 BP (Talbot and Williams, 2009) - the Katonga now flows eastward into Lake Victoria – due to uplift associated with a lineament trending parallel to the Albertine Rift.

Lakes Edward and George are linked by the 32-km long

The Kitagata Crater includes a small lake, Katwe-Kikorongo volcanic field.





Outcrops of amygdaloidal alkali lavas and agglomerate cap the walls of the Kyemengo Crater, Katwe-Kikorongo volcanic field.

Kazinga Channel, a highlight of a visit to the Queen Elizabeth National Park. This RAMSAR site attracts a wide range of wildlife, including numerous species of birds. Game viewing is enhanced as some species, including African elephant and Cape buffalo can be approached within a few metres by boat. The channel occupies the palaeo-Katonga. The sluggish, westward flow is consistent with the similar elevations of the two lakes.

the last 130,000 years. This resulted in development of a deep trough in the southeastern part which was infilled by swamp clays and coarse fluvial and alluvial clastics. Five sedimentary units of Pleistocene–Holocene age are identified. Shallow-penetration reflection seismic surveys have enabled correlation of sequences which reflect alternating arid and wet intervals due to climatic changes over the past 20,000 years.

The sedimentology of the Lakes Edward-George basin is well known, in part as the region has been intensively prospected for petroleum in recent years (Nicholas et al., 2016). The basin is constrained by northeast-southwest fault zones which underwent significant extension within

Two crater fields occur on the plains of the Queen Elizabeth National Park proximal to the Kazinga Channel, Katwe-Kikorongo and Bunyaraguru. Volcanism built up a plateau which caused the subdivision of Lakes Edward and George. The crater fields have not been



Nyinambuga Crater includes a small lake; view from Ndali Lodge, Ndali-Kasenda crater field.



dated but are probably Late Pleistocene and Holocene. They are ascribed to explosive volcanic activity (Woolley, 2001). The Katwe-Kikorongo field (area of 30 by 15 km) transects the equator and is accessed by the circular "Crater Drive". Dozens of craters with diameters of up to 4 km and depths of 100m can be observed. There are a number of crater lakes, e.g., Kitagata and salt pans, e.g., Bunyampaka and Kikeronga. This area is very scenic and includes views to the north of the Ruwenzori.

The Katwe-Kikorongo and Bunyaraguru crater fields are dominated by tuffs and agglomerates; lava flows are restricted to four occurrences; summarised from Woolley (2001) with additional references therein. Many of the pyroclastic rocks contain xenoliths of the basement, indicative of their explosive origin. Most rocks are rich in leucite consistent with the sodium-rich alkaline magmas. This is one of the major differences between the low-volcanic output of the Albertine Rift and the high volcanic output Gregory Rift (the latter reveals potassic-rich alkali volcanism). One of the alkaline lavas in the region has an unusual composition which prompted the introduction of Katungite, defined as being primarily comprised of melilite with minor olivine, magnetite, leucite, and perovskite (i.e. pyroxene-free). Another unusual lava-type is ugandite, which is comprised of augite and leucite together with minor olivine, magnetite, and perovskite (i.e. pyroxene-bearing).

The Fort Portal-Kasekere and the Ndali-Kasenda volcanic fields are located in the Albertine Rift near the regional town of Fort Portal. The Ndali-Kasenda field covers an area of 20 by 10 km and reveals a landscape of lush, conical hills dotted by deep craters. The inner slopes of craters are thickly forested. Some thirty crater lakes occur, including the Nyinambuga crater situated beneath the Ndali Lodge. This lodge includes spectacular views of the north-south trending rampart of the Ruwenzori Mountains. During a visit in 2012, the villagers suggested there had been a small eruption in an adjacent crater. Some of the smaller craters are blowholes with little ejected material. There are few details of the petrology, although Woolley (2001) has suggested the area is broadly similar to the larger Fort Portal field (area of 142 km²) which has been carbon dated to give an age of 6,000-4,000 BP. Here, the small hills are mostly comprised of lapilli tuff cones up to 150 m in height. This area includes small intrusive bodies of carbonatite.

The Ndali-Kasenda volcanic field is bordered on the eastern side by the extensive Kibale Forest. The Kibale National Park (area of 795 km²) occurs at an elevation of 1,110-1,590 m, on the eastern fringes of the Albertine Rift. The escarpment in this area is poorly defined. Kibale is mostly underlain by the Uganda Gneiss Complex. A fault-bounded basin in the southern part of the park is comprised of the Buganda-Toro System (2.2-

Outcrop of alkali volcanic ashes at base of a small crater, Ndali-Kasenda crater field. Barely visible in foreground is a small pit that may have developed from a recent gas eruption.





(A) Chimpanzee (*Pan troglodytes*) are protected in the Kibale Forest National Park; (B) Mountain gorilla (*Gorilla beringei*) are camouflaged by dense vegetation in the Bwindi Impenetrable Forest.

2.1 Ga). Kibale is one of the largest and ecologically most important wooded areas in Uganda, consisting largely of a moist evergreen and semi-deciduous forest. Several wetlands are associated with areas of internal drainage that developed from Cenozoic warping. The main attraction of Kibale for tourists is chimpanzee, with several large family groups having been habituated over many years. The close relationship established by trackers enables some close encounters. The chimpanzee at Kibale has been widely studied since 1987, including by a team led by Richard Wrangham with members from Harvard University and Makerere University, Kampala. This has complimented the pioneering work of Jane Goodall and colleagues carried out over many years at Gombe Stream National Reserve, Tanzania. There are also twelve other species of primate at Kibale, the largest number in a single park in Uganda. They include olive baboon and the endangered black-and-white colobus. Kibale contains some 335 bird species.

Mountain gorilla is preserved in two national parks in south-western Uganda, Bwindi and Mgahinga. The Bwindi Impenetrable National Park (area of 331 km²) has a resident population of approximately 400, representing half of the population of this endangered species. The park lies at an elevation of 1,160-2,607 m and is part of the Kigezi Highlands, a mountainous area that overlaps the eastern escarpment of the Albertine Rift. Bwindi is underlain by resistant metasedimentary rocks of the Karagwe-Ankolean System (1.7-1.4 Ga). The principal rock types are shale, phyllite, schist, and quartzite. An inlier of the Uganda Gneiss Complex occurs in the eastern part of the park. The dominant vegetation

types are lowland and afro-montane forest. Large sections of the park are so densely wooded it is only accessible on foot. The forest is one of the oldest in East Africa, dating from at least 25,000 BP i.e. prior to the Last Glacial Maximum. The age of the forest, together with the equatorial climate has resulted in a diversity of species. The park is a world heritage site.

The other location of the mountain gorilla is the Virunga Mountains. This is an active chain of volcanoes that transects the borders of Uganda, Rwanda and the DRC. The mountain gorilla do not reside permanently in the Mgahinga Gorilla National Park (which the writer has not visited) but migrate freely between the Volcanoes National Parks of Rwanda and the DRC (they are known to react to times of civil unrest by crossing the borders). Mgahinga is located in one of the most scenic areas of East Africa. The volcanic nature of the Virunga with three high peaks on the Ugandan-Rwandan border is well known. The highest peak is Mount Muhabura with an elevation of 4,127 m. The alkali volcanism is related to the EARS. The activity covers a broad range of ages, with the oldest date being approximately 100,000 BP. There are several active volcanoes, including Nyiragongo in the DRC.

The ancestors to chimpanzees, gorillas, and hominins i.e. monkeys and apes, first appeared in the Oligocene epoch (33.9-23.03 Ma). The fossil record of the genus gorilla is poor, but the evolutionary history may be traced to an extinct ape *Proconsul africanus*, discovered in 1948 by Mary Leaky at Rusinga Island, Lake Victoria. The gorilla probably split from the other primates at approximately



Part of the rugged Virunga Mountain chain which forms the southern boundary of Uganda, viewed from the Volcanoes National Park, Rwanda.



9 Ma. Two subspecies are recognized. The Western gorilla and Eastern Lowland gorilla are now generally grouped as *Gorilla gorilla*. The Mountain gorilla, *Gorilla beringei*, may have separated at approximately 0.4 Ma. Only two populations of Mountain gorilla are recognized, Virunga and Bwindi. The geological evidence could be construed to indicate the oldest population was Bwindi, as the basement rocks at this locality were uplifted to elevations sufficient for afro-montane forest to occur in the Pliocene-Early Pleistocene. They could only have colonised the Virunga forests in more recent times. The active nature of the Virunga volcanism, which can include fast-moving lava flows, would have made this a risky venture, possibly undertaken as a reaction to the isolated habitat of Bwindi. The absence of Mountain gorilla, from the Ruwenzori Mountains, an ancient horst block with broadly similar afro-montane forests may be an indication of the localised (and very recent) effects of Darwinian evolution in this region.



Photographs by the author

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Maps published by **Ndali Lodge** (Fort Portal and Ndali Crater Area) and by **Uganda Maps** (Queen Elizabeth National Park; Bwindi Impenetrable Forest and Kigezi Highlands) were extremely useful.



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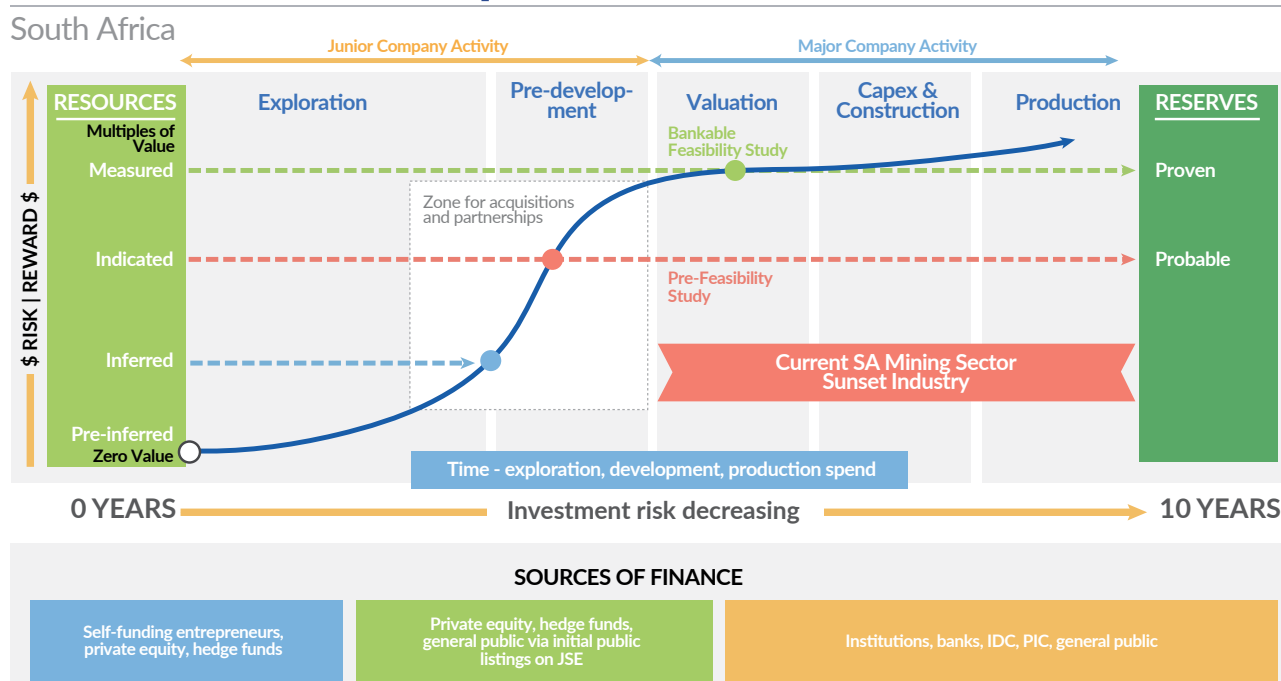
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The Investment Imperative: The Value Curve



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BACKGROUND

Geometallurgy has arisen as a multi-disciplinary practise for optimising the NPV of an ore deposit by managing ore heterogeneity. This holistic approach seeks to acquire appropriate, spatially constrained, ore body knowledge in advance that quantifies all aspects of ore body variability (including its response to blasting, excavation, crushing, grinding, separability and the environment). Ultimately this knowledge is used to drive integrated mine planning, ore flow management and processing from exploration, operations through to final closure and rehabilitation.

WHO SHOULD ATTEND

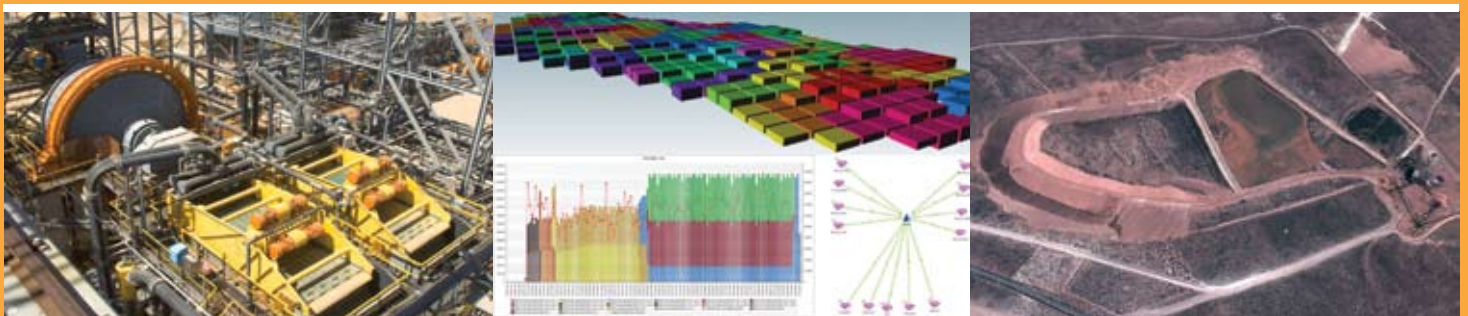
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- Project Geometallurgy & Operational Geometallurgy
- Minerals Resource Management
- Exploration and mine geology
- Geostatistics and modelling
- Mining engineering
- Minerals processing
- Metallurgy (bio-, hydro- and pyro-)
- Applied and Process mineralogy
- Environmental
- Sustainability.

For further information contact:

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First Announcement & Call for Papers

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Call for Papers

EXPRESSIONS OF INTEREST AND CALL FOR PAPERS

Prospective authors are invited to submit titles and abstracts for this conference. Abstracts of no longer than 150 words should be submitted by no later than 31 January 2018.

Please email abstracts and requests to be added to the conference mailing list to Camielah Jardine: Head of Conferencing, SAIMM at camielah@saimm.co.za.

KEY DATES

31 January 2018	Abstract Submission Deadline
28 February 2018	Acceptance of Abstracts
16 April 2018	Submission of Conference Papers
14 June 2018	Peer review process to be completed

The Southern African Institute of Mining and Metallurgy

Head of Conferencing, Camielah Jardine

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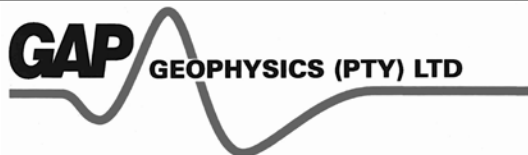
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