

geobulletin

QUARTERLY NEWS BULLETIN ~ JUNE 2014

VOLUME 57 NO. 2

The Barberton Makhonjwa Geotrail
The great southern African train Geo-safari
Kimberly Diamond Symposium & Trade Show

news



Environmental and Natural Sciences



Short Course on Diamonds and their primary and secondary sources

21 – 24 October 2014

University of Pretoria, Pretoria, South Africa

Course leaders: Mike de Wit and John Bristow

Topics to be covered in 21 – 24 October 2014:

1. **Exploration:** History of diamonds, World diamond markets, Origin of diamonds, Kimberlites/Lamproites and cratons, Structural geology and diamond exploration, Modern Exploration techniques, Geophysics and diamonds, Indicator minerals chemistry (*Mike de Wit, John Bristow, Fanus Viljoen, Hielke Jelsma, Gavin Selfe, Owen Garvie, Dave Apter*).
2. **Primary and secondary sources of diamonds:** Classification of Primary sources of diamonds including Kimberlites/Lamproites, Characteristics and settings of Secondary or alluvial diamond deposits in South Africa (Orange, Vaal River, NW province), Africa and India, Marine Diamond deposits (*Johan Stiefenhofer, Tania Marshall, John Ward, Mike de Wit*).
3. **Evaluation and Economic Valuation of Diamond Deposits:** Due diligence and geological requirements, Diamond valuation (rough and polished) and size frequency studies, Mining methods, Evaluation of alluvial deposits, financial valuation models (*John Bristow, Bob Halvorson, Jeffrey Brenner, Tania Marshall*).

The 24th October will be allocated to a:

4. Mine visit to Cullinan Mine, Pretoria

This unique course in diamond exploration and evaluation will be presented at the University of Pretoria presented by a group of experts in their respective fields ranging from exploration methods, geophysical techniques appropriate to diamond exploration, mining methods, diamonds, mineral chemistry, petrography, Kimberlites/Lamproites and cratons, and secondary diamond deposits which will add significant value to those that are involved in these exciting fields. It has been several decades since the last major discovery was made and the markets will be looking for an additional production of diamonds in the future.

Funds that might be raised as a consequence of this short course are earmarked to cover the registration expenses for the honours students at the University of Pretoria and as well as for a post-graduate fund for junior lecturers at the University.

For details of this course you can contact Mike De Wit at mdewit@delrand.com, or John Bristow at johnbristow@incubex.co.za. Details for the 2014 course will in due course also be available at: www.ceatup.com. Some of the places have been reserved for the 2014 Geology honours students so places will be limited and early bookings is recommended.

Registration and enquiries:

Samedah Davis
Tel: +27 (012) 434 2562
Email: samedah.davis@ce.up.ac.za

contents

Society News

- 2 From the Editor's desk - Chris Hatton
- 3 Executive Manager's Corner - Craig Smith
- 5 Missing members
- 5 President's Column - Avinash Bisnath

Letters

- 7 The Vredefort World Heritage site

University News

- 10 University of the Free State

Articles

- 14 Rhodes University MSc Exploration Geology Field Trip
- 19 Karoo Workshop at the University of Pretoria
- 21 The Barberton Makhonjwa Geotrail
- 22 Another layered intrusion
- 23 EGU General Assembly 2014, Vienna
- 25 EGU 2014 implications for the 35th IGC
- 27 SAMREC Code (2014)
- 28 Industrial Minerals – Reporting Resources
- 34 The great southern African train Geo-safari
- 41 Kimberley Diamond Symposium and Trade Show

Obituary

- 44 Ian Ward
- 46 Fred Gladstone Bell

Media Monitor

- 50 Antony Cowey

The Geotraveller

- 56 The English Lake district

Other Business

- 62 Classifieds



COVER PHOTO:

Swazi dancers in front of the Barberton road sign (see article on p. 21)



Geological Society of South Africa

GSSA

GB (GEOBULLETIN)
5TH FLOOR CHAMBER OF MINES
HOLLARD STREET
MARSHALLTOWN 2107
GAUTENG
SOUTH AFRICA

PO BOX 61809
MARSHALLTOWN 2107
SOUTH AFRICA

Tel: +27(11)492 3370
Fax: +27(11)492 3371
e-mail: info@gssa.org.za
Web: www.gssa.org.za

COMMITTEE

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

Design & Layout: Belinda Boyes-Varley 079 129 7748

Printing: Seriti Printing (Pty) Ltd 012 333 9757

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

Contributions for the next issue should be submitted by:
15 August, 2014.

Geobulletin is provided free to members of the GSSA. Non-member subscriptions per four issue volume are R150.00 for South Africa, R175.00 for the rest of Africa and US\$ 45.00 overseas. 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.

2014 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 15 February (March 2013 issue), 15 May (June 2013 issue), 15 August (September 2013 issue) and 15 November (December 2013 issue).

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

* Casual insertions • 4+ insertions

from the editor's desk



Can you have too much of a good thing?

Chris Hatton

The message that came back from the IUGS earlier this year was that the Local Organising Committee of the 35th International Geocongress was planning to offer too many field trips for this event in August-September 2016. Responding to this advice the First Circular contained a list that omitted several field trips that were previously planned.

The response of the local geological community to this abbreviated list generally expressed the feeling that this abridgement does not do justice to the extraordinary array of geology that southern Africa has to offer. Although a normal human failing is to exaggerate the importance of your own particular sphere, the evidence is that geologically speaking, southern Africa really is especially well endowed, providing the most complete record anywhere of intertwined geological, biological and atmospheric evolution, from the Cradle of Life in the Barberton Mountain Land to the Cradle of Humankind in Gauteng and the first footprints of modern humans at Langebaan. Appropriately, the first Geotrail in South Africa is being developed in the Barberton Mountain Land, and Genevieve Pearson outlines the latest steps in this process on pp. 21-22 of this issue. This Geotrail is an excellent introduction to what has already emerged from studies of the Barberton Mountain Land, but more is to come. The 35th International Geocongress will provide a venue where some of the outstanding mysteries may be solved. The Barberton Mountain Land has revealed fossils which though only a third of a millimetre in size, are much larger than would be expected in 3 billion year old rocks. Will these fossils turn out to be ancient eukaryotes which became extinct as the earth grew more oxidised? Although the atmosphere and the biology of Barberton is profoundly different from the present, some of the geological attributes are puzzlingly similar. Detailed studies of the sediments reveal sedimentation rates which fall in

the range of modern basins. Is there a fundamental uniformity in the evolution of cratonic sedimentary basins? Moving up the geological column, road-cuts on the Hekpoort palaeosol at Waterval Boven have revealed evidence for life on land 2.3 billion years ago, challenging the widely held assumption that life only moved onto land half a billion years ago. More disconcertingly, the Waterval Boven urn-shaped fossils show similarities to the controversial fossils in the Wits basin, described thirty years ago as lichen-like concentrators of gold. Field trips to the Wits basin are being restored to the field trip agenda, but as yet the Waterval Boven palaeosol is another glaring omission from the list; any volunteers to rectify this situation?

Water will feature as an important issue in the 35th IGC, with the Department of Water Affairs hosting sessions on hydrology. The role of river systems of southern Africa in transporting diamonds will be examined in a field trip in the area between Kimberley and Lichtenburg. The complete journey of diamonds from source to sea begins in Lesotho, and here again a further field trip is called for. In short, the LOC appreciates the advice that the extensive list of field trips that is being contemplated carries the risk that our limited resources may be overextended, but feels that the geology of southern Africa warrants as complete an offering as possible.

Part of our reason to proceed with this plan is the desire that the 35th IGC leave a permanent legacy, reflecting all aspects of southern African geology. This unique event has created a timeframe for the updating of the 1 : 1 000 000 geological map of South Africa. This in turn has stimulated the need to revisit and standardise the stratigraphic nomenclature. The field guides for the 35th IGC excursions should conform to a mutual, readily comprehensible stratigraphic standard, and the inputs of all the field guide leaders will be sought to assist in this task.

The geological diversity of southern Africa fortunately carries it with an abundance of economically recoverable

resources. These are vital for wealth creation, but mining is by its nature a creator of medium to short term wealth (very short term, if the recalcitrant attitude of the current union bosses persists). In the longer term tourism is widely regarded as a more sustainable form of wealth creation. In the article on pp. 34-39 Gavin Whitfield presents a prime example of geological tourism, displaying a panorama of southern African geological spectacles. We hope that the field trips associated with the 35th IGC will provide the platform to widen and strengthen this type of initiative.

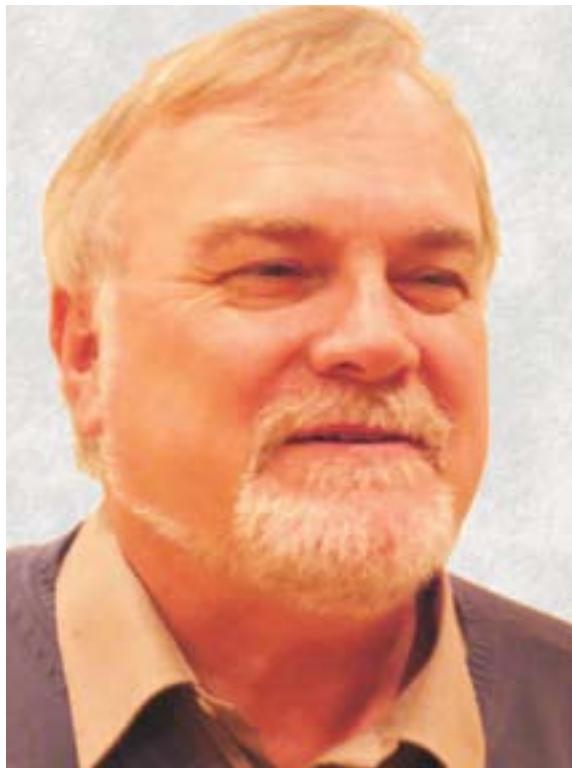
Making our geological sites more accessible unfortunately carries with it the spectre of the geovandal. In Uwe Reimold's letter on pp. 7-9 regrettable examples of the damage that uninformed persons (mindless cretins, one is tempted to say) can inflict on our geoheritage are displayed. Public access must clearly be accompanied by official protection. A necessary part of the process of developing geological tourism is engagement with government officials. As Vredefort illustrates, co-ordinating the numerous stakeholders involved is no easy task. South Africa

has a long history of protecting our natural heritage and there is no shortage of official bodies and official mechanisms to protect this heritage. Unfortunately here we do have too much of a good thing; responsibility for protecting Vredefort can be passed from a municipal body to a provincial body, from a provincial body to the national government, from the national government to UNESCO...., and so on. Any of the above might communicate with a university, the GSSA or the CGS. From the government side, the solution is obvious. National government must control the process of protecting our geological heritage. When it comes to which department of government, tourism would seem to be the most direct path to poverty alleviation. On our side the picture is not so clear. In developing the Barberton Geotrail, Tony Ferrar has stressed the importance of a responsible and capable public agency. Surely the geological community of South Africa needs to establish a single body to deal with geological tourism. Other suggestions are welcome, but the clock is ticking; the 35th IGC is a little more than two years away.

executive managers

By the time this column is in print and Geobulletin is mailed, our members should have received a special winter offer on some of the books we have in stock. This will run through the end of June, and it's a good opportunity to complete your collection of important South African works. A cold winter evening is a great time to get the fireplace going, grab a glass of red wine, and curl up with some good geology.

It does not have to be a book purchased from the GSSA. For those of you who live in the digital era, an interesting exercise is to go to http://www.goodreads.com/list/show/11003.Best_Geology_Books for a list of the top 63 geology books as rated by Goodreads.com. It's an interesting list and there is something for everyone – including those neophytes in your family who have no idea what you actually do for a living. I've had a look at several of these books over the years; I personally enjoy the writings of Simon Winchester and John McPhee. There is a lot of history in this book



corner

Craig Smith



list, and some of the classics are free on Amazon.com (for example, *Principles of Geology* by Charles Lyell; 1830).

Geological maps are of course the foundation of our profession, and Simon Winchester's book on 'the map that changed the world', an account of how William Smith became acknowledged as the father of modern geology in 1831 is recommended.

As noted in Winchester's latest book, the accolade for the first geological map actually belongs to William Maclure of the United States who in 1809 published the first map depicting the geology of the eastern United States from Maine to Georgia. This preceded the map published by William Smith in England in 1815. Maclure's effort was fairly primitive, and moreover was based on lithology rather than age differences of rocks. David Dale Owen (born 1807) took up where Maclure left off (he was a student of Maclure) and was responsible for moving geological mapping forward in the United States in the first half of the 19th century. During that time geologists on both sides of the Atlantic were progressing the science based on Smith's revolutionary idea of documenting rocks according to their relative ages. Unlike a purely lithological map, a time-based map can be used for much more prediction and extrapolation.

Sometimes it's worth sitting back and reviewing the hows and whys of those early advances. It gives us a different perspective on the earth around us. Non-geologists tend to believe that if we want to find a deposit of, say, copper, we dial up 'c' and send some geos and trucks out to site, along with securing the ground. But the first step in any program is having people with a deep understanding of the geology of the area or country in which they work. There has to be a knowledge base. That takes time and commitment – and maps – to develop and maintain. It's a non-negotiable starting point. And having that understanding is part of what makes you a professional.

I've noted before in this column that as a professional community, we are seeing a surge of interest in the earth sciences from the general public, with a significant number of books in the Goodreads list aimed at the non-professional market. Nick Norman's books on

South African geology are selling well. Wits has offered a basic course in geology for non-geologists, and it seems to be well received. The series of public lectures the GSSA and the Origins Centre at Wits collaborate in staging are almost always well attended. The last one (Hassina Mouri on medical geology) had a higher proportion of non-geologists than geologists in the room. The next one is scheduled for early August, when Mike Knoper will speak about the South African Antarctic program.

The increased interest from the public (world-wide) translates into an urgent need to design and deliver geoheritage projects to the public. Geoheritage will play a major role in the 2016 IGC meeting in Cape Town, and a number of efforts are underway, aimed at and associated with that event. The most significant recent development in South Africa is the opening of the Barberton Makhonjwa Geotrail in the Barberton Mountainland, championed by Tony Ferrar and others, including members of the Barberton branch of the GSSA. See <http://www.countrylife.co.za/geology-heaven/> for a description of the trail. This very successful project has benefitted from successful and significant fund raising, project management and marketing, and is a good example of how to do things right. When geoheritage has enough impact to attract a feature article in a popular magazine like Country Life, the professional community should take note! Other projects underway in South Africa do not yet have the success or impact of the Barberton effort, as discussed in the pages of this issue. We need to find ways of successfully progressing these. It's never an easy task as they require time, effort and most importantly, funding.

To end off, I would like to remind our members of two upcoming conferences in September. The International Mineralogical Association meeting (IMA) championed by our MINSA division will be a large international effort (with delegates representing 46 countries so far) is open for registration, and the program is on the conference website (<http://www.ima2014.co.za/>). It is a strong and varied program; note that one may register for day attendance if you are adverse to spending an entire work week in Sandton. There are still exhibitor and sponsor opportunities for marketing your brand at this meeting. There are associated workshops, one on diamonds being offered by the GIA at no cost to attendees.

The Kimberley Diamond Symposium meeting in Kimberley follows on shortly from the IMA meeting and is attracting much interest, locally and abroad. For more information see www.rca.co.za/conferences/kimberley/index.html. This meeting will be of interest to anyone involved in diamond exploration and mining, as well as academics involved in kimberlite, diamond and mantle petrology research.

Finally, we would like to contact our missing members. Please call us if you are one of them, or know of their present whereabouts.

Missing Members:

60492	Claassen	Mrs VL
6227	Jones	Mr KD
7280	Schouwstra	Dr RP
963436	Cochrane	Mr GR
964312	Kamga	Dr G
965138	Motsepe	Mrs LJ
965159	Prinsloo	Mnr JM

965603	Powell	Mr FM
965604	Robertson	Mr A Australia
965717	Narciso	Ms Nahari Patricia
965755	Richards	Mr D
965798	Malaza Jaha	MR
965828	Mbatha	Mr VH
965863	Nephawhe	Mr Baldwin Takalane
966023	Fodo	Luxolo Luyanda
966688	Mzobe	Mr Nkululeko
966708	Tshidada	Ms Tovhowani
966945	Ertugul	Mr Mert
967006	Duma	Mr Nkululeko Norman
967040	Oosthuizen	Mr Stefan
967041	Vilanculos	Mr Andrew
967281	Chipatiso	Mr Kudakwashe
967329	Wilson	Miss Helen
967349	Hlongwani	Ms Nkhensani
967420	Mmebe	Mr Samuel Gabaitsewe Tony
967731	Boyd	Miss Donna Louise
967748	Naik	Mr Sharata Kumar
967958	Lotter	Mr Dewald

president's column

The mining and geological fraternity has experienced some dramatic events during the recent months. We have experienced changes to the MPRDA, strike action across the platinum belt, strike action in sectors of the gold belt, a drop in exploration activity, corporate restructuring and retrenchments. However, all is not gloom and doom. There seems to be a rise in exploration activity, a South Africa National and Provincial Election was staged with only minor incidents and the GSSA continues to thrive.

I recently attended the WITS Faculty of Science awards evening in my capacity as an employee of the company I work for. During my discussions with Roger Gibson I learnt that they currently have in the region of 30 Honours students. After brief enquires I realized that we are producing in excess of 150 Geology Honours Graduates per year from South African universities. In my mind this is an astounding number and I could not help wonder "where are all these graduates going to find employment?" I was further astounded to realize that in addition to this number we are producing access



Avinash Bisnath

of 350 to 400 third year geology graduates; only about half our third year students can find places in the honours year. With this realization I ask the following:



1. Should we as the society be concerned?
2. How do lecturers manage to teach such large numbers?
3. Are geology departments equipped to handle these large numbers?
4. Could this be a reason for the decline in exposure students are receiving (particularly to field geology and mapping)?
5. Are we creating expectations for young graduates that cannot be met?

We spend time fighting the MPRDA, creating CDP systems, writing securities exchange rules, creating ethics committees and discipline committees etc. ensuring that we as seniors in the profession are secure, when in reality this pool of geologists is being created that in all likelihood will be unemployed. Strangely enough on a flight I sat next to an HR team from a major corporate who told me that there are not enough skilled and capable geologists being produced in our country. They went on to say that centres of geological excellence have dwindled away and are not aligned with industry needs or requirements. If this is true, are we creating an expectation for our geologist graduates that cannot be fulfilled?

My response to them was that we are all working in isolation. Industry has its own requirements, academics are concentrated on their research and focusing on providing a broad scientific and liberal arts program which is the role of a university. Students are bearing the brunt of this apparent gap between industry and academia. I welcomed them to engage with the GSSA to discuss this issue and together find a way forward. Therefore, I am making a call to our Past Presidents and Fellows of the Society to get involved with our Academic VP and myself to develop a strategy to address this concern. In my opinion it is serious and we need to do something. This goes back to my acceptance speech in 2013 when I stated: industry shouts "no skills", students say "no jobs", academics "no students for higher degrees".

When I was told that the Geobulletin article is due I sat pondering on what to write. This has been a difficult task since the society is in good shape. All the VP's are managing their portfolios efficiently and effectively. The society is in a fairly healthy financial position with money being wisely invested and managed, although membership fees are lagging behind. Once again we obtained and unqualified audit for 2013. I urge the membership to please pay up so that you can receive the SAJG, Geobulletin, enjoy discounted rates at DPP events and benefit from the society's activities.

I wish to remind the membership about the two upcoming large back-to-back meetings. The International Mineralogical Association meeting will be staged in Sandton in September and should attract around 1000 international delegates. Immediately following that will be an industry focused diamond meeting in Kimberley, and we would hope to attract 300 to 500 delegates to that. The GSSA is also working hard to ensure the success of the 35th International Geological Congress in Cape Town in 2016. As a member you should bookmark and follow the websites:

IMA: <http://www.ima2014.co.za>; **IGC:** <http://www.35igc.org/html/index.html>

to keep abreast of any new developments and deadlines.



Letters



Mr. Kishore Rao
Director, UNESCO World Heritage Centre
World Heritage Centre
7, place de fontenoy
75352 Paris
France
k.rao@unesco.org

and

The Minister
Department of Environmental Affairs
Private Bag X447
Pretoria
0001
South Africa

Open Letter: Vredefort World Heritage Site – listed by UNESCO since July 2005 but now entirely neglected and prone to vandalism.

Dear Sirs,

Nearly Nine Years of Procrastination in the Development of the Vredefort World Heritage Site, South Africa.

I am writing this Open Letter to GEOBULLETIN, Quarterly Newsbulletin of the Geological Society of South Africa, as a concerned member of the public, a scientist of 30 year-long research history on the Vredefort Dome and with a considerable interest in public promotion of the multidisciplinary importance of the Vredefort Dome in terms of its geological, biodiversity, historical and archeological heritage aspects (e.g., W.U. Reimold and R.L. Gibson, 2005, 2008, 2010: Meteorite Impact – The Danger from Space and South Africa's Mega-Impact, the Vredefort Structure; the 3rd edition of 2010 representing Springer Publisher's Geoparks of the World, volume 1), and a former President of the Geological Society of South Africa (2002) and Chairman of their Geoheritage Committee. Having been overjoyed in July 2005 about the proclamation of part of the Vredefort Dome as a UNESCO-listed World

Heritage Site (WHS), I must note that currently efforts to develop the site seem to have completely stalled. In particular, I have noted myself and also been informed by others that:

- The Minister (Dept of Environmental Affairs and Tourism) signed a "Memorandum of Agreement" with the Landowners Associations (of the Free State and Northwest province parts of the designated WHS area) and the Dome Conservancy, in which the parties agreed that the area is to be declared as a WHS in terms of South African legislation by the South African Government. To date, the area is still not declared as a WHS by the Government (after more than 3 years!). The Management Authority, as agreed to in the said Agreement, has also not been appointed yet by Government (resp. the Minister).

- The World Heritage office at Venterskroon, which had been maintained there for several years, has been abandoned, effectively abandoning the site and removing the little protection that this facility could have provided ever in the absence of a fully knowledgeable official.

- Negotiations between landowner organizations and provincial and national government seem to have stalled entirely. This is as a consequence of failure by government on all levels to properly inform the public and landowners to satisfaction and to devise a development plan that could be underwritten by all.

- The Visitors Information Centre, a grand building inaugurated with much fanfare in August 2008 together with the participants in the 4th International Large Meteorite Impact and Planetary Evolution Conference held then in the Vredefort Dome, has never opened its doors to the public. Which is probably - but sadly – a good thing, as it has begun to collapse prior to admitting the first visitor. The writer was told that a Free State Province official had intimated that the "rock was at fault for the decaying structure, as it had shifted". This appears highly unlikely given the

LETTERS



One of the famous pseudotachylitic breccia sites on the Vredefort Dome, Salvamento Quarry, has been used as a dumping ground for old tyres. This quarry is located just at the eastern boundary of the World heritage Site.



seismic history of the area; it is much more probable that poor planning and construction are the reasons for this degradation, so that fault should not be sought with nature but with building officials and construction companies.

- The completed exhibits have been stored for years in the interior of the building, where they have been left at the mercy of the elements (wind and rain) due to broken windows. A visitor finds a locked gate and fenced-in property, no presence of protective or educational personnel, and no access to information whatsoever (the latter throughout the WHS designated area).
- There is no indication that the facility will be repaired or – as it surely must be - rebuilt.
- In fact, there is no other facility in the area of the Vredefort Dome, where a visitor can obtain information about the importance of the Dome, why it has to be protected, and which sites would provide essential tuition. The so-called Information Center at Venterskroon contains merely a range of unexplained rocks and maps, and no staff with appropriate knowledge to consult either.
- The internal gravel road infrastructure of the WHS is poorly maintained by the responsible provincial departments (Free State and Northwest provinces)

with the result that visitors with normal sedan cars find it very difficult to visit and travel through the area. For this reason you find mostly 4x4 vehicles driving on the internal roads in the VDWH site. This has a direct negative impact on tourism (visitor numbers) and economic activities, such as guest houses, in the area.

- Researchers are hindered in their research endeavors due to numerous new fences around private properties or commercial setups, and the suspicion of landowners, who do not allow geoscientists and others to carry out their scientific work, in many instances. This is surely NOT what is intended by UNESCO.
- To carry this further, beyond lack of support for scientific work on the Vredefort Dome, one must point out that on the historical, archeological, and biodiversity fronts To carry this further, beyond lack of support for scientific work on the Vredefort Dome, one must point out that on the historical, archeological, and biodiversity fronts essentially no research has been carried on the Dome since 2005. Geoscientific research has continued mainly through the personal interests of a few geoscientists with long-standing Vredefort interests.
- Some of the most important sites in the World Heritage designated area have been vandalized.

This includes, for example, the San petroglyph site on Farm Daskop, where modern graffiti has defiled some outstanding cultural heritage. Another example is the Booysens Shale shatter cone site on farm Rooderand near the village of Venterskroon, where vandalism has caused destruction of fine shatter cone exhibits and, furthermore, widening of the road their partial eradication. The site is also prone to frequent rockfalls caused by water seepage, which has also caused extensive degradation of the site. A wonderful shatter cone site at Schoemansdrif Bridge at the southern limit of the designated World Heritage Area was damaged and its ambience all but destroyed when roadworkers created an access lane to the river without consideration for the heritage.

I conclude: There is lack of protection of the World Heritage Site, the breakdown of attempts to develop it responsibly, lack of information accessible to the public, and complete failure by government to ensure decisive action towards proper development – on all levels of national, provincial and local government. Here and there, one does find reference to South Africa's "7th World Heritage Site" in Tourism related publications in South Africa, but otherwise the VDWHS has fallen into disregard.

Official ignorance and mismanagement have resulted in complete breakdown of development of this world

renowned site. I want to appeal to your offices to revisit this grave situation as a matter of urgency; in particular, revisiting by SA Government and UNESCO of the required proclamation of the area as a World Heritage Site by South Africa is required, in order to re-start the management, protection and presentation of the site. This, in the interest of natural protection, tuition about some of South Africa's and, indeed, the world's outstanding natural and cultural heritage – for the people of South Africa and beyond - with the ultimate goal to provide benefit for local people and visiting tourists alike, to sustain ongoing research, and to showcase the capability of the South African people.

Wolf Uwe Reimold

Professor of Mineralogy and Petrography
Museum für Naturkunde Berlin and
Humboldt University Berlin

Invalidenstrasse 43
D-10115 Berlin
Germany
Tel. +49 30 2093 8470
Fax +49 30 2093 8565
E-mail: uwe.reimold@mfn-berlin.de

Left Image: Graffiti defacing a perhaps hundreds of years old petroglyph of a kettle or ceremonial apron on Vredefort impact melt rock on farm Daskop. Despite efforts to ensure protection by the landowner and a registered tour guide this important impact and cultural heritage site has been seriously affected by recent vandalism.



A scientifically important occurrence of shatter cones in Booysens Shale on farm Rooderand within the World Heritage Site was first destroyed by ignorants in 2008, as shown here. In early 2014, however, the entire roadcut was seriously degraded in the course of unsupervised widening of the road: many precious shatter cone exposures were directly scraped off, while several rock-falls were also triggered by this activity.



all the news fit to print



UNIVERSITY OF THE FREE STATE

It is nearly two years since our last contribution to Geobulletin, which is perhaps an indication of how busy things have been going at the department. The student selection process that was discussed in our previous contribution is slowly bringing undergraduate student numbers under control, which has positive spin-offs in terms of pass rates and, we believe, the general quality of students that we train. We are set up to accommodate 120 first-year students, and 60 students on second- as well as third-year level. Our honours group is currently limited to 35 students and competition for entry into the programme is fierce. Selection is carried out strictly based on academic performance. As from this year, we also expect that prospective honours students complete the TALPS (Test of Academic Literacy for Postgraduate Students) test before applying for admission. The test results are utilised to assist students in subject selection and to refer students for developmental training where necessary.

The Mineral Resource Throughput Management (MRTM) programme (masters level) is bursting out of its seams despite a downturn in the mining industry, with about 70 students enrolled in the programme. The MRTM staff and students are of the opinion that the programme presents a new paradigm for mining management and improvement that has the potential to elevate the industry to a next performance level. This is exactly what the industry is calling for according to a mining expert quoted in the mining weekly of 4 April 2014:

"Bruised and battered, the global mining industry today is undergoing a sea change. Practices and policies that might have worked wonders in the past are not as relevant today, and new approaches to running profitable mining operations need to be found. Many mining majors, across all commodity groups, are currently grappling with sagging profits and low company valuations. This is often regarded as the result

of the industry's 'sins' of the past, when companies were in pursuit of growing their output at all costs in a high commodity price environment."

We currently have 12 students pursuing MSc degrees on a wide range of topics, including rock mechanics, structural geological mapping in Namaqualand, petrological / geochemical / mineralogical studies on the Bushveld Complex, experimental petrological investigations on the behaviour of platinum-group elements in sulphide melts, comparative gemmological, mineralogical and geochemical characteristics of emeralds from Tanzania and Zambia, nickel mineralization in the Barberton Mountainland and sedimentological research in the Karoo Supergroup along the Great Escarpment.

A number of staff changes took place since our last contribution. Marian Tredoux officially retired at the end of 2013, but permission was given to retain her on a contract basis for 2014 and hopefully beyond. Justine Magson was appointed as Junior Lecturer in 2013. She is currently pursuing her MSc and has started to take over some of the teaching responsibilities of Marian. Thendo Mapholi, our best third-year student in 2012, was appointed as Junior Lecturer in March this year. She hopes to specialize as a Metamorphic Petrologist. Megan Purchase, who is currently pursuing her PhD under the guidance of Marian Tredoux was appointed as Analytical Scientist responsible for ensuring the effective operation of the department's analytical infrastructure, which includes an X-ray Fluorescence spectrometer, an X-ray Diffractometer and a Scanning Electron Microscope with both EDX and WDX capabilities. Willem van der Westhuizen's term as Head of Department ended in June 2013, with Freddie Roelofse being appointed the new HOD in August 2013. The department wishes to thank Willem for his services to the department as HOD over the course of his 15 year long term. Mr Peet Roodt, Control Technician with more than 30 years service in the

department retired at the end of 2013. We wish him well in his retirement. John Clark, who completed his MSc with Marian Tredoux in 2013, will be standing in for Adriaan Odendaal during the second semester of 2014. This will enable Adriaan to spend the second semester in the field acquiring additional data for his recently upgraded PhD study. Sadly, Huibrie Pretorius, our mineralogist, indicated that she will be emigrating with her husband and son to the USA at the end of June 2014. The department wishes them well on this journey through uncharted waters. The position left vacant as a result of Huibrie's resignation will be advertised in due course.

One of the highlights of 2013 was the handing over of the department's new core storage facility in August, that was erected on the main campus at a cost of ~R1.4-million and that will be used to house drill core material for both teaching and research. The 472 m² building was made possible through donations received from the Minerals Education Trust Fund (METF) and AngloGold Ashanti Ltd.

The year 2013 started with a bang, with the department playing host to 60 scientists and students from seven of the country's geology departments attending the 5th Igneous and Metamorphic Studies Group meeting that was held over the period 21-23 January. A total of 53 talks covering a wide range of topics were presented as part of the conference. A number of delegates attended the conference fieldtrip to Kimberley's Big Hole and to the Roberts Victor mine under the expert guidance of Dr. Jock Robey.

Numerous student excursions took place since June 2012. First-year student groups visited Austins Post in the Edenburg district repeatedly, where they were introduced to a variety of sedimentary, igneous and metamorphic features occurring within the Beaufort group. They also visited the Jagersfontein district on a number of occasions, where additional instruction was given on the sedimentological interpretation of fluvial and deltaic deposits. Second-year students still visit the Barkley East district annually for instruction on the principles of geological mapping and fieldwork techniques, where they are additionally introduced to aspects of physical volcanology, sedimentology, stratigraphy and structural geology as present in the upper parts of the Karoo Supergroup, viz. the Drakensberg Group, Clarens, Elliot and Molteno formations. Third-year student groups annually got the opportunity of being exposed to the realities of underground mining by visiting operating gold mines in the Free State goldfield as part of their course in Economic Geology. The annual fieldtrip to the Vredefort Dome for third-year students continued without interruption. In 2012, honours students visited numerous mining and mineral beneficiation operations in the Northern Cape and Namibia as part of their Economic Geology course. In 2013 the focus was on dimension stone, cement / colour additives, coal, iron / steel, heavy minerals and diamonds during the 7 day long fieldtrip through KwaZulu-Natal. Honours students enrolled for the Structural Geology module conducted underground mapping at the Masimong Shaft of Harmony Gold Mines in 2012 and again this year. Due to labour unrest in 2013, this exercise could not



The department's new core storage facility that was funded by the Minerals Education Trust Fund (METF) and AngloGold Ashanti Ltd.



Adriaan Odendaal highlighting an upward coarsening cycle typical of deltaic environments to first year students in the Jagersfontein district.

take part as planned and students visited the Vredefort Dome where they received practical training in structural mapping and geometric analysis. Honours mineralogy students visited Gold One's gold processing plant in Springs, the Council for Mineral Technology (Mintek) and the University of Johannesburg for a colloquium on geometallurgy in 2012. Similar excursions took place in 2013 and 2014, which included visits to Anglo American's Research facilities.

Numerous overseas visits were undertaken by staff members (and students) since our last contribution. These included visits to amongst others, the Massachusetts Institute of Technology, Laurentian University (Sudbury), the 34th IGC in Brisbane, the Natural History Museum in Berlin, GFZ (Potsdam), the First European Mineralogical

Conference in Frankfurt, the GeoHannover Conference in Germany, the Steinmann Institute at Bonn University, the Eugen Stumpfl Laboratory at Leoben University, the Gemmological Association of Great Britain, the Kiglapait Intrusion (Labrador), Cardiff University, the Karl-Franzens University of Graz, the 12th SGA meeting (Uppsala), Goldschmidt 2013 and the 24th Colloquium of African Geology (Addis Ababa). In 2014 staff members and students will be visiting Yekaterinburg for the 12th International Platinum Symposium, the Carnegie Institution for Science (Washington DC) and the 2014 meeting of the International Mineralogical Association. A number of staff members will also be present at the International Scientific Continental Drilling Programme workshop on the Bushveld Complex that is scheduled for September.

Honours students on the 2013 economic geology fieldtrip (organised by Chris Gauert) at Richards Bay Minerals



The department remains active in community outreach activities and has been responsible for organizing the Free State provincial leg of the Minquiz National Science Competition for Grade 12 learners since 2012. The department also coordinated the UFS contribution to the National SciFest in Grahamstown in 2012, and the recruitment of teachers for the first UNESCO Teachers' Workshop, which was held at the NMMU in February 2014.

Beside the visits mentioned above, the department has a number of other active research and teaching collaborations with both national and international partners, including the University of California (San Diego), the University of the Witwatersrand, the Natural History Museum (Berlin), GFZ (Potsdam), the Institute of Geology (Czech Academy of Science), the Council for Geoscience, the University of Gothenburg (Sweden) and the Martin-Luther University of Halle-Wittenburg. The department is also active in numerous research projects funded by industry.

Control of the department's undergraduate teaching load as a result of our student selection process is starting to yield dividends in terms of a renewed

focus on research activities and the ability to recruit additional MSc and PhD students. Chris Gauert is currently on sabbatical leave at the Natural History Museum (Berlin) and will be returning to South Africa in July. He will be involved in research related to gold fingerprinting and the geology of the Uitkomst Complex. Wayne Colliston is currently involved with structural geological research in Namaqualand, with two MSc students currently in the field. Freddie Roelofse received a Thuthuka grant from the NRF to investigate mineral-scale disequilibrium in the Bushveld Complex, with a total project budget on the order of R750,000 (over 3 years) with R386,350 received for 2014. Marian Tredoux and her students received generous funding from the platinum mining industry, and Johann Claassen, who was appointed as Programme Director of our Mineral Resource Throughput Management programme, has shown his worth as researcher, with numerous scientific contributions on mine management and improvement methodologies already published and in the pipeline.

Until next time.

Freddie Roelofse

DELTA Handheld XRF for Mining and Exploration



The DELTA Series
Everything You Need
in Handheld XRF with
State-of-the-Art
Innovation

INNOV-X AFRICA

Landline: 087 701 3165
Fax: (011) 450 0321
Mobile: 082 881 3152
Email: stuart@innovxafrica.co.za
Website: www.innovxafrica.co.za

Unit 17
Bedfordview Office Park
3 Riley Road,
Bedfordview 2008
South Africa

The New Generation DELTA Handheld XRF Analyzers are ergonomically advanced with a forward looking design incorporating the latest in electronics, components, and software technology.

- Mineral Exploration
- Mining and Grade Control
- Geometallurgy and Processing
- Environmental Management
- Mobile GPS-GIS Mapping Solutions for your XRF
- Two Year Warranty



**The DELTA
Professional**



**The DELTA
Premium**



**The DELTA
Classic Plus**



**DELTA
Work Station**

rhodes MSc field trip

RHODES UNIVERSITY MSc Exploration Geology Field Trip

Once again the MSc Exploration Geology class embarked upon another successful field trip covering an approximate distance of 4500 km. The field trip commenced on Saturday the 15th of March 2014 and the main stops were Kimberley (Big Hole), Mokopane (Anglo Platinum Mogalakwena Mine), Driekop (Eastern Bushveld) and Barberton Mountains (Nkomati Nickel Mine and komatiite outcrops). A group of 24 students was accompanied by 4 staff members, and as usual Prof. Yong Yao who is the Director of Exploration Geology at Rhodes University led the group with Dr. Steve Prevec (Head of Department and magmatic ore deposit lecturer), Dr. Gabi Costin (Microprobe Instrument Scientist) and Dr. Péter Horváth.

From Grahamstown the convoy headed for Kimberley in the Northern Cape Province. In Kimberley the group

the mining of the Kimberley pipe. The formal tour ended with the diamond hall.

Soon after the visit to the Big Hole, at around 12 pm, the class continued to Johannesburg on which the group arrived at around 16h30 in the afternoon. Upon arrival in Joburg the group went straight to the Wits Gold discovery site at farm Langlaagte. Given the time of arrival in Joburg, the visit to the discovery sites was a short one, and from there the class proceeded to a backpacker in Emmarentia for a night.

On Monday the 17th of March 2014 the class continued the trip on the N1 to Mokopane in the Limpopo Province. At Mokopane the team spent a night at the Waterberg Wilderness which was located about 20 km outside of town, and which turned out to be one of the best camping sites although the buses got a beating from the rough gravel road softened by recent rains. The next morning the team visited Anglo American's Mogalakwena Platinum Mine, which is located north of the town of Mokopane on the Northern Limb (Potgiterus Limb) of the Bushveld Complex. Mogalakwena Mine is the world's biggest Platinum Mine and it is the biggest single stream platinum concentrator in the World, at 600ktpm capacity. The mine is mining the Platreef for PGMs, Au and Base metals (Cu &Ni). Currently Mogalakwena Mine is the only operating platinum mine in the northern limb.

At Mogalakwena Mine the team was hosted by James Winch, who is the exploration geology manager at the mine, and his team. The first day in Mokopane started with the mine inductions, followed by a brief overview of the regional and local geology. The main visit to the mine comprised a mine geology presentation, pit visit and core logging. What was interesting to see is the effect on the mineralization resulting from the fact that in the Northern Limb the Transvaal Supergroup plus Archean granites comprise the footwall to mineralization of the Platreef, whereas in the Western and Eastern Limbs mineralization is defined mainly by magmatic lithological contacts. To see this first hand the students were given an opportunity to log three drillholes with three different footwall lithologies:



Jock explaining the local geology of the Kimberley Mine – March 16th 2014

overnighted at Gumtree Lodge backpackers. The next morning the (16th of March 2014) the group met up with Mr Jock Robey (formerly of De Beers) who facilitated the visit to the Big Hole. At the Big Hole the students enjoyed the mine origins video and were then taken around the area and introduced to the old mining equipment and different rock specimens extracted from



Students viewing the Mogalakwena Mine Operations from Vaalkop Hill – March 18th 2014

granite, dolomite and BIF footwalls were laid out for logging and comparison.

On 19th of March in the late afternoon, the class left Mokopane for Steelport (Anglo Pt's Driekop Camp) where 5 nights were spent. On 20th March the class visited Driekop exploration camp and commenced with core logging of a variety of Upper Critical Zone sequences to gain an appreciation for lateral and vertical variation in the sequence. In the afternoon the class visited the Marginal Zone (MG) along a road cut on R577: here Steve explained the current wisdom on the geology in the Marginal Zone, particularly with regard to basement interaction with the magmatic series.

On the 21st of March, the class visited the classic



Observation of a calc-silicate xenolith in the Marginal Zone – 20th March 2014



James showing drill core from a current exploration sterilization drillhole at Mogalakwena Mine – 19th March 2014



Cameron Section on Jagdlust Farm (Lower Zone to Upper Critical Zone). At the Cameron Section the main stops included the LG5, LG6, LG6A, LG7 and MG1 to MG4. Here the class excitedly observed and measured the different chromitite seams (as shown in the accompanying photo). Once again an attempt by some enthusiastic students to reach the top of the hill failed due to the changing slope of the hill, although the UG-1 was tentatively located. At the close of the day the class visited outcrops of the Merensky Reef (Modimolle Sefufule Hill). The Merensky Reef PGE mineralisation is commonly marked by thin chromitite layers marking the upper and lower contact of the reef. The hanging wall here is typically a feldspathic pyroxenite and commonly associated with a pegmatoidal footwall, unlike in the western Bushveld, where the pegmatoidal pyroxenite is likely to be found between the two chromitite layers. In the evenings at Driekop there were poster presentations by small groups of class members which highlighted the main characteristics of the various ore deposit types which were being visited on the trip, including their geological, economic, and exploration characteristics. These stimulated some lively discussions, even after a long day in the field.



LG6 and LG6A chromite layers in the Cameron Section, where LG6 constitutes the main mineralized zone for chrome.

On the 22nd of March the class went on to visit the Dwars River heritage site. This site has been declared a national monument because of the classic UG1 chromitite seams layers which are exposed at this location. At Dwars River the class observed interesting geological features such as the bifurcation (splitting) of chromitite layers, potholes and pinching structures within the interbanded chromitite layers. In the afternoon the class visited the Upper Zone (featuring the Main Magnetite Layer, and some of its neighbours)

at De-Hoop dam in the village river valley.

Sunday the 24th was the last day at Driekop and after completing their core logging, and one or two poster presentations over lunch, the class visited some UG2 and UG3 outcrops near Smoke Hill. Although it took a bit of walking to find the right outcrop, it was all worth it as the cumulus clinopyroxene in the chromitite seam displaying "chicken foot texture" were observed at this location. While observing the UG2 in this area the class met with a group of geology students from Germany who were also conducting a geology field trip. Both the Rhodes and German students were joined by a group of local children who were curious of the visitors in their area. The combined academic group then retired to our camp for a braai and bonding evening.

Steve giving an overview of the UG1 unit – March 22nd 2014



From Steelport the class proceeded to Barberton in the morning on R38, which took about 4 hours through the landscape of forest plantation reserve in South Africa to Barberton in the Mpumalanga province. Upon reaching Barberton in the afternoon the class could not wait to see some of the world's oldest lavas. The visit to the komatiites along the Komati River, near Tjakkastad village was facilitated by Mr David Mourant (a retired mine geologist). Here field observations included pillow lavas and spinifex textures in the komatiites. The next morning (the 25th March) the class visited the Nkomati Nickel Mine (Nkomati is a JV partnership of South African Rainbow Minerals and Norilsk Nickel). Before the visit commenced the class went through safety inductions together with an overview of the mine geology which was presented by the geology manager, Bryn Edwards. After ensuring that everyone



German students and Rhodes students together with the local children at UG2 outcrop near Smoke Hill - March, 23rd 2014

had the required PPE, the group visited the core yard where a few boreholes were laid out for examination of the mineralization, which is mainly the chromite, Ni-Cu and PGM. To close off the day the class visited the open pit viewpoint before proceeding to the stockpiles for sample collection and a closer view of the mining operation. The visit concluded at lunch time with a group photo before heading back to Barberton.

As the field trip wound to a close (26th of March 2014), the class was taken on a geotrail by David Mourant through the Barberton Mountains. The Barberton Makhonjwa Geotrail hosts several amazing stops (13 in total) which are sited along the Bulembu road a 40 km curving road stretch between the town of Barberton and Josefdal (Swaziland /SA border post). Here the class was treated to an amazing ancient geology with interesting geological structures. Along the Bulembu



Students viewing the komatiites, in the Komati River, near Tjakastad village with David Mourant explaining the geology – 24th March 2014



Observation of rock specimens in the open pit, Nkomati Mine – 25th of March 2014

Group photo at Nkomati Mine – 25th of March 2014



road several stops were made; one of the amazing observations in this ancient geological environment is the preservation of primary structures such as ripple marks and algal mats after such a long time, and from a geological perspective this makes Barberton a relatively unique geological place. One stop that the MSc class couldn't resist taking pictures was at the ferruginous sediments (the "painted quarry") outcrop which displays amazing folding structures.

On 27th of March 2014 the class started the marathon back to Grahamstown. Along the way the class stopped at Mount Currie forest reserve in Kokstad for a night before continuing on the N2 to Grahamstown.

In closing, we would like to express our appreciation and gratitude to the companies and people who participated in this field trip. You made this field trip

possible; we appreciate your efforts in allowing a class of 28 people (from different nationalities) to view your operations. Without their support, the field trip would not have been as informative and interesting. Furthermore we extend our gratitude to Prof. Yong Yao, his knowledge of economic and exploration geology contributed immensely to the field trip. We would like to acknowledge trip-coleader Dr. Steve Prevec for teaching the magmatic ore deposit module (in class and in the field) and for driving us, Dr. Gelu Costin (Gabi), Dr. Péter Horváth for their contributions during the field trip, and Chris Male for the long drive of the other mini-bus. Finally, a big THANK YOU to Ashley Goddard for arranging accommodation and all the administration work that comes with it.

Stefanus Sitoka and Boubacar Bah

The MSc class posing for a photo at the painted quarry outcrop – 26th March 2014



karoo workshop

Karoo Workshop at the University of Pretoria

The 1st Karoo Workshop was held at the University of Pretoria (UP) on 9th April 2014. This workshop was the first official meeting of Karoo researchers participating in the "Karoo Research Project", an academic-driven, academia-government-industry partnership, aiming at drilling of stratigraphic research boreholes and acquiring modern seismic data to investigate the Main Karoo Basin (see Geobulletin 56/4: 27). Following the kick-off meeting in September 2013, this workshop was a platform for discussions of:

- (a) the research strategies and collaborations between the university teams and
- (b) the required drilling concept as well as for
- (c) presenting the research proposals submitted in December 2013.

The proposals received, span the entire spectrum of Karoo research, including sedimentology, biostratigraphy, organic facies, diagenesis, thermal maturity, geochemistry, mineralogy, hydrogeology, geomechanics, petrophysics, and geophysics. A detailed documentation of the cores via spectral imaging and centimetre-scale logging of the different lithofacies, sediment petrology and geochemistry, with respect to facies interpretation and lateral correlation, will be conducted by the team of the Kumba-Exxaro Chair in Geodynamics at UP, Prof. Wlady Altermann, and Dr. Phil Harris of GeoSpectral Imaging. The geomechanical properties of selected lithologies will be investigated by the Engineering Geology Research Group, led by Prof. Louis van Rooy at UP. The University of Cape Town (UCT) team with Dr. Emese Bordy as principal researcher will perform an integrated study of petrography, geochemistry and fluid inclusions, aiming at the identification of factors that altered the original sediment composition and texture from source to sink and beyond. Geologists at the University of Johannesburg (UJ) under the leadership of Prof. Bruce

Cairncross, will focus on palaeomagnetic analyses of oriented core material with the aim of constructing a magnetostratigraphic framework and tracking the palaeogeographic position of the basin from the Permian to the Jurassic. Prof. Annette E. Götz at Rhodes University will establish a palynostratigraphic framework for the Permian and Triassic of the Karoo using palynofacies patterns as high-resolution correlation tool, and catalogue the organic facies, with respect to unconventional energy resource potential identification. Dolerite sills will be analysed by the igneous petrology research team of Prof. Rais Latypov at the University of the Witwatersrand (WITS), and based on new high-quality datasets of petrological, mineralogical, isotope and trace element geochemical measurements, the history of sill emplacement, cooling, crystallization, differentiation and solidification will be investigated. Researchers from UP (Dr. Nils Lenhardt), Stellenbosch University (Prof. Dirk Frei), UCT (Dr. Petrus Le Roux) and RU (Prof. Annette E. Götz) are investigating the volcano-tectonic evolution of the basin, combining lithofacies analysis with petrography, geochemistry, and isotopic dating methods (U-Pb zircon ages of tuffs, U-Pb baddeleyite ages of sills) as well as the effect of sill intrusions on maturing source rocks and producing methane-rich gases. Hydrogeologists at the University of the Free State (UFS), led by Prof. Danie Vermeulen, will study the occurrence, dimensions, hydraulic parameters and groundwater quality of shallow aquifers; the effect of potential gas releases on shallow potable groundwater resources as well as the quality of the groundwater from the deeper aquifer system. A new 2D seismic survey is planned by the geophysicists at WITS (Dr. Susan Webb), including a ca. 25 km long reflection seismic line in the vicinity of the proposed stratigraphic research boreholes. Additionally, petrophysical analyses will be performed with the aim to refine the seismic velocities as well as



geomechanical and physical properties of the sills and intruded Karoo lithologies in order to improve the interpretation of subsurface seismic images of the Karoo basin fill (Dr. Musa Manzi). Physical property measurements will also enhance the airborne magnetic and gravity studies aimed at the 3D modelling of the structure, composition and topography of the basement of the Karoo Basin. Finally, outcrop analogue studies of the University of Western Cape (UWC) team of Prof. Robbert Rutten will serve to integrate the new core data into a large-scale temporal-spatial framework of the Karoo Basin.

The ambitious common goal of all involved research teams is to improve the understanding of the complex basin-fill history of the Karoo which is crucial to estimate its potential for water, energy and mineral resources in an African context. Thus, these planned multi-disciplinary studies of the basin architecture and energy-related potential resources will significantly contribute to the development of sustainable global solutions of future climate, energy and environment challenges, as associated with growing populations in Africa and world-wide.

Annette E. Götz



Participants of the 1st Karoo Workshop at the University of Pretoria

(from left): Dirk Frei (SU), Susan Webb, Rais Latypov (WITS), Victor Tibane (UP), Sofia Chistyakova (WITS), Phil Harris (GeoSpectral Imaging), Kate Robey (CGS), Christian Wolkersdorfer (TUT), John Hancox (CCIC), Musa Manzi (WITS), Rolf Becker (SACNASP), Niall Kramer (Shell), Gordon Chunnett, Reinie Meyer (GSSA), Hermann Läuferts (Shell), Frederic Moinet (CGG), Sibbele Hietkamp (SANEDI), Ernst Bertram (DWA), Annette E. Götz (RU), Ngqondi Nxokwana (CGS), Fillsmith L. Ndongani (UP), Tania Swanepoel (ERM), Monica Oghenekome (UWC), Chris Hatton (CGS), Clarisa Vorster (UJ), Wasiu Sonibare (UWC), Emese Bordy (UCT), Herman van Niekerk, Nic Beukes (UJ), Wlady Altermann (UP), Doug Cole (CGS), Brandon Landman (UP).

Not on photo: François Fourie (UFS), Andrzej Kijko, Nils Lenhardt, Louis van Rooy, Niel Hugo, Mpho Mokhoane (UP).

geotrail officially open

The Barberton Makhonjwa Geotrail is officially open!

Have you ever wanted to travel back in time? How about 3.5 billion years back to the earliest signs of life on this planet?!



Interpretative panel at Lebombo view-point

Well, at the newly opened Barberton Makhonjwa Geotrail in Mpumalanga, you can. The Geotrail comprises 15 geosites and viewpoints along a 38km stretch of the R40 from Barberton to the Swaziland border, at the old Havelock mine. The route traverses geological features that span some 300 million years of the Archaean in which the earliest forms of planetary life have been identified. The remarkable preservation and accessibility of these features is unique in the world, making this trail globally significant for science and education and thus a top tourist attraction.

There are 11 sites which are developed with paved parking areas and photographic quality interpretation panels. One central geosite and viewpoint at Makhonjwa / Lebombo View (BM 7) serves as a one-stop-shop for the entire trail and has stunning vistas

stretching far into Swaziland and beyond. This site also has a picnic site and abbreviated panels, including Braille, for specimens of all the different rocks found along the trail where tourists can get a feel for the full diversity of the Barberton Greenstone belt.

The Geotrail, along with the Genesis Route and Barberton Gateways, forms an integrated suite of tourism developments produced by the Barberton Tourism and Biodiversity Corridor programme (Batobic), jointly funded by the National Department of Tourism and the Barberton Chamber of Business. It has been roughly 4 years in development and execution, and is the brainchild of Nico Oosthuizen, the Chairman of the Barberton Chamber of Business, Prof. Christoph Heubeck from Jena University in Germany an acknowledged world expert on this part of the



Dignitaries on the Geotrail (l to r):
Nico Oosthuizen
(President of the Barberton Chamber of Commerce), Ms Zithelo

Makobe (Deputy Mayor of Umjindi Local Municipality), Prof. Christoph Heubeck, Ms Pinky Phoza (Mpumalanga MEC for Economic Development, Tourism and Environment),

Tony Ferrar, Ms Lerato Mtlakala (Chief Director of the National Department of Tourism) and Mr Jacques Modipane (CEO of Mpumalanga Tourism and Parks Agency) with other officials



Barberton Mountainland, and Tony Ferrar, a Barberton-based wildlife ecologist and park planner. They diligently brought to life the long-held concept of these superior Geosites being able to tell a story for global

geo-heritage in the form of a Geotrail, and commissioned the incredible artwork at each site, along with interpretative illustrations and clear explanations in the guide book, make it a must for any interested traveller passing through this part of the world.

The official opening was held on 30th April 2014, attended by dignitaries and various

representatives from the Department of Tourism, with a guided tour hosted by Prof. Heubeck and Tony Ferrar

on 1st May that was attended by some 50-odd intrepid geotourists.

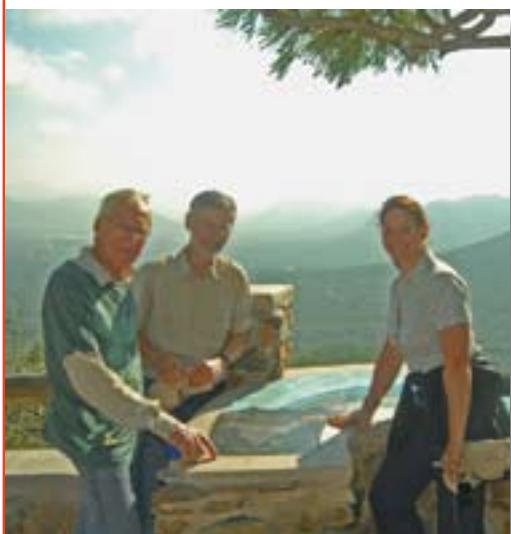
The Geotrail is the culmination of efforts by several role players and special recognition is to be given to Karl and Lesley Lane of Hamilton-Fynch, Nelspruit, who designed the panel artwork and guide book as well as Marina Landscaping who undertook the geo-site and lay-by construction. The dedication of Christoph Heubeck and Tony Ferrar in bringing this project to life, initiated and supported by Nico Oosthuizen, is to be especially commended and the GSSA is very proud to be associated with this project. Congratulations to all involved!

For more info, go to www.geotrail.co.za.

Genevieve Pearson

(GSSA Geoheritage Sub-Committee & IGC 2016 Geoheritage Chair)

Tony Ferrar,
Christoph Heubeck
and Genevieve
Pearson (GSSA).



Interactive field lecture by Prof Heubeck – a lesson in the Eureka syncline



EGU 2014, Vienna

European Union General Assembly, Vienna, Austria

Thanks to the support of the REI fund, I was privileged to attend the 2014 **European Union General Assembly**, held in Vienna, Austria. The conference took place in the week of 27 April to 2 May – an excellent time of year to be in this beautiful city.

The EGU General Assembly is the largest and most prestigious event on the calendar for European earth sciences. It attracts scientists from all over the world, not just within Europe – this year there were delegates from 106 countries – and across a vast range of geoscientific disciplines, from atmospheric sciences to solid earth sciences to solar system sciences, and more.

For the first time, the conference had a theme – “The Face of the Earth” – celebrating the diversity of earth sciences and commemorating the centenary of the death of Eduard Suess, viewed by many as the father of Austrian geology. All the delegates were asked to bring a rock from their home countries and a fantastic display was put together from these geological snippets.

For me as a student, this was a fantastic opportunity to be exposed to the spectrum of current multi-disciplinary international research. I was impressed (and at times rather overwhelmed) by the vast array of interesting sessions to choose from on each day. This year there were more than 14 000 presentations! It was also an opportunity to make personal contact with many prominent international geoscientists. I attended talks by some of the big names, including Chris Hawkesworth and Kevin Burke.

I also had the opportunity to present some of my own PhD research on the Doros layered intrusion, in the form of a PICO presentation, in the session entitled “How do magma chambers work? Recent advances in the petrology of plutons and volcanoes.” A PICO (Presenting Interactive COntent) is a new form of presentation alternate to the traditional oral or poster, tested for only the second time at this EGU meeting. It combines the advantages of the facetime provided by an oral, in a 2-minute overview, as well as the opportunities for personal interaction with a powerpoint presentation on a digital ‘posterboard.’



The impressive entrance to the Austria Center, host of the EGU 2014 General Assembly.



The main exhibition hall at the EGU conference centre.

This I judge to have been a great success, as I was able to interact with and get constructive feedback from several delegates with interests and experience in my field of study. Although the session seemed to be over all too quickly!

EGU is especially geared for students, with dedicated events for young earth scientists throughout the week and a Young Scientists Lounge for networking and

socialising. Almost a third of this year's attendees were students.

The EGU experience is one I would highly recommend, particularly for young geoscientists looking to gain international exposure.

Trishya Owen-Smith



EGU 2014

Implications for 35th IGC



The 35 IGC both at EGU:- left to right Danie Barnardo (Secretary General) Prof Laurence Robb (Chair Scientific Programmes) Prof. Peter Bowden (University of St Ettiene), Aberra Mogwessie (President Geological Society of Africa), Dr. Richard Viljoen (Co President)

As part of our marketing and delegate boosting activities for 35 IGC and to gain insights into the running of large conferences, four members of the local organising committee, Danie Barnardo (Secretary General) Lesley Ferreira (PCO) Laurence Robb (Chair of the Scientific Programme Committee) and Richard Viljoen (Co President) attended the European Geosciences Union (EGU) general assembly meeting in Vienna from 27 April to 2 May, 2014. We had a booth which attracted a large number of people assisted in no small measure by the fact that we served Rooibos Tea throughout the day.

EGU meetings represent the largest gathering of geoscientists in Europe and the 2014 event attracted over 12000 delegates with 4, 829 oral, 9583 poster and 483 PICO presentations. The event was essentially for academics, researchers and students from Europe, although delegates from 106 countries attended. Economic geology did not figure prominently in the programme and the conference exhibition was somewhat limited. EGU is flush with funds from its annual conferences and there was no sponsorship required for the 2014 event. Student posters figured prominently (see contribution by Trish Owen Smith)

but there were no field trips. A daily newsletter with information on important events, keynote addresses etc was very useful as was a specially prepared publication entitled : *The face of the Earth : "The legacy of Edward Suess"* which was presented to each delegate free of charge.

It is clear that given the correct mix of session topics and field trips, we could attract a significant number of EGU delegates, particularly from the academic fraternity, to 35 IGC. The question of cost of registration, travel, accommodation and field trips was however an important one and we are, through the chairs of all the LOC committees, trying to keep these as low as possible. Geohost under the chairmanship of Jeanette McGill will play a big role in the organizing of sponsorship for deserving students and young earth scientists to attend 35 IGC. Discussions with Susan Kay (President of the geological society of America and Carol Finn (President of the American geophysical Union) indicated that there are good opportunities through their societies and other geoscientific organizations for sponsorship of deserving students to attend 35 IGC. Wesley Hill of the GSA is compiling a list of societies with sponsorship programmes and we



will make further details available in due course.

It became apparent at EGU that the content of the scientific programme and the nature of field trips on offer for 35 IGC will be of fundamental importance to the success of 35 IGC. Besides the more traditional academic topics, some of the following themes were particularly popular at EGU and will be important for attracting European geoscientists to 35 IGC.

- Education and outreach
- Atmospheric sciences
- Biogeosciences
- Climate: past, present and future
- Cryospheric science
- Geodesy
- Geomorphology
- Hydrological Science
- Natural Hazards
- Ocean Sciences
- Planetary and solar system sciences.

Short courses and workshops at EGU were generally linked to themes and included: -

- Enhancing career prospects by adding value to research experience, marketing yourself in interviews and preparation of applications for employment
- How young scientists can contribute to a changing world
- Geomorphology for young scientists
- School outreach –a practical guide
- Short courses on soil and water
- New developments in ore deposit geochemistry.

The Vienna Centre Complex with the EGU conference venue in the middle. Danube river and centre of the old city of Vienna in the Background.



Posters are still big business at conferences such as EGU 2014 as they provide the opportunity for students to present their research findings if their paper is not accepted for oral presentation. Taking into account costs and practicality and speaking to a number of students, it looks as though the basis of poster sessions at 35 IGC should still be hardcopy.

A new innovation which is only in its second year of implementation at EGU meetings is the PI CO programme. So called PICO spots are allocated in each poster area and consist of a screen and projector and seating for about 150 people. Posters are presented by authors in powerpoint format with continuous 2 minute presentations being held over specified hour long time slots during the day.

Almost all delegates we spoke to were interested in attending 35 IGC and excited by the more than forty field trips we are planning. The great train geosafari, our flagship trip, caught the attention of many and we are endeavouring to keep the costs of all our trips as low as possible.

We are confident that the attendance of the EGU meeting and interaction with participants will assist greatly in delegate boosting for 35 IGC, particularly from Europe.

R.P. Viljoen

Co President, 35 IGC, Local Organising Committee

SAMREC code (2014)

South African Mineral Resource Committee (SAMREC)

Re-write of the SAMREC Code (2014)

The mining industry is a vital contributor to national and global economies; never more so than at present with soaring demand for the commodities that it produces. It is a truly international business that depends on the trust and confidence of investors and other stakeholders for its financial and operational well-being. Unlike many other industries, it is based on depleting mineral assets, the knowledge of which is imperfect prior to the commencement of extraction. It is therefore essential that the industry communicates the risks associated with investment effectively and transparently in order to earn the level of trust necessary to underpin its activities. (CRIRSCO Website)

The SAMREC Code which sets out minimum standards, recommendations and guidelines for Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves in South Africa is being reviewed and improved to ensure that it remains relevant to the minerals industry and keeps abreast with recent developments. This revision is considered necessary because as the guidelines of the Code are used various issues and practical realities have become apparent which require further guidance from the Code. This rewrite is designed to improve the Code and eliminate possible contradictory reporting practices, align SAMREC with recent changes to international codes in keeping with international best practice.

The SAMREC Code is one of seven codes that are affiliated under the CRIRSCO family of reporting codes. As a result of the CRIRSCO/CMMI initiative, considerable progress has been made towards widespread adoption of globally consistent reporting standards. These are embodied in similar Codes, guidelines and standards published and adopted by the relevant professional bodies around the world. The definitions in this edition of the SAMREC Code are either identical to, or not materially different from,

those existing international definitions. In recent years the Russian Code (NAEN) (2011) was added to the original Codes. Various Codes have been revised and reissued – CIM of Canada (2010), PERC representing Europe (2013), JORC representing Australia and New Zealand (2012) and SME representing the USA (in review for issuing in 2014).

Various aspects of the Code remain unchanged. Because SAMREC is part of the CRIRSCO family, there are 15 core definitions e.g. mineral resource, mineral reserve etc that are common between the international codes. These are not being changed. Rather the guidance and interpretation is being improved so that the Code is relevant. The Code remains a guideline for minimum public reporting of Exploration results, Mineral Resources and Mineral Reserves. The desire of the SAMREC Working Group is that the Code is used for all forms of reporting of Exploration results, Mineral Resources and Mineral Reserves both public and private. The principles that underpin the code remain Transparency, Materiality and Competence. The Code requires that anyone who uses the Code and asserts themselves as Competent Person in accordance with the Code needs to have the 5 Years relevant experience and be registered with SACNASP or ECSA or be a member of GSSA, SAIMM or PLATO or a Recognised Professional Organisation (RPO).

The requirement of a body whose members put them forward as CPs is that there is a code of ethics and a disciplinary code. Scientists working in South Africa are required to comply with The Natural Scientific Professions Act of 2003. However where the SAMREC Code is used as the basis for a mineral resource or reserve declaration and it falls outside of the jurisdiction of South Africa laws as well as the CP declares his/her membership of GSSA or SAIMM in support of the declaration, then these organisations require the CP to follow the newly instituted procedure.

Because the GSSA and SAIMM are not statutory bodies and represent broader interests than just minerals reporting, the GSSA and SAIMM have introduced by-laws that require individuals who are utilising their



membership for reporting purposes, notify the societies and subject themselves to a peer review prior to the publication of the work. This peer review entails confirming that they are members of the societies in the category they claim and have the necessary qualification and experience to undertake this assignment as a CP. However it does not mitigate against the individual producing work that is substandard. Should the individual complete substandard work and a complaint is laid, they will be subject to the disciplinary process.

Issues regarding the rewrite are discussed at a monthly meeting of the SAMREC Working Group (WG) chaired by Ken Lomberg (ken.lomberg@coffey.com) held on the last Thursday of each month at the Military Museum in Saxonwold. All interested parties are invited to participate. This is also provides an opportunity for the industry to highlight aspects that may need to

be reviewed or improved upon. We would like to encourage all interested parties to submit any issues relevant to the re-write of the SAMREC Code via the SAIMM (sam@saimm.co.za) by 30 June 2014. The intention is to complete a draft for public comment by the end of Q3 2014.

Once a draft has been finalised it will be issued for comment prior to being ratified by the SAMREC. SAMVAL Committee (SSC). It is also the intention of the SAMREC WG to prepare a companion volume which would include the practical application of the code and assist to provide a bench mark for all the industry practices. This is likely to be a volume that is produced after launch of the code as the proceedings of a SAMREC conference.

Ken Lomberg

industrial minerals

Industrial Minerals – Reporting Resources according to Clause 49 of JORC 2012

The current edition of The Australasian Joint Ore Reserves Committee (JORC) Code was published in 2012 and after a transition period the 2012 Edition came into mandatory operation from 1 December 2013. There are some significant changes between JORC 2004 and 2012 for the reporting of industrial mineral resources, which should be addressed by players in the industrial minerals space.

Industrial Minerals Definition

Industrial minerals are essentially minerals and rocks mined and processed for the value of their non-metallurgical properties, hence for the benefits they impart to the products and processes in which they are used. Industrial minerals are commonly classified according to their end uses, where there are a diverse (and sometimes bewildering) number of specifications, for example chemical purity, density, insulating properties, mineralogy, particle shape, particle size distribution, thermal resistance, rheology, whiteness and oil or water absorption.

Recent interest in Industrial Minerals

Industrial minerals such as phosphates, potash, graphite and spodumene have recently become the focus of much attention for listed exploration companies, particularly the latter two due to developments in battery technologies related to the emerging electric vehicle and green energy market. Consequently the race has been on to report larger tonnage exploration targets and resources, with certain projects being described, for example, as *the biggest* or *second biggest* in the world, *world class* or *highest grade* and perhaps hundreds of millions of tonnes containing a certain percentage of a particular mineral. However being the biggest doesn't necessarily mean being the best and the author's intention is to highlight the need to report resources by market-related specification (Scogings, 2014a, 2014b, 2014c) as such headline claims run the risk of being seen as misleading by investors and regulators.

As noted on the website of Industrial Minerals Magazine 'Without a market, an Industrial Mineral deposit is merely a geological curiosity'. Too many industrial minerals explorers forget the significance of this, which is a bit like the geochemical anomaly in metals

exploration that remains a geochemical anomaly and never becomes a mineable resource. Similarly, as noted by Border and Butt (2014) concerning the modifying factors for industrial minerals "Without a potential market, there can be no resource; without a good knowledge of the planned market (volume, price and competition), there is no reserve".

JORC 2012 – Reporting Resources and Reserves according to Specifications

The fundamental difference between JORC 2004 (Clause 44) and 2012 (Clause 49) is contained in an all-important new paragraph, which requires that Industrial Mineral Resources or Reserves must be reported in terms of mineral specifications when:

'For minerals that are defined by a specification, the Mineral Resource or Ore Reserve estimation must be reported in terms of the mineral or minerals on which the project is to be based and must include the specification of those minerals.'

Further references to specifications are found in the JORC 2012 guidelines, of which excerpts are listed below:

'It may be necessary, prior to the reporting of a Mineral Resource or Ore Reserve, to take particular account of certain key characteristics or qualities such as likely product specifications, proximity to markets and general product marketability.'

'Some industrial mineral deposits may be capable of yielding products suitable for more than one application and/or specification. If considered material by the reporting company, such multiple products should be quantified either separately or as a percentage of the bulk deposit.'

It is noteworthy that the word 'specification' is referred to no less than four times in Clause 49, demonstrating its significance in reporting according to JORC 2012.

Examples of Industrial Mineral Specifications

Industrial Minerals which are commonly defined according to size and / or purity specifications include Andalusite, Barytes, Chromite, Feldspar, Graphite, Limestone, Magnesite, Silica, Vermiculite, Wollastonite and Zircon. Other minerals and clays

such as Attapulgite, Bentonite and Kaolin may be specified according to final product sizing and purity, but more importantly according to performance in particular markets and applications as diverse as civil

Bentonite waterproofing membrane inside a tunnel has to meet permeability specifications.



engineering, oil well drilling, cat litter, metal casting, iron ore pelletising, paint, paper and plastics.

'Greensand' used to make metal-casting moulds, in which silica sand is bonded by bentonite.

A quick glance at the Price Listing pages in Industrial Minerals Magazine (April 2014) highlights that different specifications and markets command a range of prices (Table 1). For example barytes for use as a weighting agent in drill muds varies between US\$ 110 and US\$150 per tonne FOB Chennai according to SG. High brightness, high purity barytes for paint applications commands even higher prices, up to US\$400 per short ton.

Similarly chromite sand varies significantly in price according to specification and markets, from US\$230 per tonne for chemical grade to US\$500 per tonne for refractory grade FOB South Africa. The chromite price is generally directly related to specifications such as particle size, SiO₂ and Cr₂O₃ content and Cr/Fe ratio and is driven by overall market conditions.



Of particular importance in today's industrial minerals arena, crystalline graphite may range from US\$750 per tonne to as much as US\$1300 per tonne. It is clear that such price variations could have a significant impact on the economics of a graphite project, especially considering the wide range of possible markets e.g. friction linings, lubricants, electrical, refractories and foundries.

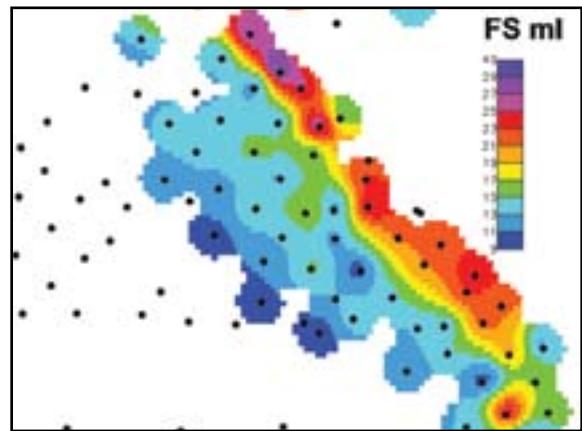
From the above examples it is obvious that when publicly reporting an industrial mineral resource it is insufficient to simply report a tonnage and the contained percentage of the mineral. Not only is this contrary to JORC 2012 requirements but it could be misleading to investors. Let us take the case of a hypothetical flake graphite resource reported as 200 million tonnes at 10% graphitic carbon. Essentially all this tells us that the resource contains 20 million tonnes of in-situ flake graphite, but it conveys nothing specific to us about: 1) graphite flake size distribution, 2) the likely purity of extracted graphite flakes, or 3) markets, which may be limited relative to the size of the deposit.

The same would apply to a vermiculite deposit, where flake size and exfoliation characteristics are required to be reported. In the case of clay such as bentonite, reporting a tonnage simply based on purity measurements (e.g. Cation Exchange Capacity or XRD mineralogy) conveys little useful information as to possible market applications - if any. Individual bentonite deposits may have similar montmorillonite content, but perform entirely differently in markets as diverse as paper manufacture, metal casting or oil well drilling. Bentonite quality may also be affected by depth of weathering, whereby 'blue' bentonite is oxidised to 'yellow' bentonite at shallow depths. Such

Turkish bentonite illustrating oxidised yellow rind around remnant blue bentonite core



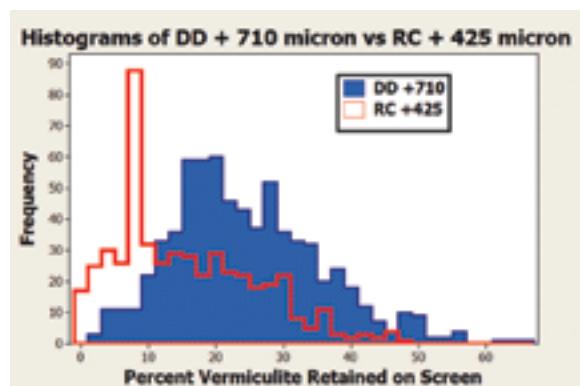
oxidised clay may have improved performance for certain applications, despite having identical CEC and montmorillonite content.



Map of a bentonite deposit. Oxidised bentonite has high Free Swell >20 whereas unoxidised bentonite has Free Swell <10. Strike length 350m

Exploration Methods – Possible Impact on Specifications

Industrial mineral performance or size classification can be affected by the drilling method used, something that is not always recognised by industrial minerals explorers. For example, drilling bentonite by auger may improve rheological properties due to the shearing effect imparted by the auger flights. This is akin to extruding the clay through a die plate, a method sometimes used to improve rheological properties for drilling products. Similarly, reverse cycle (RC) drilling will most likely result in reduced flake size of minerals such as graphite and vermiculite, or in reduced aspect ratio of acicular wollastonite, resulting from comminution by the hammer action of the drill bit. Based on the authors' experience, RC drilling may reduce the average size and population distribution of mineral flakes significantly compared with diamond core drilling (DD) as illustrated below



Histograms of two sample populations across a vermiculite deposit: DD mean value = 24.5%; RC = mean value of 15.5% vermiculite.

Table 1. Selected industrial mineral prices. (Industrial Minerals Magazine, April 2014.)

Barytes	US\$
OCMA/API bulk lump, SG 4.2, FOB Chennai	135-150
OCMA/API bulk lump, SG 4.1, FOB Chennai	110-130
Paint Grade Chinese lump, CIF Gulf Coast	235-275
Paint Grade ground, 96-98% BaSO ₄ , ex-works USA (\$/s. ton)	315-400
Chromite	
Chemical Grade, 46% Cr ₂ O ₃ wet bulk, FOB South Africa	230-280
Refractory Grade, 46% Cr ₂ O ₃ wet bulk, FOB South Africa	425-500
Foundry, +47% Cr ₂ O ₃ dried 1 tonne big bags FOB South Africa	330-360
Foundry, 45.8% min Cr ₂ O ₃ wet bulk, FOB South Africa	260-290
Graphite - Crystalline	
Fine, 90% C, -100 mesh	750-850
Medium, 94-97% C, +100-80 mesh	1050-1150
Large flake, 94-97% C, +80 mesh CIF	1250-1300
Magnesia - Fused	
Lump, FOB China 96% MgO	600-630
Lump, FOB China 97% MgO	890-1000
Lump, FOB China 98% MgO	1023-1100

Appropriate Quality Tests (Assays)

As per JORC 2012 Clause 49 guidelines:

'Assays may not always be relevant, and other quality criteria may be more applicable. If criteria such as deleterious minerals or physical properties are of more relevance than the composition of the bulk mineral itself, then they should be reported accordingly.'

Similarly the CIM (2003) guidelines to estimation of industrial minerals resources and reserves (pages 38 and 39) highlight the importance of physical properties as well as end products and markets:

'Critical elements to the Mineral Resource estimate for industrial minerals are: (i) the consideration of the physical and chemical properties of the subject mineral; (ii) the spatial relationship of these properties within the mineral occurrence; and (iii) the relationship of the physical and chemical properties of the mineral to the available market(s).'

'Customer specifications for industrial mineral products are frequently based solely on physical properties rather than, or in addition to, chemical characteristics.'

Sample testing should include those tests that will provide the physical characteristics and chemical analyses that relate to the specifications of the end product.'

The responsibility falls on the Competent Person to ensure that exploration samples are tested for appropriate parameters in addition to basic tests for mineral content:

- Individual or appropriate composite samples should be evaluated according to size, purity of extracted minerals and / or market performance specifications.
- It may be difficult to find a commercial lab that can run such tests, as most industrial minerals testing is done in-house by producers. Either a current producer may be approached to test the samples, or test methods will have to be developed internally.
- Some test methods are industry standards, such as bentonite rheology which are available from bodies like the American Petroleum Institute, while other physical and / or chemical test methods may be obtained from institutions such as the British Geological Survey (e.g. Mitchell, 1993).
- The question is often raised about how to test graphite, given that relatively expensive and time-consuming flotation procedures are usually required



to separate graphite from gangue minerals. It is suggested that estimation of flake size and mineral relationships using petrographic examination of polished thin sections, or perhaps SEM methods such as QEMSCAN® could augment flotation data.

Taking bentonite as an example, this complex clay may be characterised or fingerprinted by a number of metrics such as purity, chemistry and exchangeable cations including:

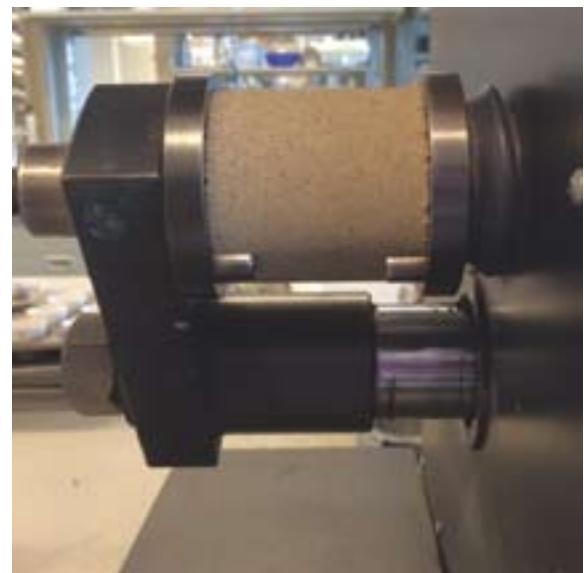
- in-situ moisture
- in-situ density
- pH
- grit content
- purity – montmorillonite vs inert minerals (cation exchange capacity)
- Ca, Mg and Na exchangeable cations (Ca or Na bentonite?)
- XRF (chemistry)
- XRD (mineralogy).

However these measures don't necessarily indicate how the clay might perform in various applications; therefore a range of tests may be required to determine market opportunities including:

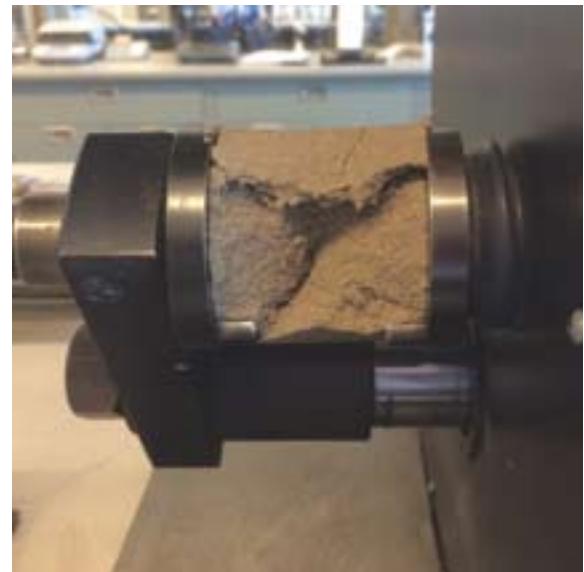
- plate water absorption (Iron Ore and Chromite Pelletising)
- bond strength (metal casting)
- thermogravimetric analysis (metal casting)
- rheology (drilling mud)
- fluid loss, free swell and permeability (geosynthetic clay liners and membranes)
- clump strength (cat litter)
- lees formation (wine fining)
- toxin adsorption (animal feed).

Conclusions

- Clause 49 of JORC 2012 is a welcome and timely improvement to Clause 44 of JORC 2004.
- The CIM (2003) guidelines on reporting of industrial minerals resources and reserves are an invaluable reference for the CP reporting according to JORC 2012.
- It is no longer sufficient to simply report a resource of contained industrial mineral.
- The estimation must include the specification of those minerals, if those minerals are defined by a specification.
- If multiple products are possible from a deposit, such multiple products should be quantified either separately or as a percentage of the bulk deposit.

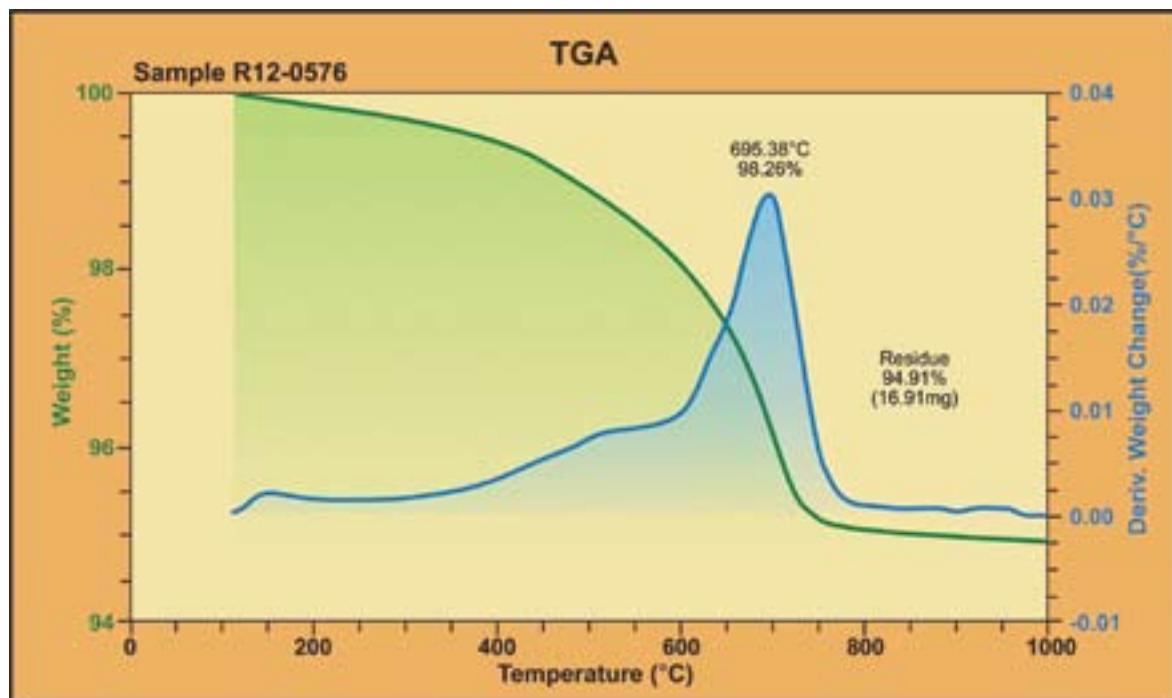


Bond strength testing of a laboratory-prepared 'greensand'.



An example could be a bentonite deposit that yields metal casting and drilling products from different parts of the deposit based on weathering domains.

- Specific market-related testing and / or metallurgical (mineral processing) testwork is required for industrial minerals deposits. It does not suffice to rely solely on traditional mineralogical or chemical purity (assay grade) tests as commonly used in metals exploration.
- Commercial laboratories may not be equipped to test minerals to industry specifications. In this case test procedures could be developed either in-house or in conjunction with a commercial lab. Samples may alternatively be submitted to an existing industrial minerals producer or potential customer, for example a greensand foundry in the case of bentonite.



Bentonite TGA: 695°C dehydroxylation peak indicates high thermal durability.

- Examination by petrographic, SEM or other methods is recommended to augment metallurgical testwork in the case of minerals such as chromite, graphite, wollastonite and other minerals where morphology is important.
 - Proximity to markets and general product marketability must be taken into account, remembering that 'without a potential market, there can be no resource'.
- <http://www.jorc.org> (The Joint Ore Reserves Committee of The Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia).
- Mitchell, C.J., 1993. Industrial Minerals Laboratory Manual: Flake Graphite. BGS Technical Report WG/92/30. 31pp. ©NERC 1993. Keyworth, Nottingham, UK.

References

Border, S. and Butt, B.C., 2014. Mineral Resources and Ore Reserves of Industrial Minerals – Markets and Other Modifying Factors, in Mineral Resource and Ore Reserve Estimation – The AusIMM Guide to Good Practice, pp 467 – 472, Monograph 30 (The Australasian Institute of Mining and Metallurgy: Melbourne).

CIM, 2003. Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines. Available from: <http://web.cim.org/standards> Canadian Institute of Mining, Metallurgy and Petroleum.

Industrial Minerals Magazine, April 2014. Price Listing. Industrial Minerals, Euromoney Institutional Investor PLC, Nestor House, Playhouse Yard, London EC4V 5EX, United Kingdom.

JORC, 2012. Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (The JORC Code) [online]. Available from:

<http://www.jorc.org> (The Joint Ore Reserves Committee of The Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia).

Scogings, A.J., 2014a. Public Reporting of Industrial Mineral Resources according to JORC 2012. Industrial Minerals Magazine, May 2014, 26-27. Industrial Minerals, Euromoney Institutional Investor PLC, Nestor House, Playhouse Yard, London EC4V 5EX, United Kingdom.

Scogings, A.J., 2014b. Public Reporting of Industrial Mineral Resources according to Clause 49 of JORC 2012. AIG News, No. 116, 1-6. Australian Institute of Geoscientists Quarterly Newsletter.

Scogings, A.J., 2014c. Public Reporting of Industrial Mineral Resources according to JORC 2012. The AusIMM Bulletin, No.3, 34-38. Feature: Mineral Resource & Ore Reserve Estimation. Journal of the Australasian Institute of Mining and Metallurgy.

Andrew Scogings

Industrial Minerals Geologist
www.klipstone.com.au



geo-safari

"THE GREAT SOUTHERN AFRICAN TRAIN GEO-SAFARI"

35th International Geological Congress "Flagship"

Field Trip

Sunday 4th to 13th September 2016

This once-in-a-lifetime field trip will start directly after the 35th IGC when the Shongololo Express departs



from Cape Town and it will end at Victoria Falls (Zimbabwe) 10 days later. En route there will be geological and general interest day excursions to a variety of important sites, including the Swartberg Pass in the Karoo, the Big Hole in Kimberley, Sterkfontein Caves and the Cradle of Humankind, seeing the Witwatersrand, Mapungubwe National Park, Great Zimbabwe National Monument and the Matoba Hills. Passengers will see the Victoria Falls on the Zambezi River, visit Livingstone in Zambia, and go on a river safari in Botswana's Chobe National Park.

You will travel, dine and sleep throughout on the comfortable and privately-owned Shongololo Express train. All compartments have 2 beds and en-suite toilet facilities. While a vast distance will be covered travel will mostly be at night. All day excursions, using mini-buses and drivers that are carried on the train, are included in the tour price. This field trip is endorsed by the 35th IGC and will be run by JB Train Tours, an experienced railway tour operator (see www.jbtours.co.za) but only 70 passengers can be accommodated. In Cape Town passengers will be collected at their hotel and transferred to the station, and at the end passengers need to make their own onward travel arrangements from Victoria Falls.

Geological Day Excursions: At each site of geological interest we will make use of local experts to share their knowledge with you. An overview of the daily,

geologically-focussed excursions is provided in the itinerary below, and this includes a number of tourist destinations of more general interest. More details will become available closer to the field trip and a comprehensive guidebook will be provided on departure. At the moment the trip looks like this:

Sunday 4th September, Day 1:

Depart Cape Town at 11 a.m. for Prince Albert Road; includes a short stop at Matjiesfontein village.

Geology and landscape:

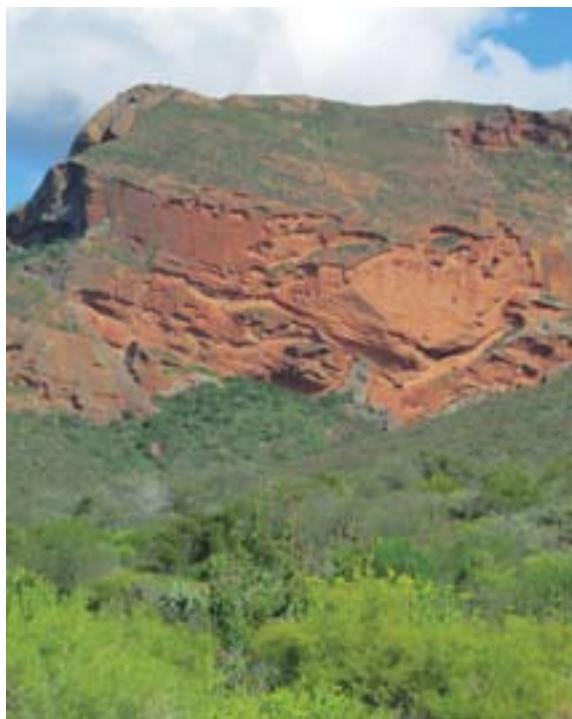
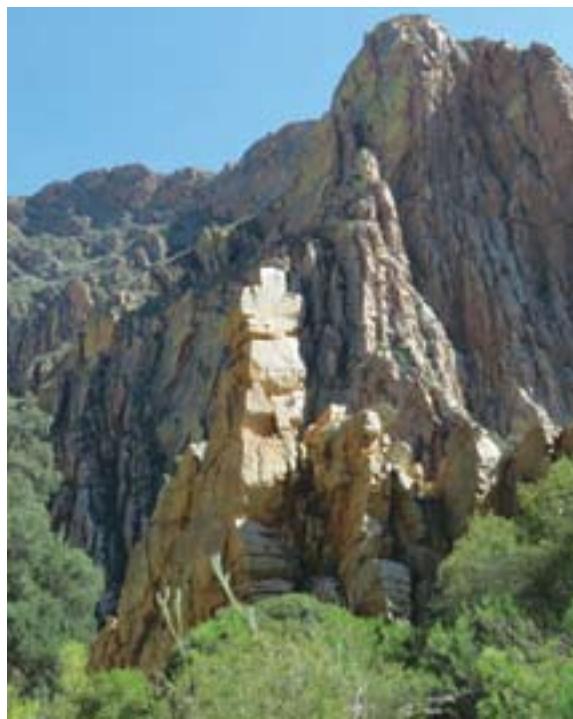
After crossing the sandy Cape Flats and passing the intrusive Precambrian granite domes of Paarl Mountain the train winds its way through the intensely folded Hex River Mountains of the Ordovician-Devonian Cape Supergroup where you will enjoy the breathtaking scenery of vineyards and fold mountains. The train will make a brief stop at the Victorian village of Matjiesfontein at the start of the Great Karoo where the geology of the lower part of the Karoo Supergroup will be explained, and which is now prime exploration country for shale gas. The train will arrive late evening at Prince Albert Road station.

Monday 5th September, Day 2:

Road trip across Swartberg Pass and Meiringspoort; overnight from Beaufort West to Kimberley.

Geology and landscape:

Passengers depart by mini-bus to Prince Albert village at the entrance to the magnificent Swartberg Pass for one of the geologically most impressive day tours. Carboniferous-Permian Dwyka tillite will be seen before venturing into the northern end of the Swartberg Pass and incredible folding is seen as you make your way across the entire Cape Fold Belt. On the southern side of the pass there are intensely deformed Precambrian formations of the Cango Group. The return route will be via Oudtshoorn, passing impressive red-bed



LEFT IMAGE
Vertically dipping
quartzite strata of the
folded Cape Super-
group at the northern
end of the Swartberg
Pass, near Prince
Albert

*Red-bed conglomerates
of the Uitenhage Group
east of Oudtshoorn in
the Klein Karoo, de-
posited in a continental
semi-graben during the
Cretaceous*

conglomerates of the Cretaceous Uitenhage Group on the way, before heading back through spectacular folding in Meiringspoort. The train is re-joined in Beaufort West from where it departs for the overnight trip to Kimberley, climbing the Great Escarpment

Tuesday 6th September, Day 3:

Road trip to Barkly West, Wildebeestkuil Rock Art

Centre and Kimberley's Big Hole; overnight from Kimberley to Krugersdorp.

Geology and landscape:

Kimberley lies on the interior plateau in the centre of South Africa. The day starts with a trip to Barkly West and the historic Vaal River diggings at Canteen Koppie, where in 1870 South Africa's first big diamond rush took place. On the return we will detour to the Nooitgedacht



*Spectacular folding
and thrusting of the
Cape Fold Belt are
magnificently seen in
Meiringspoort, a gorge
through the Swartberg
linking the Klein and
Great Karoos*



Vaal River and the old bridge (dated 1884) at Barkly West, site of South Africa's first big diamond rush in 1870, near Canteen Koppie



glacial pavement on Archaean Ventersdorp lava and later see numerous San Bushman petroglyphs etched on outcrops at the Wildebeeskul. The day's highlight will be the famous Big Hole, the world's deepest hand-dug hole, and the mined-out location of the original Kimberley Pipe, one of a cluster of large diamond-rich kimberlite pipes of Cretaceous age in the area. There is a historic mining village, world-class displays and a diamond exhibition. Later the train travels overnight to Krugersdorp west of Johannesburg.

Wednesday 7th September, Day 4:

Optional tours to either Sterkfontein Caves and the Cradle of Humankind, or to see Witwatersrand

geology and visit Gold Reef City; overnight from the Pretoria area to Musina.

The group will disembark at Krugersdorp station for one of the optional tours, either a 'Cradle of Humankind' tour or a 'Witwatersrand Geology' tour. The tours will rejoin the train in the late afternoon outside Pretoria from where it will travel northwards to Musina.

'Cradle of Humankind' geology and landscape:

This area is underlain by Late Archean stromatolite-bearing Malmani Dolomite, part of the Transvaal Supergroup that here forms a treasure house of caves, and is a renowned World Heritage Site. You will go into Sterkfontein Caves, the discovery site of many of the world's Australopithecus (ape-man) fossils, dated from around 2.5 million years ago, including the famous 'Mrs Ples' skull (found in 1947) and 'Little Foot' (found in 1997). Nearby Wonder Cave is a vast chamber full of amazing cave formations while the Maropeng visitor centre provides an unrivalled look at the evolution of the Earth and the path to humankind.



Kimberley's Big Hole, the deepest hand-dug hole in the world and once the site of a famous, diamond-rich kimberlite pipe, one of a cluster in the area

'Witwatersrand' geology and landscape:

The ridges of the Witwatersrand form an east-west trending regional watershed that is part of South Africa's Highveld Plateau. During the course of the day you will see a cross-section of Archaean Witwatersrand Supergroup stratigraphy, upwards from granites and greenstones of the Johannesburg Dome, the overlying West Rand Group and Central Rand sediments, the



Witpoortjie Falls and south-dipping Orange Grove quartzite of the Witwatersrand Supergroup forms the backdrop, and start of the JCI Geological Trail at Walter Sisulu National Botanical Garden, near Krugersdorp



Exposed conglomerate and quartzite layers of the Main Reef and Main Reef Leader at their 1886 discovery site in George Harrison Park, west of central Johannesburg

latter hosting the world's largest goldfield. This tour will see the Geological Rock Garden and Trail at the Walter Sisulu National Botanical Garden, the discovery site of the Main Reef in 1886, and go down a working mine shaft at Gold Reef City.

Thursday 8th September, Day 5:

Optional tours to either Mapungubwe National Park or Sand River Gneiss and Soutpansberg; overnight from Musina – Rutenga (Zimbabwe).

After disembarking at Musina the group will have the option of either a tour to 'Mapungubwe World



A commemorative bust of Dr Robert Broom holding the "Mrs Ples" skull, a hominin fossil that he found in 1947 at the Sterkfontein Caves, Cradle of Humankind near Krugersdorp

Collapsing escarpment of orange-weathering Clarens sandstone overlying greyish Elliot siltstone of upper Karoo-age, in Mapungubwe National Park, Limpopo



National Park' or to the famous 'Sand River Gneisses & Soutpansberg'. Both tours will rejoin the train in the late afternoon before crossing into Zimbabwe.

Mapungubwe geology, landscape and archaeology:

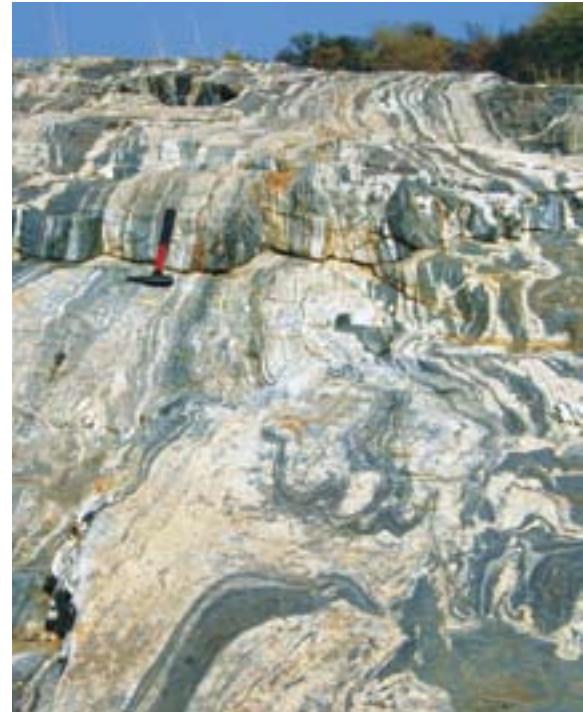
Located about 60 km west of Musina, at the confluence of the Limpopo and Shashe Rivers, and bordering Botswana and Zimbabwe. You will visit iconic Mapungubwe Hill that was once a rocky citadel of a southern African royal family, and the world-class interpretation centre where you will experience southern Africa's 14th century cultural heritage. The area is underlain by upper Karoo sediments and remnants of basalt, and is a landscape formed by a dissected sandstone escarpment, mesas and buttes separated by wide sandy valleys. Notable are the unusual sandstone pillars that are interpreted to be fossilized termite nests of Early Jurassic age.

Sand River Gneiss & Soutpansberg geology and landscape:

These formations lie south of Musina. You will first go to the famous tectonised gneiss and migmatite exposures in the usually dry Sand River valley which are part of the Archean Limpopo Metamorphic Complex that was formed during collision between the Kaapvaal and Zimbabwe Cratons. Later you will see the Mid-Proterozoic Soutpansberg massif in Wyllie's Poort, in a sequence of strongly faulted, graben-related quartzites that represent one of Earth's earliest 'red-bed' sequences.

Friday 9th September, Day 6:

Great Zimbabwe National Monument; overnight to Bulawayo via Gweru.



Incredible plastic deformation seen in high-grade gneisses and migmatites of the strongly metamorphosed Limpopo Complex, in the usually dry Sand River near Musina

Geology, landscape and archaeology:

You will disembark at Rutenga, Zimbabwe and bus drive (about 2 hours) to Great Zimbabwe, another World Heritage Site. This iconic monument is at the heart of Zimbabwe's history and culture, and gives its name to the country. It is located in attractive hilly landscape underlain by eroded Archean granite, the same rock that was used for its impressive dry-stone construction. A powerful and thriving city-state existed at what is the largest stone construction south of the



The hematite-rich, pink and maroon Soutpansberg Group quartzites seen in Wyllie's Poort, Limpopo represents some of the Earth's oldest red-beds, reflecting free oxygen becoming available in the atmosphere.

pyramids. People lived here for around 300 years until the late 15th century when it went into decline. There are several footpaths to be walked and a couple of hills to be climbed. In the afternoon the train departs for Bulawayo, Zimbabwe's second largest city.

Saturday 10th September, Day 7:

Rhodes Matopos National Park and Bulawayo; overnight to Victoria Falls.

Geology, landscape and archaeology:

An early rise is essential prior to departure on 4x4 vehicles for the Rhodes Matopos Hills National Park. Located south of Bulawayo this is another important World Heritage Site, characterized by spectacular scenery, interesting archaeology and a viewsite called "The View of the World". The Matoba Hills provides a granite landscape showing typical whale-backs, balancing boulders, castle koppies and gorges. Granite intrusion took place in the Late Archean, and the area subsequently experienced a long and complex geological and erosional history. The hills were inhabited since the Early Stone Age and are richly endowed with countless rock paintings, some of which will be seen. Later if time permits we will visit the National Museum in Bulawayo. The train departs for

its final overnight trip to Victoria Falls, arriving there around mid-morning.

Sunday 11th September Day 8:

View the Victoria Falls from both Zimbabwe and Zambia; the train stays at Victoria Falls station.

Geology and landscape:

Today could be the highlight of the geo-safari as we visit yet another World Heritage Site, one of the world's great waterfalls. When the Zambezi River is in full flood the Victoria Falls forms the world's longest continuous sheet of falling water. Notably the underlying basalt lavas are part of the Karoo magmatic event that took place in the Jurassic. This major knick-point on the Zambezi River separates the mature low gradient Upper Zambezi and the youthful, headward-eroding middle Zambezi. There is a fascinating geomorphological story to tell, the deep gorges below the falls representing a series major fracture zones and the sites of earlier waterfalls.

Monday 12th September, Day 9:

Chobe National Park (Botswana) and river safari; the train stays at Victoria Falls station.

A visit to Chobe National Park in Botswana, only 76 kms from Victoria Falls, is a MUST when visiting this area. One WILL see lots of game and a big variety as well. The geology that you see is part of the Cenozoic Kalahari Group. The cruise on the Chobe River will give wonderful opportunities for good pictures and this is a day NOT to be missed. Tonight we dine on the banks of the Zambezi River, a never-to-be forgotten experience. This is the last night on the train.

Tuesday 13th September, Day 10:

End of a memorable geo-safari; passengers make their own arrangements.

Breakfast will be served on board the train. If guests are transferring to a local hotel, this will be arranged for them in the morning. If guests are flying from Victoria Falls International Airport (18 km away) they will be transported to the airport. But we highly recommend that you stay another night or two before departing, as there is still so much to be seen and enjoyed.

Gavin Whitfield



The GSSA Professional Programmes Committee
in collaboration with John Bristow and Mike De Wit
PRESENTS

KIMBERLEY DIAMOND SYMPOSIUM & Trade Show

Thursday 11th, Friday 12th, and Saturday 13th September 2014

Mittah Seperepere Convention Centre, The Big Hole, Kimberley, Northern Cape



kimberley diamond symposium



Famous diamond claim staking rush at Brakfontein on the Middle Orange River in the 1920's

Kimberley Diamond Symposium and Trade Show **10 - 13 September 2014**

The Geological Society of South Africa (GSSA) Directorate of Professional Programmes (DPP) in conjunction with John Bristow and Mike DeWit is once again running the Kimberley Diamond Symposium and Trade Show in Kimberley from 10th – 13th September 2014. A similar highly successful Diamond Symposium was held in 2007 in Kimberley.

The Conference is being organized by RCA and Associates who also helped organize the 2007 Kimberley Diamond Symposium. Interested parties can contact Michele at events@rca.co.za (telephone +27 (0)11 487 3819/2260), John Bristow (jwbdia@mweb.co.za), or Mike DeWit (dewit@icon.co.za) and visit the following websites for more information www.gssa.org.za, or www.rca.co.za.

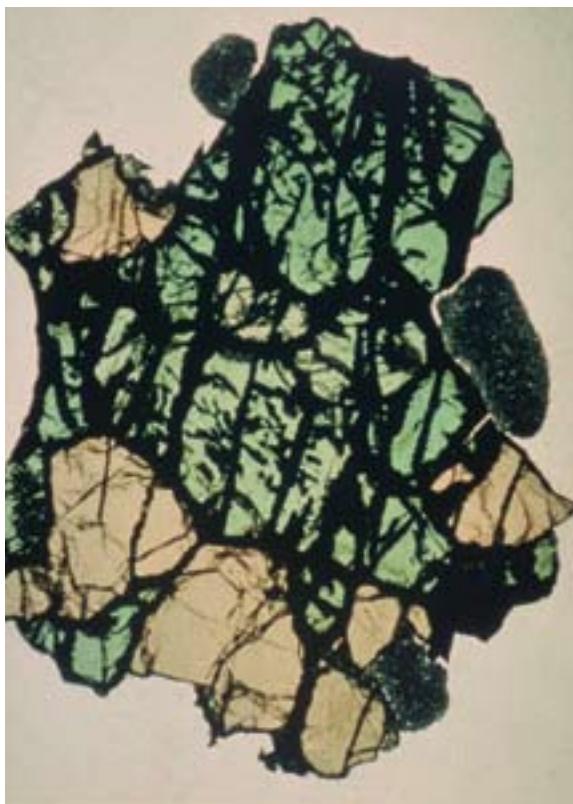
Following the World Financial Crisis of 2008/09 and subsequent down turn in the diamond industry, the past 18 months have seen the steady resurgence of the diamond trade, with renewed interest in mine

development and expansions in South Africa and Botswana, and new project development in Brazil and Canada. Diamond exploration activities are also showing some green shoots. New technologies and refinements are surfacing in all facets of the diamond industry including exploration methods and geophysics, processing plant design and optimization, diamond recovery systems, and diamond cutting and polishing.

Reprocessing of old tailings dumps is also increasingly providing further sources of gemstone diamonds along with the recycling of old diamond jewellery. Recently there has also been debate about the role and place of synthetic diamonds in diamond jewellery. With Carbon Vapour Deposition (CVD) and High Pressure High Temperature (HPHT) technologies for diamond synthesis advancing rapidly, and annual production of synthetic diamonds somewhere in the 6 – 10 billion carat range compared to natural production of 130 million carats per annum, it is inevitable that synthetic diamonds will find their way into the diamond jewellery business. The 2014 Kimberley Diamond Symposium will provide a platform for highlighting and discussing changes and trends in the local and international diamond



Polished thin section of a Roberts Victor eclogite – unique mantle sample from the deep mantle brought to the earth surface by the Roberts Victor kimberlite



industry. It will also showcase new technological developments in diamond exploration, processing and recovery equipment, present new scientific information relating to the origin of diamonds and the formation of diamond bearing deposits, and provide an opportunity to debate other developments noted above.

Looking forward, the world diamond market is facing declining production and steadily increasing demand. Consequently new discoveries, mine expansions, and additional production will be required to fill the growing gap between supply and demand. As the local and international diamond industry emerges from four to five challenging years the Kimberley Diamond Symposium will also provide an ideal event to show how the challenges of the past four to five years have been addressed and provide insights into the future of the industry.

Kimberley is where the diamond business started in South Africa. Hence the Symposium will also take this fascinating industry back to its local roots. The event will in this respect also highlight the various mining and developmental activities that continue to make the town of Kimberley and the Northern Cape an important focal point of the local and international diamond business. The Kimberley Diamond Symposium will comprise a

day and a half of technical presentations and poster sessions, indoor and outdoor exhibitor displays, and two days of mine visits, including underground visits and field trips.

The technical and poster sessions have attracted considerable interest from local and international diamond experts, researchers and companies and will focus on wide ranging new developments, trends, and leading edge research and development in the diamond industry

The planned field trips will have tour guides with specific knowledge of the areas, geology and activities to be seen on these trips. The following destinations and mines have been targeted as part of the field and mine trip programme:

- Underground visit to the famous Kimberley Mines lead by Petra Diamonds
- Underground trip to the World class Finsch diamond mine owned by Petra Diamonds
- Nootgedacht & Barkly West Alluvial Diamond Tour including Kanteenkoppie, and Holpan-Klipdam alluvial deposits
- Middle Orange River to inspect alluvial deposits and mining operations on extensive ancient remnant terrace deposits, and visit DeKalk which is the site of the first diamond discovery in South Africa
- Rooipoort Vaal River alluvial diamond mining operations, rehabilitation activities, and unique wildlife viewing opportunity
- Ekapa Mining dump retreatment operation which is reprocessing old Kimberley tailings dumps
- Roberts Victor mine trip to sample unique eclogite and other nodules from a micaceous Group 2 kimberlite locality
- Kimberley 'Big-holes', Tailings Dumps, and Mantle Nodule Tour

Other visits to historical places of interest will also be available to interested participants and partners including the following:

- Belgravia Historical Walk incorporating Historical Houses and places of interest in Kimberley
- Kimberley Africana Library
- Kimberley Club
- Sol Plaatjie Museum
- Kimberley Ghost Tour
- Magersfontein Boer War Battlegrounds



Vaal River Gravels at Windsordon on the Vaal River north of Kimberley – note old tunnels dug by Welsh miners in the early 1900's

- South Africa's First Flight School Museum
- Big Hole Museum
- Macgregor Museum
- William Humphreys Art Gallery
- Kamfersdam Flamingo Colony
- Wildebeest Kuil Rock Art Centre

A number of key Sponsors, including De Beers, have already signed up for the Symposium, and as noted above there has been excellent interest in the September 2014 Kimberley Diamond Symposium. Interest includes local and international geologists, engineers and diamond researchers. A wide range of service providers and equipment suppliers and manufacturers, including large earth moving companies, will be exhibiting their wares.

The upgraded Kimberley Big Hole Diamond Museum where DeBeers spent approximately R50-million to help redevelop this facility into a world call museum is a great place for tourists as well as for people interested in the industry. The Kimberley Club, with all its history and character will also feature in the activities of the Symposium, and there will be opportunity for delegates to experience other unique pieces of South African history and politics including the Sol Plaatjie, McGregor and Pioneers of Aviation Museums, various galleries, and the famous diamond mines of Kimberley represented by five "big holes".

Besides the participation many well known diamond operators, scientists and individuals, the Symposium also intends to attract old characters of the industry including diamond diggers from the Vaal and Orange

River, and Ventersdorp areas, many of whom have become legends in the industry, and are now in their senior years. The intention is again to bring these characters together to share some of their experiences and pioneering deeds, and chat about some of the large and remarkable diamonds that they have recovered in the Northern Cape.

To date registrations have been received from Australian, Brazilian, Canadian, UK, Russian, African and local companies, individuals, researchers, and service providers. Space is filling up fast for the Symposium, Fieldtrips, and Trade Show and interested parties are advised to register early.

John Bristow



Kimberley Mine Big Hole – site of the famous Kimberley Mine diamond museum.

obituaries:

John (Ian) Hortor Waddie Ward

Ian Ward

John (Ian) Hortor Waddie Ward

29 June 1933 – 30 October 2013

Ian with his special partner, Grace McQueen. Switzerland, June 2013.



An obituary often tells the tale of what a person did in their life rather than who they were. That being the nature of an obituary, I hope that I am able to convey who Ian was as well. My first meeting with Ian was in 1987 when he had just joined what was then the Geological Survey of South Africa. This meeting led to many camping and fishing trips in search of trout (and sometimes tiger fish), plenty bottles of wine and beer, a shared enjoyment of sailing and lots of banter.

Ian's untimely death shortly after his 80th birthday came, surprisingly, as a shock not only to his family, but also to his friends. I am pretty sure that Ian did not either realize or really regard himself as an eighty year old man who should be taking things a bit easy. Photos, frequent newsletters and telephone calls revealed a vibrant, energetic man who was still sailing the Mediterranean on "Green Fin" with his very special partner Grace, walking the Alps, playing golf and tennis, and spending lots of time with his family.

Although Ian was a Scot, born and schooled in Scotland, he was an African at heart. Ian was not a dour Scot though – all who knew him will remember his cheerful greetings, broad smile and eternal optimism. Ian was frugal but massively generous to a fault, free-spirited but highly principled with a very strong moral compass, and a deep faith in the institution of the

church. His strong sense of duty was evidenced by his work with the Boy Scouts, service to the Geological Society of South Africa, and the numerous other committees he served on, which included the parish council of Garsfontein Anglican Church, chairman of the tennis section at Irene Country Club and, lastly, vice- commodore of the Pretoria Sailing Club. This sense of duty was underpinned by an enormous self-discipline, unwavering attention to detail and superb written and verbal skills. Ian's strong character was intertwined with a wry but robust sense of humour and wickedly droll observations that made working with him such a pleasure. Every time I reach for a cup of tea, I still remember Ian's words of praise to the "the cup that cheereth, but does not inebriate"!

Ian was enormously and rightfully proud of his children and their accomplishments. Marianne, Douglas and James I am sure, benefitted enormously from his sage advice and unflinching honesty. Ian was never one to shy away from his own mistakes to ensure that others did not do the same.

Ian, christened John Hortor Waddie Ward, was born of Scottish parents in Edinburgh, Scotland, on 29 June 1933. While his primary schooling was in Scotland, he had to endure secondary schooling in the south of England. He spent most of his school holidays in the remote Scottish Highlands and there began his lifelong enjoyment of outdoor activities, including walking, camping, trout fishing, backpacking, sailing, tennis, and, later, geology.

At the age of 18, Ian emigrated to Southern Rhodesia and attested as a constable in the British South Africa Police - with "horses and forage provided"! Following seven years' service, when the winds of change in southern Africa increased to a stiff breeze, Ian, then a

detective sergeant, resigned from the BSAP in 1959 and enrolled as a student of geology at Rhodes University.

After completing the B.Sc. degree in 1961, and the B.Sc.Hons. degree in 1963, during which time he was elected senior student of Drostdy Hall and a member of the SRC, Ian joined Rio Tinto Rhodesia Limited as a rookie geologist. He then spent five years going through the mill, firstly on surface and underground exploration at Sandawana Emerald Mine, involved in detailed surface and underground mapping and exploratory drilling. Thereafter he was mine geologist at Patchway Gold Mine responsible for the underground development programme, geological mapping and ore reserves management.

Ian, the wise man that he was, realized that there was more to life than rocks, fishing and hiking, and married Martine, a physiotherapist from Rondebosch, in 1967. Ian departed Rhodesia in 1968, and the Wards settled in Cape Town where Ian worked as a junior lecturer in the Department of Geology at the University of Cape Town. He enrolled at Rhodes University and completed an M.Sc. degree on the geology of the Patchway Gold Mine in 1969. With encouragement, he soldiered on as a lecturer in economic geology and a researcher in the Precambrian Research Unit at UCT for ten years. During this time the Ward family grew by the welcomed addition of a daughter, Marianne, and two sons, Douglas and James.

In 1979 Ian joined Anglo American Prospecting Services Limited and spent two years prospecting for gold in the Barberton greenstone belt. The Wards had by then settled in White River, and the opportunity to stay in the Lowveld came with an offer of employment in 1981 from Delta (EMD) Limited in Nelspruit. Ian worked there as a technical manager, firstly on a potential pilot project to manufacture magnesium metal from magnesite and then, when silica impurities in the feedstock proved to be an insurmountable obstacle to the viability of the magnesium process, as marketing manager at the electrolytic manganese dioxide (EMD) manufacturing facility. Following extensive research into the applied mineralogy and application of this battery-active product, Ian demonstrated that the world-wide market for electrolytic manganese dioxide was tied to five principal primary dry cell battery manufacturers,

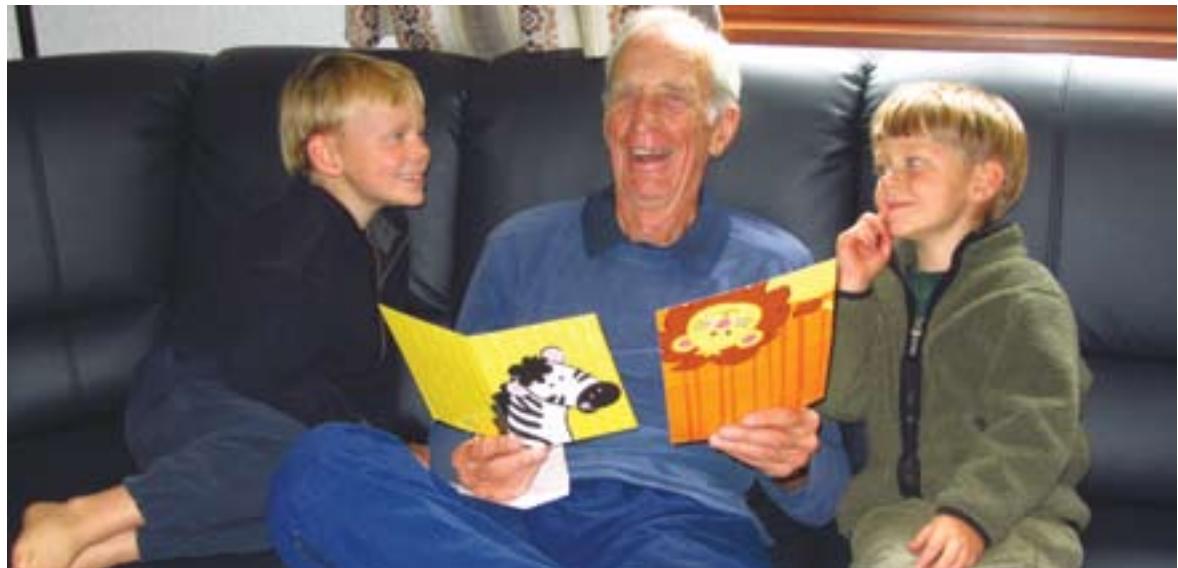
whereupon the chairman of the company decided he would himself handle the marketing function. Ian was then transferred to a sister company, Delta Manganese Limited, where he undertook research into the quality, mineralogy and calcining properties of available South African manganese ores.

The Ward children were by now ready for senior schooling but with the steel market in decline Ian was retrenched and the family returned to their home in Cape Town in 1983. Ian found a job as director of administration at the national headquarters of the Boy Scouts of South Africa. At the end of 1984 and, following divorce, Ian left Cape Town to undertake a survey of the Frankfort Gold Mine at Pilgrim's Rest, before going on to Zimbabwe as the mine geologist at Vubachikwe Gold Mine in the Gwanda greenstone belt. He returned to South Africa in 1986, where he taught for nine months as a sabbatical replacement lecturer in economic geology at Rhodes University. He was also appointed as an external director of the Zimbabwean company that owns Vubachikwe Gold Mine in 1987.

Ian joined the Geological Survey of South Africa (Council for Geoscience) in 1987 and was appointed as a geologist in the Mineral Resources Division. Here he was involved in regional studies and metallogenic mapping. The latter culminated, in the production of a meticulously researched memoir and 1:100 000 scale metallogenic map of the Barberton greenstone belt. Ian went on pension on 1 October 1998, but was appointed as a consultant to undertake the compilation of an explanation and 1:250 000 scale metallogenic map of Sheet 2530 Barberton.

A member of the Geological Society of South Africa since 1964, Ian became involved in the work of the Pretoria branch of the Society in 1987 and was elected chairman for the years 1990 and 1991. He was elected member of the council of the Geological Society of South Africa in 1991, and served as an appointed member of the South African Council for Natural Scientific Professions from 1995 to 1998. During this period he focused on promoting in-service training and furthering professionalism in the earth sciences.

Ian with his two grandsons, Jonathan (left) and Simon, on 29 June 2013, his 80th birthday.



Ian retired from professional life in about 2000, and focused his efforts on golf, tennis, hiking and sailing, as well as travelling between South Africa and Europe to be with his children. His meeting of Grace McQueen in 2006 added a new dimension to his life and he revelled in being able to share his passion for, amongst other activities, sailing and hiking.

Ian celebrated his 80th birthday in Switzerland with his family in June 2013 and, to add to the special occasion, the marriage of Douglas to Victoria. The

photographs of the occasion showed Ian surrounded by a loving family, which included a few grandchildren as well. News of Ian's death in Pretoria came a short few months later: he had gone in to hospital to have a leaky valve in his heart replaced. The operation was a success, but after a few days he developed a chest infection and shortly thereafter went into shock.

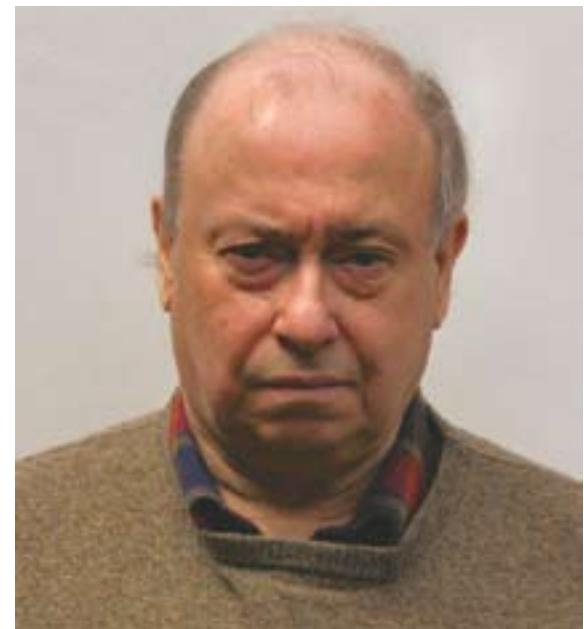
Ian lived life to the full – all who knew him will miss him.

Angus Christie

Memorial to Fred Gladstone Bell (1938–2014)

Fred Gladstone Bell passed away at his home in Nottinghamshire, United Kingdom, on the 3rd of May this year. His contribution to the fields of Engineering Geology, Environmental Geology, Civil Engineering and Geology is unparalleled, not only in the great number of practical, technical books and papers that he penned, but also in terms of their scope. He effortlessly overlapped and interlinked these various fields in contributions that have become the gold standard for study and research; Fred's legacy to our science is unassailable. Possibly his greatest legacy is the hundreds of young engineering geologists, engineers and geologists that benefitted from his caring diligence and heartfelt encouragement, a lot of it on a personal basis, to start, finish and excel at their degrees and careers.

Fred Gladstone Bell



From personal experience and from many words written in response to news of his passing, his breadth of knowledge and energy in research and publishing were matched only by the size of his heart - described as "planet-sized" by one of his close colleagues - and his unwavering integrity and loyalty.

Early Years

Fred was born on 12th July 1938 in Ashington, Northumberland, an only child to parents Connie and Fred, a coal miner.

Fred's intellect was recognised early and he gained a scholarship to Blyth Grammar school in Northumberland. His father was determined to spare his son from the darkness and dangers of the pit and supported him as much as he could. When Fred was in his early teens his dad contracted pneumoconiosis (also known as miner's lung or black lung). Every day Fred came home from school to find his father on the couch in their front room coughing his lungs out. After a long illness Fred came home one afternoon to find that his father had died, leaving him alone with his mother.

Fred loved football and was the striker in his school's team. He turned up for their match the day after his father's death because he didn't want to let his teammates down. He had a terrible first half and the coach berated him for playing so badly. Fred hadn't told the coach, or the school, that his father had died and refused to use it as an excuse for his poor playing.

His mother was granted a widow's pension from the National Coal Board and the two of them started out on a very tough road to get him through school. Connie, however, was resolute that Fred would get the best possible education. Fred got through 6th form (the broad equivalent of our matric level) and, with a little help from his Headmaster, obtained a place at Durham University studying Geology. His academic career had started.

Why choose Applied Geology? As the narrative goes, he was out with school friends one day and they walked home through tailings of a nearby mine.

For some reason, his friend wandered off the beaten track and suddenly found himself sinking into the fine, muddy slime, with no way to extract himself. Fred knew very well that it was dangerous but decided that he had no time to call for help. He simply walked up to his friend and pulled him out. Both were thoroughly told-off for both being covered in mud, but being young boys, they thought it was a great joke. He never could understand how he had managed to save his friend, with the same treacherous ground underfoot for both of them, but it sparked an interest. Add this to the long history of mining in the north-east of England and Applied Geology was a natural choice for a budding academic and the son of a coal miner.

Education: Received and Given

After that initial spark, Fred graduated B.Sc., M.Sc. from the University of Durham and received his Ph.D. from the University of Sheffield, United Kingdom in 1974. He later received a D.Sc. from the University of Natal. He opted for an academic career, although one with an applied emphasis. Consequently, he served with distinction in the following positions:

Assistant Lecturer in Geology, University of Northumbria, Newcastle upon Tyne, U.K.

Lecturer in Geology, University of East London, London, U.K.

Senior Lecturer in Engineering Geology/Geotechnical Engineering, Department of Civil Engineering, Sheffield Hallam University, Sheffield, U.K.

Principal Lecturer in Geotechnical Engineering and subsequently Deputy Head of Department, Department of Civil and Structural Engineering, Teesside University, Middlesbrough, U.K.

Professor and Head of Department, Department of Geology and Applied Geology, University of Natal, Durban, S.A.

Distinguished Visiting Professor, Department of Geological Engineering, University of Missouri-Rolla, U.S.A.



Visiting Research Associate, British Geological Survey in the Engineering Geology Unit.

He was responsible for the development and expansion of numerous curricula, most of which continue to this day. In the United Kingdom, he was instrumental in developing B.Sc. (Hons) Civil Engineering, B.Sc. Mineral Surveying and B.Sc. Environmental Resources at Sheffield and B.Eng. (Hons) Civil Engineering at Teesside.

In South Africa, he was brought into the department, by Prof. Ron Tavener-Smith (then HOD), to take over Engineering Geology and, subsequently, the department's leadership and ongoing development of their Geology and Applied Geology courses. He consequently worked on furthering and developing the B.Sc. (Hons) Engineering Geology and B.Sc. (Hons) Environmental Geology curricula and majors that had been established by Dr Colin Jermy and others since the 1980's. The trend of providing applied, hands-on courses continued under his guidance, with B.Sc. General Geology and Applied Geology being prime focusses. His greatest legacy, at least in my view, are the responsible scientists that have grown out of his efforts to expand these curricula and his encouragement to each and every one of these to follow the path of hard work and the scientific method. During his academic career he acted as external examiner for Aston University, Newcastle University, Sheffield University, Southampton University and Keele University.

Subjects and Writing

Fred's interests were extremely wide and overlapping. His research areas included ground instability; subsidence; ground treatment; the engineering behaviour of soils (clays, expansive clays, saprolites, tills, laminated clays, dispersive and collapsible soils, sands); the engineering behaviour of rocks, including weathered rocks (sandstones, carbonates, evaporites, shales, basalts, dolerites, granites); building materials; cement, lime and PFA stabilization of clay soils; acid mine drainage; impacts of mining; landfills, derelict and contaminated ground; rock durability in relation to tunnelling; slope stability; aggregates; building stone and geohazards.

Fred penned over 230 papers on these subjects in international journals and conference proceedings, stemming both from his research and consulting.

He authored, co-authored and edited over 20 books from 1975 onwards, in other words, his full-scale publishing of books commenced one year after his Ph.D. was awarded. Several of these volumes have been reprinted; *Engineering Properties of Soils and Rocks*, originally published by Butterworths, London in 1981, is on its fourth edition. *Engineering Geology*, published by Blackwells, Oxford in 1993, is on its second edition. His books have been translated into French, Malay, Turkish and Italian. Notable for the South African chapter of his career is the 600-page *Environmental Geology: Principles and Practice*, first published by Blackwells, Oxford in 1998. This volume won the University of Natal Book Prize.

While not writing, Fred served on the editorial boards of 5 international journals and acted as a series editor for three publishing houses. These editorial boards included *Quarterly Journal of Engineering Geology and Hydrogeology*, *Geotechnical and Geological Engineering*, *Geomechanical Abstracts*, *Engineering Geology* and the *Bulletin of the International Association Engineering Geology*. He was also an Advisory Member of the Editorial Board of Earth Sciences (Yerbilimleri - Turkish) and was invited to become a member of Springer's new journal *Urban Environment*.

Consulting

Although I am less familiar with his consulting activities, it's quite clear that much of his world-renowned work was based on real, hand-on experience, which resulted directly from his consulting activities. He served as advisor to the Department of Water Affairs and Forestry, South Africa and to NERC in the United Kingdom on Engineering Geology and Hydrogeology.

Fred worked with Drennan-Maud and Partners in Durban; Steffen, Robertson and Kirsten (SRK), Gold Fields of South Africa, AngloGold and Amplats in South Africa. He consulted to J. Ducker and Associates, CSL Surveys Ltd, Design Associates Ltd, F.G. Bell and Associates and The Land and Development Practice

in the United Kingdom. A (probably) limited list of his other consulting clients include civil engineering firms Tarmac Holdings Ltd; Terrasearch Ltd; Cementation Ltd; Abbey Underpinning; Newcastle and Gateshead Water Board; Hutter, Jennings and Titmarsh; Solmek Ltd.; Rocheford and Partners; East Pennine Drilling etc. He was retained by Chesterfield Metals, Elliott's Bricks, Holiday Inns, Monsanto Chemicals, Denny Mott, Darrington Quarries, Hoveringham Gravels and Lyons Bakeries, to name a few.

Awards

It would be far easier to list the fellowships and awards which Fred was not given by leading institutions and societies, in recognition of his unparalleled contributions in research, publication and consulting in his chosen field. In addition to being both a Chartered Engineer (CEng) and a Chartered Geologist (CGeoI), his fellowships included the Royal Society of South Africa (FRSSAf); Institution of Civil Engineers (FICE); Institute of Materials, Minerals and Mining (FIMMM); Geological Society (FGS) and the Institution of Mining and Metallurgy (FIMM). Fred was also a Fellow of the University of Natal.

His memberships were numerous:

the British Geotechnical Association; International Association of Engineering Geology and the Environment; International Society of Soil Mechanics and Geotechnical Engineering; International Society of Rock Mechanics and the Association of Engineering Geologists (America).

Fred received the prestigious Coke Medal from the Geological Society, London and the Holdredge Award from the Association of Environmental and Engineering Geologists (America) on two occasions (2000, 2004) for outstanding contributions to the Engineering Geology profession. In 2007 he received the Burwell Award from the Geological Society of America, which is awarded for a published paper of distinction that advances knowledge concerning principles or practice of Engineering Geology, or of related fields. As indicated elsewhere in this memorial, Fred received the University of Natal Book Prize, but

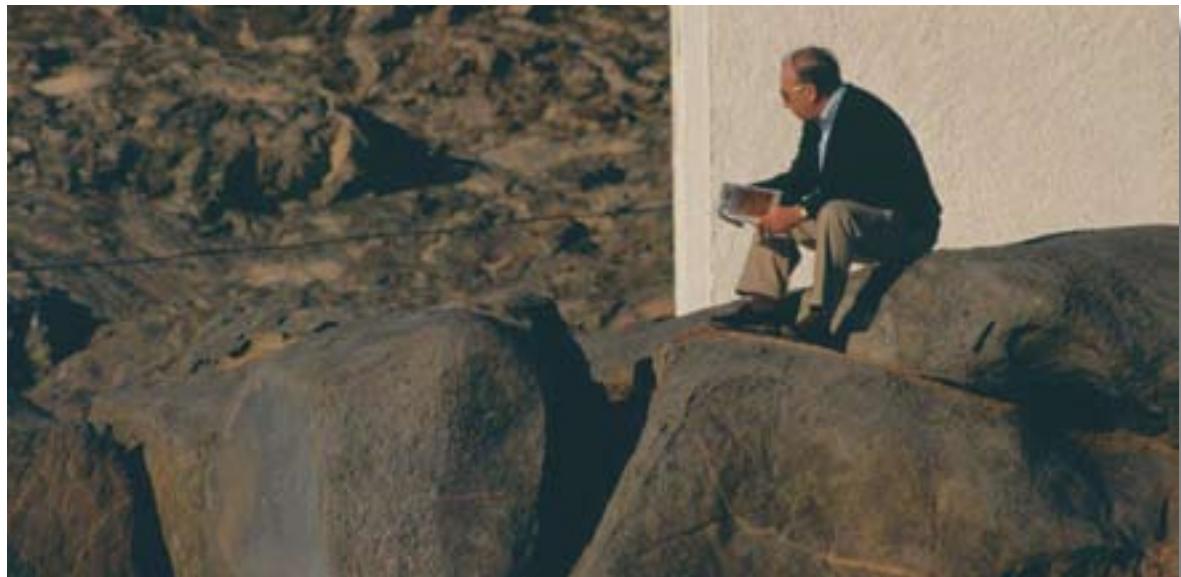
it's remarkable that he achieved this feat on no less than three occasions, in 1991, 1997 and 1999. As far as I am aware, he was the only person that can lay claim to this accolade.

The Man Behind the Work

Most of us remember a bundle of energy, with a twinkle in his eye, rapidly pacing down a corridor to or from a lecture or his office. Fred never walked slowly, but he always spoke in a careful, measured manner. Fred was always a gentleman and he knew what he wanted to say. Very often he knew what you wanted to say, too, well before you'd said it. He had several modes, which were all parts of his personality: jocular; encouraging; open disbelief; curious; amazed, but invariably friendly and always well-meaning. If you were sincere in your desire to study and apply yourself, then you had an ally.

In the 10 years that I knew him from a first year student in 1991 to the end of my Ph.D. at the University of Natal, Durban (UND), he was unshakable when on the trail of something, whether this was encouraging a student not to give up or to meet a deadline, or in convincing a colleague or student on a course of action or on the development of the curricula that he so carefully and painstakingly expanded from his own knowledge and experience. He took over Applied Geology at UND in the 1990's, from Prof. Ron Tavener-Smith, who in turn resurrected the department during the post-L.C. King era. Along with his team, he enthusiastically advanced and expanded this institution's curriculum well into post-apartheid South Africa. The department at UND became almost the only place in South Africa to get a solid degree in Engineering and/or Environmental Geology. It's also safe to say that the Department was one of the homes of Environmental Geology, as applied to Earth Sciences, in South Africa. The majority of Engineering Geologists that I meet during my own consulting as a structural geologist either come from UND or the University of Kwazulu-Natal (as it's now known). They invariably have fond memories of their education at this institution, particularly during the time in which Fred was at the helm. I consider myself most fortunate to have studied there too.





Fred was a keen judge of one's personal capacity and promise. He employed a quiet – although persistent – combination of "needling" and persuasion to nudge his "subjects" into doing more and making more of themselves and, in the process, working for the common good that would inevitably emerge if one took his advice and applied it. My own start in Geology, my degrees and current career are inextricably linked to – and due to – his involvement in my life and the positive learning environment that he and his team created at UND.

His passing has left an immense hole in the lives of many, in his science and in the lives of his students, colleagues and friends. It was impossible to be a good student of his, or a valued colleague of his, without being his friend.

I.J. Basson

with contributions from Alex Bell (Fred's son, UK), Dr Allen Hatheway (USA), Prof Martin Culshaw (UK), Dr John Cripps (UK), Dr Laurance Donnelly (UK), Prof Ron Tavener-Smith (SA), Dr Colin Jermy (SA), Prof Tom Mason (UK)

media monitor

MINING AND EXPLORATION NEWS

EXPLORATION TRENDS

The latest World Exploration Trends report from SNL Metals & Mining reveals that all company types cut their exploration activity sharply in 2013 in response to lower metal prices, uncertain demand, and poor market conditions. SNL's 24th edition of Corporate Exploration Strategies shows that global spending on nonferrous metals exploration in 2013 was US\$15.2 billion, 29% down from the record US\$21.5 billion in 2012. The steep decline was due to a combination

of investor wariness of the junior sector, which made it difficult for most companies to raise funds, and a strong pullback by producing companies on capital and exploration spending in order to improve their margins.

COPPER

Blackthorn Resources is moving to a definitive feasibility study at its Kitumba copper project in Zambia after completing an optimized pre-feasibility study. A 3 Mt/a underground operation would produce an average of 58 kt/a of copper metal over

an 11-year life from proven and probable reserves of 31.5 Mt at 2.04 % Cu, using pressure oxidation leaching, solvent extraction, and electrowinning. Project development costs are estimated at US\$680 million, with cash costs of US\$1.57 per pound of copper cathode. Blackthorn has sold its remaining 27% interest in the Perkoa zinc project in Burkina Faso to Glencore Xstrata for US\$12 million in order to focus on Kitumba, and is holding discussions with potential development partners.

Antofagasta plc will earn 70% of Argonaut Resources' Lumwana West project in Zambia by spending US\$18.9 million on exploration and funding a feasibility study. The Lumwana West licence is situated in the 'domes' region of the Zambian Copperbelt, between Barrick's Lumwana mine and First Quantum's Sentinel project.

GOLD

QKR Corporation is buying the Navachab gold mine in Namibia from AngloGold Ashanti for US\$110 million. QKR is a UK-based private mining investment group, with principal shareholders Qatar Holding and Kulczyk Investments.

ASX-listed Papillon Resources appointed Lycopodium Minerals to lead the definitive feasibility study for the Fekola gold project in south-western Mali. The study is scheduled for completion in the second half of 2014. A prefeasibility study was completed in 2013. From Measured and Indicated mineral resources of 44.3 Mt at an average grade of 2.46 g/t, the PFS supported an average annual production profile of 300 000 ounces over an initial 9-year mine life, at a project capital cost of US\$292 million.

INDUSTRIAL MINERALS

Allana Potash has formed a strategic alliance with OCL, one of the world's largest fertilizer producers, for a potential total investment of up to C\$84 million. ICL will purchase the entire production of Allana's Danakhil potash project in Ethiopia, and provide technical assistance for the development and operation of the project. According to the 2013 feasibility study, Danakhil will produce 1 Mt of muriate of potash per

annum from 93 Mt of Proven and Probable sylvite reserves at 28.5% KCl. In addition, there are more than 2 billion tons of Measured and Indicated resources, containing 340 Mt of KCl, in carnallite and kainite horizons. In an adjoining concession, Danakil Potash Corp announced a maiden resource of 227 Mt of sylvite at 25.9% KCl (Indicated), out of a total of 1.8 billion tons, including carnallite and kainite resources.

Energizer Resources has acquired the remaining 25% interest in the Molo graphite project in Madagascar from joint venture partner Malagasy Minerals. Molo is one of the largest known crystalline flake graphite deposits, with an Indicated mineral resource of 84 Mt grading 6.36% carbon. Energizer has begun a full feasibility study, targeted for completion in the fourth quarter of 2014, and aims to start production in 2016.

IRON ORE

Ironveld plc completed a definitive feasibility study for a £36 million pig iron project on the northern limb of the Bushveld Complex. Test work has shown that ore from the Main Magnetite Layer, grading 48% Fe and 1.12% V₂O₅, can be fed directly to a DC smelter without the need for beneficiation, delivering an exceptionally high-grade product (99.5% Fe). In addition to 42 kt/a pig iron, 415 t/a vanadium (in slag) and 8 kt/a titanium (in slag) would be produced. The company aims to begin construction towards the end of 2014, with first production in late 2015.

Assmang will take a 19.9% stake in Australian iron ore explorer IronRidge Resources for £11.74 million, subject to the company completing £25 million capital raising and being admitted to the London AIM. IronRidge holds three prospecting licences in Gabon, covering approximately 5 352 km². The Tchibanga and Tchibanga North licenses are located about 60 km from the port of Mayumba. The Belinga Sud license area lies on the Trans-Gabon railway immediately to the south of the massive Belinga deposit.

Glencore Xstrata subsidiary Sphere Minerals has given the go-ahead for the 7 Mt/a Askaf North iron ore





International Conference coming to South Africa!

Experience mineralogy at its best in South Africa at IMA 2014

21st General Meeting of the
International Mineralogical Association

1 - 5 September 2014
Sandton Convention Centre, Gauteng, South Africa

Hosted by:



We are very pleased to invite you to attend the 21st General Meeting of the International Mineralogical Association, which will take place at the Sandton Convention Centre, Johannesburg, from 1 to 5 September 2014.

SESSIONS

The Scientific Programme Committee has received fantastic feedback to their call for session proposals, with over 50 sessions and 6 workshops being accepted for inclusion in the programme, and over 850 abstracts have been received. The various sessions are covered under the following themes:

- Open Theme • Clay Science • Deep Earth • Environmental Mineralogy / Geochemistry • Economic Geology / Mineralogy, Applied Mineralogy • Geochemistry and Petrology • Mineralogical Crystallography • Methods and Applications • Minerals, Museums, Culture and History • Planetary and Cosmic Mineralogy

WORKSHOPS	DATES	PRICE	CONVENOR	VENUE	MIN.BOOKINGS REQUIRED
PRE-CONFERENCE					
Applied Mineralogy of Cement and Concrete (Sponsored by PPC Cement)	Saturday, 30 and Sunday, 31 Aug.	R6,000	Dr Maarten A.T.M. Broekmans	Sandton Convention Centre	30
Thin Section Preparation Workshop	Saturday, 30 August (full day)	R1,000	Annegret Lombard	SGS	10
Quantitative Phase Analysis	Saturday, 30 and Sunday, 31 Aug.	R4,000	Dr Ian Madsen	Sandton Convention Centre	20
POST CONFERENCE					
Gem diamonds: Treatment, synthetics and its identification (Hosted by GIA)	Saturday, 6 September	R0	Dr Ulrika D'Haenens-Johansson	Sandton Convention Centre	N/A
Infrared core imaging: An emerging technology for geological & mining applications	Saturday, 6 & Sunday, 7 September	R4,500	Dr Phil Harris	Sandton Convention Centre	10
Raman and IR Spectroscopy in Mineralogy	Saturday, 6 & Sunday, 7 September	R5,500	Dr Sherif Kharbish	Sandton Convention Centre	15

FIELD TRIPS

The Organising Committee is planning the following field trips for IMA delegates:

- Vredefort Dome • Pilanesberg Alkaline Complex • Skorpion, Rosh Pinah and Oranjerund Alluvial Deposits • Northern Bushveld • Namibia Pegmatites and Industrial Minerals • Eastern Bushveld and Nkomati • Pilanesberg Geology, Fauna and Flora • Witwatersrand Golden Geology • Iron Ore and Manganese Deposits of the Northern Cape • Geology of the Early Earth • Cape Peninsula and West Coast • Day trips to various localities

For more information, visit our website and select the "Field Trips" button on the menu.

Confirmed sponsors & exhibitors:

Silver Sponsors



Bronze Sponsor



Exhibitors



For more information visit: WWW.ima2014.co.za Email: info@ima2014.co.za • Tel: +27 11 463 5085

project in Mauritania. Construction costs are estimated at US\$900 million, and first production is expected in early 2017. Rail and port services will be provided under a contractual arrangement with the state-owned iron ore producer Société Nationale Industrielle et Minière de Mauritanie (SNIM). Askaf North contains a Measured and Indicated magnetite quartzite resource of 360 Mt at 35.5% Fe, which is upgradeable to more than 69% Fe at a mass recovery of 46%.

Anglo American and Kumba Iron Ore have agreed to fund and manage exploration at Ferrex plc's Mebagia iron ore project in Gabon for up to two years. The agreement also allows for Anglo and Kumba to acquire 100% of the project through a purchase arrangement.

PLATINUM GROUP ELEMENTS

Preliminary economic assessments were completed for two projects on the northern limb of the Bushveld Complex. Ivanhoe Mines outlined a phased approach to the development of a large, mechanized underground operation at its Platreef project, with an initial 4 Mt/a run-of-mine operation in production by 2020, expanding later to 8 Mt/a (the base case), and possibly further to 12 Mt/a. Annual production at start-up would be 455 000 ounces of 4E (platinum, palladium, rhodium, and gold) and 20 million pounds of nickel at an estimated pre-production capital requirement of approximately US\$1.5 billion. Surface construction for the 800 m bulk sample shaft is under way, and Ivanhoe plans to begin development work on the main production shaft early in 2015. A pre-feasibility study is targeted for completion in the second half of 2014. The Platreef mine will be Africa's lowest-cost producer of platinum group metals, with cash costs at start-up estimated at US\$367 per ounce of 3PGE+Au at stage 1, including Ni and Cu credits. The 'Flatreef' mineral resource is characterized by its very large (approximately 24 m) vertical thicknesses of high-grade mineralization and a platinum-to-palladium ratio of approximately 1:1, which is significantly higher than other recent PGM discoveries on the northern limb of the Bushveld Complex.

On the far northern limb of the Complex, Platinum

Group Metals is starting pre-feasibility studies on its 49%-owned Waterberg Joint Venture. The preliminary economic assessment considered an underground mine with a steady-state production of 655 000 ounces of platinum, palladium, and gold per annum, based on Inferred resources of 167 Mt grading 3.26 g/t 3E (0.98 g/t Pt, 1.97 g/t Pd, and 0.32 g/t Au). The peak funding requirement would be US\$ 885 million, with operating costs of US\$555 per 3E ounce excluding Cu and Ni credits (US\$368 including credits). Drilling outside the JV area is targeting a 30 km projected strike extension of the Bushveld Complex, and a potential new style of Pt-Pd mineralisation has been identified in drill-holes 10 km north of the current resource and located higher in the sequence.

Aquarius Platinum has agreed to sell its indirect interests in the Blue Ridge and Sheba's Ridge projects to a consortium led by the China National Arts & Crafts Group for US\$37 million. The company is also disposing of its Kruidfontein prospecting right on the western limb of the Bushveld Complex to Pilanesberg Platinum Mines for US\$30 million.

URANIUM

Paladin Energy is divesting a 25% stake in its Langer Heinrich uranium mine in Namibia to China National Nuclear Corporation (CNNC) for US\$190 million. The operation, which began production in 2007, has a design capacity of 5.2 million pounds of uranium concentrate per annum and a current 20-year mine life. Separately, Paladin announced the suspension of production at its Kayelekera mine in Malawi, which will be placed on care and maintenance until the uranium price improves.

Other Geoscience News

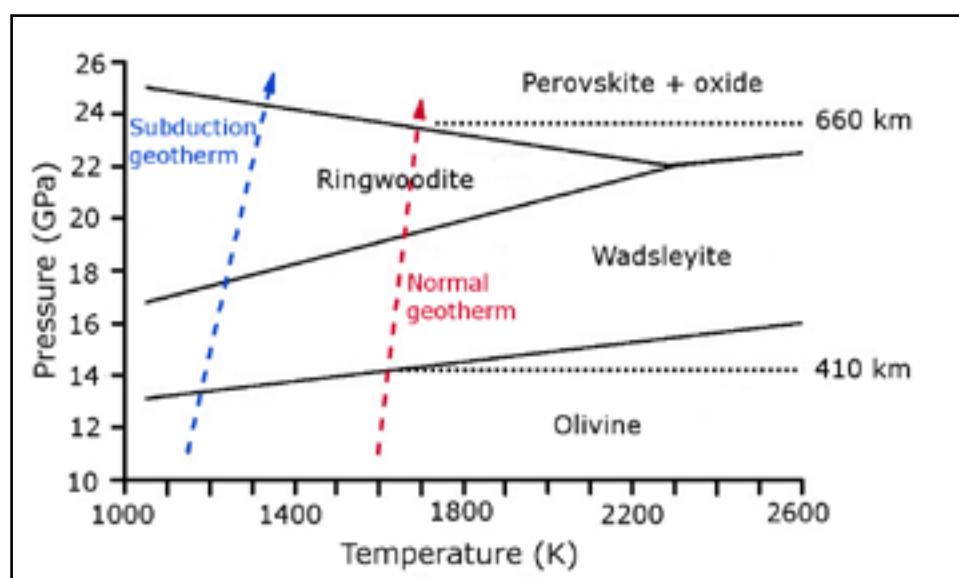
The first terrestrial sample of ringwoodite, a high-pressure polymorph of olivine, has been discovered in a diamond from the Matto Grosso region in Brazil, confirming the hypothesis that the transition zone in the Earth's mantle could host substantial volumes



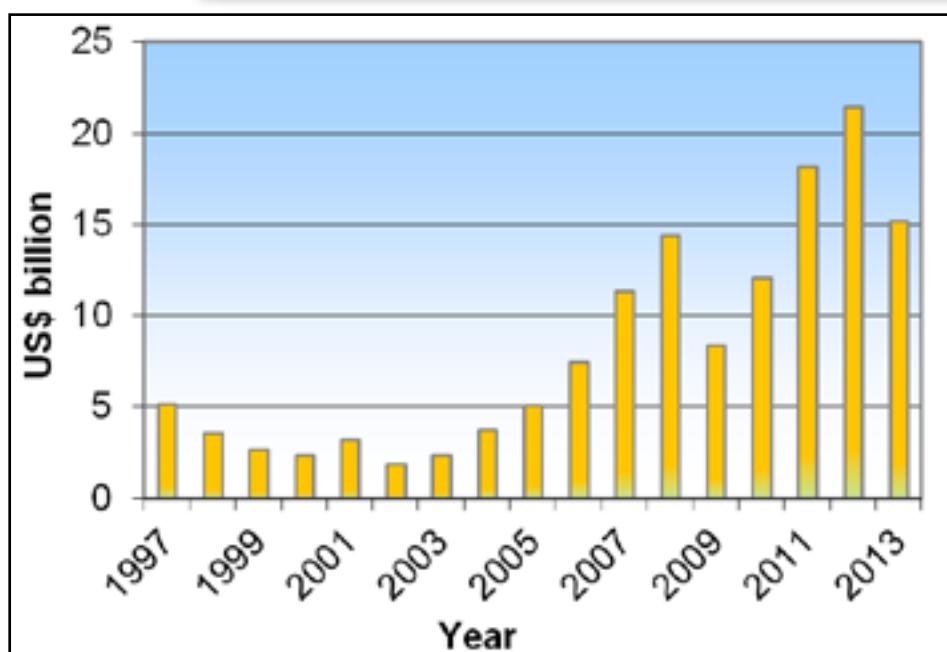
of water. The findings were published in the online edition of *Nature* [dx.doi.org/10.1038/nature13080]. First identified in meteorites, ringwoodite is thought to be a major constituent of the mantle transition zone at depths of 410–660 km. Synthesized under appropriate conditions (approximately 18–22 GPa and 1400–1500°C), ringwoodite has been found to contain up to 2.6% water by mass in lattice vacancies, but geophysical measurements on the transition zone by methods such as electrical conductivity have provided conflicting results. The 40 µm inclusion underwent several years of analysis using Raman and infrared spectroscopy and X-ray diffraction before being officially confirmed as ringwoodite. The critical

water analysis by infrared absorption, which indicated a water content of 1.5% by mass, was performed at the Arctic Resources Geochemistry Laboratory at the University of Alberta, Canada, which is home to the world's largest academic diamond research group. If the sample is representative of the transition zone, the amount of water there could be about the same as in all the world's oceans combined. A hydrous transition zone would play a key role in terrestrial magmatism and plate tectonics. The finding also indicates that some kimberlites must have their primary sources in this deep mantle region.

Antony Cowey



*Ringwoodite phase diagram_2 Schematic phase diagram for Mg_2SiO_4 in mantle peridotite (after G.R. Helffrich and B.J. Wood, *Nature* 412, pp. 501–507[doi:10.1038/35087500])*



World exploration budgets 1997–2013 Global exploration spending 1997–2013 (excluding iron ore, aluminium, coal, oil and gas). Source: SNL Metals & Mining



The microscopic ringwoodite sample was found in this diamond from Juína, Brazil. The diamond is 5 mm across in its longest dimension (photo: Richard Siemens/University of Alberta)

35TH INTERNATIONAL GEOLOGICAL CONGRESS

27 AUGUST - 4 SEPTEMBER 2016 | CAPE TOWN, SOUTH AFRICA



The International Geological Congress is the principal event of the International Union of Geological Science. The International Union of Geological Sciences (IUGS) is one of the largest and most active non-governmental scientific organizations in the world. Founded in 1961, IUGS is a member of the International Council of Science. IUGS promotes and encourages the study of geological problems, especially those of world-wide significance, and supports and facilitates international and interdisciplinary cooperation in the earth sciences. It is the umbrella body for geoscience world-wide.

The conference represents the “Olympics” of geology and is held every four years in a city selected for its attraction as a meeting destination and also in recognition of the host country's outstanding geology and long term contributions to the earth sciences.

South Africa will be hosting the 35TH IGC in Cape Town in 2016. The event will be a Pan African one with the support of the major African Geo-scientific Societies and other related organizations. Large numbers of African delegates are expected to attend and field trips are planned to all parts of the African continent.

For general enquiries, please contact Danie Barnardo on barnardo@geoscience.org.za

www.35igc.org



Under the patronage of
UNESCO
United Nations
Educational, Scientific and
Cultural Organization



The English Lake District

THE GEOTRAVELLER

By Roger Scoon

THE ENGLISH LAKE DISTRICT: A Caledonide Inlier and Historical Mining

The Lake District, part of Cumbria in the north-western part of England reveals some of the most interesting geology in the British Isles. The lower Palaeozoic rocks contain abundant ore deposits and the area initially supported an extensive mining industry. The dramatic scenery, including ice-sculptured landscapes, has made the area popular with visitors since the late 18th Century and tourism has in part alleviated economic issues created by collapse of mining. The area is well known not only for lakes and mountains, but also for associations with

English literature and landscape paintings. The nearest large town is Penrith and there are a number of small towns and villages within the Lakes.

This is the only part of England over 900 m in height and the rugged typography and high rainfall (over 5000 mm in some areas) results in a risk of storm flooding, as recently experienced at Cockermouth. The Pleistocene glaciations reshaped the land surface and most of the large lakes such as Windermere and Coniston Water

Landsat 7 ETM+ image for 2000 of Cumbria, processed by Philip Eales of Planetary Visions. The mountainous area (centre) is mostly underlain by the Borrowdale volcanics. Unconformity on upper contact of latter shown by dashed line. Solway Firth demarcates suture separating the Avalonian (Lake District, Wales) and Laurentian (Scotland) components of the British Caledonides.

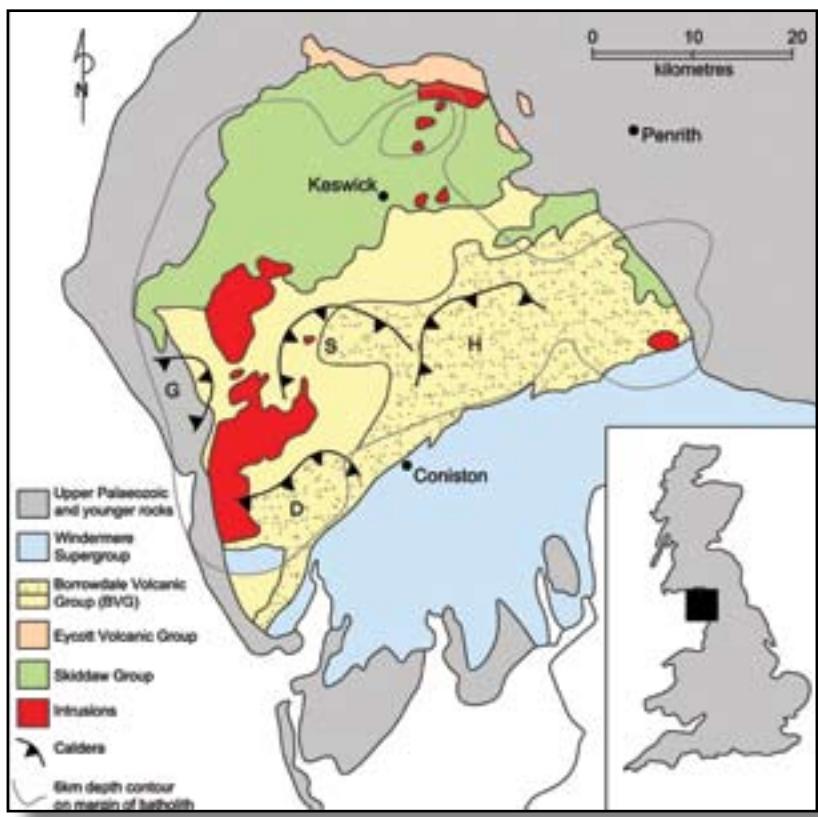




The steep scree slopes above Wastwater were mostly derived by glacial erosion during the Pleistocene.

are linear features partially filling ice-carved valleys, as seen on the satellite image. The rounded Derwent Water and Crummock Water are minor exceptions in that they were once joined to make a much larger finger-type lake. Glacial features such as rocky hilltops (pikes) and steep scree slopes, hanging valleys and waterfalls, and drumlins and eskers can all be observed in the Lakes. The scree slopes above the deepest lake in the area, Wastwater, were made famous by Arthur Holmes famous textbook. The area has a long and complex history of human settlement and this is in part reflected by the complexity of the language for natural features (mere for lake, beck for stream, fells for hills etc). The Lakes is the most visited of the British national parks with over 15 million annual visitors. The area has not been accepted as a World Heritage Site as human activities, including forestry, have adversely impacted the assessment. Conflict with development, typical of parks in more remote parts of the world, is an ongoing issue particularly where mining is concerned and the wishes of local people can be sacrificed by outside pressure groups.

The geological framework is well known and some publications date from the early 19th century. The area constitutes one of the disjointed Lower Palaeozoic terrains collectively known as the British Caledonides. As shown on the attached map, the system of identifying three rock groups, which become younger from north to south dates to the work of Otley published in 1820. Two of the groups are dominated by sedimentary rocks, the oldest being the Skiddaw Group, the youngest the Windermere Supergroup. They are separated by the Borrowdale Volcanic Group. (The Eycott volcanics are restricted to the northern fringes.) Intrusions of Ordovician and Devonian ages are widespread and a large granitic batholith is in part responsible for the upland massif. The Lake District inlier is enclosed by Upper Palaeozoic strata.



There are no Cambrian strata preserved in the Lakes, as may be expected in light of the subduction hypothesis advanced for the Caledonides by John Dewey (in a classic article of 1969), as discussed by Windley (1977). Interpretation of terrains from both the British Isles and North America, i.e. on either side of the Iapetus (proto-Atlantic) Ocean which separated the landmasses of Laurentia and Avalonia played an important role in acceptance of plate tectonic theory in the northern hemisphere. Avalonia was a fragment of Gondwanaland that drifted northward, although reconstruction is complicated by accretion of Baltica, a continental mass from the east. The Solway Firth is correlated with a suture.

The article by Millward and Stone (2012) provides a detailed overview of the lithostratigraphy of the sedimentary sequences of the Lakes. The 5000 m-thick Lower Ordovician Skiddaw Group is a succession of turbidites (mudstones and siltstones). They form rounded hills, as they are readily eroded and friable. The most well known example is the Skiddaw massif (north of Keswick), the nature of which contrasts with the rugged volcanic peaks farther south. Key outcrops occur near Lake Buttermere, one of the most scenic localities in the Lakes. Five formations (Tremadoc through Llanvirn: type

Simplified geological map of the Ordovician and Silurian sequences of the Lake District inlier (simplified from sources referenced in the article). The Borrowdale Volcanic Group is separated into a lower (plain) and upper (stippled) component as discussed in the text. Intrusive rocks are of Ordovician and Devonian ages. For details of the calderas refer to the text.



View of Derwent Water and Keswick from base of Cat Bells (Borrowdale volcanics) with rounded slopes of Blencathra and part of the Skiddaw massif (Skiddaw slates) in background. The Castlerigg site is behind the low ridge.



sections are in Wales) are recognized, in part on the basis of graptolite biozones.

The Skiddaw Group was uplifted and eroded prior to onset of the short-lived, but explosion volcanism preserved in the Borrowdale Volcanic Group (460-450 My). These mostly subaerial calc-alkaline lavas and volcaniclastics form the central, most mountainous section of the Lakes. Millward (2010) and Beddoe-Stephens and Millward (2000) suggest they were emplaced in response to southward subduction during closure of the Iapetus Ocean. The lower part is dominated by an extensive plateau andesite lava field, which probably formed within an intra-arc extensional rift. These rocks can be seen in many of the northern peaks. The upper part is dominated by volcaniclastics with abundant dacitic-rhyolitic ignimbrites. Huge caldera sequences are recognized, including Scafell, which includes the highest peak in the area. The contrast between dark grey-green andesitic lava/ash and reddish rhyolitic rocks is readily observed. Farther to the south, in the Dutton area, and in the eastern part around the Helvellyn massif, the volcanics include thick sequences of volcaniclastics indicative of additional (younger?) calderas. The Gosforth section is mostly obscured by younger rocks and is mostly known from drill sections. The San Juan volcanics, Colorado, a sequence of nested calderas developed during emplacement of a batholith at depth, has been proposed as a younger analogue.

The hill slopes above Coniston Water reveal thick, intercalated sequences of lavas (andesite and rhyolite) and volcaniclastics. Individual formations can be traced for many km. Volcanism was followed by a marine transgression and deposition of the Windermere Supergroup. The earliest components, (late Ordovician) crop out extensively in this area and include a shallow water limestone formation exposed in cliff faces at the edge of a distinct change in topography. This unconformity can be delineated along strike for tens of km (this was one of the first unconformities recognized in England). The deeper erosion associated with the younger (Silurian) rocks of the Windermere Supergroup - shale, mudstone, chert, and greywacke - has given rise to the gentle, rolling countryside of the southern part of the Lakes, as for example south of Coniston Water and around much of Windermere. Fossils are dominated by shelly fauna in the upper Ordovician and graptolites in the Silurian. They do not reveal the high degree of provinciality of the lower Ordovician, indicative of the contraction of the Iapetus Ocean. The drastic change to a palaeofaunal source occurred in mid-Ordovician (Caradoc) but because of the volcanicity, evidence of this is not fully preserved.

Ordovician magmatism also produced a suite of intrusive rocks including the 450 My-old granite plutons in the western Lakes, at Ennerdale and Eskdale. Mafic bodies are less abundant but the Ordovician-age Carrock Fell intrusion provides outcrops of layered gabbro with





Rugged hanging valley and tarn at Goat Fell underlain by Borrowdale volcanics. In the distance is Coniston Water (made famous by Donald Campbell and his boat "Bluebird") located in the gentle countryside typical of the sediments of the Windermere Supergroup.

magnetite bands. The final closure of the Iapetus Ocean and onset of the Caledonide orogeny is preserved in the Lakes by a granitic pluton associated with a trans-tensional tectonic regime of Devonian age. Maximum deformation and cleavage-formation, essential to the production of slate, also occurred at this late-stage.

View over Coniston Water of rugged hill slopes of the Borrowdale volcanics including the "Old Man", a popular hike. Unconformity at top of Borrowdale volcanics clearly visible from the break in the topography (upper centre). Lower slopes and lakeside underlain by Windermere Supergroup (view from Brantwood House which includes the geological collection of philosopher John Ruskin).



Columnar jointing in ignimbrite layer, Yewdale Breccia, upper part of Borrowdale volcanics, near Coniston.



THE GEOTRAVELLER



The bulk of the Devonian pluton is concealed but small outcrops occur in the northern, e.g., Skiddaw granite and eastern, e.g., Shap granite (quarried as pink dimension stone) Lakes.

Stone tools were produced in the Lakes from volcanic rocks in Neolithic times, particularly from the popular climbing area around Langdale Pike. A number of ancient stone circles occur, including Castlerigg, near Keswick. The volcanic standing stones were transported several km from the south as they are underlain by Skiddaw slates. The industrial revolution spawned an extensive coal and iron ore industry from the younger strata enclosing the Lakes, but non-ferrous mining within the inlier can be traced to the Romans. Evidence for this activity includes, in addition to old mines, ruined forts and ancient harbours. Hikers that use popular trails - footpath erosion is a serious problem – observe the profusion of spoil heaps in many areas and often see mining negatively, without appreciating that many trails are old mining routes. The main phase of exploitation of copper, lead (with minor silver), barytes, graphite and slate was between the 16th and early 20th centuries. Most mines are closed with the tungsten mine at Carrock Fell one of the more recent casualties.

Coniston provides a good base from which to examine old mining sites. Two trails, Coppermines and Tilberthwaite (slate), can be followed. Mining of copper-rich quartz veins within the Borrowdale Volcanics was once a major industry. In Elizabethan times, German miners were brought over to modernize operations and some of their legacies, together with later operations (mines closed in the 1890's) can be examined. There are numerous workings dotting the hillsides, including open cuts, on-vein drives, and adits, the latter used to access deeper veins and for drainage. An undertaking to drain the entire Levers Water, a sizable tarn in a hanging valley



The Coppermines valley, near Coniston.

perched above the mines, despite not being completed, bears testament to the skills of the German miners. Samples of chalcopyrite, chalcocite, bismuthinite, and barytes, among other ore minerals, can be collected from spoil heaps.

Some mining of slate still occurs in the Lakes although the quantities being removed are tiny compared to Victorian times. The quarries and underground caverns on the slopes of the Old Man of Coniston and around Tilberthwaite are huge and produced a good quality light green slate (andesitic pyroclastics) or darker grey slate (mudstones). In the northern lakes, the Honister mine, near Keswick, has been reopened with a successful tourist component including underground visits. The quality slate occurs in small "pockets" and the size of waste dumps attests to the high proportion of waste (similar to the dimension stone industry). The dark blue-grey Honister slate is reported to be the most durable in the world; it is derived from water-lain pyroclastics and occurs in an area of high deformation. St Paul's Cathedral and other famous buildings are roofed by Honister slate. It has a lifespan of >400 years as compared with 100 years or less for slate from the southern Lakes or North Wales. (The longevity of slate is crucial in areas exposed to acid rain.)



Neolithic stone circle at Castlerigg. Rugged hills typical of the Borrowdale volcanics in background.





Portal at Honister slate mine in steeply dipping volcanics of the Borrowdale volcanics.

Locally mined graphite from workings at Borrowdale, near Keswick, led to the development of a world-famous pencil industry. Coloured pencils sold under names such as Cumberland and Derwent Water are well known to geologists. Despite formation of graphite being hindered by the low carbon content of magmas and degassing processes, these deposits are one of only two known occurrences within volcanics (Ortega and colleagues, 2010). Workings are aligned along a subvertical fault system and the graphite occurred with quartz and in veins and pockets. The old lead mine at Greenside, near Glenridding, which dates back to the Romans and during Victorian times was the largest and richest of the mines in the north of England, has an unusual claim to fame. The underground workings were used to test an atomic device during the 1950's (the only locality in the UK where this

has occurred). There are a number of mining museums in the Lakes, including Threlkeld, between Keswick and Penrith, where mine plans and details of processing plants, as well as many of the ore types can be seen. Detail of the pencil industry, including the smuggling of graphite in times when the mineral was highly prized, is told in a museum in Keswick.

Photographs by the author.



REFERENCES:

1. Windley, B.F. (1977). *The evolving continents*. John Wiley and Sons, Chichester 399 pp.
2. Millward, D. (2004). Stratigraphic framework for the upper Ordovician and lower Devonian volcanic and intrusive rocks in the English Lake District. British Geological Survey research report RR/01/07, 54p.
3. Millward, D., and Stone, P. (2012). Stratigraphic framework for the Ordovician and Silurian sedimentary strata of northern England and the Isle of Man. British Geological Survey research report RR/12/04, 122p.
4. Beddoe-Stephens, B., and Millward, D. (2000). Very densely welded, rheomorphic ignimbrites of homogenous intermediate calc-alkaline composition from the English Lake District. *Geol. Mag.* 137, 1550-173.
5. Ortega, L., Millward, D., Luque, F.J., Barrenechea, O., Huizenga, J-M., Rodas, M., and Clarke, S.M. (2010). The graphite deposit at Borrowdale (UK): a catastrophic mineralizing event associated with the Ordovician orogeny. *Geochim. Cosmochim. Acta* 74, 2429-2449.



Fine layering typical of high quality Honister slate (left); volcanoclastic breccia (right).



classifieds

ACUDRAFT ENTERPRISES CC

CHRIS BOTHAM

GEOLOGICAL DRAUGHTING SPECIALIST
(CAD & G.I.S. ENABLED MAPS & PLANS)

8 MEERLUST ROAD
NORTHCLIFF EXT 19
CELL: 082 330 2387
TEL/FAX: (011) 477 5217

GEOLOGICAL DRAUGHTING SPECIALIST

PO BOX 48474
ROOSEVELT PARK
2129

e-mail: chris@acudraft.co.za

EXPLORATION GEOLOGIST SOUTH AFRICA

Allan E Saad

Msc Pr Sci Nat

FGSSA

CONSULTING EXPLORATION GEOLOGIST

PO Box 35270
Menlo Park 0102
Pretoria
Tel: 082 881 7850
Fax: (012) 348 9458
e-mail:
asaad@mweb.co.za

Clive Feather

Ph.D Pr Nat Sc FGSSA FSEG

Geochemical Consultant and XRFs specialist

X-RAY FLUORESCENCE SPECTROMETRY SPECIALIST

- Calibration and optimisation of X-ray fluorescence spectrometers
- Training courses in XRFs
- Design, automation, optimisation, calibration, benchmarking and quality management of laboratories
- Laboratory audits
- Advice in the choice of analytical techniques and methodology

XΦX

PO Box 55231
Milnerton 7435
Tel: 021 551 6237
Cell: 083 442 0239
Fax: 086 614 6918
cfeather@global.co.za
www.clivefeather.co.za

CONSULTING GEOLOGIST

David de Carcenac

B Sc (Hons) FGSSA Pr Sci Nat

Consulting Geologist

PO Box 72403 Parkview 2122 Johannesburg South Africa
Tel/Fax: +27 (0)11 646 8779 Cell: +27 (0)82 420 4596
email: decarcenac@worldonline.co.za



DIABOR GEOTECHNICAL & EXPLORATION DRILLING

Chris Strydom

+27(0)83 227 0586

chris@diabor.co

Tel: +27 (0)12 542 7404

Geotechnical drilling services include:

- Geotechnical Core Drilling
- Geotechnical tests
- Barge/Jack-up platform drilling
- DPSH tests

Exploration Drilling services include:

- Core drilling
- Percussion drilling
- RC drilling
- BEE Level 2 compliant

ECO DYNAMICS

Removing the Hydrocarbon Footprint Naturally

EcoDynamics has successfully treated sites contaminated with the following hazardous substances: Crude oil, diesel, petrol, jet fuel, motor oil, hydraulic fluids, drilling polymers, PCB, alcohols, chlorinated solvents, dichloromethane, carbon, terachloethyne, tetrachloride 1, dichloroethyne, toxiphemes, pentachlorphenol, perchlorate, explosive wastes (nitrate compounds), heavy metals.

Contact Cyril Raitt

011 769 2257 083 450 2617
cyril@exol.co.za www.ecodynamics.co.za

FERRIT

Ferret Mining & Environmental Services (Pty) Ltd.

- Water Quality Management
- Mine Water Management
- Water & Environmental Technology
- Mine Reclamation & Closure
- AMD & Geochemistry

Turnberry building, Fourways Golf Park, Roos Str, Fourways
PO Box 72313, Lynnwood Ridge, 0040

ENVIRONMENTAL SPECIALISTS

Rudy Boer PhD, FGSSA, Pr Sci Nat

- Risk Management
- Permitting & Compliance
- Environmental Assessments
- Environmental Auditing
- Public Participation

Tel: 011 025 7711 Fax: 086 716 5576.
Email: rudy@ferretmining.co.za
Web: www.ferretmining.co.za

GEMECS (Pty) Ltd

Specialize in coal resource modelling.

Mine design and scheduling services.

Exploration management and core logging services



Software support and training for
Gemcom/GEOVIA Minex.

Database management solutions

Vlakfontein Office Park
268 Beyers Naude Dr.
Blackheath Ext1

www.gemeecs.co.za
gemeecs@gemeecs.co.za
+27 11 431 2327

classifieds

GEO-EXPLORE STORE GEO-EXPLORE STORE (PTY) LTD

SUPPLIERS OF GEOLOGICAL & EXPLORATION EQUIPMENT

Denis Blewett

Cell: 082 744 7594

67 Watt St
Route 24
Meadowdale
Edenvale

Tel: +27 (0) 11 392 5324
Fax: +27 (0) 86 580 7392
denis@geoexplorestore.co.za
www.geoexplorestore.co.za

Judy Schlegel

MSc Pr Sci Nat

Geochemist



Geostatistical data processing and data management

Training and support of geological staff for geochemical surveys

Geochemical Orientation Surveys; sample media, analytical techniques, procedures for quality assurance

Tel: +27 11 476 7015

Cell: +27 73 234 6688

e-mail: geodatafocus@mweb.co.za

GeoRAY Geophysical Services

GEOPHYSICAL SERVICES

Specializing in:

Magnetic surveys

Electromagnetic surveys

Resistivity surveys

Gravity surveys

Hand held XRF surveys

Differential mode GPS surveys



P.O. Box 25004, Gezina, Pretoria, 00031

Tel: 082 789 3088 Fax: 086 609 6455

E-mail: georay@yebo.co.za

GEOTRON

MANUFACTURERS & SUPPLIERS

- **Manufacturers of Geophysical equipment**
- **Suppliers of Earth Science Hardware & Software**

10 Jeppe St, Potchindustria
PO Box 2656, Potchetsfroom 2520
South Africa

Tel: +27 (18) 294 4004
Cell: +27 (0) 83 750 0944
e-mail: ray@geotron.co.za



RECRUITMENT

The preferred way to employ Geoscientists
Visit our website for more information:

<http://www.geostaff.co.za>

Zaheedah Gardee 061 425 2584 zaheedah@geostaff.co.za

Wilna Lamb 061 428 3852 wilna@geostaff.co.za

PO Box 4745, Weltevreden Park 1715

If you are registered please update your registration with us - for your own benefit!

GISNET CC

GIS Consulting (Mining and Exploration)
Prenesha Pillay
B. Sc. Hons (Geology) Wits
Geoinformatics (UJ), Pr Sci Nat

GEOGRAPHIC INFORMATION SYSTEMS

Phone: +27 11 4546832
Mobile: +27 83 6241564
E-Mail: prenesha@ananzi.co.za
Web: www.gisnet.co.za
GPS: 26.1585; 28.134E

Digitising & Vectorisation
Geo-Processing & Analysis
Spatial Modeling
Map Production

Database Management & Audits
Data Acquisition (Public & Private)
Large Format Scanning & Printing
Training

SLOPE STABILIZATION

Tel: +27 11 493 8270
Fax: 086 623 4294
www.gunite.co.za

CONTRACTING

guncrete
geotechnical

THIN SECTION PREPARATION PETROGRAPHIC & MINERALOGICAL SERVICES

Microsearch cc

Prosperitas House, 729 4th Street, Wynberg, Sandton.

PO Box 97409, Petervale 2151

Tel/Fax: +27 (11) 885 3473

e-mail: thatchere@acenet.co.za

Mineral Logic



DIAMOND EXPLORATION CONSULTANCY

Paul Zweistra BSc(Hons) Pr Sci Nat
Consulting Diamond Geologist

- Comprehensive Indicator Mineral Service
- Petrography
- Project Management/Evaluation
- Geological Modelling

14 Schilpadvlei Rd, Constantia, Cape town, 7806, RSA.
Tel. +27 (21) 794 2109 Cell. +27 82 444 8424.

e-mail: mineral.logic@upinternational.co.za

classifieds

Dr Sabine Verryn
(PhD (Geology), Pr. Sci. Nat)
 75 Kafue Street, Lynnwood Glen. 0081
 Cell: 083 548 0586 Fax: 086 565 7368
 e-mail: sabine.verryn@xrd.co.za
 skype:sabine.xrd Website:www.xrd.co.za

X-RAY POWDER DIFFRACTION
 SPECIALIST

- Analytical and consulting services include:**
- Phase identification of crystalline materials
 - Phase quantification using the Rietveld method
 - Glass (amorphous) content quantification
 - Retained austenite quantification using the Rietveld method
 - Customer specific quality control methods
 - Powder Diffraction training courses
 - Petrographic descriptions



A FOOTPRINT ON SOUTHERN AFRICA

MINROM Mining Services

MINROM FOCUSES ON AFRICA AND ON THE MANGANESE, IRON, CHROME, PLATINUM, COPPER, URANIUM AND GOLD INDUSTRY.

MINROM OFFERS:

- Execution of Geological Due Diligence Studies
- Tailor made Exploration Drilling Program Management
- 3D Geological Block Model construction
- GIS Functionality

MINROM CONSULTING SERVICES

Minrom Consulting
34 Selborne Street
Lyttleton Manor, Ext 3
Centurion 0157

MINROM CONSULTING SERVICES

Tel: +27 (0)12 277 5006 or +27 (0)82 745 9860
Email: info@minrom.co.za
Web: www.minrom.co.za

Minxcon Exploration

Data Compilation - GIS
Target Generation
Exploration Program Management
Compliance Auditing
Ore Resource Management Systems

EXPLORATION

MSA
THE MSA GROUP

Specialist Consultants and Contractors to the Resource Industry

Tel: +27 (0)11 880 4209
Fax: +27 (0)11 880 2184
Email: info@msagroupservices.com www.msagroupservices.com

RCA The One-stop Conference & Workshop Solution

www.rca.co.za

ROBBIE CAMERON

Tel: +27 11 728 8173 Fax: +27 11 728 1675
Cell: +27 (0) 83 229 1380 Email: robbie@rca.co.za
PO Box 72147, Parkview 2122, Johannesburg, South Africa

RED DOG SCIENTIFIC SERVICES

Your one-stop shop for geological software and exploration equipment

Borehole logging equipment & software
Magnetometers, magnetic susceptibility meters, spectrometers
Ground Penetrating Radar (GPR)
3D visualization & contouring software

TERRY ODGERS
Ph: +27-(0)11-467-3371
reddog@geoafrica.co.za

Cellular : 082 89 29 771
www.RedDogGeo.com

Offering consulting and contracting services to exploration and mining companies in Africa

Project design, implementation and management
Data interpretation and reporting
Drill programme support
Geological mapping
Geochemical sampling
Geophysical surveys
RadonX™ Radon Emanometry

RES REMOTE EXPLORATION SERVICES.
An M3 Group Business

tel: + 27 21 531 0400
email: info@res.co.za
web: www.res.co.za

Rock&Stock INVESTMENTS (Pty) Ltd

YOUR AFRICAN EXPLORATION PARTNER

BEE accredited

TECT GEOLOGICAL CONSULTING

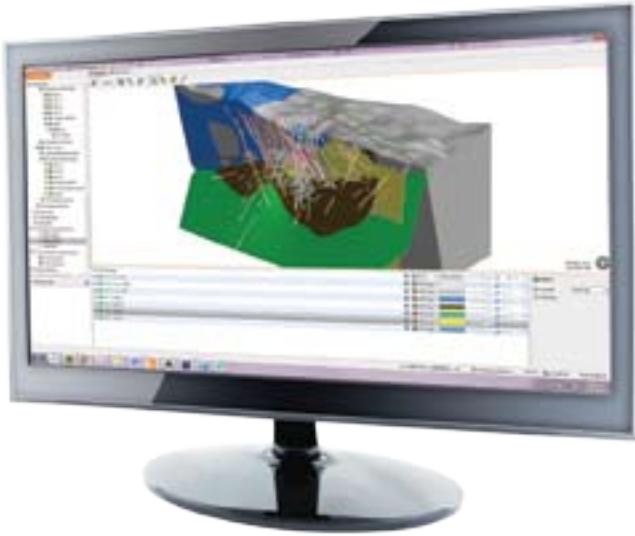
www.tect.co.za

3D modelling
Structural analysis of mines
Input into geotechnical designs
Resolution of ore-structure relationships
Structural interpretation of geophysical data

Dr Ian Basson
Ph.D. Struct. Geol.
Pr. Nat. Sci., FGSSA



Setting the standard in geological modelling.



Leapfrog are the pioneers in implicit modelling technology. For over 10 years the world's largest mining and exploration firms have trusted Leapfrog to create dynamic geological models, faster than they ever thought possible.

Contact your local Leapfrog team for an evaluation licence. www.leapfrog3d.com

The geobulletin is a non-profit making magazine published by the Geological Society of South Africa on a quarterly basis; March, June, September & December.

There are the following advertisement options:
Professional Directory advertisement (Classified)
or full or half page, quarter page advertisements.

It serves an important function in informing the members of the Society of current events and developments in the mining, exploration and academic spheres of geology. It also serves as a medium for companies and individuals to put their message across to geologists.

**Contact Jann Otto,
GSSA Geobulletin Advertising Coordinator,**
to insert an advertisement for your company
to a targeted market in the last 2 issues of 2014 –
September and December.

Jann.Otto@mweb.co.za / 082 568 0432

082 2
568
0432



5TH FLOOR CHAMBER OF MINES
HOLLARD STREET
MARSHALLTOWN 2107
GAUTENG
SOUTH AFRICA

PO BOX 61809
MARSHALLTOWN 2107
SOUTH AFRICA

Tel: +27(11)492 3370
Fax: +27(11)492 3371
e-mail: info@gssa.org.za
Web: www.gssa.org.za