

“The postgraduate Mineral Resource Management programme is becoming increasingly popular with 15 Magister students enrolling for 2011.”

– Prof. Willem van der Westhuizen

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Department of Geology

Overview

Teaching and research activities continued unabated during 2011. A slight decrease in student numbers was evident as a result of the newly-implemented selection process. This practice has already provided evidence of an increase in the standard of students in the department. Selection will continue through all the years to raise the standards even higher. It is expected that student numbers will continue to decrease for the next two years after which numbers should remain constant. First year student numbers declined from 234 students (GLG114) in 2010 to 194 in 2011. Second year student numbers were 98 for GLG214 (89 in 2010) while third year numbers for GLG324 were 81 (64 in 2010). Honours students totalled 24 (29 in 2010).

The postgraduate Mineral Resource Management programme is becoming increasingly popular with 15 Magister students enrolling for 2011. Workshops were conducted at the Council for Geoscience in Pretoria. The following number of Geology degrees was conferred in 2011: 49 B.Sc., 26 B.Sc. (Honours), 4 M.Sc. and 4 MRM degrees. Graduates from this institution continue to be preferred by employers in the mining industry.

A new Panalytical X-ray diffractometer (XRD) was installed as part of the equipment replacement and purchasing strategy of the Faculty of Natural and Agricultural Sciences, replacing the previous XRD that gave excellent service over a period of 22 years.

Prof. Marian Tredoux contributed to the monthly column for Media24 published in the Saturday edition of *Die Burger*, Cape Town, under the title *Die wetenskap vandag*. During part of the second semester she was on sabbatical leave in Europe and while in Germany, presented a workshop entitled *The geochemistry of the platinum-group elements*, from 15-17 July at the Martin Luther University in Halle, which attracted a full complement of 15 participants from several German universities. Prof. Tredoux and M.Sc. student Ms B. Kennedy also participated in a workshop on platinum-group elements in Prague that was hosted by the Czech Geological Survey and the Society for Economic Geologists.

Dr Freddie Roelofse presented a popular lecture titled *The $M_w=9.0$ Tohoku earthquake and the wrath of the giant wriggling catfish* in the Department of Geology, University



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**Prof. Willem
van der Westhuizen**

Prof. Willem van der Westhuizen's field of research includes: Geology and geochemistry of ancient volcanic successions, Mineralogy and Mineral Resource Management.

of the Free State, on 24 March 2011. Due to popular demand the lecture was repeated at the Boyden Observatory, Bloemfontein, on 6 May 2011.

A student conference was held during November 2011 where postgraduate students presented their research results. Three alumni, Messrs N. Scholtz, H. Kennedy and Ms T. Lekgetlo also presented talks. Lecturing staff contributed to the proceedings by presenting talks on a variety of subjects.

Prof. C.D.K. Gauert gave two public lectures at the Natural History Museum, Berlin, Germany on the Critical Zone transition of the eastern Bushveld Complex and on Gold provenance of the Black Reef at the East Rand on 10 February 2011.

Research

Research during 2011 covered a variety of disciplines including mineralogical and geochemical characteristics of the Bushveld Igneous Complex, the largest layered complex in the world hosting massive platinum group element ore reserves. Other research areas covered were that of economic geology, including chrome deposits, gold and uranium, nickel, lithium and coal deposits, Witwatersrand gold deposits, kimberlites, clay mineralogy and geochemistry, sedimentology, basin analysis, gas occurrences in the Karoo, ancient volcanology, hydrogeochemistry and more. Research concerned with optimising the mining value chain is also building momentum, especially with the appointment of Dr Johann Claassen, formerly from Exxaro Mining Company.

The Inkaba research initiative, a German-South African collaborative programme, continued during 2011. The research in this programme covered a variety of topics from research concerning the platinum value chain to the occurrence of heavy metals relating to a number of factors in the arena of environmental geochemistry. Ms B. Kennedy visited the Steinmann Institute in Bonn, Germany during July/August and continued to the Goldschmidt Congress in Prague, Czech Republic. Mss Bianca Kennedy and Nequita McDonald also attended the 9th annual "Suid-Afrikaanse Studentesimposium" where both presented oral presentations on their recent research findings.

Visitors to the department

Prof. Becky Flowers from the University of Colorado presented a departmental talk entitled *Unroofing and uplift histories of cratonic plateaus and cratonic settings from apatite (U-Th)/He thermochronometry: examples from the Colorado Plateau, Canadian Shield and southern Africa* on the 2nd of August.

Prof. Wlady Altermann from the University of Pretoria visited the Department of Geology during January 2011 to discuss matters relating to economic geology with Prof. C. Gauert.

Prof. Johan Kruger, formerly from the Department of Geology, University of the Witwatersrand, presented lectures to the honours students on geochemistry and the interpretation of geochemical data.



Additional to the Inkaba meeting in Cape Town was a visit of the delegates to view granite exposures at Langebaan.



The Inkaba excursion visiting the fossil park at Langebaan.

Dr Michael Wiedenbeck, a leading expert in SIMS technology from the Geoforschungszentrum (GFZ) in Potsdam, Germany, gave a fascinating talk on SIMS technology on the 3rd of December 2011 in the Geology Department. He plans to set up a virtual SIMS laboratory in South Africa, which will be linked to a state-of-the-art, upgraded, Camecca 1280 HR SIMS instrument that the GFZ has recently purchased.

Dr Neil Anderse and Mr Junior Potgieter from GEX paid a number of visits to the Geology Department to discuss

matters relating to the fracking and extraction of gas from Karoo shales.

Staff members visiting abroad

Prof. C.D.K. Gauert conducted the following international visits: Natural History Museum, Berlin, Germany in October. In February he used the LA-ICP-MS at the Curt Engelhorn Centre for Archaeometry in Mannheim, Germany, and the sy-



Inkaba students on their way to a meeting in Cape Town.

XRF at Karlsruhe Institute of Technology/ANKA, Germany for 5 days to determine trace elements in gold. During a visit to the Martin Luther University at Halle in Germany in June 2011 he had a meeting with Prof. Gregor Borg to discuss future cooperation with the Geology Department at UFS. Leoben in Austria was also included in his itinerary where potential cooperation with the mining academy was on the table.

He visited Chile and Peru, where he attended the Society for Geology Applied to Ore Deposits (SGA) Conference in Antofagasta, Chile, presented a talk in September 2011, attended an excursion to several mines (Li-salt, copper porphyries) and also visited an exploration company in Lima, Peru with a field trip to prospects in the mountains to investigate iron-oxide-copper-gold (IOCG) and Pb-Zn-Ag deposits.

Prof. Marian Tredoux spent three months in Germany, during which time she attended the prestigious Goldschmidt 2011 Congress in Prague during 14-19 August 2011 where she contributed two oral presentations and one poster. Three M.Sc.-students from the department also attended: Mss M. Purchase and J. Potgieter delivered oral presentations while Ms B. Kennedy contributed a poster presentation. Before the conference she visited the University of Leoben to discuss their joint research projects on the Bushveld complex with the platinum-group mineral experts Dr F. Zaccarini and Prof. G. Garuti.

While at the University of Halle, Prof. Tredoux paid visits to postgraduate students now resident in Germany (in Leipzig and Magdeburg) to discuss their research, started co-supervision of a M.Sc. student of Prof. G. Borg, and did field trips in the region to sample the local Kupferschifer

deposits. She also spent two days in Potsdam to discuss research related to the "Platinum value chain" project with co-workers from the Geoforschungszentrum (Potsdam), the University of Potsdam, the Technical University of Berlin and the German Geological Survey (Hannover).

Local conferences and workshops

The Colloquium on African Geology Congress 23, organised by the Geological Society of Africa, was held in Johannesburg from 8-14 January. Profs Tredoux, Gauert, Ms H. Pretorius, Mr A. Odendaal Ms M. du Plessis and students J.C. Ngaruye (Rwanda), B. Kennedy, M. Purchase, J. Clarke, N. Chabangu and K. Milanzi, attended the congress and presented oral presentations and posters. Prof. Tredoux also served as a panellist for a workshop about women in the geoscience workplace, which was organised for CAG23 by the organisation SAWISE (South African Women in Science and Engineering). Prof. Gauert led the 4-day Bushveld-Nkomati excursion with international scientists from Australia, France and Holland. Prof. Tredoux was co-leader (with Prof. M. Coetzee of the University of Northwest) of a field trip to the Vredefort impact structure.

The AMREP Workshop took place in February in Rustenburg with two excursions to the open pit/tailling dams at Impala Platinum and Anglo platinum mines. Profs Gauert and Tredoux as well as staff from the Physics and Chemistry Departments attended to discuss results to date (the presentations being given by UFS postgraduate students

from all 3 departments, who are doing the research) and plan for further cooperation with German scientists from GFZ-Potsdam, BGR-Hannover and the University of Hannover. Delegates of three SA Platinum companies were also present. A 3-day visit to the eastern Bushveld at Two Rivers Platinum and Nkwe Platinum mines with the German scientists was co-organised by Prof. Gauert. He also led the 4-day eastern Bushveld excursion with the international group from GFZ. Part of this excursion was also a visit to Anglo Platinum's Driekop Core Storage Facility together with UFS Honours students.

The Inkaba-8 meeting was held in Cape Town from 5 to 8 September, to coincide with the Geosynthesis 2011 meeting which was organised by SAGA (South African Geophysical Association). As has become standard at Inkaba meetings, the UFS contingent was the largest, and the Geology Department's group was the largest within it. Profs M. Tredoux and C.D.K. Gauert contributed oral presentations and both also chaired sessions during the meeting. The following students presented either oral presentations or posters: N. McDonald (oral and poster), N. Chabangu (oral), J. Clark (oral), B. Kennedy (oral), J. Beukes (oral), T. Legoale (oral), M. Dimick-Touw (oral), M. Shai (oral) and K. Milanzi.

Student excursions

The following student geological excursions took place during 2011.

During the first semester a number of excursions that form the GLG232 course were undertaken in the Bloemfontein area and at Austin's Post towards the eastern Free State to introduce students to the intricacies of field mapping techniques, aerial photographic interpretation, road cut mapping as well as core logging. Eighty-nine students participated in this course.

An economic geology excursion took place from 5 June until 15 June and, during this excursion, a total of ten mines were visited including the Kalgold Gold mine, Thabazimbi Iron Ore, Palaborwa Cu and Phosphate Mine, Black Reef Gold mine and platinum mines in the Bushveld Igneous Complex. Prof. C.D.K. Gauert and Mr A. Odendaal accompanied the students.

Three one day excursions (79 students) to Harmony Gold Mines were undertaken during August: Tsepong, Masimong and Phakisa shafts. Prof. C.D.K. Gauert led the excursions.

From 1-5 October Dr H.E. Praekelt, Messrs L. Nel, A. Odendaal and Ms M du Plessis accompanied the second year students (GLG202) on the annual field school to Barkly East. The students had instruction in field mapping, geological observations, section drawing, sedimentary and volcanological interpretations and report writing. Seventy-eight students attended the excursion.

Second semester first year students (GLG124) were split into two groups and each group attended a one day field school in the Jagersfontein area in the southern Free State on the 14th and 15th October.



Megan Purchase, M.Sc. student, next to a spiral on a visit to the Mint.

Prof. Tredoux and Dr Roelofse accompanied a group of 57 students to the Vredefort Impact Structure to instruct them on impact related aspects as well as metamorphic/igneous petrology and geochemistry (15-16 April).

Structural Geology honours students under the leadership of Prof. Wayne Colliston, undertook their yearly underground mapping school to Harmony Gold's Tsepong Mine from 21 to 25 March.

Interaction with industry

Samancor Chrome - Eastern Chrome Mine, Xstrata Alloys Kroondal, African Rainbow minerals/Nkomati Mine, Norilsk Nickel, Dt. Rohstoff AG, Two Rivers Platinum (Impala), Great Basin Mines, Rand Uranium, Gold One, Harmony Gold Mines, Xstrata and Exxaro.

The following M.Sc.-students graduated during 2011

1. Lombard, A.: *A mineralogical and geochemical study of seven meteorites from Malawi, Namibia and Lesotho.*
2. Netshitungulwana, R.N.: *An investigation of the trace element composition of gold from Zimbabwe and South Africa: Implications for tracing the source of archaeological gold artefacts.*
3. Pecher, M-L.: *Field relationships and petro-chemical investigation of mafic sills and dykes in the vicinity of the Uitkomst Complex, Mpumalanga, South Africa.*
4. Potgieter, J.: *Volatiles around two dimensional defect structures in the diamond window as indicated by micro-diamonds in decompression cracks.*
5. Ngaruye, J-C.: *Petrographic and geochemical investigation of Sn - W - Nb - Ta - pegmatites and mineralized quartz veins in south-eastern Rwanda.*

Magister in Mineral Resource Management

1. Birch, C.
2. Coffee, P.
3. Mashao, M.
4. Vorster, W.

Community Service

EarthWISE report 2011

A. EarthWISE activities 2011

1. **23rd Colloquium of African Geology and Young Earth Scientists (YES) symposium (8 – 14 January)**
EarthWISE attended CAG23 and had a poster entitled: *Geotourism and its place in Africa's future.*
2. **SciFest Africa in Grahamstown (4 – 10 May)**
EarthWISE assisted the science exhibition of the Faculty of Natural and Agricultural Sciences, UFS at the annual SciFest in Grahamstown. The theme of the festival was *Science Across Nations* and the Faculty's theme was *Crime Scene: Do Not Cross*. EarthWISE and the Department of Geology contributed by adding a forensic geology section to the interactive exhibition.
3. **ScienceUnlimited Express in Bloemfontein (22 – 24 March)**
EarthWISE partook in the Science Unlimited Express and the coordinator had a presentation entitled: *Whoa! My continent is moving!* and Ms Megan Purchase (Department of Geology) had a presentation entitled: *The Story beneath our Feet*. Both of these presentations were given multiple times to Grade 6 – 9 learners from different schools. The coordinator also had a presentation entitled *Whoa! My continent is moving* for educators.



EarthWISE coordinator (Marike du Plessis) playing the role of a forensic geologist at the SciFest festival.

4. **“Tohoku Earthquake: Japan’s day of terror” & “Are we at risk with nuclear after the Fukushima incident?” (24 March)**

In the aftermath of the massive Tohoku earthquake on 11 March 2011, EarthWISE and the Department of Physics organized a public lecture on this event. The speakers were Dr F. Roelofse (Geology) and Dr John Prior (nuclear specialist, NECSA).

5. **First Science & Technology Train and Space Geodesy Observatory Workshop, Matjiesfontein (28 March – 1 April)**

EarthWISE attended the abovementioned workshop and would actively want to participate in the future endeavours.

6. **Kovsie Open Day, University of the Free State, Bloemfontein (2 May)**

EarthWISE organized the interactive exhibition to encourage learners to study geology.

7. **Science Adventure Camp in Bloemfontein (7 – 9 July)**

Held as a marketing event by the Faculty of Natural and Agricultural Sciences, the top grade 12 achievers from different high schools in the Free State were invited. During this camp several life sciences, physical science and space science activities and presentations were given. EarthWISE assisted by organizing a geology representative to partake in this camp.

8. Sasol TechnoX Science Exhibition in Sasolburg (16 – 19 August)

EarthWISE assisted the science exhibition of the Faculty of Natural and Agricultural Sciences, UFS at the annual TechnoX festival.

9. Science Day, De Aar (25 October)

The CED presented EarthWISE the opportunity to organize this year's Science Day at De Aar High School. The coordinator arranged 8 science presenters and a marketing manager to participate in this day and presented to around 300 learners.

10. Inkaba yeAfrica Workshop in Cape Town (28 Augustus – 2 September).

The coordinator attended this workshop and had a poster presentation entitled: *EarthWISE community outreach – the future is bright!*

11. 6th Science Centre World Congress, Cape Town (4 – 8 September)

EarthWISE coordinator attended the above mentioned congress.

B. Ongoing plans and future developments

1. EarthWISE website

EarthWISE and Riptide cc is in progress of developing an informative earth science website for learners and educators.

2. EarthWISE – “taking science to the people”

EarthWISE in collaboration with the Science & Technology Train is in progress of establishing a mobile science centre.

3. Geotourism

Exposing tourists to the geological wonders of our beautiful country.

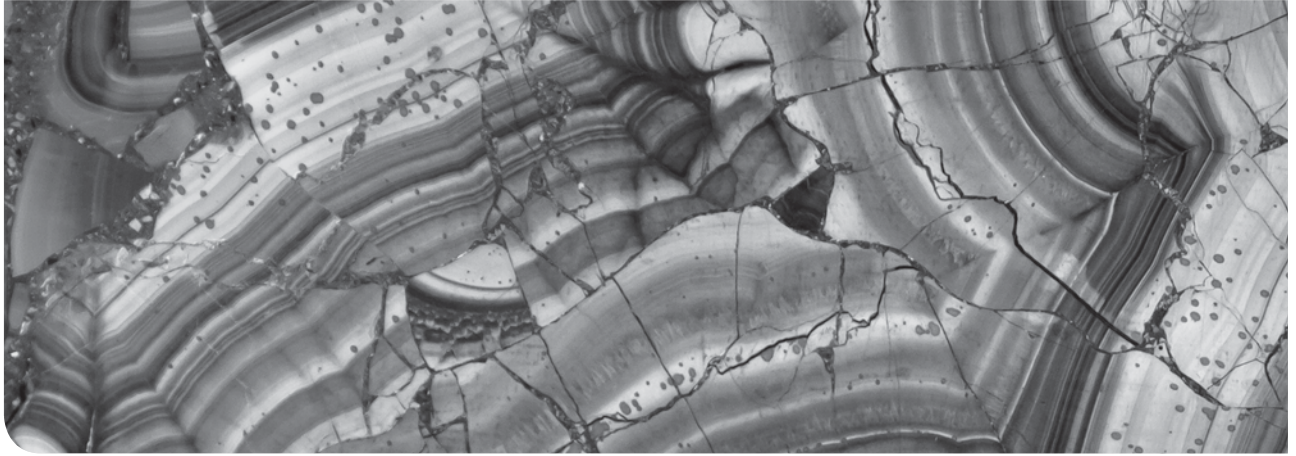
4. Minquiz 2012

EarthWISE will organize the Free State provincial part of the Minquiz 2012 annual science competition.

5. Drakensberg talk, Eunice high school

EarthWISE was asked by Eunice high school, Bloemfontein, to present a talk on the geology of the Drakensberg (including the Amphitheatre and Mount-Aux-Sources).





Research articles

Gauert, C., Batchelor, D., Fuchs, S. & Kloess, G. 2011. Black Reef and Witwatersrand Gold fingerprints, South Africa. *Mineralogical Magazine* 75(3): 897. (Abstract only).

Kennedy, B., Tredoux, M., Ballhaus, C., Steyl, G., Helmy, H.M., Swart, H.C. & Coetsee, E. 2011. Studying possible PGE nano-structures in magmatic systems, using synthetic sulphide melts. *Mineralogical Magazine* 75(3): 1169. (Abstract only).

Rantzsch, U., Gauert, C.D.K., Van der Westhuizen, W.A., Duhamel, I. & Cuney, M. 2011. Mineral chemical study of U-bearing minerals from the Dominion Reefs, South Africa. *Mineralium Deposita* 46: 187-196.

Reisberg, L., Tredoux, M. & Harris, C. 2011. Re and Os distribution and Os isotope composition of the Platreef at the Sandsloot-Mogolakwena mine, Bushveld complex, South Africa. *Chemical Geology* 281: 352-363.

Roelofse, T. & Roelofse, F. 2011. On the occurrence of loughlinite (Nasepiolite) in pans of the Northern Cape Province, South Africa. *South African Journal of Geology* 114: 201-206.

Sommer, H. & Gauert, C. 2011. Hydrating laterally extensive regions of continental lithosphere by flat subduction: A pilot study from the North American Cordillera. *Journal of Geodynamics* 51: 17-24.

Tredoux, M., Zaccarini, F., Garuti, G., Kotke-Levin, J. & Gauert, C. 2011. Geochemistry and PGE mineralogy of chromitite seams of the eastern Bushveld complex, South Africa. *Mineralogical Magazine* 75(3): 2030. (Abstract only).

Wildau, A., Williams-Jones, A. & Tredoux, M. 2011. Hydrothermal mechanisms in the Bon Accord Ni-oxide body, Barberton, Republic of South Africa. *Mineralogical Magazine* 75(3): 2159. (Abstract only).

Research report

Mei, T. & Tredoux, M. 2011. *Toxicity effects of tungsten, molybdenum and copper on the environment at the Tweedam tungsten mine, Namaqualand, South Africa.* Report prepared for the Department of Mining of the Northern Cape Province, South Africa.

Conference contributions

Ashwal, L.D., Roelofse, F. & Webb, S.J. 2011. *Construction of the Bushveld Complex by repeated intrusion of crystal-rich magmas.*

Paper presented at Geosynthesis 2011, integrating the Earth Sciences Conference & Exhibition, during the 8th Annual Inkaba yeAfrica (IyA) Workshop, Cape Town International Conference Center, Cape Town, South Africa. 28 August – 2 September.

Chabangu, N., Tredoux, M. & Madala, F. 2011. *An investigation of nickel mineralization in the northwestern part of the Barberton Greenstone Belt, South Africa.* Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 69.

Clark, J.H.A., Tredoux, M. & Van Huyssteen, C.W. 2011. *The environmental geochemistry of mercury in Bloemfontein, South Africa.* Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 80.

Gauert, C. 2011. *Chemical fingerprinting of Black Reef Conglomerate Gold at the West and East Rand, South Africa.* Paper presented at Geosynthesis 2011, integrating the Earth Sciences Conference & Exhibition, during the 8th Annual Inkaba yeAfrica (IyA) Workshop, Cape Town International Conference Center, Cape Town, South Africa. 28 August – 2 September.

Gauert, C. & Roettger, S. 2011. *Mineral provenance aspects of the Black Reef conglomerate in the East and (far) West Rand areas.* Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 4.

Gauert, C., Brauns, M., Batchelor, D. & Simon, R. 2011. *Gold Provenance of the Black Reef Conglomerate, West and East Rand, South Africa.* Proceedings of the 11th Biennial Meeting and Conference of the Society of Geology Applied to Mineral Deposits (SGA2011): Geochemistry of ore deposits, Antofagasta, Chile. 26-29 September. pp. 232-234.

Gauert, C.D.K. & Mphatse, C.T. 2011. *Genetic aspects of the PGE-bearing Mg chromitite layers of the Bushveld Complex – PGE ore bodies of the future?* Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 154.

Kennedy, B. & Tredoux, M. 2011. *The behaviour of platinum group elements (PGE) in synthetic sulphide melts.* Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 216.

Legoale, T., Tredoux, M. & Roelofse, F. 2011. *Degree of nickel weathering from Vredefort komatiites and possible influence on*

adjacent soils. Paper presented at the Inkaba Workshop of the Geosynthesis 2011, integrating the Earth Sciences Conference & Exhibition, during the 8th Annual Inkaba yeAfrica (IyA) Workshop, Cape Town International Conference Center, Cape Town, South Africa. 28 August – 2 September.

Ngaruye, J.C. & Gauert, C. 2011. *Ta (-Au) mineralizations in the mineral deposits of eastern Rwanda*. Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 302.

Ngaruye, J.C. & Gauert, C.D.K. 2011. *Metallogenetic aspects of Sn-W-Nb-Ta (-Au) mineralizations in the mineral deposits of eastern Rwanda*. Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 203.

Pecher, M.-L. & Gauert, C.D.K. 2011. *Petro-chemical investigation of (ultra-) mafic sills in the vicinity of the Uitkomst Complex, Mpumalanga, South Africa*. Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 331.

Pretorius, H.C.F., Andreoli, M.A.G., Tredoux, M. & Vermeulen, D. 2011. *Natural radionuclides in groundwater from Vaalputs, Namaqualand, South Africa*. Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 342.

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Bultfontein, south (UNESCO IGCP 557). Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 343.

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Shaat, S.K.K., Roelofse, F., Swart, H.C. & Ntwaeaborwa, O.M. 2011. *Synthesis and photoluminescence properties of Tb³⁺-doped Sr_{0.5}Zn_{0.5}Al₂O₄ phosphor prepared via combustion process*. Proceedings of the 56th Annual Conference of the South African Institute of Physics (SAIP2011), UNISA, Pretoria, South Africa. 12-16 July. pp. 285-290.

Sommer, H. & Gauert, C. 2011. *Hydrating laterally extensive regions of continental lithosphere by flat subduction (UNESCO IGCP 557)*. Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 371.

Tredoux, M., Wildau, A., Miller, D., Cloete, M., Zaccarini, F. & Garuti, G. 2011. *Micro-phases in a Ni-rich rock type from an archaean ophiolite, South Africa*. Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 401.

Van der Westhuizen, W.A., Grobler, J., Gauert, C.D.K. & Viljoen, S. 2011. *Ultra high pressure waterjet cutting: The future of deep Gold mining?* Proceedings of the 23rd Colloquium on African Geology (CAG23), University of Johannesburg, South Africa. 8-14 January. p. 413.

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