CGS Conference 2016 — In pursuit of Excellence in the Geosciences

The Council for Geoscience hosted its first annual conference on 4 and 5 February 2016 at the CSIR International Convention Centre. CGS Conference 2016 was officially opened by the Deputy Director-General of the Department of Mineral Resources, Mr Joel Raphela, who graced the occasion with his presence on behalf of the Minister, Mr Mosebenzi Zwane. In his opening address, Mr Raphela commended the CGS for hosting the conference and praised the organisation for the important work that it is undertaking.

The theme of the conference was “In pursuit of Excellence in the Geosciences”. The focus of the conference was to showcase the work undertaken by the CGS, paying particular attention to the five projects that are funded by the Department of Mineral Resources under the Medium Term Expenditure Framework. These projects are the Shale Gas Research project, the Management of Derelict and Ownerless Mines, Mine Water Management, the Promotion of Investment in Exploration and Mining and the Seismic Microzonation of Johannesburg. In his welcoming note, the Acting Chief Executive Officer, Mr Simon Sikhosana, highlighted that the conference aims to serve as a platform for discussion around various scientific issues of national importance as well as to provide greater insight into the scientific work of the organisation.

The conference featured presentations from CGS scientists and researchers that highlighted the progress made on their various projects. The conference also featured presentations from four international and local experts. Professor Brandon Nuttall from the University of Kentucky presented a talk...
on the successes and challenges in the development of shale resources, a topic that gave an overview of the research that has been conducted in the United States as well as the industrial progress in the extraction of the shale resources. Ms Marianne Stuart from the British Geological Survey complemented the discussion around shale gas by speaking about the risk of groundwater contamination from shale gas wells and the pressures on freshwater resources.

Day two of the conference was opened by Professor Chris Wolkersdorfer with his presentation “Mine water in South Africa — present and future”. He highlighted the challenges of mine water drainage and the progress that had been made to mitigate the historic problems associated with mining in South Africa. This presentation was followed by presentations by Dr Henk Coetzee and his team who elaborated on the work that the CGS is undertaking in the area of mine water management. The last keynote speaker, Dr Declan Vogt, outlined advances in mining practices in his presentation “Surviving the change — South African mining in the future”.

The conference was well received by over 130 delegates who agreed that the CGS had taken an important step towards publicising its function and capabilities through oral and poster presentations. In her closing remarks, the Chief Operations Officer, Dr Mosidi Makgae, thanked the delegates and presenters for their attendance and for bringing their expertise to the gathering and she promised to host an even more vibrant event next year.

For more information contact:
Lionel Muchirahondo
Office of the COO
+27 (0)12 841 1031
lmuchirahondo@geoscience.org.za

Investigating the origin of alluvial diamonds in the North West Province

As part of a countrywide incentive driven by the Department of Mineral Resources (DMR) to advance and support mining in South Africa, the Council for Geoscience has proposed several projects to investigate the mineral potential of specific minerals and the general mineral potential of various target areas in an attempt to promote sustainable mining and exploration. In 2015, the CGS launched a number of DMR-funded projects, including an investigation of the mining potential of the alluvial diamond fields in the North West Province using high-resolution geophysical surveys, remote sensing data and field mapping. The project focusses on mapping and associated research to determine the origin, character, transportation, distribution and trapping of diamonds in alluvial gravel. The results from these
investigations will empower the Council for Geoscience to provide informed suggestions to the local communities and miners enabling them to perform cost-effective and sustainable mining and to propose exploration methods and targets for future mining.

Alluvial mining in the area started in the early 19th century. Renewed interest in the mining of alluvial diamonds was generated by the El Niño related drought of 1974 when many farmers turned to diamond mining. Much larger volumes of gravel could be moved and greater depths of gravel were reached owing to modern earth moving and sorting equipment. The drought and the presence of the El Niño weather phenomenon during 2015–2016 are only coincidental in this study. The geological mapping programme for the project was initialised and detailed planning commenced with a workshop held on 16 July 2015 at the Council for Geoscience head office in Pretoria. Participants in the mapping project included: Pieter Bosch, Refilwe Shelembe, Dawn Black, Victor Mothetha, Hendrik Minnaar, Debbie Claassen, Jurie Viljoen, Neo Moabi, Tebogo Maja, Ponani Mthembi, Portia Munyangane, Sisanda Makubalo and Pumelela Mlokothi.

The distribution of known diamond occurrences was plotted on maps with a background showing the rivers and elevation data overlain onto 1:50 000-scale topographic maps. Field mapping was done from 2 August to 30 October 2015 during which time alluvial diamond occurrences were visited in the field and described systematically using standardised data sheets. Targets generated by remote sensing and geophysical data were also visited. About sixty-five 1:50 000-scale topographic maps were targeted and approximately 100 samples were obtained for heavy-mineral separation and indicator mineral identification studies.

The diamondiferous gravels are distributed predominantly in three major areas, namely the area underlain by dolomite from the east of Ventersdorp towards Lichtenburg and Bakerville and beyond (VLB), the Lichtenburg–Delareyville–Bloemhof–Klerksdorp–Lichtenburg area (LDBKL), which is mostly underlain by Ventersdorp Supergroup basalt and Dwyka Group tillite and the area associated with the Vaal River terraces and gravels. Diamondiferous gravels are concentrated along straight and meandering runs, sinkholes and dolines in the VLB area. In the LDBKL area, the diamonds are present in ancient and current river channels, terraces or banks and as elluvial and colluvial deposits. Along the Vaal River, the diamonds occur along the gravels of the current river and along the older gravels present along ancient terraces.

During the study, it was found that the processes, structures and deposits associated with the Dwyka Group, karst formation, erosion and fluvial activity since the Cretaceous period associated with the uplift and erosion of the African surfaces and pedogenesis played a major role in the transportation, concentration and confinement of the alluvial diamonds. It is now hypothesised that some diamonds were transported by ice sheets and glaciers during Dwyka Group deposition and may have concentrated along eskers and/or drumlins and/or as a thin sheet of moraine on the Chuniespoort Group dolomite. The directions of movement of the glaciers and preferred orientations of the eskers and possibly drumlins suggest that the kimberlite of the 1 180 Ma, 32 hectare old Cullinan kimberlite pipe may have been a major source of alluvial diamonds in the North West Province. Relatively thicker deposits of moraine and end-moraine were deposited by fluvioglacial streams and during the melting of ice sheets in the areas predominantly underlain by the Ventersdorp Supergroup (LDBKL area). The extent of underlying moraine in the LDBKL area is inferred from tillite exposed in excavations, erratics on surface and small round pans possibly related to kettles. The eskers and drumlins were possibly the forerunners of the straight and meandering runs which were later deepened by karstic processes as the dolomite was exhumed during uplift and related African erosion cycles.
These deeper runs with sinkholes and isolated sinkholes formed concurrently as they were progressively filled with the resistant remains of the Dwyka Group and Karoo rocks, including the Drakensberg basalt. The autochthonous weathering and dissolution of the dolomite account for the large percentage of locally derived chert in some of these gravels.

It is also possible that some diamonds were transported from Cretaceous diamond-bearing pipes along streams formed during the uplift and buckling of the Kaapvaal Craton. The Vaal River formed an early barrier for the transportation of diamonds to the south and north. The current river shows downcutting of at least 550 m along the Vredefort Dome which suggests that it was already in existence while the Venterdorp Group basalt and Chuniespoort Group dolomite were being covered by Karoo Supergroup rocks and Drakensberg basalt. This makes the presence of diamonds from the Free State kimberlite pipes in the North West Province alluvial diamond fields unlikely. However, transportation of diamonds from known sources, including the kimberlite dykes at Swartruggens, is possible from the early Cretaceous up to the period during which northeast oriented buckling in the crust formed a watershed just north of Bakerville which terminated streams flowing to the south and southwest.

It is apparent that Dwyka glaciation had an important influence on the distribution of the diamondiferous gravels and the identification of glacial structures and deposits may therefore be an important aid in targeting potential diamond exploration areas.

For more information contact:
Pieter Bosch
Geoscience Mapping
+27 (0)12 841 1350
pbosch@geoscience.org.za

The CGS Field School celebrates 10 years with a bang

The Council for Geoscience Field School celebrated its ten year anniversary with the successful completion of the 2015 field mapping training programme. The growth and transformation of the field school programme over the decade has been significant. Initially, the field school was designed as a two-year programme linked to the Annual Technical Programme targeting mostly recently employed geoscientists. These scientists would spend their time at the Limpopo regional office benefitting educationally from the vast economic mineral deposits of the province (for example gold, platinum and copper) and the highly complex, high-grade tectonometamorphic terrane, the Limpopo Belt. During this time, the field school participants would work on map compilations and the writing of complementary map explanations. This work was undertaken in addition to courses on microscopy, GIS and 4x4 driving, all of which would provide the participants with the vital knowledge and skills needed to ensure a successful start to their careers.

In recent years, the field school has transformed into a compact one-month programme. This shorter version retains many of the objectives of the earlier programme and also includes a geographical road trip across the South African stratigraphy. The 2015 field school was a highly ambitious programme that covered a wide range of geoscientific topics and included an even wider range of participants, largely interns, from all the CGS offices.

South African stratigraphy trip

The tenth annual field school began on 18 October 2015. Participants travelled east from the CGS head office in Silverton over most of the Transvaal Supergroup to near Sabie where they observed spectacular stromatolites within the Malmani Subgroup. The journey continued to the best preserved remnants of early Earth, the Barberton Greenstone Belt. From there, the group travelled south over Archaean granites straddling the Swaziland border before ending the first day in the town of Ermelo. On the second day, the Pongola Supergroup was covered which included visits to the abandoned gold mines near Denny Dalton and an impressive ca 2 500 Ma unconformity between Pongola and the Karoo.

The third day saw the team travelling further south along the Wild Coast into the Natal sector of the Namaqua-Natal Mobile Belt with a stopover to investigate coastal wave action at Hole in the Wall, Coffee Bay. On the fourth and fifth days, the intrepid explorers ventured into and across the Cape Fold Belt. Various structural features associated with the formation and breakup of Gondwana were discussed and thoroughly debated. The trip ended in Cape Town with a tour of the Cape Peninsula geology and a lecture series on GIS and advanced geological mapping.

Mapping the Richtersveld

The mapping region chosen for the 2015 field school is near the small town of Eksteenfontein in the Gariep Belt, south of the Ais-Ais/Richtersveld Transfrontier Park. Three mapping areas were defined and encompassed much of the Port Nolloth zone, which forms part of the Gariep Supergroup. Rocks of this region highlight a complicated depositional and tectonic history associated with the breakup of Rodinia and the formation of Gondwana when the Adamastor Ocean opened, allowing for the deposition of the Gariep rocks. These rocks were later deformed during continental accretion and basin closure. The Gariep rocks consist largely of siliciclastic fan deposit quartzites, glacially derived diamictites and various carbonaceous
rocks including limestone, dolomite and marble. The ca 1 900 Ma Vioolsdrift granite-gneiss forms the basement to the Gariep rocks with the lower sequence being intruded by ca 720 Ma Gannakouriep dyke swarms. The wide variety of lithological units and structural fabrics make this a tough, but ideal, learning environment.

**Richtersveld Science Week**

An important facet of the mapping work in the Richtersveld is the CGS Field School-driven Richtersveld Science Week. During this week, some of the geoscientists participating in the field school spent time with learners from the surrounding schools. This is an extremely isolated location and schools in this region are often forgotten during educational outreach programmes. The schools visited included Stephen Malherbe Primary School in Eksteenfontein, Johan Hein Primary School in Kuboes and the Alexander Bay High School.

Topics for the school visits included an interactive lecture series on Earth Science, life as a geoscientist and information on becoming an earth scientist. A wide range of in-house designed scientific posters were presented to the schools and a series of experiments, created by Haajierah Mosavel, were demonstrated highlighting how volcanoes and sedimentary processes function. The culmination of the visits was undoubtedly the donation of nine CGS refurbished computers and several stationery packs to the schools. These computers are equipped with open-source office, graphic design and GIS software. It is envisioned that these computers may provide learners with an effective tool to kick-start their academic development.

**Into the future**

The CGS Field School strives to equip early career geoscientists with the best possible skills needed to begin their careers in the geosciences. The field school has come a long way these past ten years and is looking forward to growing together with an evolving Earth and to developing the skills necessary to ensure the sustainable growth of the geosciences in South Africa.

Visit cgsfieldschool.blogspot.com set up by regular trainer Taufeeq Dhansay.

**13th SGA Biennial Meeting in Nancy, France**

The Society for Geology Applied to Mineral Deposits (SGA) is an international scientific society that promotes the science of the geology of mineral deposits. The 13th Biennial Meeting of the SGA was organised by the CNRS (Centre national de la recherche scientifique) and a consortium of universities, including the Université de Lorraine in Nancy, the KU Leuven, the Université de Liege and RWTH Aachen University, representing Lorraine, Flandres, Wallonie and North Rhine-Westphalia along the borders of France, Belgium and Germany, regions that retain a strong historical heritage of both coal and iron mining activities.

The 13th SGA meeting was held in Nancy, France and celebrated the 50th anniversary of the society. Economic growth results in a global increase in the demand for mineral raw materials, which have to be supplied in a reliable and responsible way to meet the requirements of a sustainable world. Thus the theme for the 2015 meeting was “Mineral Resources in a Sustainable World”.

The conference was attended by 712 delegates and international research on mineral deposits and related topics was presented and discussed during 16 scientific sessions, 5 symposia and 8 plenary talks. The five volumes
of these proceedings presented 518 extended abstracts over 2 134 pages and included state-of-the-art coverage of the entire spectrum of scientific topics from economic geology to the mine environment and geometallurgy. These abstract volumes are an example of the high scientific quality of the 13th SGA meeting.

Valerie Nxumalo from the Economic Geology Competency presented a poster which focussed on the distribution and occurrence of uranium in the Springbok Flats Basin of South Africa. Her presentation formed part of Special Symposium C (Uranium Deposits) in honour of Michel Cuney (the “father of uranium” and the uranium expert for the International Atomic Energy Agency — IAEA) and highlighted the mode of occurrence of uranium in the vitrinite-rich high-volatile bituminous coals of the Vryheid Formation and the mudstones of the Volksrust Formation in the Springbok Flats Basin. The geoscientific information presented at the SGA 2015 conference will make an invaluable contribution to achieving the objectives of South Africa’s Mineral Beneficiation Strategy of 2011 through the scientific understanding of the relationship between coal and uranium in the Springbok Flats Basin together with an understanding of the type, content and feasibility for extraction of these commodities. Prof. Kurt Keyser and Ms Adrienne Hanly, IAEA uranium experts, were also present at the conference.

Other topics of interest that were discussed at the conference were geometallurgy, which is a rapidly evolving field of interdisciplinary research that bridges the gaps and breaks down silos between the geosciences, minerals research, metallurgy, environmental aspects and the mining and exploration industries. Applied geoscience in South Africa today should be focussing on geometallurgical studies (advanced mineralogical studies of orebodies) to bring solutions to the exploration and mining industries (for example in view of lowering financial and environmental risks).

CIMERA (Centre of Excellence for Integrated Mineral and Energy Resource Analysis) and the University of Johannesburg are acknowledged for funding the trip to France. Dr Wojciech Przybylowicz at the Materials Research Department, iThemba LABS, Cape Town, is thanked for allowing Valerie to analyse coal and mudstone samples using proton induced X-ray emission (PIXE) and proton backscattering spectrometry (BS) in conjunction with Nuclear Microprobe.

Ms Nosibulelo Zilibokwe is an intern geologist in the Economic Geology Competency of the Council for Geoscience. She was selected as an exceptional beneficiary by the Mining Qualifications Authority (MQA) in 2015 and, consequently, was invited to give a talk at the 2015 MQA Annual Consultative Conference on 20 November 2015 at the Birchwood Conference Centre in Johannesburg.

Nosibulelo’s presentation focussed on the theme “Empowering our Youth through Skills”. She stated that the mining industry has shaped, and continues to shape, the country’s economic, sociopolitical and cultural development, including the choice of careers in geology for some of the youth. The Council for Geoscience interacts with the mining industry on a regular basis and gives scientific advice in respect of various matters related to minerals development. Being part of the CGS has helped Nosibulelo to interact with these mining companies, amongst others. It is her ambition not only to be part of an industry that contributes significantly to the economy, but also to make a difference and to be a role model for other young women (especially from historically disadvantaged communities) towards achieving a successful career in the geosciences.

She also elaborated on the skills and experience that she is gaining by working
at the Council for Geoscience. These include, but are not limited to:

1. conducting geoscientific investigations under guidance and limited supervision,

2. providing scientific advice, together with senior geoscientists, to the public and private and mining sectors,

3. geological mapping and collection of geological data, coupled with data processing, analyses and interpretations using modern analytical equipment such as the Scanning Electron Microscope (SEM), Electron Probe Micro Analyser (EPMA) and Mineral Liberation Analyser (MLA),

4. contributing towards writing and compiling detailed auditable annual technical reports,

5. giving presentations to managers from the mining industry and stakeholders such as the Department of Science and Technology and the National Research Foundation,

6. participating in several projects which include drilling for the assessment of mineral resources (e.g. energy resources such as coal, uranium and coalbed methane gas),

7. presenting the results of the investigations to support the promotion of South Africa’s mineral industry through participation in conferences and seminars,

8. participating in the emerging science field of geometallurgy which is a multidisciplinary, applied science that integrates mining, geology and metallurgy in view of accurately assessing requirements to process orebodies. This field is instrumental in addressing and solving mineral recovery problems in the mines of South Africa.

Nosibulelo is currently working on a project (as part of her MSc studies at Rhodes University) that focusses on aspects of the mining and beneficiation of platinum group mineral (PGM) ores at the Two Rivers and Modikwa Platinum Mines. The purpose of this project is to improve knowledge of the genetic processes leading to the mineralisation of the orebody (Merensky Reef of the Eastern Bushveld Complex) and to understand the link between platinum group element (PGE) distribution and sulphide mineralisation. The study also aims to assist the current mining operation to understand the mineralogy and PGM deportment of the ores for improved recoveries. Currently, there is a lack of accessible information covering these aspects of mineralogical and geometallurgical characterisation.

For more information contact:
Nosibulelo Zilibokwe
Economic Geology
+27 (0)12 841 1135
nzilibokwe@geoscience.org.za

Showcasing our work at our first geoscience conference
If you are not on our mailing list and you would like to receive a copy of GEOclips, please send an e-mail to:

Mahlatse Mononela, Go to Market, mmononela@geoscience.org.za
Private Bag X112, Pretoria 0001, South Africa / 280 Pretoria Street, Silverton, Pretoria
Tel: +27 (0)12 841 1911 / Fax: +27 (0)12 841 1221 / www.geoscience.org.za