

APPLICATION FORM FOR THE NMMU ENGAGEMENT EXCELLENCE AWARDS: TEAM AWARD

SUBMITTED BY AEON/ESSRI FOR THE KAROO SHALE GAS BASELINE RESEARCH PROGRAMME (2015)

(CONSULT THE NMMU ENGAGEMENT EXCELLENCE AWARDS POLICY AND READ THE APPLICATION FORM BEFORE COMPLETING THE TEMPLATE IN ORDER TO AVOID A DUPLICATION OF INFORMATION.)
COMPLETE THIS FORM IN TYPESCRIPT. PROVIDE ONLY THE INFORMATION REQUESTED.

SECTION A: Application category		
<ul style="list-style-type: none"> Indicate with an X in the appropriate box the award you are applying for. Your application will only be considered for the award you have applied for 	<input type="checkbox"/> Engagement Excellence Award – Science, Technology and Engineering <input type="checkbox"/> Engagement Excellence Award – Social Sciences and Humanities <input checked="" type="checkbox"/> Engagement Excellence Team Award <input type="checkbox"/> Engagement Excellence Project Award – Science, Technology and Engineering <input type="checkbox"/> Engagement Excellence Project Award – Social Sciences and Humanities <input type="checkbox"/> Emerging Engagement Excellence Awards <i>(note that Professors and Associate Professors are not eligible for this category)</i>	
Surname of Applicant/Team Leader	Doucoure	
First Name	Moctar	
Initials	M.S.	
Title	Prof.	
Telephone numbers	082 705 9072	
E-mail address	moctar.doucoure@nmmu.ac.za	
Employment position held at NMMU	Managing Director AEON and Professor of Geophysics	
Faculty	Science	
Department	AEON-ESSRI	
Division	N/A	
Immediate line-manager	Dean of Science	
Eligibility: Are you permanently employed and/or on a long term (3 years or more) fixed contract? <i>(indicate with an X)</i>	Permanent X	Fixed term contract
If this is an application for one of the Engagement	Title:	

<p>Excellence Project Awards, provide a brief title and description of the project (250 words maximum)</p>	<p>N/A</p> <p>Description:</p> <p>N/A</p>
<p>If this is an application for either the Excellence Awards or the Emerging Award, provide a brief description of your engagement activities and initiatives (250 words maximum)</p>	<p>Description:</p> <p>N/A</p>
<p>If this is an application for the Engagement Excellence Team Award, provide</p> <ul style="list-style-type: none"> • the names of all staff members and students participating • the nature of their involvement • a brief description of the team's engagement initiatives and activities (250 words maximum) 	<p>Staff:</p> <ol style="list-style-type: none"> 1. Moctar Doucouré (Managing Director) 2. Maarten de Wit (Chair Earth Stewardship Science and Science Director) 3. David Bell (Chair Earth Systems Science) 4. Barry Morkel (Karoo SG Research Programme Coordinator) 5. Divan Stroubel (Groundwater Research Programme Coordinator) 6. Emily Bosire (Senior Administrator) 7. Abiel Kidane (Laboratory manager – coordinator) <p>Students:</p> <ol style="list-style-type: none"> 1. Bastien Linol (Postdoctoral Researcher - Geoscience) 2. Viera Wagener (Postdoctoral Researcher - Physics) 3. Lucian Bezuidenhout (PhD – Physics) 4. Onwaba Semane (MSc - Geoscience) 5. Jade Greve (MSc - Geoscience) 6. Martin Bentley (MSc – Geoscience and IT Science) 7. Taufeeq Dhansay (PhD - Geoscience) 8. Thomas Muedi (PhD - Geoscience) 9. Vuvu Nengovhela (MSc - Geoscience) 10. Tebatso Maake (MSc - Geoscience) 11. Lebo Malebogo Shezi (MSc - Geoscience) 12. Divan Stroebel (PhD - Geoscience) 13. Keegan Jeppesen (MSc - Geoscience) 14. Sinazo Dlakavu (MSc - Geoscience) 15. Mimi Mokoena (PhD - Geoscience) 16. Zanele Hobongwana (MSc - Geoscience) 17. Mulalo Nevhulamba (MSc - Geoscience) 18. Megan de Jager (PhD- Geoscience) 19. Marion Holmes (PhD - Life Sciences) 20. Annah Mabidi (PhD - Life Sciences)

21. Kristen Ellis (MSc - Life Sciences)
22. Stephanie Martin (MSc - Life Sciences)
23. Barry Morkel (PhD - Conflict and Political Studies)
24. Nyaradzo Dhliwayo (PhD - Social Science)
25. Chwayita Kani (MA - Social Science)
26. Mkhusele Mtsila (MA - Social Science)
27. Ami Hawley (MDipl - Arts / Applied Design)
28. Shanene Olivera (MSur - Health Science)
29. Nadia van der Walt (MA - Arts / Applied Design)

See Appendix 1 for details on all participating post graduate student research focus areas, faculty and departmental affiliation across the University.

Description:

This programme has been enabled and resourced through partnerships with the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (DEDAET), as well as additional support from the DST/NRF (through the 'Iphakade' Programme which is located with AEON-ESSRI at NMMU). The purpose of the programme is to deepen existing knowledge on potential SGD (Shale Gas Development) in the Karoo, which is driven through scholarship and post-graduate research.

The entire Shale Gas Baseline Research Programme in the Karoo is dependent on the engagement and participation of various communities within the Karoo, including local farmers. Given that almost all of the study area is constituted by privately owned farm land, the research teams needed to gain access from individual farmers for access to land parcels and farms scattered Eastern Cape (EC) Karoo. This was facilitated through engagement with Agri-EC and its affiliated local farmer associations across the EC Karoo. In excess of 15 farming associations were visited and consulted on the study, allowing our teams' access to approximately 400 farms. *(See this link for detail, including Maps, Pics and more detail on the Programme, study area, and engagement activities during 2015, at:*

<http://caec.nmmu.ac.za/caec/media/Store/2015%20colloquium%20presentations/Barry-Morkel-Nyaradzo-Dhliwayo-AEON-Karoo-Shale-Gas-2015-Engagement-Colloquium.pdf>.

Additionally, the programme also has as one of its key objectives, the participation of local communities as citizen scientists and community monitors in support of

	<p>the programme's research agenda, with a special prioritization of the poor and marginalized of the Karoo. To this end, the team is working with the community of Cradock, through the creation of a Community SG Roundtable. <i>(See Appendix 2, for detail on the Cradock SG Community Roundtable).</i></p> <p>(See this link for news coverage from the Programme Launch hosted at NMMU, March 2014: http://www.sabc.co.za/news/a/11bbc500433ad32494f49c45a23ba143/E-Cape-to-research-socio-economic-impact-of-shale-gas-20141103)</p>
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<p>Are your Engagement activities/projects/initiatives registered on the Engagement Management Information System (E-MIS) on SharePoint? If not, please ensure that they are before you submit this application. Applications that are not registered and updated on the E-MIS will not be considered for Awards. The most recent date on E-MIS for each project update (achieved when 'submit' is clicked) must be in 2015. Provide the exact titles (as featured on the E-MIS) for all of the Engagement activities/ projects/ initiatives with which you are involved. Visit http://caec.nmmu.ac.za/Engagement-Information-and-Development/Engagement-Management-Information-System</p>	<p><u>Titles:</u></p> <p>The Karoo Shale Gas Baseline Research Programme.</p>
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<p>SECTION B: Engagement categories</p> <ul style="list-style-type: none"> • <i>You are required to describe and report in detail on a minimum of <u>two engagement categories (these are 1, 2, 3 and 4 below) in order to be considered for an award.</u></i> • <i>If you or your teams are involved in three or four of the engagement categories, report in detail on all of these categories.</i> • <i>Applications that describe and can provide evidence of <u>engagement activities across all four categories are encouraged.</u></i> • <i><u>Refer to section 5 of the attached Engagement Excellence Awards policy which provides a guideline on the specific activities you should report on under each of the categories you have chosen.</u></i> 	
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<p>Report on your:</p> <p>1. <u>Engagement through Teaching and Learning:</u></p> <p>i. <u>Experiential Learning</u></p> <p>Central to AEON/ESSRI's approach to teaching and learning is an unrelenting emphasis on imparting practical skills in the production of scientific knowledge which is based on robust data collection and analysis. This is further advanced through the ongoing introduction and application of new cutting-edge technology in our research. In the context of The Karoo SG Baseline Research Programme we believe that this has benefited all of the stakeholders involved in this research. Here we see our students, as well as the research outcomes themselves benefitting from this emphasis on experiential research and our application of world-class cutting edge technology, both within a laboratory and field context. In this regard the following activities can be reported in support of our achievements in 2015:</p> <p>a. <i>Our team of Groundwater researchers and students has received specialized training and mentorship in Groundwater monitoring research, in field hydrocensus and water sampling, as well as Groundwater chemistry and methane gas analysis.</i> This has included</p>

specialized workshops hosted by international product and equipment manufacturers such as the Picarro methane gas analysis training team from Brussels (during early 2015, and recently in 2016). The team also benefits from the collaborative activities hosted with similarly focused institutions such as the Institute for Groundwater Studies (IGS) at University of the Free State.

The groundwater monitoring team has taken measurements on 851 boreholes across 249 farms within an area of 45,000 km², focused on water quality. Groundwater quality and level is variable but generally tend to decrease from North to South of the surveyed area. Linked to our groundwater monitoring programme in the Karoo there is a citizen science component which includes the training of women and high-school leavers to take water sample measurements in the Karoo, as part of this important component of the Programme. This component of the research has been at the forefront of our programme since the beginning, and is prioritized due to the potential risk of hydraulic fracturing to the scarce groundwater resources of the Karoo.

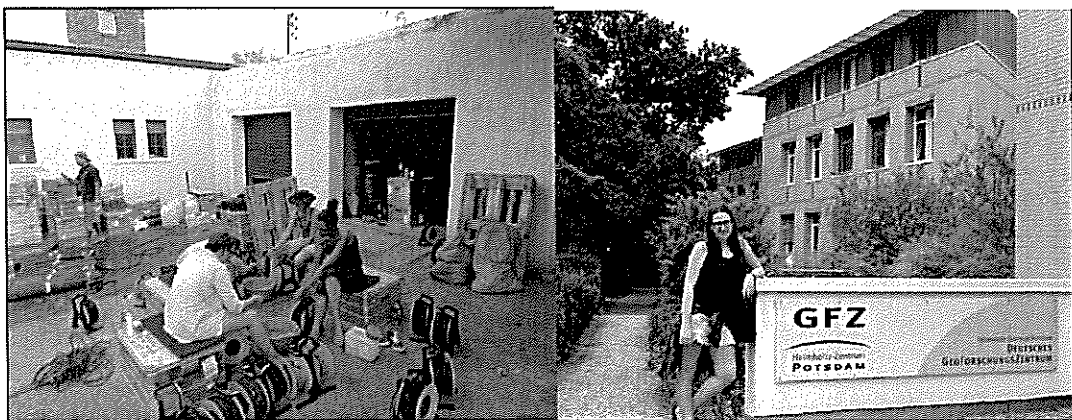
Against this backdrop, the groundwater research team under the mentorship and guidance of Prof. David Bell and Mr. Divan Stroebel has spent the longest time in the field, with the largest coverage in terms of ongoing data collection in the programme since late 2014. Commencing with an extensive hydrocensus in the Karoo, and now entering its 2nd round of water sampling and chemical analysis having commenced this team has established one of the largest independent groundwater monitoring databases in the Karoo, and possibly SA. The team members involved in this component of the programme included: Ms. Sinazo Dlakavu, Ms. Zanele Hobongwana, Mr. Keegan Jeppesson, Mr. Tebatso Maake. In addition, and as a general rule in the Programme, all students are required to participate and contribute to the groundwater sampling and data collection, regardless of which faculty participating students are located. This is done in an attempt to ensure that all participating students gain a deeper understanding of the transdisciplinary nature of the broader research agenda of the Programme.

- b. ***Training and in-field operationalization of the latest Unmanned Aerial Systems/Vehicles (UAVs)*** (i.e. drone technology and remote sensing). In his regard, the team had conducted initial training of 4 team members on the basics of UAV piloting and airborne operations in late 2014. In 2015 this was continued with the further training and advancement of a dedicated 2 person team in AEON-ESSRI on advanced deployment of the system, which was conducted in partnership with our dedicated Airborne Partners (GyroLag). This is being led by Prof. Moctar Doucouré and supported by Mr. Martin Bentley who is an MSc student in the team. This was done in response to the need to deploy the necessary UAV applications in the field for data collection across the various disciplines (i.e. geo-physics and surface ecosystems monitoring). See slide 11 in the presentation in this link: <http://caec.nmmu.ac.za/caec/media/Store/2015%20colloquium%20presentations/Barry-Morkel-Nyaradzo-Dhliwayo-AEON-Karoo-Shale-Gas-2015-Engagement-Colloquium.pdf>
- c. In addition, ***training in field deployment and data modelling and analysis of 'Deep subsurface imaging and deep geophysics'*** has also been central to the process of experiential learning through rigorous fieldwork and data collection and analysis in the Programme. Initial fieldwork commenced in November 2014, with the data analysis currently proceeding through 2015-2016. This involved imaging to expose the deep, hidden architecture of the Karoo basin is done using electrical conductivity and seismic velocity data in an area near Jansenville. The rationale for starting in this area is the proximity of two boreholes drilled by the NMMU in 2012, and that of an electrical conductivity profile acquired in 2007 through research collaboration between AEON and the GFZ in Germany. Electrical conductivity data are obtained

from measurements of naturally occurring magnetic field and electrical current in the earth (known as telluric), giving the technique its name Magneto-Telluric (MT). MT data recorded along 6 profiles have been processed to produce 2-Dimensional (2D) sections. These sections are further being processed introducing complexity/heterogeneity into 3-Dimensional (3D) models of the area covered by the profiles. Preliminary results show the presence of high conductive features at varying depths between 3 and 10 km. These could be indicative of deep saline water and/or shale rocks associated with, or similar to, the potentially gas bearing Whitehill formation. Also exposed is the presence of weak but conductive zones at shallower depths. Such zones need to be further investigated through possible correlations with salinity information from boreholes. AEON-ESSRI / NMMU team members within the KSGBRP included Prof. Moctar Doucouré, Dr. Viera Wagener, Dr. Bastien Linol, Mr. Lucian Bezuidenhout, Ms. Megan de Jager, Ms. Jade Greve.

Critical to the broader engagement category being responded to here, this project required months of ongoing engagement and consultation with individual farmers with the assistance of members of the local farmers' association in Jansenville and Waterford Districts in the 'Noorsveld' Karoo during mid to late 2014. Acquiring access and the participation of Karoo farmers in the current context of local resistance to proposed SGD in the Karoo had also required that the team spend time with all relevant stakeholders, both as organized constituencies but equally when it pertained to individual farmers who we depended on to provide our teams with access to studies sites around the Karoo, and in the Jansenville/Waterford District in particular. In accessing the study area for this study the team had to access approximately 50 individual land parcels, so as to plat the 110 MT stations across the study area.

See picture below of the team preparing the MT equipment, in Jansenville, with fellow students from the University of Potsdam and the GFZ in Germany, and our post graduate team member from NMMU (Ms. Jade Greve) at the GFZ where she is conducting data modeling and analysis during early 2015. Below is a group picture of members of the team.





d. Geological Field work and drill core logging

A group of our post-students spend many weeks relogging Soekor cores (which were initially extracted and logged in the 1960s and 1970s) which are currently stored in Pretoria and reanalyzed them to construct new 3-d models of the Karoo and assessing their gas potential.

Dr. Bastien Linol, Ms. Naledi Chere, Mr. Thomas Muede, Ms. Vuvu Nengovhela and Mr. David Moorcroft (an honours student). Several of these students are continuing to investigate the effects of sill intrusions on the sale gas potential using sophisticated electron microscope studies in the HRTEM and in the USA.

Linked to the numerous geological field surveys and mapping trips undertaken by the team, including the work conducted on the studying dolerite structures in the Eastern Karoo, in the rural areas of the Chris Hani District, of the Eastern Cape by Mr. Thoma Muede there is continuing engagement and collaboration with the traditional leaders and local rural communities in the area. In this regard the team continues to collaborate and engage with Chief Sibongile Dumalisile as the traditional leader in the region.

ii. Customized training and short learning programmes

The AEON-ESSRI / NMMU hosted as part of the 2015 NMMU Cape Karoo Imbizo – 2nd Iphakade Workshop Programme a two (2) day Short Course on “*Sedimentary and Diagenesis of (un) conventional petroleum systems: Basics and selected topics from prominent oils and gas fields*” which was presented by Dr. Hans-Martin Schultz, a leading Organic Geochemist of the Helmholtz Centre Potsdam, GFZ (German Research Centre for Geoscience). This is enabled through the ongoing and sustained collaboration/engagement between AEON/ESSRI - NMMU through the Programme in the Karoo. (*See course outline in the following link at: www.aeon.org.za/capekaroo/*).

Report on your:

2. Engagement through Profession/Discipline-Based Service Provision:

Team engagement through professional and Discipline-based collaboration and leadership at both national, and international levels have been strengthened through the ongoing focus of the research team on Karoo SG and its surface and sub-surface ecosystems observations and research. In terms of the ongoing activities which contribute to the advancement of this category include:

- i. **Serving as an elected officer of a professional society/council/board/association:**
 - a. Prof. Maarten De Wit is an Honorary Fellow of the Geological Society of America; an Honorary Fellow, and Chartered Geologist of the Geol. Soc. London; a founding member of the SA Academy of Science; past chair of the SA National Committee of IYPE (International Year of Planet Earth); and a member of the ICDP Scientific Advisory Board.
 - i. He also actively serves on the editorial boards of 5 international journals.
 - b. Prof. Moctar Doucouré is on the Management Board of ANESI - African Network of Earth Science Institutions.
- ii. **Representing the University on external committees, task teams or in public forums and providing expert opinion and thought leadership to internal and external stakeholders.** Team members have contributed to a number of external task teams and external expert panels during 2015 such as:

The Academy of Science of South Africa (ASSAf) Expert Panel Report on the Technical Readiness to Support the Shale Gas Industry? The Academy of Science of South Africa (ASSAf), in partnership with the SA Academy of Engineering was mandated to provide an evidence-based scientific report to the Department of Science and Technology (DST) on this critically important subject. The report addresses a number of critical subjects related to SGD in South Africa such as: Skills development, energy sustainability, baseline studies, and job creation are all addressed in this report on the technical readiness of South Africa for shale gas development. The study was developed utilizing the traditional ASSAf consensus study methodology and was developed and compiled by a panel of experts, under the leadership of a panel chair. Members serve in a voluntary capacity, as part of evidence-based approach, with multiple perspectives and free of partisan interests. The Report is still embargoed and is anticipated for release by the Minister for the DST during 2016. AEON-ESSRI's Prof. Maarten de Wit formed part of the expert panel, which included national and international experts on the subject, whilst Mr. Barry Morkel on our team had also contributed to the report. Emanating from this Prof. de Wit has been invited to present a series of National Public Lecturers entitled: Karoo Dilemmas: Prospective SG Development in the Karoo, on behalf of the National Academy of Engineering, which is being presented in each of the non (9) provinces in the Country during 2015/2016. (*See the advert for the National Lecture Series below for details*).

Prof. De Wit also represented the ASSAf at a Shale Gas technical meeting of twelve (12) international Academies of Science and Engineering in Sydney 2015 (*See Appendix 4*); and is presently the ASSAf's representative at round table discussions organized by the National Academy of Sciences (USA, Washington) with the most recent invitation to Academies Roundtable workshop on May 25-26-- Use of Flowback and Produced Water.



SOUTH AFRICAN
ACADEMY OF ENGINEERING

ACADEMY LECTURE

Karoo Dilemmas: Prospective shale gas development in the Karoo - What is the outlook?

presented by

Prof Maarten de Wit of the NMMU

13h30 for 14h00 on Wednesday 11 May 2016

Vulindlela, the Training Academy of the DBSA,
1258 Lever Road, Headway Hill, Midrand (map attached)

RSVP for catering purposes by Friday 6 May 2016 to office@saae.co.za

The National Strategic Environmental Assessment (SEA) for Shale Gas in South Africa, which is being implemented by the Council for the Scientific and Industrial Research (CSIR). The SEA had been commissioned by the National Department of Environmental Affairs (DEA) in mid-2015, with the inclusion of a number of relevant national agencies and government departments such as the Department of Mineral Resources (DMR), the Petroleum Agency of South Africa (PASA), Civil Society organizations (such as Agri-SA, The Treasure Karoo Action Group, amongst others), and Chapter nine bodies such as the Human Rights Commission of South Africa. In terms of the team's participation herein, various members of the team participate in the SEA at different levels with Prof. Moctar Doucouré participating on the writing team (as a contributing author) for the chapter on Earthquakes, whilst Prof. Maarten de Wit and Mr. Barry Morkel participate as members of the Project Custodian Group (PCG) which is an external reference group serving as custodians of the integrity of the Project (See the following link for details on the SEA at: <http://seasgd.csir.co.za/> and <http://seasgd.csir.co.za/library/>)

Operation Phakisa, which is the National Government Programme focused on the Ocean Economy and fast-tracking a number of strategic programmes in the Marine and Ocean Economy of the Country. Key to Operation Phakisa has been the prioritization of skills development, and natural resource development and beneficiation, with the inclusion of off-shore oil and gas development. Here the AEON team has been represented by Prof. Moctar Doucouré who serves as a Chairperson of the Phakisa Oil and Gas Skills Development Working Group. Through this role the University continues to find representation at the centre of this critically important process for the future development and governance of South Africa's off-shore oil and gas industry. (See details for Operation Phakisa at: <http://www.operationphakisa.gov.za>).

By way of illustrating thought leadership within the context of The UAV (Unmanned Aerial Vehicle) system acquire by the team, and which is to be deployed in the Karoo Programme has been presented to the **South African Geophysical Association (SAGA)**, and the system was demonstrated at the 14th Biannual Geophysical Conference, 6th -9th September 2015, which was hosted at the Champagne Sports Resort in the Drakenburg.

iii. **Organizing professional and Student Conferences and Symposiums**

- On the 23rd to 30th of November 2015, AEON-ESSRI / NMMU hosted '**The Cape-Karoo Imbizo' (2nd Iphakade Workshop)** which was focused to a large extend on improving our understanding of the evolution of the Cape Mountains and the Karoo Basin, and in doing so our knowledge of the shale gas potential that is presently under investigation by a number of exploration companies. A total of 91 participants attended the conference, from across eight South African universities, as well as from Norway, Germany, and Brazil. Details of the Cape Karoo Imbizo and the Oil & Gas Short course can be found also on the AEON website (www.aeon.org.za/capekaroo/). A book on the findings at the Imbizo is in press by Springer and will be presented for sale at the 35th International Geoscience Conference in Cape Town in August 2016.
- The First Iphakade Workshop and Student Conference Programme, **The 1st Annual Scientific Iphakade WATER WORKS Workshop** was organised and held from Monday, 2 - Friday, 6 November 2015 at the University of the Free State - Bloemfontein, SA. This workshop built on the previous 10 (ten) Annual Scientific Inkaba yeAfrica Workshops. It focused on water and its importance in the biosphere. Themes have been developed around the hydrological cycle, addressing the importance of water in each component of this cycle, as well as its sensitivity to impacts from human activity. Specific focus was placed on the water challenges faced in South Africa. Themes included: climate and the potential effects of climate change on water resources; the impacts of mining, industry, agriculture and the energy sector on water resources; management of our water resources; water, human rights and dignity; earth stewardship science and the future of water in Africa and the world.

(See Appendix 4 for details on both the 'The Cape-Karoo Imbizo' (2nd Iphakade Workshop) and the 'WATER WORKS Workshop' Programmes and List of Presentations by AEON-ESSRI / NMMU Programme team members).

Report on your:

3. Engagement through Research and Scholarship:

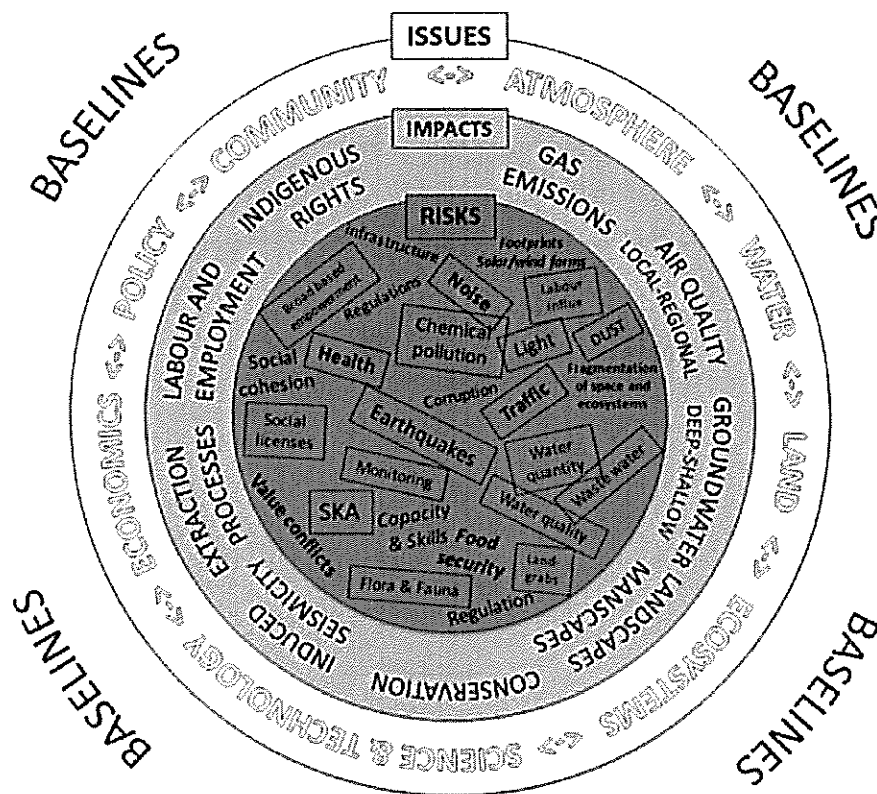
i. **Policy Research, Analysis and advice:**

Key outcomes in this context are to be identified under the Section 2 (paragraph 2)

- *Background*

The rationale for the baseline study was to enable the availability of data and knowledge relevant information on key attributes or characteristics of the situation prior to the commencement of exploration and exploitation for shale gas in the Karoo, without which defense of potential litigation may prove almost impossible. This programme is located in the diversity and interconnectedness of all the issues involved in the receiving environment of the Karoo, as well as the potential impacts related to prospective SGD as identified in the study area. The research programme is driven through a transdisciplinary approach. This is inclusive of a number of studies ranging from research on groundwater, structural geology and geophysics, vegetation and freshwater invertebrates to the social and political economy of shale gas development and how to engage local communities in scientific and health-related research through citizen science.

Figure 1: Issues, Impacts and Risks associated with SGD Baseline Studies in the Karoo



AEON - NAMUJ

Source: AEON, 2015

In conducting the baseline, whilst meeting the objective of deepening technical and scientific skills in the area of SG in the Karoo, the programme is currently providing 32 post graduate student-bursaries across a wide range of topics related to the SG baseline studies (see table below that summarizes these studies). This is a pioneering research programme within South Africa, if not globally.

- *Operational Performance: Set-up, Acquisition of equipment, and the Transdisciplinary approach to the research*

State-of-art instruments have been acquired to perform water analysis and geophysical deep probing. For water analysis, an ICAP-Q Inductively Coupled Plasma Mass Spectrometer (ICPMS) and an ICS-2100 Ion Chromatograph have been acquired for the purpose of analyzing water chemistry. An

instrument for the detection and analysis of isotopic methane gas and carbon dioxide, the Cavity Ring-Down Spectrometer, has been also acquired. These analytical instruments have been installed in a dedicated laboratory at the NMMU and two postgraduate students trained to operate the instruments. The microseismic recording and monitoring system is a set of 20 data cubes including GPS and geophone. This is the only such system currently in operation in South Africa. Three vehicles to support the field operations were also acquired. An Unmanned Aerial Vehicle was also acquired for the purpose of monitoring the surface and near-surface conditions in the Karoo. The procurement, installation and training in general, and around the laboratory in particular took considerable time and effort which impacted significantly on the operational timeline.

The Karoo baseline research is by nature a trans-disciplinary programme that involves a large research team, focusing on: *groundwater chemistry, geology and geophysics, surface ecosystems monitoring, citizen science, social and community impacts, as well as potential impacts to human health*. Given that all of the research is being driven through post-graduate research and mentorship, it is important to note that some of these researchers have required and continue to require further training and mentorship to undertake their research. Evidence of this has been reported in quarterly reports from time to time, such as the specialist training being received by the geophysics students and reported on in this report. Here is where there is a visible overlap with the achievements and activities cited in this application under the Category: *Experiential Learning (see narrative above under Section B 2)*.

- *Groundwater Monitoring and Sampling*

The groundwater baseline programme commenced with a desktop study, laying out the areal extent for in-depth study into the requirements to conduct a robust and scientific groundwater baseline research. The research also aims to enable future groundwater monitoring of potential impacts of hydraulic fracturing for shale gas in the Karoo. The research commenced by conducting a hydrocensus (i.e., the gathering of information on water features, water supply sources and sources of potential water pollution in a particular site or area), during which access to boreholes to be included into the research was critical. To date, a total number of 249 farms were visited on which a total of 851 sites were visited and recorded. These sites include 64 natural springs and 787 water boreholes. Of the 787 water boreholes, 577 are equipped boreholes i.e. contains a pump and is actively being used, and 210 open, unequipped boreholes. Electrical Conductivity (EC) and temperature readings have been recorded at the active boreholes and springs, whilst the open, unequipped boreholes have been EC profiled and slug tested.

The data acquired from the hydrocensus have been processed and scrutinised from which the sampling protocol was delineated. Sampling commenced 1 October 2015, which serves as post-winter seasonal sampling phase. To date, 451 samples have been submitted to the laboratory for analysis. The results from the first batch of 298 samples have been received. These results contain the nutrient composition of the samples. Further analyses of these samples, as well as newly and already submitted samples, will continue upon completion of the nutrient analysis. For this reason, samples are being preserved under laboratory specific conditions. Sampling is currently continuing with ongoing analysis of all submitted samples. All acquired data are scrutinised and interpreted on a continuous basis.

- *Geophysics and Micro-Seismic Studies*

- i. Magnetotelluric (MT) measurements (essentially research using natural electrical signals) across selected area of the eastern Karoo Basin is being conducted to 1) better define the geometry of the conductive, gas-bearing reservoirs in the Whitehill Formation at depth, 2) aid in the identification of deep saline water reservoirs. Stations are arranged into profiles separated from each other by 5km, and with a 2-3km site spacing along the profiles, thus enabling high resolution 2D and 3D MT inversions and subsurface modelling of these reservoirs.

ii. Microseismic studies are also an integral part of our baseline studies. This passive seismic approach allows for easy deployment of seismic stations and eliminates induced sources (e.g. explosives or vibrations), thereby permitting access to remote areas without surface disturbance. It is also an environmentally low impact technique that is cost effective compared to conventional (active) seismic methods. In this study, a passive seismic network of 20-50 three-component geophones is deployed around the south-eastern Karoo. A novel way has been established to determine microseismicity using ambient noise and to invert micro-seismic velocities into a 3-D tomography down to several kilometres below surface. The study will also undertake detection of potential micro-earthquakes across the region.

- *Geological Field work and drill core logging*

A group of our post-students spend many weeks relogging Soekor cores (which were initially extracted and logged in the 1960s and 1970s) which are currently stored in Pretoria and reanalyzed them to construct new 3-d models of the Karoo and assessing their gas potential.

Dr. Bastien Linol, Ms. Naledi Chere, Mr. Thomas Muede, Ms. Vuvu Nengovhela and Mr. David Moorcroft (an honours student), under the mentorship of Prof. Maarten de Wit this team conducted this innovative research. Several of these students are continuing to investigate the effects of sill intrusions on the shale gas potential using sophisticated electron microscope studies in the HRTEM and in the USA.

- *Surface Ecosystems Monitoring*

- i. Freshwater invertebrate assemblages of the Eastern Cape Karoo region:

This project entails the study of patterns of aquatic invertebrate species richness and diversity in surface freshwater wetlands (depressions, dams and rivers) of the Eastern Cape Karoo. It involves the documentation of existing invertebrate species and determination of their relative abundance and distribution. This project aims to relate patterns of invertebrate assemblage composition and diversity to local or regional environmental variables and processes among different surface freshwater wetlands (depressions, dams and rivers) between Aberdeen in the west and Tarkastad in the East.

- ii. Controlled Experiments using 'fracking' fluids on succulent and thicket vegetation:

The study is investigating botanical environmental impacts on the local Eastern Cape vegetation through injecting fracking-fluids, with variable compositions and under controlled conditions, into seeds and mature plants of selected Karoo succulent and thicket species as well as the compilation of a species list for those areas likely to be affected by hydraulic fracking, highlighting Species of Conservation Concern. An upscaled test site of 1 hectare is now in progress with the participation of Prof Eileen Campbell (Dean Science and HOD Botany).

- *Stakeholder Engagement and Cradock Shale Gas Community Roundtable*

- i. The process of engaging local communities in the Karoo Shale Gas Research Programme has served as a critical enabler for the ongoing field work being conducted by the various research teams. Without this process of engagement with critical stakeholders across the Karoo it would have been near impossible to undertake any of the envisaged research. Engagements with various stakeholders in the Karoo include:

- District and specific Local Municipalities located in the study area, mainly within Sarah Baartman DM and the Chris Hani DM.
 - Organized Agriculture (NWGA and AGRI-SA), and local farmers' associations in the various districts. Including private land owners and individual farmers across the Karoo.

- Local CBOs, and civic organizations located across the study area, specifically in Cradock, Ikwezi LM, and Camdeboo LM. In most instances we work closely with local councilors, public participation processes and forums.

ii. *Community Based Research Projects and Participatory Research Networks*

The team, through its Citizen Science programme has also initiated the establishment of SG community Round Table in the Karoo, starting with the Cradock Round Table meeting, convened in October 2015; a report and feedback has been send to the communities in 3 languages. The inclusion of this dedicated platform for sustainable engagement was initiated out of the need to enable our existing participatory research and citizen science agenda in the Karoo, whilst piloting this initiative in Cradock. In this regard, we have started working with constituencies represented in the Roundtable on the planning and visioning process for our community based groundwater monitoring project, which will see a cohort of 15 local citizen scientists trained and capacitated to conduct groundwater monitoring and sampling within their community.

In engaging the community of Cradock on their own agenda for the forum, and their envisaged terms of reference (TOR) for the roundtable, we are able to use it also a forum through which we can specifically address the knowledge gaps pertaining to proposed SGD in their area. Our experience has been that many of the community representatives from civil society, civic organizations, and political formations in the community are generally not informed on government's exploration licensing programme, which has been unfolding since 2009. Similarly, many feel left out of the Karoo SG debate raging around them on and the fact that engagements of the matter have historically not been inclusive enough. (*See Appendix 2, for detail on the Cradock SG Community Roundtable*).

SECTION C: Descriptions

1. Describe the impact your Engagement activities have made on stakeholders/beneficiaries/communities and provide details on how these activities are acknowledged/recognized by:

1.1. External communities/stakeholders/beneficiaries:
(not staff and students of NMMU)

In this regard, the programme can report on its achievements across two (2) broad categories of stakeholders/partners, namely: *Local Communities in the Karoo*, and our *National, Provincial and Local Government partners/beneficiaries*.

- i. Local Communities in the Karoo, such as the Cradock Community SG Roundtable and ordinary farmers in the Karoo have continued to benefit through this programme, either through the information sharing on SG in the Karoo (*which is unbiased and free from sectional interests*). To date there has been little independent scientific information sharing with local communities across the Karoo. Over the last year, this programme has endeavored to provide empowering information to numerous constituencies in the Karoo.
- ii. In the public sector, which has never

	<p>previously had to deal with the complexities of On-Shore Unconventional Oil and Gas extraction/industries, earmarked for a relatively pristine area such as the Karoo – this Programme has made significant strides towards closing this information gap and aiding in the public Government’s learning curve in grappling with the complexities and uncertainties of proposed SGD in the Karoo. This is evident through our ongoing work through contributions to the Assaf (DST) Report, and our participation in the National SEA for Shale Gas in South Africa. Provincial Government continues to benefit through the partnership with the Eastern Cape Government, and at a local level this is evident in our partnership with Inxuba Ya Themba Local Municipality through our collaboration in the joint coordination of the Cradock Community SG Roundtable.</p>
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<p>1.2. Internal communities/stakeholders/beneficiaries: (staff and students of NMMU)</p>	<ul style="list-style-type: none"> i. Driven through a strong transdisciplinary focus and approach to the research and programme implementation, the Karoo Shale Gas Baseline Research Programme is currently located across four faculties within the University (Science, Arts and Humanities, Health Science, and the Business and Economic Sciences). Post graduate research is currently ongoing across these faculties under strong scholarly supervision and mentorship across these faculties. Studies ranging from; design systems, groundwater chemistry, surface ecosystems monitoring to human health and community impacts, including land tenure rights and rural livelihoods in the context of proposed shale gas development in the Karoo are being investigated in this programme. ii. All students, and by extension the research agenda and its outputs, have benefited from the necessary engagement with farmers and communities, local authorities, various agencies and departments of state, international and national scientific and professional collaborations facilitated through the programme since 2014. iii. For many of the young scientists participating in the programme, the ability to engage confidently with Karoo farmers, farmworkers and representatives of local communities has been a critical life skill which has taken many of our students, and staff members out of their comfort zones. This has required maturing and personal growth on the part of individual team members. It has also contributed to creating well-rounded scientists and researchers who have a much better appreciation of the textured and complex social fabric in communities such as the Karoo.
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2. Describe how your Engagement activities contribute towards faculty/department/entity engagement goals and objectives. (Refer to your Department/Faculty/Entity's strategic plan here)

AEON-ESSRI is a Cross-Faculty, Transdisciplinary Institute with Departmental Status at NMMU and as such its engagement activities fall under the NMMU institutional research theme – Karoo Shale Gas Baseline. As engagement should be part of Faculty Strategy feeding into the University 2020 Vision, the AEON-ESSRI engagement activities contribute directly to the goals/objectives of NMMU.

3. Describe how your Engagement activities contribute towards the achievement of the NMMU Vision 2020 Engagement Strategic Goals and Objectives. (Refer to the attached NMMU Engagement Strategic Goals and Objectives)

The transdisciplinary research approach underpinning the research agenda and the programme as a whole is intrinsically guided and imbedded in ***the University's 2020 Vision's, Strategic Priority 4: Position NMMU as an engaged institution that contributes to a sustainable future through critical scholarship.*** In line with this strategic priority and its associated objectives, and performance measures, the following objectives / Indicators have been directly responded to through this programme over the last year, namely:

- i. **Respond to societal needs in line with the institutional engagement focus areas:**
 - a. The teams have convened numerous conferences and workshops, as well as hosting a number of talks at the university relevant to Earth Stewardship Science, Natural Resource Management and Research. All of these have been made open to the public and publically advertised for broad participation. These are outlined and noted in this application in the section B, Sub-section 2 (including the AEON-ESSRI / NMMU hosted 'The Cape-Karoo Imbizo Workshop, On the 23rd to 30th of November 2015) and (the The Iphakade Workshop and Student Conference Programme, 'WATER WORKS' Workshop was organised and held from Monday, 2 - Friday, 6 November 2015).
 - b. Team has also hosted two (2) public lectures with International specialists in 2015, including the following:
 - i. Dr. Audrey Levine: The former National Director of The US Environmental Protection Agency (EPA) was hosted in partnership with the South African National Water Research Commission (WRC) who had requested AEON/ESSRI – NMMU as a leading shale gas research group to host Dr. Levine on her Eastern Cape leg of her country wide tour. This include a series of engagements with staff and students on ongoing research projects in the group, a one (1) day field trip to the Karoo where she interacted with local communities, and a public lecture hosted at NMMU on the last day of her visit to the University.
 - ii. The team also hosted a public viewing of an award winning documentary by an international film maker and geologist, Mr. Jeff Barbee - who created the award winning documentary entitled: 'The High Cost of Cheap Energy'.
- ii. **Promote the integration of engagement, research, innovation and teaching and learning.**

Critical indicators relevant to this objective include the following:

 - a. Number of projects performed by multi-disciplinary teams:
 - i. In 2015 there were twenty nine (29) post graduate research projects running / ongoing across four (4) faculties in the University, and include the Faculties of Science, Arts and Humanities, Health Sciences, and Business and Management Sciences (BES). These research projects range from studies on: Ground Water Chemistry, Surface Eco-systems Monitoring, Socio-Economic and Community Impacts of Shale Gas Development (including land tenure rights and land use patterns) in the Karoo, as well as Systems Design and Documentary film making and videography. It is truly integrated across the entire University, and has the potential to be an example to the rest of the world on how best to conduct Baseline Studies in areas identified for resource extraction, such as Shale Gas Development in the Karoo Basin of South Africa *Appendix 1 (The list of postgraduate research projects – Masters, Doctoral, and Post-Doctoral projects currently funded through the programme).*

- b. Number of projects funded through the Karoo SG Baseline Research Programme:
 - i. Linked to the projects sited above, it is important to note that AEON / ESSRI – NMMU is currently funding all of the ongoing postgraduate research projects in the University. This is done to incentivize and ensure that there is focused prioritization of the transdisciplinary focus for this research programme on the development of a Karoo Shale Gas Baseline study, which is inclusive of as many faculties in the University as possible. This integrated approach is also employed within the Baseline Study in response to the multifaceted and multidimensional context in which SGD might potentially impact the natural environment, including human and social systems in the Karoo (see *Diagram 1, in this document above*) also refer to Appendix 1 (*The list of postgraduate research projects – Masters, Doctoral, and Post-Doctoral projects currently funded through the programme*).

iii. **Promote engagement for the public good.**

In this regard, the following sections of this application are to be referred to, and are directly relevant in advancing this particular indicator of the strategy. These include:

- a. The team leader Prof. de Wit, had commenced in a national series of guest lectures around the country (to be presented in each of the nine (9) provinces) on the topic of 'Prospective Shale Gas Development in the Karoo Basin', on invitation of the National Academy of Engineers of South Africa. This is significant to the engagement profile of the University, and adds considerable recognition and acknowledgement of the work being conducted by the team and the University (NMMU) in this complex space.
- b. Similarly, the Baseline as a programme and the compilation for the Karoo SG and Technical/scientific Data Base is in its very essence and rational for existence being conducted in the interest of the broader public good, and of Karoo communities in particular. This includes the engagements targeted at giving ordinary people, who might otherwise be excluded from ongoing debate, access and voice in the process through providing them with relevant information on proposed SGD in the Karoo – through initiatives such as the Cradock Community SG Roundtable, and our ongoing interactions with various constituencies in the Eastern Cape Karoo.

iv. **Develop and sustain mutually beneficial local, regional and international partnerships that contribute to a sustainable future.**

All of the partnerships *sited in Section 7.2, sub-section B of this application document below* in greater detail are to be identified as sustainable and mutually beneficial to all participants, and outline nature of our partnerships at a local, provincial, national, and international level.

4. Describe how your Engagement activities contribute towards: (*Refer to any relevant media coverage, representation on boards or committees, scholarly publications, conference presentations etc.*)

4.1. Addressing the needs of society and various external communities served by NMMU:

See the following Sections of this application document for reference to how this programme serves the needs of external communities, namely: Sections B and C (including sub-section C6 below) predominantly in this document above.

Additionally, the Programme is intended to ensure that there is scientific and technical data which can provide an adequate baseline of the current environment in the Eastern Cape Karoo prior to the commencement of hydraulic fracturing and SGD in the Karoo. The rational being that without this

data base, it will be impossible to monitor and police potential contamination as a result of SGD in the Basin.

This therefore has a direct beneficial impact and contribution to society's need to ensure that all development is sustainable, responsible, and not in confrontation with their constitutionally protected right to a health environment.

4.2. Profiling and promoting the NMMU as an engaged university:

- a. Currently the AEON/ESSRI - NMMU SG Baseline Research Programme remains the most engaged research agenda focused on SGD in South Africa. This is true, as it remains the only SG research programme with an ongoing field based programme of data collection in the Karoo, and which has a dedicated and sustained focus on stakeholder engagement across the existing study are of the Eastern Cape Karoo.
- b. Secondly, the Programme has allowed NMMU to retain a visible presence and footprint in the Karoo, whilst ensuring its prominence at the forefront of SG research and independent (*i.e. independent from industry funded research*) baseline studies – both internationally and in South Africa.
- c. Lastly, this commitment and dedication to engagement and collaboration, especially on the ground in the Karoo, has also established the Programme and the University at the forefront of shale Gas research in the Karoo, and in touch with where local communities find themselves within the process to date.

5. Describe how you have successfully integrated engagement into the Teaching and Learning and Research functions of the university. (Refer to sections 5.1, 5.2 and 5.3 of the Engagement Excellence Awards Policy as a guideline)

This is explained and articulated throughout the narrative of this application, and can be summarized as "embedded" in both the methodology and as a critical enabler for all components of the Baseline Research Programme.

It is further evidenced in the research outcomes and activities produced by the team, which are outlined below.

In addition, this also witnessed in the continued relevance and continued engagement of the AEON-ESSRI / NMMU team in the numerous processes of knowledge production and thought leadership on Shale Gas in the Karoo by external stakeholders such as government, civil society and the various professional and academic networks with which we have collaborated and supported.

6. Provide details of scholarly outputs/contributions made to a body of knowledge as a result of your engagement activities. (Refer to publications, new teaching programmes, technical reports, conference proceedings, etc.)

The following research outputs and publications have emerged out of the programme in 2015:

Books:

- Maarten J. de Wit, François Guillocheau, Michiel C. J. de Wit. ed., (2015) *Geology and Resource Potential of the Congo Basin*. ed. Springer: Heidelberg.

Book Chapters:

- Morkel, B. & de Wit, M.J (2015) Prospective Shale Gas Development in the Karoo Basin of South Africa – Can it be another 'Game Changer' for a Divided Nation? In *The Shale Dilemma: A Comparison of Approaches* (edited by Shanti Gamper-Rabindran), University of Pittsburgh Press (In press).

Journal Articles:

- Geel, C. et al. (2015). Palaeo-Environment, Diagenesis and Characteristics of Permian black shales in the lower Karoo Supergroup flanking the Cape Fold Belt near Jansenville, Eastern Cape, South Africa: Implications for the shale gas potential of the Karoo Basin, *South African Journal of Geology*, 2015, Volume 118.3 pp. 249-274.
- Dhansay T, Serper A, Linol B, Ndluvo S, Perumal L, De Wit M. Transdisciplinarity within South Africa's global change research: How (well?) are we doing? *South African Journal of Science* 2015; 111(5/6), Art. #a0107, 4 pages. Available online at: <http://dx.doi.org/10.17159/sajs.2015/a0107>

Media Article:

- Martin Bentley, Scientists unearth how to manage the Karoo. In *Mail&Guardian Science Voices*, 2015. See article at <http://mq.co.za/article/2015-07-30-scientists-unearth-how-to-manage-the-karoo>

Conference Proceedings:

- Mr. B. Morkel, Presentation of Draft Book Chapter at *The University of Pittsburgh: International Conference on Managing Risks in the Shale Industry: A Comparison of Policies Worldwide, exploring the risks and benefits of the shale gas industry*, 18 -19 March 2015, Hosted/led by GSPIA. See this link for more detail: <https://www.gspia.pitt.edu/About-GSPIA/Digital-Media-Center/News/View-Article/ArticleID/1621/Conference-Explores-the-Impact-of-Public-Policy-in-the-Shale-Gas-Industry>
- Prof. M. de Wit, Panel Presentation: *Towards national and international best practice in policy and regulation: Academy of Science of South Africa* at the *ATSE, Unconventional Gas Conference 2015*, 22-23 September, Sofitel Wentworth, Sydney (See Appendix 4 for details)

Technical Reports:

Team members have participated in authoring the following National and International technical reports during the period under review:

- Academy of Science of South Africa (ASSAF) (2015). Shale Gas: Is South Africa technically ready to support the shale gas industry? September 2015 (Still Embargoed and Unreleased by DST).
- AGEO - Airborne Geophysics Observatory for Earth and Human Resources, Ecosystems and Built Environment. C.M. Doucouré, L. Ameglio, C.J. Fourie, and M.J. de Wit. 2015.

7. Describe the important role performed by you or the team in:

7.1. The leadership and management of the engagement activities and initiatives:

The Programme has dedicated social facilitation and coordination capacity in the Karoo, which is facilitated through the Programme Coordinator (Mr. Barry Morkel). All activities are internally planned with the Programme leadership and team members (i.e. The Science Director and Management Director, and relevant team members, including post graduate researchers/students) prior to the commencement of the various research projects within the Baseline Programme. All activities in the field commence with an identification and scoping of relevant community stakeholders, and dependent upon where in the Karoo our fieldwork is conducted we prioritize engagements with local councilors (and local authorities), and in particular those who control access to the study area (such as custodians of the land, both private and communal). Similarly, all students and researchers participate in our engagement activities, especially in the day-to-day activities in the field where there are ongoing interactions and encounters with farmer owners, farm laborers, and community leaders and ordinary people in the Karoo.

In the context of the SG Community Roundtable and our engagements Government (Local, Provincial and National) the Science Director (Prof. de Wit) and Managing Director (Prof. Doucouré) provide direct leadership in engagement process. This provides confidence amongst our stakeholders that the Programme and the University has prioritized interaction with them at a sufficiently senior level.

7.2. The level and extent of partnerships/collaborations/networks/linkages formed internally and externally:

See A and B Below:

a. Internally (inter-departmental, inter-faculty and interdisciplinary):

The internal partnerships and collaborations/networks have been extensively discussed and illustrated in this document, and should be read across all Sections of the application.


- Having noted the above, the Programme is extensively integrated across the various faculties and departments across the University - across four (4) faculties in the University thus far.
- However, it is intended that the Programme

	<p>will be expanded to the Law faculty in the near future, with an identified need for greater emphasis on Environmental, Resource, and Land Tenure rights all becoming a growing factor in the ongoing debate on resource extraction, mining, energy – water – food security nexus in the Karoo in particular, and on the Global Change agenda in general.</p>
<p>b. Externally <i>(at local, national and international level):</i></p>	<p>This research programme remains unique in many respects. To the best of our knowledge the Programme remains the first of its kind in South Africa, and potentially globally, as all existing SG baseline studies thus far have been driven by industry contracted processes linked to EIA processes. This uniqueness is derived from it being implemented as an independent base line study across an area which is relatively pristine and largely untouched by mining and extractive industries. Additionally, the extent of the geographical area covered by the study is vast, stretching across three (3) district municipalities in the Province, inclusive of numerous local municipal areas – all of which have their own network of stakeholders and partnerships which need to be fostered and maintained (<u>See NMMU talk by our team members Mr. Barry Morkel and M. Nyaratzo Dhalwyao, at the NMMU Engaged Scholarship Colloquium 2015 – at: http://caec.nmmu.ac.za/Engagement-Information-and-Development/2015-Second-NMMU-Engagement-Colloquium</u>). In this regard there is considerable interest in the programme and the research.</p> <p>The extent of partnerships and linkages developed and maintained through this programme exists on numerous levels, as outlined below:</p> <p><i>a. At a Local/District and Provincial level:</i></p> <ol style="list-style-type: none"> i. Starting with our partners in the Karoo such as the numerous local farmer associations/farmers, community based organisations, and local councilors as representatives of the ordinary people of the Karoo who we interact with on a daily basis, in enabling the ongoing research programme. ii. The Eastern Cape Provincial Government, which remains a co-sponsor of this programme and who benefits through the ongoing research in the form of new and deeper knowledge on the potential future impacts of proposed SGD in the Karoo, which has the potential to offer essential support to policy development and decision-making processes by Government.

- b. At National Level:*
- iii. The DST/NRF through the Iphakade Programme, hosted by AEON-ESSRI (NMMU) which provides support to the programme through bursaries to our post-graduate students and enabling the ongoing research.
 - iv. The National Departments, Agencies of government, and broader policy community and networks relevant to SGD in the Country through our participation and contribution to a number of strategic initiatives coordinated by National Government, such as the National Strategic Environmental Assessment (SEA) for Shale Gas (by the Department of Environmental Affairs and the CSIR).
 - v. Through ongoing collaboration and partnerships through existing professional and academic networks, such as the Academy of Science of South Africa (ASSAf), the SA groundwater research community (including our collaboration with the Institute for Groundwater at UFS and the WRC).
 - vi. The wider network of academic and student collaborators AEON-ESSRI has been able to maintain and nurture through it various Conferences, Research Imbizo's, and collaborative publications across many universities and research institutes around the country.
- c. At International Level:*
- vii. AEON is the southern Africa region representative in the UNESCO based AENESI initiative with the vision to make Earth sciences knowledge and information accessible and useful to all in Africa. ANESI has already supported a number of training initiatives in Africa including the AfricaArray field geophysics based at Wits, the visiting Fellowship for Outstanding Women Geoscientists, and the Student Exchange Programme across regions

(See Slide 6 in Programme Team presentation to the 2nd NMMU Engaged Scholarship Colloquium, in the following link:

<http://caec.nmmu.ac.za/caec/media/Store/2015%20colloquium%20presentations/Barry-Morkel-Nyaradzo-Dhliwayo-AEON-Karoo-Shale-Gas-2015-Engagement-Colloquium.pdf>

Applicant Signature		Date	13 May 2016
SECTION E: FOR OFFICE USE <i>(Administered by the Centre for Academic Engagement and Collaboration and the NMMU Engagement Committee)</i>			
Resolution regarding application from Awards Committee:			
Feedback to applicant:			

SECTION F: Portfolio of Evidence

Attach any relevant documents as a portfolio of evidence to support your application. **Limit this portfolio of evidence to a maximum of 20 pages.** This can include photographs, promotional material, commendations from stakeholders/beneficiaries etc., publication references, (extracts from) annual or project reports to funders/sponsors etc., or any other relevant materials that may serve as evidence.

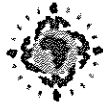
List of supporting documents submitted along with this application as addendums:

Please ensure that the documentary evidence below is clearly cross-referenced with the relevant section and number in the application template, for example Section B1 or Section C4.

- Appendix 1: List of Post Graduates Researchers participating in the Karoo SG Baseline Research Programme (Except from stakeholder report to the ECPG and the NRF)
- Appendix 2: Report of the Information Sharing Workshop with Cradock Stakeholders, October 2015. (1st Cradock Community SG Roundtable)
- Appendix 3: Briefing on the Cape Imbizo (23-24 November 2015) *and* the WATER WORKS Workshops (2-6 November 2015)
- Appendix 4: Conference Programme: ATSE Unconventional Gas Conference Program, 22-23 September, Sofitel Wentworth, Sydney, Australia

APPENDIX 1: LIST OF POSTGRADUATE PARTICIPATING IN THE KAROO SHALE BASELINE RESEARCH PROGRAMME

AEON-ESSRI KAROO BASELINE STUDIES ACROSS AN EASTERN CAPE REGION IDENTIFIED FOR POTENTIAL SHALE GAS DEVELOPMENT				
SYSTEMS	PROJECTS	FACULTY/ DEPT	RESEARCHER	TYPE
EARTH Geology Geophysics Geochemistry Geomorphology Gasses	Stratigraphy of the main Karoo Basin and Gondwana equivalents	Geoscience	Bastien Linol	PD
	Micro-seismicity based on ambient noise and broadband wave field	Physics	Viera Wagener	PD
	Micro-Seismic velocity inversion and 3-D tomography of the Karoo Basin	Geoscience	Lucian Bezuidenhout	PhD
	Testing local microseismic swarms	Geoscience	Onwaba Semane	MSc
	3D Magnetotelluric Modelling of deep water reservoirs	Geoscience	Jade Greve	MSc
	Airborne geophysics for subsurface architecture and natural resource detection	Geoscience	Martin Bentley	MSc
	Characterising brittle deformation structures of the critical zone	Geoscience	Taufeeq Dhansay	PhD
	Surface and subsurface geometry and petrology of dolerite sill and dykes	Geoscience	Thomas Muedi	PhD
	Metamorphism and fluid migration adjacent to dolerite dike and sill contacts.	Geoscience	Vuvu Nengovhela	MSc
	Tracing geochemical evolution of Karoo Black Shales	Geoscience	Tebatso Maaake	MSc
WATER Surface Ground-water Deep-water Soil	Mineralogical and chemical composition of groundwater	Geoscience	Lebo (Malebogo) Shezi	MSc
	Groundwater chemistry and aquifer connectivity	Geoscience	Divan Stroebel	PhD
	Geochemical characterisation of the shallow water aquifers	Geoscience	Keegan Jeppesen	MSc
	Age and origin of groundwater	Geoscience	Sinazo Dlakavu	MSc
	Geochemistry of hydrocarbon gases associated with formation waters	Geoscience	Mimi Mokoena	PhD
	Geochemistry of Radon in the groundwater	Geoscience	Zanele Hobongwana	MSc
	Characterisation soils using spatial statistics of termite mounds	Geoscience	Mulalo Nevhulamba	MSc
LIFE Ecology Botany Zoology	Landscape functionality and spectral analysis	Geoscience	Megan de Jager	PhD
	A Diatom early warning system to detect surface and groundwater contamination	Life Science	Marion Holmes	PhD
	Invertebrate assemblages in lakes and wetlands	Life Science	Annah Mabidi	PhD
	Controlled experiments using fracking fluids on Succulent and Thicket vegetation	Life Science	Kristen Ellis	PhD
PEOPLE Socio-Economics Public Participation Citizen Science Risk & Regulations Land & Indigenous Rights Epidemiology	Mammals as ecosystem engineers	Life Science	Stephanie Martin	MSc
	Community impacts - history and dynamics	Political Science	Barry Morke	PhD
	Developing local monitoring capacities within rural communities	Social Science	Nyaradzo Dhlwayo	PhD
	Agriculture livelihoods	Social Science	Chwayita Kani	MA
	Land tenure rights	Social Science	Mkhusele Mtsila	MA
	Social designs and entrepreneurship	Arts/Applied Design	Ami Hawley	MDipl
DATA MANAGEMENT	Endemic health and disease patterns	Health Science	Shanene Olivera	MSUR
	Big data integration and visualisation of multi-parameter	IT Science	Martin Bentley	MSc
DOCUMENTARY	Video-scientific documentary of Baseline Research	Arts/Applied Design	Nadia van der Walt	MDipl



AEON
AFRICA EARTH OBSERVATORY NETWORK
INSTITUTION FOR INTEGRATED RESEARCH

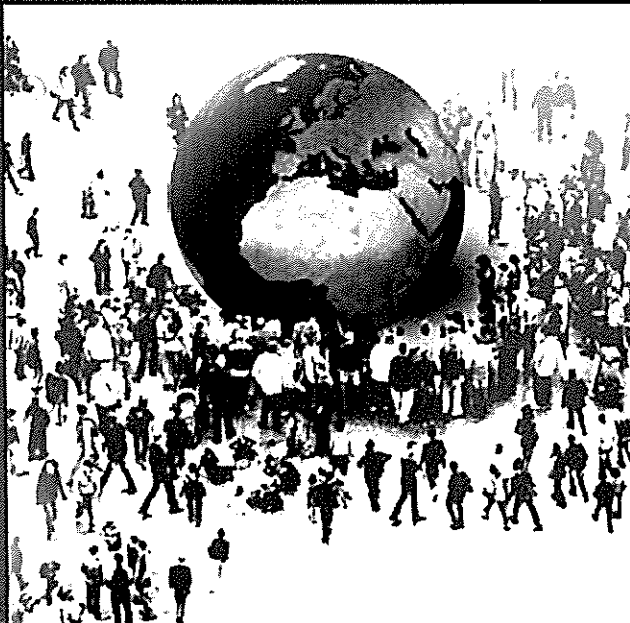


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**Earth Stewardship Science
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Meeting new challenges in Africa

APPENDIX 2



**REPORT ON THE SHALE GAS INFORMATION SHARING WORKSHOP WITH
STAKEHOLDERS FROM CRADOCK**

Hosted on 21 OCTOBER 2015,
Vusubuntu Cultural Village,
Cradock

www.aeon.org.za

www.nmmu.ac.za

**REPORT ON THE SHALE GAS INFORMATION SHARING WORKSHOP WITH
STAKEHOLDERS FROM CRADOCK**

**Hosted on 21 OCTOBER 2015,
Vusubuntu Cultural Village, Cradock**

Report Contents:

- A. Introduction
- B. Workshop Agenda
- C. Summary of presentations
- D. Summary of the day proceedings and way forward

1. Introduction

This report follows an information sharing workshop and round table discussions held at the Vusubuntu Cultural Village in Cradock, with the Cradock community stakeholders, relating to the ongoing Shale Gas Baseline Study being conducted by the African Earth Observatory Network (AEON). Part of this study includes the development of a Citizen Science Program that needs to be initiated in Cradock and surroundings, thus facilitating this workshop under the leadership of the Programme Study leader, were some of the graduate students from Nelson Mandela Metropolitan University (NMMU).

And with the consent of the Cradock community leadership, this workshop was planned in conjunction with the local councilors and civil society representatives in the community. Attached is a list of workshop attendees.

2. Workshop Agenda

The workshop was structured in response to a growing need expressed by various community leaders and community based structures for deeper community awareness and knowledge sharing on the proposed shale gas development previously announced in the Karoo by national government. In addition, the session was also important for introducing the community to the AEON-NMMU Citizen Science Programme on Shale Gas development and community participation in the baseline study and its related Community Ground Water Monitoring Initiative. In advancing these objectives the following considerations informed the agenda for the day:

- Information sharing on NMMU Shale Gas Baseline Study in Eastern Karoo;
- Develop relationship between NMMU-AEON and Cradock community in relation to the NMMU Shale Gas Baseline Study and to gain a better understanding of community opinions and perspectives on proposed shale gas development in their area;
- Attain consent from Cradock community stakeholders to conduct Baseline research study;
- Formulate strategy of community engagement for the NMMU Shale gas Baseline study (draft)

To achieve the above-mentioned workshop agenda, the following programme was a guide to the facilitators and the community stakeholders present.

**INFORMATION SHARING WORKSHOP ON THE NMMU KAROO SHALE GAS BASELINE STUDY IN
COLLABORATION WITH STAKEHOLDERS FROM CRADOCK COMMUNITY**

21 OCTOBER 2015 at 0930hrs – 13:00hrs

Vusubuntu Cultural Village, Cradock

PROGRAMME

- 09:30 - 09:35** Opening and Welcome (**LED Chairperson**)
- 09:35 - 09:40** Purpose of the day (**Barry**)
- 09:40 – 10:20** Introduction to Shale gas and Baseline studies in the Karoo (**Maarten**)
- 10:20 – 10:30** Community Rights and Consultation (**Barry**)
- 10:30 – 10:45** Citizen Science (**Nyari**)
- 10:45 – 11:00** TEA BREAK
- 11:00 - 12:00** Round Table Discussion (**Nyari**)
- 12:00 – 12:15** Feedback session (**All Groups / Rapporteurs**)
- 12:15 – 12:30** Plenary Discussion / Question and Answer
- 12:30 – 12:50** Summary and way forward (**Nyari and Barry**)
- 12:45 – 13:00** Vote of Thanks (**SANCO Representative**)

3. Summary of Presentations and Report on the Process

Session 1: Information and Knowledge Sharing

The workshop opened with welcome remarks from Councilor Goniwe (LED Portfolio Councilor for IYLM) who immediately introduced the agenda of the day and the responsible presenters from Nelson Mandela Metropolitan University.



Presentations and discussions followed as per programme in the previous section. Firstly a detailed presentation from Prof Maarten De Wit (AEON-NMMU Programme Study Leader) was given, which focused on the background of Shale gas production and its technical aspects and processes involved in exploration and extraction of the gas. The presentation focused on aspects of shale gas development such as extraction of the gas, and how the gas

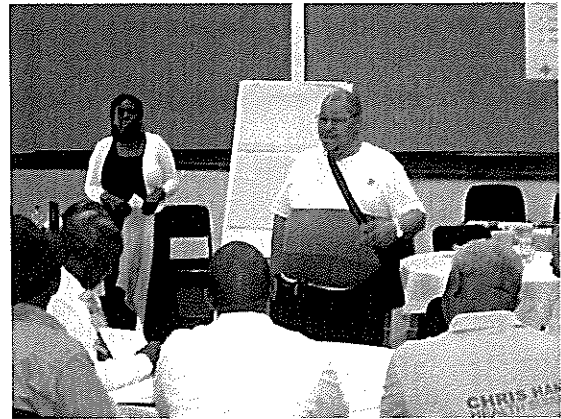
is extracted. The presentation also addressed some of the risks involved within this process of shale gas development.

Mr Barry Morkel (Programme Coordinator and Doctoral Student) followed with a presentation on community rights and importance of community participation in the decision making and management of natural environment and resources. This presentation included an overview on of the various pieces of legislation impacting on the process of mineral rights, licensing and public participation within the process. In this regard a brief presentation was made on the opportunities for public comment and participation within the overall process of licensing, and the various obligations placed on petroleum companies in ensuring that environmental impacts are considered, mitigated and consulted with local communities through various stages in the process.

As a collaborative way of community engagement, stakeholders were asked to respond to the presentations in progress. Concerns were however raised particularly on the technical nature of the presentations, which made understanding of some of the concepts challenging to some of the stakeholders present. It was agreed by all present to allow a repeat of technical presentation on shale gas production, its concepts and its potential effects, on a simpler scale. It was agreed that this would be facilitated at a later stage, and possible at the next Round Table meeting. Some suggestions brought forward also included the need of a translator, or a model to allow quick and easy understanding to the shale gas production concept and the process as a whole.

Session 2: Introduction to Citizen Science and Roundtable Discussion

The workshop continued further with more on community participation being discussed during a presentation by Ms. Nyaradzo Dhlwayo (AEON-NMMU Doctoral student) that centered on the citizen science concept and its relevance to the Shale Gas Baseline study by NMMU in the Karoo. The presentation outlined Citizen Science is a concept which refers to the participation of local citizens (*umthathi nxaxheba* or *Ulungiso*) in scientific research. She highlighted how important citizen science is in terms of it being an opportunity for new ideas, and co-creation of new scientific knowledge when scientists work together (*intsebenziswano*) with the local communities during research (particularly in the Shale gas baseline study). Benefits of social cohesion, resource ownership (*isilawuli*) and connectivity (*uqhagamshelwano*) among others were highlighted to the stakeholders.



Session 3: Round Table Discussion and Participant Interaction

In order to meet the objective of designing a strategy of community participation, in the Shale Gas baseline study, a round table discussion was suggested in which the workshop participants were divided into groups for discussion of various themes pertinent to prospective shale gas development in this community.

This session was facilitated by Ms Dhlwayo and Mr Morkel in collaboration with all the stakeholders present, with each group identifying a group facilitator, scribe and rapporteur. It was important for participants to interact and engage with the subject in a participative, free, open and non-threatening environment.

In facilitating this, a set of concerns and questions were raised by the stakeholders, and with assistance from the NMMU research team, four groups were formed amongst the participants, where each of these concerns were addressed. The community representatives, municipal councilors, civic society representatives present engaged in the discussions. The participants' responses were recorded and put in Table 1.1 below, as per the feedback provided by the rapporteurs.

ROUND TABLE GROUP DISCUSSION and REPORT BACK FROM GROUPS

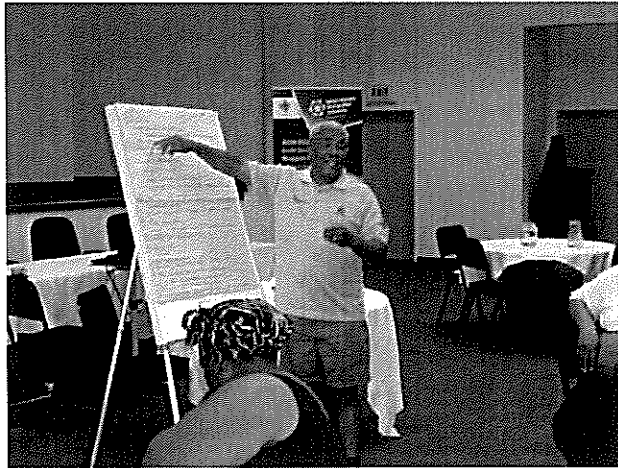
Themes/Questions	GROUP 1	GROUP 2	GROUP 3	GROUP 4
<p>a) What are your concerns about shale gas, as the community?</p>	<ul style="list-style-type: none"> • There is a need for more information (<i>on shale gas</i>) • More simplified technical presentations (with models and demonstrations, needing to be more interactive) • Impact on the environment from contamination (precautionary measures) • Lack of measuring tool 	<ul style="list-style-type: none"> • What will happen in the future concerning the next generation? • Eruption – tsunami (earthquakes) • Who is going to gain? 	<ul style="list-style-type: none"> • Job controlled opportunities • Boost or growth of economy • Gas and oil price decrease or affordable • Poverty reduction • Possibility of earthquakes • Air and water pollution • Health risk • Danger to ecosystem 	<ul style="list-style-type: none"> • The community is not well informed • Who will benefit from shale gas?
<p>b) How best to engage the process and build community awareness and participation?</p>	<ul style="list-style-type: none"> • Establish a study group (diversity) • The group needs to assist in the information transfer 	<ul style="list-style-type: none"> • Nothing about us without us 	<ul style="list-style-type: none"> • Community meeting • Establish a structured forum • Mass media 	<ul style="list-style-type: none"> • AEON must have an open line so that we can put our concern across through the structure we are going to set up here
<p>c) How best to communicate information amongst the community?</p>	<ul style="list-style-type: none"> • Community meetings • Direct contact with stakeholders and 	<ul style="list-style-type: none"> • Some workshops – us and them • Sharing of 	<ul style="list-style-type: none"> • Social media (whatsapp, emails, Facebook) • Public consultation and 	<ul style="list-style-type: none"> • We need to set-up a structure from the stakeholders

	community groups	information using media	participation	(currently here)
d) Other stakeholders which need to be included in the process.	<ul style="list-style-type: none"> Department of Agriculture and Environment and Energy Water uses associations 	<ul style="list-style-type: none"> Community involvement Municipality Different organisations (SANCO, Women's Organisations; etc) 	<ul style="list-style-type: none"> Ward committees, SGB's, clinic committees, CDW's, sport council, political parties, faith based organisations 	<ul style="list-style-type: none"> The structure must communicate with other stakeholders that are not here
e) Which are the critical resources within the community which need to be considered in the process?	<ul style="list-style-type: none"> Water Human resources Land (Access for Drilling and factory or facility) 	<ul style="list-style-type: none"> Land security - guard against soil erosion, etc minerals - water pollution 	<ul style="list-style-type: none"> skills empowerment bursaries gas land water oil 	<ul style="list-style-type: none"> Workshops and the technical information on protection of natural resources (e.g. water)
f) What do you not like about the ongoing shale gas debate and how information is communicated, overall?	<ul style="list-style-type: none"> Exclusion from previous discussions 	<ul style="list-style-type: none"> Untrustworthy 	<ul style="list-style-type: none"> Emphasise on profit making rather than the welfare of community Poor community involvement Implementation moves at small pace 	<ul style="list-style-type: none"> The different kind of information (companies) because it is not empowering our communities
f.1) What did you not like about today's session, or what could be improved upon?	<ul style="list-style-type: none"> First part of presentation, too technical 	<ul style="list-style-type: none"> Language (complicated and scientific) Advantages and disadvantages 	<ul style="list-style-type: none"> Too complex, technical and scientific Practical functioning of IT 	

<p>(explain to us)</p> <ul style="list-style-type: none"> • Proposal: To be educated in a simple language and more practical than theoretical 	<ul style="list-style-type: none"> • Was informative (we understand where we fit in, or our role) • A bit of knowledge about shale gas • The difference between shale gas and moss gas • Simplified and complex presentations • Marginal knowledge about shale gas • We as the communities have the right to be informed
<p>g) What have you gained today?</p>	

4. Summary of the day proceedings and way forward

In summarising the feedback from communities it had clearly emerged that there was a need for a sustained discussion and information sharing platform on Shale Gas Development in the Karoo. In plotting the way forward, the workshop agreed to establish a Cradock Community Shale Gas Round Table, which would include all relevant community based structures, the local municipality, and other relevant stakeholders.



The meeting agreed to convene another session to adopt this report, and to agree on the form and terms of reference for the Shale Gas Round Table. It was agreed that the AEON – NMMU team would circulate this report, and that the next round table meeting will be convened through the office of the Inxuba YeThemba LM, specifically through the Office of the Portfolio Councillor for LED (Cllr. S. Goniwe).

Concluding the workshop however, some simpler ways for dissemination of information on the Shale gas baseline study was requested, which requires further discussion in the next stakeholders' workshop (date to be confirmed). The NMMU graduate research team was requested by the stakeholders to organize a follow-up workshop with the same stakeholders and others who had failed to attend. This follow-up workshop would address the issues raised on this day during the presentations and roundtable discussion. In addition the setting-up of a working community representative structure or team to work with NMMU graduate researchers will be done at the same forum.

The session enabled concerns, needs and experiences surrounding the ongoing Shale Gas Baseline Study currently in the Eastern Karoo, to be shared openly between NMMU researchers and the Cradock community. This was also in line with the main goal of the AEON-NMMU project. The workshop also led to the understanding of the expectations in terms of collaboration and interaction between NMMU researchers and the Cradock community in this project.

Contact Persons

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The NMMU/AEON Shale Gas Baseline Study is being implemented in partnership with the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (DEDEAT)

APPENDIX 3: Briefing on the Cape Imbizo (23-24 November 2015) and the WATER WORKS Workshops (2-6 November 2015)

Cape-Karoo *Imbizo*

AEON-ESSRI (African Earth Observatory Network-Earth Stewardship Science Research Institute) organized a Cape-Karoo “*Imbizo*” from 23rd to 30th November 2015, at the Nelson Mandela Metropolitan University (NMMU) in Port Elizabeth. The objective of this “*Imbizo*” was to provide a platform for geoscientists to collaborate and contribute to the advancement of research in the Karoo Basin and the flanking Cape Mountains of South Africa.

91 participants attended the conference, including from Germany, Norway and Brazil, dominated by student and academics from South African universities (NMMU, Cape Town, Western Cape, Stellenbosch, Johannesburg, Witwatersrand, Pretoria, and University of Free States), and professionals from natural museums (Rhodes and Iziko South African Museums) and national agencies/companies (Council for Geosciences, Exxaro Resources, Petroleum Agency and PetroSA). The 3-days conference was preceded by a 2-day Scientific Oil & Gas short course, focussed on Conventional and Unconventional (shale) resources by Dr Hans-Martin Schulz of the GFZ-Potsdam, Germany (with 26 participants) and followed by a 3-days field trip across the Eastern Cape, starting along the Algoa coast near Port Elizabeth, and Graaff-Reinet, across a Cape mountain pass to Steytlerville and vast areas of the Karoo hinterland, including the Kalkkop meteor impact site, both below and above the South African Great Escarpment, including a memorable visit to the legendary Paleontology Museum on the Rubidge farm (52 participants). The trip ended at the Stormsriver Mouth. Details, including the conference programme and the field-trip guide are provided online: www.aeon.org.za/capekaroo.

The main conference included 55 oral and 15 poster presentations covering a wide range of disciplines, divided into 9 sessions: 1) Subsurface geology and geophysics; 2) Structural geology; 3) Magmatism and metamorphism; 4) Stratigraphy and sedimentary systems; 5) Palaeontology and paleo-environments; 6) Karoo gas shale and shale gas potential; 7) Petrophysics of reservoir rocks; 8) Critical zone: soil, water and ecosystems; and 9) Geodynamics. These presentations form the basis for a book entitled: “Origin and Evolution of the Cape Mountains and Karoo Basins” to be published by Springer-Verlag early in 2016. Following the formation of Gondwana the Cape-Karoo system developed along the southern margin of this supercontinent. The lower Paleozoic Cape Supergroup was first deposited along the Gondwana passive margin coast. As this continent it migrated over the South Pole it became covered by a major ice sheet, as witnessed by the Dwyka tillites (300-350 million years ago). During rapid deglaciation, black shales were deposited, followed by regional deformation between about 275 and 250 Ma. This resulted in deposition of thick sequences of marine turbidite and terrestrial fluvial sandstones and mudstones that form most of the Karoo Supergroup

and which preserve a unique fossil record of (Gondwana) land colonization prior and during the dinosaurs. The terrestrial record of the major Paleozoic- Mesozoic extinction at 251 Ma is probably better preserved in the Karoo than elsewhere globally. The Karoo sequences terminate with abundant dolerite intrusions and the eruption of large volume of basalts at around 182 Ma, during the break out of Africa from Gondwana and the opening of the southern Ocean. This book describes the geologic and biological evolution of this unique landscape, a region in South Africa that is presently being considered for shale gas exploration and development.



Conference participants at the NMMU Council Chamber



Field trip participant observing the Karoo Basin near Jansenville



PROGRAM

IMBIZO: Origin and Evolution of the Cape Mountains and Karoo Basin

Monday & Tuesday (23-24th Nov.)

09:00 - 16:30 **2 DAYS** by Hans-Martin Schulz (GFZ-German Center for Geoscience, Potsdam, Germany) Oil & Gas Shale Short course - Venue: Science Faculty, Room 0111, Building 13, South Campus

CONFERENCE - Venue: Council Chamber, Main Building, South Campus
Wednesday (25th Nov.)

Welcome - DVC Research

The shaping of southernmost Africa: Fun and Challenges - M. J. de Wit (AEON/NMMU)

- Chair: M. Doucouré

Session 1: Subsurface Geology and Geophysics

1.1. Boreholes

09:30 - 09:45 Karoo Basin deep borehole stratigraphy revisited - B. Linoi, N. Chere, T. Muedi, V. Nengovhela and M.J. de Wit (AEON/NMMU)

09:45 - 10:00 Diagenetic, thermal and provenance histories of the Permian lower Ecca Group based on two newly drilled boreholes in the western and eastern main Karoo Basin - C. Geel & E.M. Borch (UCT)

10:00 - 10:15 The Karoo Supergroup in the Free State province: Thickness and depth to basement in the vicinity of a basin forebulge - A. Rutherford (Witwatersrand)

10:15 - 10:30 Towards a digital 3D model of the main Karoo Basin - S.S. Speiman & E.M. Borch (UCT)

BREAK

1.2. Geophysics

11:00 - 11:15 Seismic imaging of sills, dykes and hydrothermal vents in the main Karoo Basin, South Africa: implications for shale gas potential - S. Webb, M. Manzi and S. Scheiber-Enslin (Univ. Witwatersrand)

11:15 - 11:30 Flexure modelling of the Whitehill Formation, a key to unlocking basin formation - S. Scheiber-Enslin, J. Ebbing and S. Webb (Univ. Witwatersrand)

11:00 - 11:15 Microseismic Observations in the Karoo: Leeu-Gamka - M. Fynn, R. Kahle and B. Kahle (UCT)

11:30 - 11:45 Preliminary results of microseismicity in the south-central Karoo using ambient noise - L. Bezuidenhout, V. Wagener and M. Doucouré (AEON/NMMU)

Q&A / Discussion

Session 2: Structural Geology - Chair: M.J. de Wit

12:00 - 12:15 Geochronology and tectonic history of the Gamtoos Complex, Eastern Cape - W. Miller, R. Armstrong, and M.J. de Wit (AEON/NMMU)

12:15 - 12:30 Folds, faults and crustal shortening in the eastern part of the Cape Fold Belt: Examples from the Steytlerville and Port Elizabeth areas - P. Booth, C. Anderson and G. Brunsdon (NMMU)

12:30 - 12:45 An evaluation of the brittle evolution of the Cape Fold Belt and Karoo Basin, South Africa - T. Dhansay (AEON/NMMU)

Q&A / Discussion

LUNCH

12:45 - 13:00

13:00 - 14:00

Session 3: Magmatism and Metamorphism

- Chair: N. Tonnelier

14:00 - 14:15 Evidence for the correlation of basalts of the Suurberg Group with the upper part of the Karoo basalt sequence of Lesotho - J.F. Marsh (Rhodes Univ.)

14:15 - 14:30 The petrogenesis of the Mount Ayil Complex and its genetic relationship to the Karoo Igneous Province: Evidence from Cr spinel mineral geochemistry - B. Nisabula & S.A. Preveeck (Rhodes Univ.)

14:30 - 14:45 Contact metamorphism along a dolerite sill within the Lower Ecca black shale of the QU1/65 borehole, northern Cape - D. Moorcroft & N. Tonnelier (NMMU)

14:45 - 15:00 Karoo volcanic cycle revisited: integrating the surface geological record with mantle evidence and complex systems theory - D. Bell (AEON/NMMU)

BREAK

15:00 - 15:30

15:30 - 17:00

17:30 - 19:00 Posters presentations and Discussions
CAPE-KAROO SOCIAL - Beer, wine and snack at Rendez-vous Café

Thursday (26th Nov.)

Session 4: Stratigraphy and Sedimentary Systems - Chair: E.M. Bordy	
4.1. Cape	
09:00 - 09:15	A record of sedimentation of the late-Ordovician Soom Member (Cedarberg Formation) from new borehole data in the Cedarberg region - C. Browning et al. (Council for Geoscience)
09:15 - 09:30	The shifting sands of the Devonian of South Africa: Assessment of eustatic trends and palaeoenvironmental shifts in the Bokkeveld Group - C. Penn-Clarke, B. Rubidge and Z. Jinnah (Univ. Witwatersrand)
4.2. Karoo	
09:30 - 09:45	Dryka eskers along the northern margin of the main Karoo Basin - M.J.C. de Wit (Univ. Pretoria/Isodilo Resources Ltd.)
09:45 - 10:00	Towards quantifying the spatiotemporal variations in the composition and geometry of the Permian Whitehill Formation, main Karoo Basin - K. Chukwuma & E.M. Bordy (UCT)
10:00 - 10:15	Reanalysis of cryptic sedimentological relationships between the Southern Karoo Ripon and the south-western Karoo Visekvuif-laingsburg formations - S. Walter & R.T. Tucker (Univ. Stellenbosch)
10:15 - 10:30	Recognising stratigraphic gaps in the Beaufort Group: Consequences for basin modelling - B.S. Rubidge, M. Day, P.A. Vignelli and F. Abdala (Univ. Witwatersrand)
10:30 - 11:00	BREAK
11:00 - 11:15	Changing rock accumulation rates in the end-Permian Balfour Formation, Beaufort Group - C. Hatton & L. Magadaza (Council for Geoscience)
11:15 - 11:30	Magnetostatigraphy of the Elliot Formation and the Triassic-Jurassic boundary in southern Africa - L. Sciscio, E.M. Bordy, M. de Kock and F. Knoll (UCT)
11:30 - 11:45	
11:45 - 12:00	Q&A / Discussion
Session 5: Palaeontology and Paleo-environments - Chair: B.S. Rubidge & R.M.H. Smith	
5.1. Palaeontology	
12:00 - 12:15	Fossils heritage of the Lower Devonian Voorsteek Formation (Cape Supergroup) and its stratigraphic value for correlations in SW Gondwana - M. Reid, E.M. Bordy and W. Taylor (UCT)
12:15 - 12:30	The Witteberg fossil record and the end Devonian Extinction event - R.W. Gess (Albany Museum)
12:30 - 12:45	Middle Permian tetrapod biostratigraphy in the main Karoo Basin and the Guadalupian-Lopingian faunal transition - M. Day and B.S. Rubidge (Univ. Witwatersrand)
12:45 - 13:00	The Daptocephalus Assemblage Zone - P.A. Vignelli, B.S. Rubidge and R.M.H. Smith. (Univ. Witwatersrand)
13:00 - 14:00	LUNCH
14:00 - 14:15	
14:15 - 14:30	Towards a refined sauroptomorph biostratigraphy for the Elliot Formation of southern Africa - J. N. Choiniere, B.W. McPhee, E.M. Bordy and L. Sciscio (Univ. Witwatersrand)
14:30 - 14:45	Reviewing correlations between the terrestrial and marine records of the End-Permian extinction - J. Neveling et al. (Council for Geoscience)
5.2. Palaeobotany & Palynology	
14:45 - 15:00	Fossil woods from the Upper Carboniferous to Lower Jurassic Karoo sequence and the environmental interpretation - M.K. Bamford (Univ. Witwatersrand)
15:00 - 15:15	Glossopteris floras of South Africa: an untapped biostratigraphic resource or a lost cause? - R. Prevec (Albany Museum/ Rhodes Univ)
15:15 - 15:30	Proximal and distal facies correlations in the Karoo retroarc foreland system using palynology - N. Barbolini, B.S. Rubidge and M.K. Bamford (Univ. Witwatersrand)
15:30 - 16:00	BREAK
5.3. Ichthyology	
16:00 - 16:15	Burrowing as a tetrapod survival strategy during rapid environmental changes: evidence from the Beaufort Group, Karoo Basin - R.M.H. Smith (Iziko South African Museum/Univ. Witwatersrand)
16:15 - 16:30	Ichthyostratigraphy of the Triassic-Jurassic of southern Africa (Lesotho and South Africa) - E.M. Bordy, L. Sciscio and R. Tucker (UCT)
16:30 - 16:45	Digital assessment of trace fossils in the Karoo Supergroup, South Africa - W. Krummeck & E.M. Bordy (UCT)
16:45 - 17:30	Q&A / Discussion

Friday (27th Nov.)

Session 6: Karoo Gas Shales and Shale Gas Potential - Chair: B. Linol	
09:00 - 09:15	H. M. Schulz et al.
09:15 - 09:30	Macro- to nano scale investigations of the Permian black shales of the Ecca Group for their shale gas potential in the main Karoo Basin - N. Chereh, H.-M. Schulz, M.J. de Wit and B. Linol (AEON/NMMU)
09:30 - 09:45	The effect of dolerite intrusions on the shale gas potential of the Ecca Group in borehole from the central Karoo Basin - E.O. Adeniyi, M.O de Kock, F. Ossa Ossa and N.J. Beukes (Univ. Johannesburg)
09:45 - 10:00	Physicochemical Properties of South African Shales in the Context of CO2 Geological Storage - Nkokwana et al. (Council for Geoscience/University of Pretoria)
Session 7: Petrophysics of Reservoir Rocks - Chair: M.J. de Wit	
10:00 - 11:15	High resolution scanning of Karoo sedimentary rocks along dolerite sill contacts: Metamorphic effects on shale porosity and permeability - V. Nengovhela et al. (AEON/NMMU)
10:15 - 10:30	Paleo-stress patterns and its possible implications on hydrocarbon migration in offshore Orange Basin - C. Samakinde & J. van Bever Donker (UCT)
BREAK	
10:30 - 11:00	Petrophysical evaluation of sandstone reservoirs: A case study of selected wells in the Bredasdorp Basin, offshore South Africa - M. Macqoba & M. Opuwari (UWC)
11:00 - 11:15	Electrolithofacies analysis and its application for reservoir characterization in the Southern Pleistocene Basin, offshore South Africa - M. E. Oghenekame et al. (UWC)
11:30 - 11:45	Q&A / Discussion
Session 8: Critical Zone: Soils, Water, Caves and Ecosystems - Chair: R. Prevec	
11:45 - 12:00	An investigation of the movement of sediment through the Noordhoek headland bypass dune field system at Cape Recife - G. Goosen (NMMU)
12:00 - 12:15	Understanding sediment dynamics on intertidal salt marshes of South African estuaries: The case of Keurbooms Estuary - A. Mfikili, T. Bornman and D. Du Preez (NMMU)
12:15 - 12:30	A preliminary assessment of the physico-chemical characteristics of surface waterbodies in a region earmarked for shale gas exploration (Eastern Cape Karoo) - A. Mabidi, M. Bird and R. Perissinotto (NMMU)
12:30 - 12:45	A geochemical characterisation of the shallow water aquifers in the Border-Kei region, Eastern Cape - K. Jeppesen (AEON/NMMU)
12:45 - 13:00	Cango Cave stalagmites reveal rapid ecosystem changes : Clues to early Homo sapiens adaption to external forces - M.J. de Wit et al. (AEON/NMMU)
13:00 - 14:00	LUNCH
Session 9: Geodynamics - Chair: S. Webb	
14:00 - 14:15	West Gondwana-scale correlations of the Cape-Karoo sequences - B. Linol et al. (AEON/NMMU)
14:15 - 14:30	T. Anders
14:30 - 14:45	The Cape - Sierra de la Ventana Fold Belt of southwest Gondwana - A. Assis et al. (UFRJ, Brazil)
14:45 - 15:00	The onset of flexural subsidence in the Karoo Basin - Z. Jimnah, M. Berti, and K. Mogaadile (Univ. Witwatersrand)
15:00 - 15:15	Cape-Karoo tectonometamorphism - D. Bell and M.J. de Wit (AEON/NMMU)
15:15 - 15:30	Epitogeny and evolution of the landscapes of the Cape-Karoo - M.J. de Wit, B. Linol and D. Bell (AEON/NMMU)
15:30 - 16:00	BREAK
Discussion - Progress and Future	
16:00 - 17:00	Towards a comprehensive understanding of the evolution of the Cape-Karoo heritage. Step1 : Book, Springer-Verlag

Saturday (28th Nov.)

Departure: 8:30 from Pine Lodge	Field Trip	overnight in: Steytlerville
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Sunday (29th Nov.)

Memorial thoughts D. Roberts @ Kalkkop	Field Trip	overnight in: Graaff-Reinet
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Monday (30th Nov.)

Return: 19:30	Field Trip	
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List of Posters

- First 3D inversion results from magnetotelluric data of the Eastern Karoo Basin, South Africa - A. Platz, J. Greve, U. Weckmann and M. Doucouré (AEON/NMMU)
- Structural and geochemical analysis of the Karoo sedimentary rocks along dolerite dyke and sill contacts, Eastern Cape Province - V. Nengovhela (AEON/NMMU)
- Carbon isotope ratios and impurities in diamonds from southern Africa - A. Kidane, M. Koch-Müller, M. Wiedenbeck and M.J. de Wit (AEON/NMMU)
- Gypsum Deposits Associated with the Whitehill Formation (Ecca Group) in the Steytlerville-Jansenville Area, Southern Karoo - R. Almanza (AEON/NMMU)
- Fluvial architectural study across the Abrahamskraal and Teekloof Formations (lower Beaufort Group, Karoo Supergroup) in the South-West main Karoo Basin - F. Paiva and E.M. Bordy (UCT)
- Preliminary results from a field reconnaissance to locate the base of the Changhsingian in the Karoo Basin - L. Magadaza & C. Halton (Council for Geoscience)
- Lungfish burrows in the Adelaide Subgroup of the Beaufort Group in the south-western part of the Karoo Basin - A.I. Odendaal & J.C. Looock (Univ. Free State)
- The stratigraphic value of the Pronksberg Bentonite in the upper Elliot Formation (Early Jurassic) Eastern Cape - M. Abrahams, E.M. Bordy and D. Frei (UCT)
- Tracing the geochemical evolution of Karoo black shales - T. Maake (AEON/NMMU)
- A groundwater study Origin and evolution of groundwater in the southern Karoo region - S. Dlakavu (AEON/NMMU)
- Geochemistry of Radon in the groundwater of the southern Karoo - Z. Hobongwana (AEON/NMMU)
- Characterisation of soils in the Karoo using spatial statistics on termite mounds and remote sensing imagery - M. Nevhuamba (AEON/NMMU)
- Soil properties associated with erosion in the Eastern Karoo - M. de Jager (AEON/NMMU)
- Surface and subsurface descriptions of the Early Jurassic Karoo dolerites of the eastern Cape - T. Muedi (AEON/NMMU)
- Anticipated seismicity within the Karoo Basin - R. Ebrahim-Trollop (AEON/UCT)

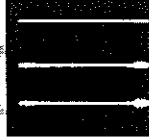


FIELD GUIDE

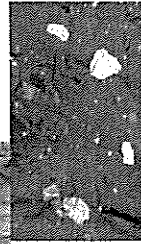


Petrology

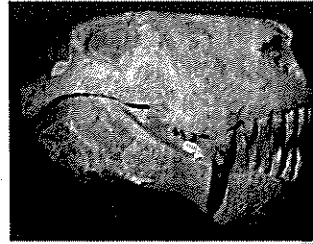
Structure / Geophysics



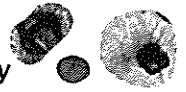
Stratigraphy



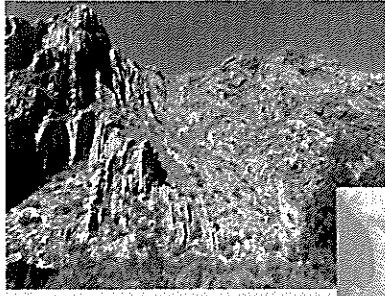
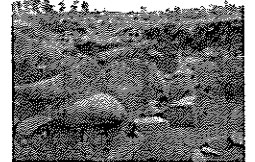
Palaeontology



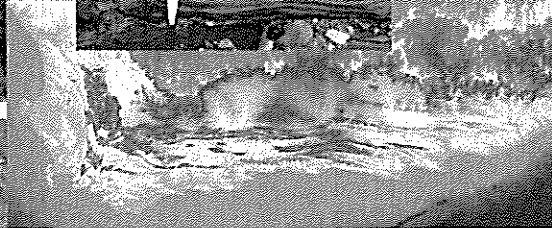
Palynology



Weathering / Soils



Sedimentology



Geomorphology / Thermochemistry



Geochronology

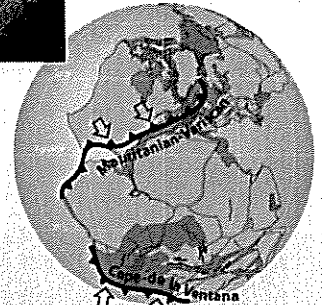


Plate tectonics

Hydrogeology

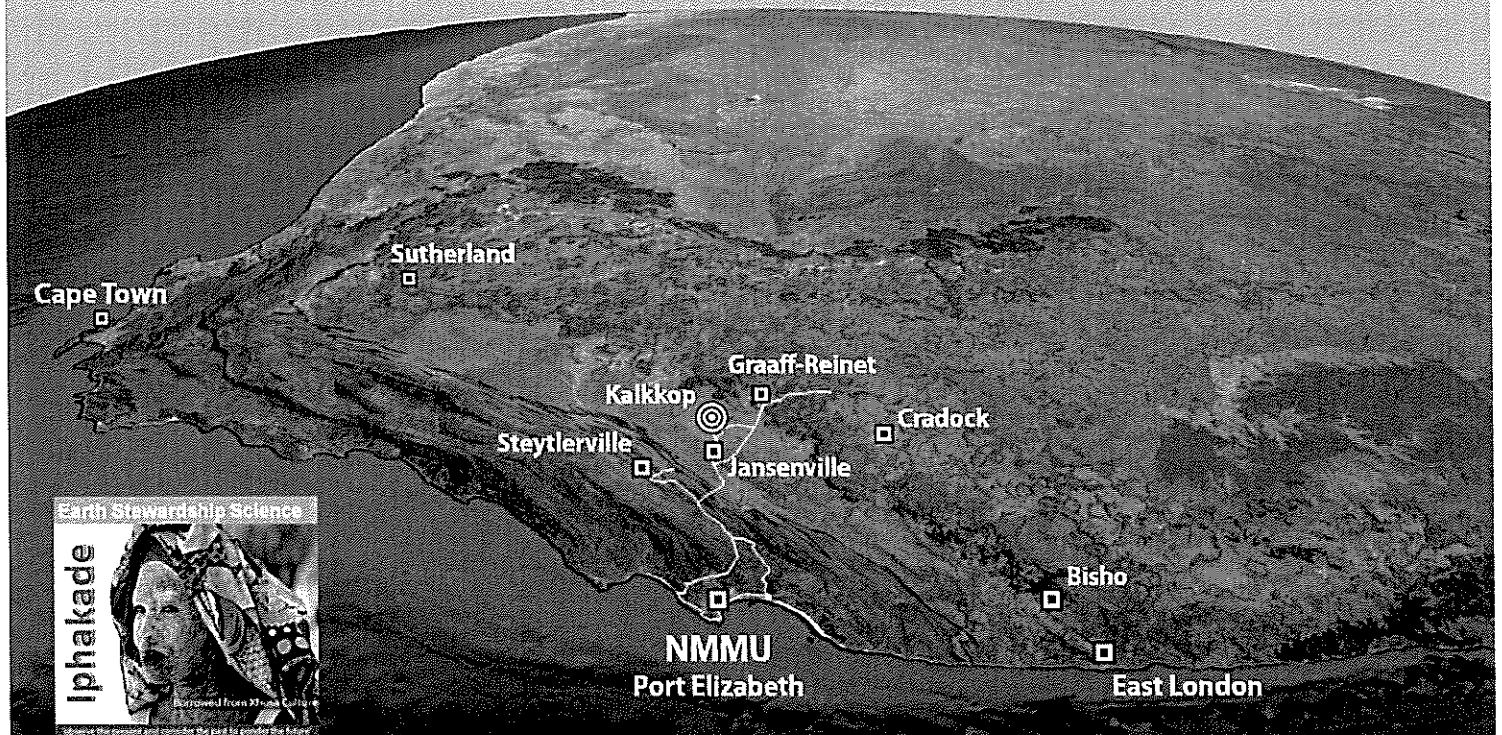


Imbizo

Origin and Evolution of the Cape Mountains and Karoo Basin

Port Elizabeth - Steytlerville - Graaff-Reinet - Port Elizabeth

28th to 30th November 2015



Bastien Linol (Bastien.aeon@gmail.com)
Warren Miller (macwazmac@gmail.com)
Maarten de Wit (Maarten.deWit@nmmu.ac.za)



INKABA yeAFRICA
Earth Systems Science



Oil and Gas Short Course



Earth Stewardship Science
Research Institute



Sedimentology and diagenesis of (un)conventional petroleum systems

Basics and selected topics from prominent oil and gas fields

Hans-Martin Schulz



		Monday, 23 rd November 2016	Tuesday, 24 th November 2016
morning	8:30 – 10:00	Unconventionals Introduction - Shale gas in the Karoo Basin: the Challenges. <i>by M. de Wit</i> Sedimentology and diagenesis of black shale	Conventionals Basics of oil degradation: <i>Processes, consequences and examples</i> The world's largest oil field Ghawar: <i>The role of carbonate-evaporite cycles</i>
	Break		
afternoon	10:30 – 12:00	Some practical guidelines how to investigate black shales Examples of successful shale gas/oil systems	Composite basins and diagenesis of siliciclastics: <i>The North Sea vs. The Western Siberian basin</i> Breaking continents (S America vs. W Africa) & why subsidence matters (S Caspian Basin)
	Lunch		
	13:00 – 14:30		
	Break		
	15:00 – 16:30		

Dr. Hans-Martin Schulz is senior research scientist and group leader "Quantitative Diagenesis" in Sect. 4.3 Organic Geochemistry of Helmholtz Centre Potsdam GFZ-German Research Centre for Geosciences. He coordinates and leads projects about (un-) conventional oil & gas and organic-inorganic interactions in sedimentary basins.



He is a lecturer in program "Basin and Petroleum System Dynamics" (Jacobs University, Bremen), and for Geology at the Institute for Geology and Palaeontology at the Technical University of Clausthal, both in Germany.

In 2014, he co-founded the spin-off WiPS. Consulting GmbH, a consulting company for the upstream industry that offers solutions in all matters regarding hydro-geochemical processes in petroleum systems. He is the scientific director for petroleum system analysis.

Water Works Workshop and Student Conference Programme

The 1st Annual Scientific Iphakade WATER WORKS Workshop** was organised and held from Monday, 2 - Friday, 6 November 2015 at the University of the Free State - Bloemfontein, SA. This workshop built on the previous 10 (ten) Annual Scientific Inkaba yeAfrica Workshops. It focused on water and its importance in the biosphere. Themes have been developed around the hydrological cycle, addressing the importance of water in each component of this cycle, as well as its sensitivity to impacts from human activity. Specific focus was placed on the water challenges faced in South Africa.

Themes included: climate and the potential effects of climate change on water resources; the impacts of mining, industry, agriculture and the energy sector on water resources; management of our water resources; water, human rights and dignity; earth stewardship science and the future of water in Africa and the world.

Details of the workshop agenda are summarized below

Workshop

Monday (2 November 2015)		
Start	End	Item
07:00	08:30	Breakfast + bus ride to UFS
Session 1 - Welcoming and Introduction		
08:30	08:45	Welcoming & Opening - <i>Prof Danie Vermeulen (Acting dean of the Faculty of Natural and Agricultural Sciences, UFS)</i>
08:45	09:00	Housekeeping - <i>Dr François Fourie (UFS, IGS)</i>
Session 2 - The Earth and Water Chair: <i>Dr Modreck Gomo</i>		
09:00	09:30	Origin and distribution of water in the Earth and planets - <i>Prof David Bell (NMMU/AEON)</i>
09:30	10:00	South African geology and aquifer systems - <i>Mr Paul Lourens (UFS, IGS)</i>
10:00	10:30	Tea
10:30	11:00	Isotope hydrology, springs and hot springs - <i>Prof Chris Harris (UCT)</i>
Session 3 - Surface Water Chair: <i>Dr Modreck Gomo</i>		
11:00	11:30	Water resources in South Africa: major challenges faced - <i>Ms Surina Esterhuysen (UFS)</i>
11:30	12:00	Wetlands in urban development areas – assessment, impact and management challenges - <i>Dr Johan van der Waals (Terrasoil Science)</i>
12:00	12:30	Q&A / Discussion
12:30	13:30	Lunch
Session 4 - Energy and Water Chair: <i>Dr François Fourie</i>		
13:30	14:00	Hydraulic fracturing for shale gas extraction: risks to our groundwater resources - <i>Mr Fanie de Lange (UFS, IGS)</i>
14:00	14:30	Water baseline studies in the Karoo - <i>Mr Divan Stroebel (NMMU/AEON)</i>
14:30	15:00	Chemical and isotope fingerprinting of methane with examples from Karoo groundwater - <i>Mr Siep Talma (private)</i>
15:00	15:30	Tea
Session 5 - Water Data Chair: <i>Dr François Fourie</i>		
15:30	16:00	GIS for the presentation and management of water data - <i>Mr Eelco Lukas (UFS, IGS)</i>
16:00	16:30	How much groundwater data is enough to make decisions on? - <i>Dr Koos Vivier (Exigo)</i>
16:30	17:00	Q&A / Discussion
17:00	20:00	Icebreaker: (Gym hall)
20:00		Bus ride to Bain's Lodge

Workshop and Field Excursion

Tuesday (3 November 2015)		
Start	End	Item
07:00	08:30	Breakfast + bus ride to UFS
Session 6 - Climate, Agriculture and Water Chair: Ms Amy Allwright		
08:30	09:00	Climate and the hydrologic cycle; potential impacts of climate change - <i>Mr Stephan Steyn (UFS)</i>
09:00	09:30	Regional drought in KZN and confused decision-making with knock-on effects - <i>Dr Anthony Turton (UFS)</i>
09:30	10:00	Agriculture and its dependence and impacts on water - <i>Mr Wandile Nomqophu (WRC)</i>
10:00	10:30	Tea
10:30	11:00	In-field rainwater harvesting - <i>Mr Cobus Botha (ARC)</i>
Session 7 - Groundwater Exploration and Modelling Chair: Mr Fanle de Lange		
11:00	11:30	Groundwater geophysics: successes, opportunities and challenges - <i>Prof Maarten de Wit (NMMU/AEON)</i>
11:30	12:00	Numerical modelling of groundwater flow and contaminant transport: advantages and limitations - <i>Ms Amy Allwright (UFS, IGS)</i>
12:00	12:30	Q&A / Discussion
12:30	13:30	Lunch
13:30	18:00	Field excursion (Rustfontein Water Treatment Works)
18:00	21:00	Dinner: Shisa Nyama
21:00		Bus ride to Bain's Lodge

Workshop and Field Excursion

Wednesday (4 November 2015)		
Start	End	Item
07:00	08:30	Breakfast + bus ride to UFS
Session 8 - Mining and Water Chair: Mr Eelco Lukas		
08:30	09:00	Water issues in mining environments - <i>Prof Danie Vermeulen (Acting dean of the Faculty of Natural and Agricultural Sciences, UFS)</i>
09:00	09:30	Acid Mine Drainage and the PUMP concept for water treatment - <i>Ms Thakane Ntholi (NMMU/AEON)</i>
09:30	10:00	Mine water: decants, impacts, treatment, potential to use as a resource - <i>Dr Stoffel Fourie (TUT)</i>
10:00	10:30	Tea
Session 9 - Humans and Water Chair: Prof Marian Tredoux		
10:30	11:00	Water governance: the Modder-Riet Catchment Management Forum experience - <i>Dr Johan van der Merwe (Bloemwater)</i>
11:00	11:30	Socio-economic issues related to water use and contamination during hydraulic fracturing - <i>Prof Doreen Atkinson (UFS)</i>
11:30	12:00	Food and water security from domestic rainwater harvesting - <i>Ms Anita Venter (UFS)</i>
12:00	12:30	Earth stewardship science and water - <i>Prof Maarten de Wit (NMMU/AEON)</i>
12:30	13:00	Q&A / Discussion
13:00	14:00	Lunch
14:00	18:00	Field excursion (Paradys Experimental Farm)
18:00	22:00	Dinner: Braai at Paradys Experimental Farm
22:00		Bus ride to Bain's Lodge

Student Conference

Thursday (5 November 2015)		
Start	End	Item
07:00	08:30	Breakfast + bus ride to UFS
Student Conference Chair: Prof Maarten de Wit		
08:30	08:45	Investigating deep basin groundwater flow systems in the Main Karoo Basin of South Africa - <i>Thandokazi Maceba (UWC)</i>
08:45	09:00	Origin and evolution of groundwater in the southern Karoo region of South Africa - <i>Sinazo Dlakavu (NMMU/AEON)</i>
09:00	09:15	Geochemistry of Radon in the groundwater of the Southern Karoo - <i>Zanele Hobongwana (NMMU/AEON)</i>
09:15	09:30	Surface and subsurface descriptions of the Early Jurassic Karoo dolerites: toward a comprehensive understanding of the emplacement mechanism and possible gas migration - <i>Thomas Muedi (NMMU/AEON)</i>
09:30	09:45	The Petrology and Geochemistry of the Karoo shales - <i>Tebatso Maake (NMMU/AEON)</i>
09:45	10:00	A systematic approach to the interpretation of conductivity anomalies across intrusive dolerite dykes and sills in the Karoo Supergroup - <i>Dakalo Makhokha (UFS, IGS)</i>
10:00	10:30	Tea
Student Conference Chair: Prof Cornie van Huyssteen		
10:30	10:45	Investigating the potential of using groundwater associated with a ring-dyke to augment the municipal water supply to Bloemfontein - <i>Lebohlang Molaba (UFS, IGS)</i>
10:45	11:00	Petrological investigation and geochemical characterization of various rock types of the Palabora Carbonatite Complex, South Africa - <i>Sicelo Botha (UFS)</i>
11:00	11:15	The mineralogy and geochemistry of selected Uitkomst Complex contact aureole rocks, Mpumalanga province, South Africa - <i>Malefa Moleme (UFS)</i>
11:15	11:30	The adsorption of heavy metal ions by clay minerals – A possible remediation for contamination in the Witbank coalfield - <i>Rinae Makhadi (UFS)</i>
11:30	11:45	The geochemical and isotopic studies of the Platreef, Turfontein/Macalacaskop, Limpopo Province, South Africa - <i>Jarlen Beukes (UFS)</i>
11:45	12:00	Soil colour as an indicator of soil organic carbon and wetland boundaries on the Maputaland Coastal Plain - <i>Lulu Pretorius (UFS)</i>
12:00	12:15	Land use change affecting soil humic substances in three semi-arid agro-ecosystems in South Africa - <i>Palo Lake (UFS)</i>
12:15	12:30	A geochemical characterisation of the shallow water aquifers in the Border-Kei region, Eastern Cape, South Africa - <i>Keegan Jeppesen (NMMU/AEON)</i>
12:30	13:30	Lunch
13:30	17:00	Field excursion (Florisbad Quaternary Research Station)
17:00	18:00	Free time
18:00	22:00	Dinner: Botanical Gardens Closing - <i>Mr Robert Kriger</i>
22:00		Bus ride to Bain's Lodge

Field Excursion

Friday (6 November 2015)		
Start	End	Item
07:00	08:30	Breakfast + bus ride to the National Women's Monument
08:30	11:00	Field excursion (National Women's Museum)
11:00	11:30	Tea (National Women's Museum)
11:30	12:00	Bus ride to the UFS
12:00		Depart



Unconventional Gas Conference Program

22-23 September
Sofitel Wentworth, Sydney

Day 1	
0800 - 0900	<i>Registration and coffee</i>
0900 – 0930	<p>Session 1: Scene setter</p> <p>Welcome Dr Alan Finkel AO FTSE, ATSE President & Professor Peter Cook CBE FTSE, Chair of the Conference Committee</p> <p>Ministerial Address</p> <ul style="list-style-type: none"> • The Hon Anthony Roberts MP, Minister for Industry, Resources and Energy, NSW Government
0930 - 1100	<p>Session 2: Gas resources and their economics</p> <p>Speakers</p> <ul style="list-style-type: none"> • Dr Francis O’Sullivan, Director of Research & Analysis, Massachusetts Institute of Technology - Energy Initiative, United States • Dr James Johnson, Chief of Division & Deputy CEO, Geoscience Australia • Mr Tony Wood, Energy Program Director, Grattan Institute <p>Panel Discussions and Q&A <i>The following experts will join the session speakers listed above for panel discussions (each panel session will be formed by the same structure)</i></p> <ul style="list-style-type: none"> • Dr Brian Fisher AO PSM FASSA, Managing Director, BAEconomics • Ms Lucy Carter, Project Leader, Boston Consulting Group <p>Panel Chair:</p> <ul style="list-style-type: none"> • Mr John Ryan PSM, Associate Secretary, Department of Industry and Science
1100 – 1130	<i>Morning Tea</i>
1130 – 1300	<p>Session 3: Optimising technologies and minimising impacts</p> <p>Speakers</p> <ul style="list-style-type: none"> • Professor Mark Zoback, Professor of Geophysics and Director of the Stanford Natural Gas Initiative, Stanford University, United States • Professor Rick Chalaturnyk, Foundation CMG Research Chair in Reservoir Geomechanics for Unconventional Resources, University of Alberta, Canada • Ms Michelle McGregor, Senior Oil and Gas Development Advisor, The Nature Conservancy, United States <p>Panel Discussions and Q&A</p> <ul style="list-style-type: none"> • Professor Robert Clark AO FAA, Chair of Energy Strategy and Policy, University of New South Wales

	<ul style="list-style-type: none"> • Mr Wally Kozak, Director of Industry and Government Relations, Calfrac Well Services, Canada • Professor Mike Sandiford FAA, Director, Melbourne Energy Institute – The University of Melbourne <p>Panel Chair:</p> <ul style="list-style-type: none"> • Mr Rick Wilkinson, Chief Technical Officer, Australian Petroleum Production & Exploration Association (APPEA)
1300 – 1400	<i>Lunch</i>
1400 – 1540	<p>Session 4: Protecting groundwater resources</p> <p>Speakers</p> <ul style="list-style-type: none"> • Professor William Fisher, Leonidas T. Barrow Chair and Professor in the Department of Geological Sciences, The University of Texas at Austin, United States • Emeritus Professor Peter Flood, Committee Member, Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) • Ms Gayle Milnes, Assistant Secretary, Office of Water Science, Department of the Environment • Mr Andrew Moser, Groundwater Manager, Origin Energy <p>Panel Discussions and Q&A</p> <ul style="list-style-type: none"> • Mr Randall Cox, General Manager, Office of Groundwater Impact Assessment Queensland • Mr Fanie de Lange, Lecturer, Institute for Groundwater Studies, University of the Free State, South Africa • Mr Wally Kozak, Director of Industry and Government Relations, Calfrac Well Services, Canada <p>Panel Chair</p> <ul style="list-style-type: none"> • Dr Andrew Johnson FTSE, Chair, Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC)
1540 – 1600	<i>Afternoon Tea</i>
1600 – 1730	<p>Session 5: Addressing community concerns</p> <p>Speakers</p> <ul style="list-style-type: none"> • Councillor Ray Brown, Mayor, Western Downs Regional Council • Associate Professor Will Rifkin, Chair in Social Performance, Centre for Coal Seam Gas – University of Queensland • Dr Sara Bice, Director, Research Translation, Melbourne School of Government <p>Panel Discussions and Q&A</p> <ul style="list-style-type: none"> • Ms Peta Ashworth, Adjunct Associate Professor Sociology, University of Queensland • Dr Elizabeth Eide, Director, Board on Earth Sciences and Resources, National Academies of Sciences, Engineering, and Medicine, United States • Mr Cameron Walker, Campaign Co-ordinator, Friends of the Earth • Associate Professor Melissa Haswell, School of Public Health and Community Medicine, UNSW Medicine <p>Panel Chair</p> <ul style="list-style-type: none"> • Professor David Brereton, Director – People Centres (Minerals

	Industry Safety and Health Centre and the Centre for Social Responsibility in Mining), University of Queensland
1900	<p>Conference Dinner</p> <p>Keynote Speaker</p> <ul style="list-style-type: none"> • The Hon Martin Ferguson AM, Former Minister for Resources and Energy and Chair of APPEA Advisory Board
Day 2	
0800 - 0900	<i>Tea and Coffee</i>
0900 – 0915	<p>Session 6: Opening address</p> <ul style="list-style-type: none"> • The Hon Gary Gray AO MP , Shadow Minister for Resources, Federal Opposition
0915 – 1110	<p>Session 7: Towards national and international best practice in policy and regulation</p> <p>Speakers</p> <ul style="list-style-type: none"> • Mr Mark Gifford PSM, Chief Environmental Regulator, NSW Environment Protection Authority • Dr Allan Hawke AC, Commissioner, Northern Territory Hydraulic Fracturing Inquiry • Mr Barry Goldstein PSM, Executive Director Energy and Resources, South Australian Department of State Development <p>International Presentations</p> <ul style="list-style-type: none"> • Academy of Science of South Africa (Professor Maarten de Wit) • Chinese Academy of Sciences • Council of Canadian Academies (Professor Rick Chalaturnyk) • National Academy of Engineering Argentina (Professor Ing. Roberto Carnicer) • National Academy of Engineering United States (Professor Mark Zoback) • The Royal Society and The Royal Academy of Engineering United Kingdom (Professor Hywel Thomas FEng FRS) <p>Panel Chairs</p> <ul style="list-style-type: none"> • Professor Geoffrey Maitland FEng, Professor of Energy Engineering, Imperial College London, United Kingdom, and • Professor Mary O’Kane FTSE, Chief Scientist & Engineer, NSW Government
1110 -1130	<i>Morning Tea</i>
1130 - 1245	<p>Session 8: Climate and gas emissions</p> <p>Speakers</p> <ul style="list-style-type: none"> • Dr Paul Hardisty, Flagship Director, CSIRO Land and Water Flagship • Professor Tom Wigley , ARC Discovery Outstanding Researcher Awards Fellow, School of Biological Sciences – University of Adelaide • Professor Geoffrey Maitland FEng, Professor of Energy Engineering, Imperial College London, United Kingdom <p>Panel Discussions and Q&A</p> <ul style="list-style-type: none"> • Ms Olivia Kember, National Policy & Research Manager, The Climate Institute • Dr Francis O’Sullivan, Director of Research & Analysis Massachusetts Institute of Technology - Energy Initiative, United States • Mr Tony Wood, Energy Program Director, Grattan Institute

	Panel Chair <ul style="list-style-type: none"> • Ms Chloe Munro FTSE, Chair and Chief Executive Officer, Clean Energy Regulator.
1245 - 1345	<i>Lunch</i>
1345 - 1530	Session 9: Impacts on land and the environment <p>Speakers</p> <ul style="list-style-type: none"> • Professor Damian Barrett, Director, Gas Industry Social and Environmental Research Alliance (GISERA), CSIRO • Professor Samantha Hepburn, Professor at the School of Law, Deakin University • Mr Stuart Anstee, Principal, Stuart Anstee + Associates <p>Panel Discussions and Q&A</p> <ul style="list-style-type: none"> • Dr John Williams FTSE, Adjunct Professor, Australian National University and Charles Sturt University • Ms Kate Smolski, Chief Executive Officer, Nature Conservation Council of NSW • Ms Danica Leys, Policy Director – Environment, NSW Farmers Association <p>Panel Chair</p> <ul style="list-style-type: none"> • Dr Richard Sheldrake AM FTSE, Chair, ATSE NSW Division & Former Director General, NSW Department of Primary Industries
1530 – 1600	<i>Afternoon Tea</i>
1600 – 1700	Session 10: Conference summary
1700 – 1715	Conference close

Representatives of International Academies

- National Academy of Engineering (United States)
- National Academies of Sciences, Engineering, and Medicine (United States)
- The Royal Society (United Kingdom)
- The Royal Academy of Engineering (United Kingdom)
- Canadian Academy of Engineering
- Council of Canadian Academies
- Academy of Science of South Africa
- South African Academy of Engineering
- National Academy of Engineering (Argentina)
- Chinese Academy of Engineering
- Chinese Academy of Sciences
- Royal Society of New Zealand
- acatech (Germany)
- Swiss Academy of Engineering Sciences

Conference Committee

- **Professor Peter Cook CBE FTSE** (Chair), University of Melbourne & CO2CRC
- **Dr Vaughan Beck FTSE** (Deputy Chair), Senior Advisor, ATSE

- **Professor Damian Barrett**, Director, Gas Industry Social & Environmental Research Alliance (GISERA) & Research Director, Unconventional Gas, Energy Flagship, CSIRO
- **Professor David Brereton**, Director of People Centres, Sustainable Minerals Institute, Centre for Social Responsibility in Mining, University of Queensland
- **Dr James Johnson**, Deputy CEO and Chief of Resources Division, Geoscience Australia
- **Mr Will McGoldrick**, Director of Government Relations (Australia), The Nature Conservancy
- **Dr Richard Sheldrake AM FTSE**, Chair, ATSE NSW Division & former Director General, NSW Department of Primary Industries
- **Mr Rick Wilkinson**, Chief Technical Officer, Australian Petroleum Production & Exploration Association (APPEA)