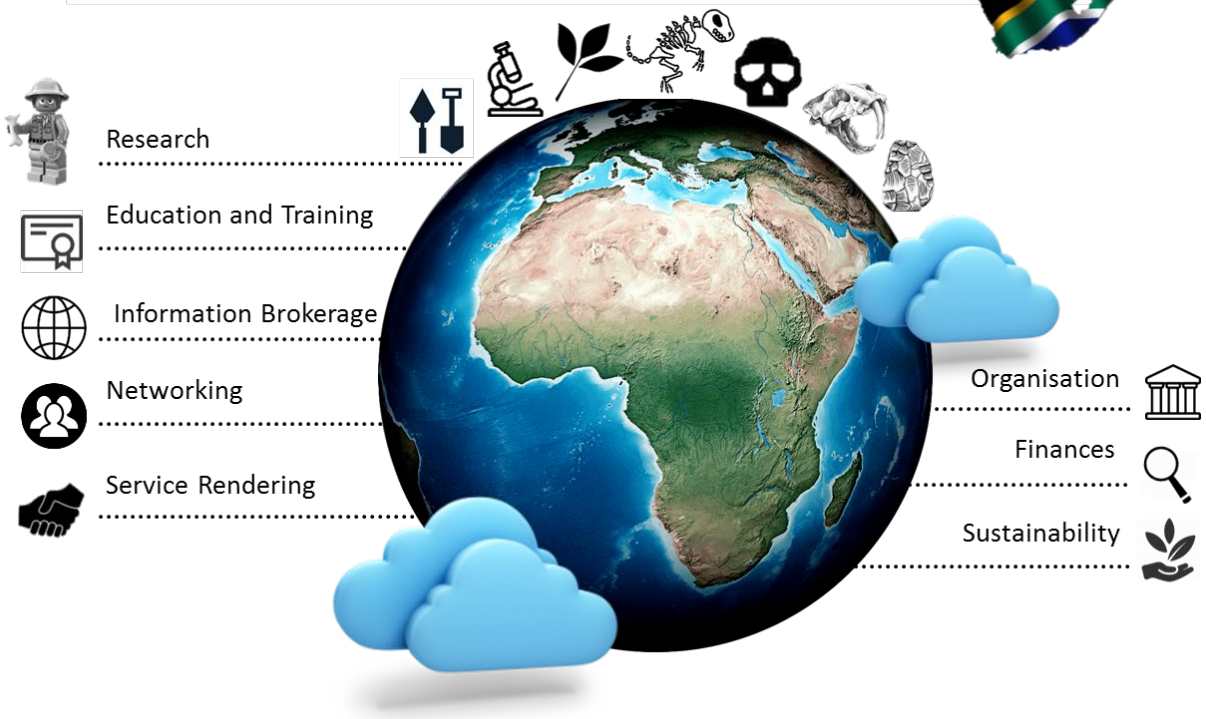
DST-NRF CENTRE OF EXCELLENCE IN PALAEOSCIENCES



Annual Progress Report

February 2018

Written by

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Dr Christine Steininger, Manager

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation

CONTENTS

LIST OF ABBREVIATIONS

'CoE-Palaeo' 'the Centre' or 'CoE in Palaeosciences' – DST-NRF Centre of Excellence in Palaeosciences

CoE – Centres of Excellence

CoH - Cradle of Humankind

Ditsong – Ditsong National Museum of Natural History

DST – Department of Science and Technology

ESI – Evolutionary Studies Institute

ESRF – European Synchrotron Radiation Facility

GAES – Geography, Archaeology and Environmental Studies

Iziko – Iziko Museums of South Africa

KFEC – Kitching Fossil Exploration Centre

NSCF – Natural Science Collections Facility

NRDS – National Research and Development Strategy

NRF – National Research Foundation

'Partners' – Includes the University of the Witwatersrand, University of Cape Town, Albany Museum, National Museum Bloemfontein, Ditsong Museum, and Iziko Museum

'Palaeosciences' – Here it the word refers to all disciplines of palaeontology and archaeology up to the Middle Stone Age

SAASTA – South African Agency for Science and Technology Advancement

SAASTEC – Southern African Association of Science and Technology Centres

SAHRA – South African Heritage Resource Agency

SLA – Service Level Agreement

SARIR - DST South African Research Infrastructure Roadmap

SAMA – South African Museums Association

SapienCE – Norway Centre of Excellence in Modern Human Behaviour

UCT – University of Cape Town

Wits – University of the Witwatersrand, Johannesburg

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1 INTRODUCTION

The Centre of Excellence in Palaeosciences (CoE-Palaeo), established in May 2013, is a global hub for the study of the origins of species, using cutting-edge research techniques to understand South Africa's unique and time extensive fossil and archaeological record. The Centre adopts a multi- and inter-disciplinary approach to research incorporating the disciplines of palaeontology, palaeo-anthropology, palaeobotany, molecular biology, genetics, geosciences, archaeology, geography, biology, ecology, and climatology to interpret our unique South African Fossil Heritage. We promote an environment in which the creativity of researchers, postdoctoral fellows, and postgraduate students are strongly encouraged in achieving the research aims and directions of the CoE for Palaeosciences. The Centre achieves this by providing the necessary infrastructure and funding, as well as having a research culture which encourages dialogue and collaboration. Workshops are organised to inform members of the research undertaken by the Centre and to assist staff and students in writing, "winning" funding proposals.

The CoE-Palaeo operates across six partner institutions: University of the Witwatersrand (Host); University of Cape Town (UCT); Iziko Museums, Cape Town; National Museum, Bloemfontein, Albany Museum, Grahamstown; and Ditsong Museum, Pretoria. Our Centre is the only CoE to have natural history museums as partners. The Centre continues to expand its already extensive and international network of collaborators. These collaborations not only provide an additional stream of funding, but they also enable access to equipment and expertise not available in the country to South African students and researchers. They thus enhance the quality and scope of research projects the Centre undertakes, and provide a superior training experience to the students. This collaboration extends to the European Synchrotron Radiation Facility at Grenoble in France where the CoE-Palaeo has a very active and productive collaboration. In addition to seed funding supplied by the Centre, members continue to leverage additional funding from several different sources, including industry, to enable completion of their research projects.

To address the research aspirations of the South African Strategy for the Palaeosciences of the Department of Science and Technology (DST), and to cover a large percentage of the palaeoscience record reflected in the South African stratigraphic record is a considerable challenge for the Centre within its budget constraints. To achieve its mandate, the Centre undertakes a diverse range of research projects including the origin of life and multicellularity, invertebrate palaeobiology, palynology, and palaeobotany of various ages, taxonomy and palaeobiogeography of fishes, amphibians, parareptiles, therapsids and dinosaurs, origins of mammals and hominins. Additional projects include, but not limited to, hominin morphology and behaviour, the earliest tools of hominins, the emergence of behavioural complexity, faunal analysis, and taphonomy. Additionally, palaeontology is applied in groundbreaking broader multidisciplinary studies to understand climate and biodiversity change, stratigraphy and basin development studies. The CoE-Palaeo is proud of the productivity and quality of our members reflected in a large number of researchers who have National Research Foundation (NRF) ratings; these include 5 A; 9 B, 13 C, 2 Y and 3 P rated researchers.

The *DST South African Strategy for the Palaeosciences* recognises the scarcity of well-trained human capacity as the most severe threat facing the discipline of palaeosciences. To address this issue, the Centre has funded and trained palaeoscience expertise at various levels, including school learners, technicians, collections curators, palaeo-tourism guides as well as undergraduate students, postgraduate students, and postdoctoral fellows.

Knowledge brokerage and service rendering are an essential aspect of the CoE-Palaeo output. Almost all CoE-Palaeo researchers and students participate in science communication or public awareness as this is a requirement of all our members. The Centre supports the salary of a Palaeoscience Outreach Officer, who in turn raises additional funding to employ an assistant and to run outreach activities, with the result that the Centre is very active in public awareness and educational outreach. Social media is a robust platform for science communication. The Centre hires, on a contractual basis, a Science Communication Officer who has experience in the field of palaeosciences.

Apart from supervising more than 43 MSc and PhD students and hosting 13 postdoctoral fellows, members of the CoE-Palaeo also teach in undergraduate and honours programmes in the archaeology, geosciences, and biological science curricula of Rhodes University, University of Cape Town, and the University of the Witwatersrand.

In collaboration with partners and the NRF African Origins Platform, National Science Collections Facility, the CoE-Palaeo assists in the maintenance and expansion of important palaeontological and archaeological museum collections and world-class palaeoscience research facilities. It is essential to keep updating these to ensure that the CoE-Palaeo Partner Institutions continue to be at the cutting-edge in the use and application of state of the art technology for palaeoscience research.

The Centre recognises the uniqueness and importance of the southern African fossil heritage and its significance to South Africa and the rest of the world. To this end, the Centre is committed to the objectives outlined in the *DST South African Strategy for the Palaeosciences*. To maintain and enhance the momentum, which has been built up by the actions of the Centre to fulfil this mandate, we are strategising for the successful movement of the CoE in Palaeoscience to a National Institute for Palaeosciences at the end of the next five-year cycle in 2022.

Highlights from 2018

1. A media release for a Nature paper on two discoveries of tetrapods from the Devonian period that come from localities in tropical to subtropical paleolatitudes found by Dr Robert Gess from Albany Museum. One species is named after Desmond Tutu – *Tutusius umlambo.* The Minister of Science and Technology opened the proceedings to the media release.
2. A media release for a new giant dinosaur from early Jurassic South Africa. The article was published in Current Biology by our current and previous grantees Drs Blair McPhee, Jonah Choiniere, Jennifer Botha-Brink, Emese Bordy.
3. Both of these discoveries were mentioned by the Minister at Parliament and is recommended for presentation at the State of the Nations Address.
4. The CoE-Palaeo Director, Prof Bruce Rubidge, gave a presentation on South African palaeosciences to BRICS leaders at Maropeng.
5. NRF Science Matters vol 1; issue 3 featured Dr Rebecca Ackermann research on hybridisation and the science of becoming human and Dr Jonah Choiniere research on South Africa's 200 million-year-old dinosaur.

1.1 Strategic Context

The National Research and Development Strategy (NRDS) has identified some knowledge fields in which South Africa should aim at achieving international research excellence because of our geographical position and natural or cultural heritage. The Palaeosciences (collectively including

Palaeontology, Palaeo-anthropology, Palaeobotany, Middle Stone Age Archaeology and related disciplines) are areas in which South Africa has a geographical advantage, owing to the quantity and diversity of finds within our national borders.

The *DST South African Strategy for the Palaeosciences* document addresses five goals which recognise the need for a holistic approach to the development of palaeosciences:

1. Transform the minds of South Africans to instil a sense of pride and provide the intellectual content to their African heritage
2. Support the country's universities to produce a critical mass of palaeoscience researchers with a range of research, technical, curatorial, public engagement and managerial skills
3. Enhance the capacity of museums to curate, conduct and support research in palaeosciences
4. Ensure that South Africa's palaeoscience heritage is well managed and used for the benefit of current and future generations
5. Make South Africa the destination of choice for palaeo-tourism

The establishment of a DST-NRF funded Centre of Excellence in Palaeosciences has been by far the most productive and effective way to realise the goals of the Palaeosciences Strategy.

1.2 Organizational Context

The distinctive character of the Centre includes its value system of visibly committed academics and students, and a socially engaged and independent-minded institution. These values are in the Wits policies and procedures, ethical governance outlined in the *King III Report,* and the *Singapore Statement on Research Integrity*. To effectively manage and govern, we follow the guidance embedded in the *Handbook to assist with the Operation of a DST-NRF Centre of Excellence* (2015), the *Framework for the Establishment of DST-NRF Centres of Excellence* (version 3.0, 2015).

1.2.1 CoE-Palaeo Partners and Collaborators

Current Partners

1. The University of the Witwatersrand, Johannesburg (School of Geosciences, School of Animal, Plant, & Environmental Sciences, School of Geography, Archaeology, & Environmental Studies, Evolutionary Studies Institute)
2. University of Cape Town (Dept of Geological Sciences, Dept of Biological Sciences, Dept of Archaeology)
3. Iziko Museums of South Africa, Cape Town
4. Ditsong National Museum of Natural History, Pretoria
5. National Museum, Bloemfontein
6. Albany Museum, Makhanda

Collaborators

1. Centre of Excellence in Modern Human Behaviour (SapiensCE), University of Bergen, Norway
2. Evolutionary Studies Institute, University of the Witwatersrand
3. Geography, Archaeology, and Environmental Studies, University of the Witwatersrand
4. School of Geosciences, University of the Witwatersrand
5. School of Animal, Plant, and Environmental Sciences, University of the Witwatersrand

6. School of Anatomical Sciences, University of the Witwatersrand
7. Dept of Geological Sciences, University of Cape Town
8. Dept of Biological Sciences, University of Cape Town
9. Dept of Archaeological Sciences, University of Cape Town
10. Rhodes University
11. University of Free State
12. Sol Plaatje University
13. Council of Geosciences
14. Palaeontological Scientific Trust

Potential Partners

1. University of Johannesburg – Collaborative Agreement under the advisement of university management
2. Sol Plaatje University - Collaborative Agreement under the advisement of university management. Delay in obtaining Higher Education approval for Heritage Management Courses
3. South African Coastal Palaeosciences, Nelson Mandela University. Dean and DVC were on board but had some complications with the Directors of the Centre. Requested a business plan, but was never sent. Told that they had enough funds for their students and research.
4. Sefako Makgatho Health Sciences University – a Skype meeting set up, but the HOD never made the Skype meeting appointment.
5. National Science Collection Facility

1.2.2 Management

The Director of the CoE-Palaeo, Professor Bruce Rubidge, is an NRF A2-rated scientist with high international standing. Professor Rubidge leads multiple projects within the Karoo sedimentary Basin and has given keynote talks all over the world. He has supervised 36 postgraduate students, produced 160 peer-review papers some in top journals such as Nature and Science, and several books.

The management of the Centre provides a functional framework within which we operate. It is concerned with organising people, financial resources and procedures so that research, education, and outreach can prosper (Table 1). It proposes strategic direction and action while retaining the flexibility to accommodate unforeseen circumstances as they arise.

Table 1. 2018 Management Team.

CoE-Palaeo Team	Name
Director	Prof Bruce Rubidge
Project Manager	Dr Christine Steininger
Financial Officer: Grants	Ms Tandi Scott-Turner
Education Outreach Officer	Dr Ian McKay

Science Communication Officer	*Ms Kimberleigh Tommy

* Ms Kimberleigh Tommy will be continuing with her Doctoral Degree at the University of the Witwatersrand, School of Anatomical Sciences starting in February 2019. Her research project is on the knee joint of modern and fossil hominins. She has set up a science communication company and will be consulting on our social media content.

Executive Committee

CoE-Palaeo Executive Committee members are selected and based at partner institutions. Membership of the Committee is representative of the Themes of Research Focus, and they advise the Director on the running of the Centre and are responsible for allocation of finances for human capital development and research activities (Table 2).

Table 2. CoE-Palaeo Executive Committee 2018 – 2020 (excluding the CoE-Palaeo Director and Project Manager).

Executive Committee Position	Name	Based at	NRF Rating
Theme Leader: Evolutionary Process	Dr Jennifer Botha-Brink	National Museum	B3
Theme Leader: Cultural & Behavioural Evolution	Prof Sarah Wurz	Wits	C1
Theme Leader: Palaeo-environments & Palaeoclimates	Prof Marion Bamford	Wits	B2
Theme Leader: Applications & Innovations	Prof Judith Sealy	UCT	B1
Theme Leader: Palaeosciences & its Publics	Dr Thalassa Matthews	Iziko Museum	C1
Member	Dr Mirriam Tawane	Ditsong Museum	not rated

Steering Committee

The activities of the Centre are guided and directed by the Steering Committee who give strategic direction and are responsible for high-level control of the CoE-Palaeo (Table 3).

Table 3. Steering Committee, 2018 - 2020.

Steering Committee	Positions	Based at
Prof Zeblon Vilakazi	Chairperson	Wits
Dr Gilbert Siko	Director: Science Platforms	DST
Dr Makobestsa Khati	Executive Director: CoEs & SARCHI	NRF
Prof Bruce Rubidge	Director: Centre of Excellence in Palaeosciences	Wits
Prof Michelle Hammer	Director: National Science Collection Facility	SANBI
Dr Gilbert Siko	Director: Science Platforms	DST
Prof Marion Bamford	ESI Director	Wits
Dr Johann Neveling	Member	Council of Geosciences
Prof Christopher Henshilwood	Executive Director: Sapiens	University of Bergen /of the Witwatersrand

1.2.3 Institutional commitment

Wits University, as host of the CoE-Palaeo, has a distinguished eight-decade history of research in the palaeosciences and generates a remarkable quality of work acknowledged by local and international peers as being of critical value. ***Researchers in the palaeosciences from Wits have made some of the most globally important fossil discoveries.*** The palaeosciences are integral to the focus areas identified in the *Wits University Research Strategy.*

While the University of the Witwatersrand hosts the Centre, the Centre is dependent on its partner institutions to reaching excellence. Our partners and grantees are productive in their research programmes, human development, and outreach initiatives.

The Centre, although housed in the building of the Evolutionary Studies Institute at the University of the Witwatersrand, operates independently across South and even southern Africa, and is active in promoting the palaeoscience programmes of our partner institutions.

The CoE in Palaeosciences is closely allied with the Evolutionary Studies Institute (ESI) at Wits, the largest palaeoscience research entity in South Africa. The ESI has world-class palaeontological research facilities and is thus an ideal hub for the CoE in Palaeosciences. Wits have invested millions of Rands in building up, maintaining, curating and developing sophisticated practices of fossil curatorship of one of the world's most extensive and significant fossil and artefact collections that focuses on the evolution of life on Earth and the evolution of humankind in the southern hemisphere. The collections are used extensively for teaching, public outreach, and research programmes, and are particularly noted for their early therapsid 'mammal-like' reptiles and dinosaurs from the Karoo, the largest palaeobotany herbarium in the southern hemisphere, and an extensive assemblage of fossils (including hominins) and artefacts from the Cradle of Humankind (CoH) and other palaeoanthropological and archaeological sites. These collections are used on an ongoing basis for research by both local and international scholars. In addition Wits is the owner of two major fossil hominid-bearing sites (Swartkrans and Sterkfontein), holds artefact collections from most sites in the Cradle of Humankind, was closely linked with the development of the latter's World Heritage status, and is a full partner with the Gauteng Provincial Government in the management of the Cradle.

The ESI has sophisticated research facilities that support the palaeosciences and houses palaeontological and palaeoanthropological collections, staff offices, laboratories and working spaces, a preparation laboratory, casting rooms, a palaeontology museum with an active outreach programme, exceptional scanning, image processing and GIS facilities and extensive interactive databases. The Micro CT scanner and Virtual Image Processing Laboratory at Wits, which is supported by CoE-Palaeo, provides the country with a significant advantage in a wide range of palaeosciences related disciplines and other ancillary studies.

2 THE NRF PROGRESS REPORT SECTIONS

For SLA Stage 4 targets and achievements, please refer to Appendix 1 & 2.

2.1 Registration details of the Director

Table 4. Registration details

Title	Professor
Surname	Bruce
Initials	BS
First name	Bruce
Maiden Name / Previous Surname	NA
Citizenship	South Africa
ID Type	ID
ID / Passport Number	On NRF System
ID / Passport Document	Attachment on NRF System
Race	White
Gender	Male
Date of Birth	1956/06/01
Are you a full-time student	No
NRF rating	A2

2.2 Contact Details of the Centre

Table 5. Contact details

Organisation where based	University of the Witwatersrand
Is this the organisation which funds your salary?	No
If not, the primary organisation that funds the Director's salary?	Centre of Excellence in Palaeosciences
Department / School / Institute	
Faculty	Research
Work Postal Address	Private Bag3
City / Town	Johannesburg
Code	2050
Primary Telephone Number	011 717 6685
Fax Number	011 717 6694
Mobile Number	072 575 7752
Please tick for sms notification	On NRF online system
Primary Email Address	Bruce.Rubidge@wits.ac.za

Alternate Email Address	coe.pal@wits.ac.za
Web Address	https://www.wits.ac.za/coepalaeo/
Country	South Africa
Province / State	Gauteng
Please click on the arrow should your physical address be different to the postal work address	On NRF online system

2.3 Qualifications of the Director

- 1988 PhD (Geology/Palaeontology), University of Port Elizabeth
- 1983 MSc (Palaeontology) cum laude, University of Stellenbosch
- 1979 BSc Honours (Palaeontology) cum laude, University of Stellenbosch
- 1975–1978 BSc (Zoology and Geology), University of Stellenbosch

2.4 Research Expertise of the Director

Table 6. The research expertise of the Director

Scientific Domain

Scientific Domain	Natural Sciences *

Primary Research Field

Primary Research Field	Priority	Priority Up	Priority Down	Delete
Earth and marine sciences	1			
Biological sciences	2			

Secondary Research Field

Secondary Research Field	Priority	Priority Up	Priority Down	Delete
Palaeontology	1			
Geology	2			
Biology	3			

Add Another

Fields of Specialisation

Field of Specialisation	Priority	Priority Up	Priority Down	Delete
Vertebrate paleontology	1			
Permo-Triassic therapsids	2			
Karoo biostratigraphy	3			
Basin analysis	4			
Karoo sedimentology	5			

2.5 Career Profile of the Director

Apart from my first work-year in 1980, my entire research career has been in positions of research leadership. From 1981 to 1990 I was head of the Karoo Palaeontology Department at the National Museum in Bloemfontein, and since 1990 was the Director of the Bernard Price Institute for Palaeontological Research (BPI) at the University of the Witwatersrand, Johannesburg (Wits). Under my directorship the research staff component of the Institute has doubled, the number of

postgraduate students has more than doubled, and the research programme of the Institute has greatly expanded. I was closely associated with setting up and fundraising for the Institute for Human Evolution (IHE) at Wits, driving the amalgamation of the Wits palaeontological collections under a single collections curator. Also, I was responsible for planning the expansion and renovation of the building for The Palaeosciences Centre which for the next decade will serve the research and curatorial requirements of the newly established Evolutionary Sciences Institute (ESI) (a recent amalgamation of the BPI and IHE). Being passionate to expose the remarkably diverse palaeo-heritage of South Africa to the public, I was involved in the development of the Cradle of Humankind World Heritage site, and in setting up the Kitching Fossil Exploration Centre as a sustainable business in the Karoo town of Nieu Bethesda. On an annual basis, I teach at least two palaeontology courses to undergraduate students, three courses to honours students and am involved in the supervision of MSc and PhD graduates.

Although I have administered and sponsored research on the Cenozoic fossil hominid sites in the Cradle of Humankind and have supervised postgraduate geology and palaeontology students researching the Devonian rocks of the Cape Supergroup, most of my research has been on projects relating to the palaeontology, sedimentology, stratigraphy, and basin analysis of the Permian-Jurassic Karoo Supergroup. In the process, I have attempted to stimulate international research collaboration on the Karoo and its fossils, and as a result, have ongoing collaborations with palaeoscientists involved in research on Karoo-aged rocks on all continents of the world. The Karoo fauna is of global interest as southern Africa occupied a central place in Gondwana, and the fossils found in the time-extensive Karoo Supergroup have a global distribution. Recently collaborators and I have published the first radiometric dates for the Permian biozones of the Beaufort Group, a development that will have significant consequences for dating tetrapod-bearing Permian deposits from around the world, the timing for basin modelling, as well as determining the rate of evolutionary development in Permian tetrapods.

My current research speciality is to understand biodiversity changes in the lowermost Beaufort Group (Abrahamskraal Formation). This Formation comprises the complete fossil-bearing Middle Permian terrestrial succession and is one of the only places in the world able to provide evidence for the effect of the end Guadalupian mass extinction (recently noted in the marine realm) on land. For three decades my collaborators and I have undertaken stratigraphic fossil collecting and documentation of the 3000 m thick Abrahamskraal Formation at various localities around the Karoo basin; in the process, we have described more than fifteen new basal tetrapod species, discovered a new and older faunal biozone, as well as undertaking taxonomic and phylogenetic research on the tetrapod faunas. Because of the complicated structural geology of the southern Karoo and the relative paucity of fossils in these lower horizons; research progress was at first slow as it was difficult to build up large and representative numbers of specimens. Now, however, trends are beginning to emerge around the basin and shortly we will be publishing the first accurate stratigraphic ranges of Middle Permian tetrapod taxa, presenting diversity trends, and proposing a new basin development model for the Abrahamskraal Formation. These findings will have international importance, as they will be the first accurate representations for understanding Middle Permian biodiversity changes in the terrestrial realm.

2013-	Director: DST-NRF Centre of Excellence in Palaeosciences,
2013-2017	Interim Director: Evolutionary Studies Institute, &
2001–2013	Director of Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg
2001–2002	Deputy Dean (Research), Faculty of Science, University of the Witwatersrand, Johannesburg

May 1990– 2000	Director of Bernard Price Institute for Palaeontological Research & Head of Palaeontology Department, University of the Witwatersrand, Johannesburg
1992–1993	Consultant on Beaufort Biostratigraphy for the Atomic Energy Corporation Uranium Exploration Programme
August 1988	Consultant on Palaeontology for ERL in the Environmental Division of the Lesotho Highlands Development Authority
Jan 1981–Apr 1990	Head of Department of Karoo Palaeontology, National Museum, Bloemfontein
Apr 1980–Dec 1980	Associate curator of Karoo Palaeontology, National Museum, Bloemfontein

2.6 Student Supervision Record of Director

Masters Students

1. GROENEWALD, D. (Full time, first registration January 2016 submitted January 2017, achieved MSc with distinction and upgraded to PhD) *A litho- and biostratigraphic analysis of the Lower Beaufort Group, Karoo Supergroup, in the central Free State Province, South Africa.* Supervisors B.S. Rubidge & M. Day.
2. VAN DEN BRANDT, M. (Full time, first registration January 2015, graduated with distinction 2017). *Cranial morphology of Embrithosaurus schwarzi (Parareptilia, Pareiasauria), and a taxonomic and stratigraphic reassessment of the South African Middle Permian pareiasaurs.* Supervisors B.S. Rubidge & F. Abdala.
3. WALTERS, S. (Full time, first registration January 2015, graduated 2017 with distinction) *Reanalysis of cryptic sedimentological relationships involving the Southern Karoo Ripon Formation and the southwestern Karoo Vischkuil/Laingsburg Formations: Implications for the basin and palaeoenvironmental reconstruction*. Stellenbosch University. Supervisors: R. Tucker and B. Rubidge.
4. KRUGER, A. (Full time, first registration January 2013, graduated Nov 2014). *Ontogeny and cranial morphology of the basal carnivorous dinocephalian, Anteosaurus magnificus from the Tapinocephalus Assemblage Zone of the South African Karoo.* Supervisors B.S. Rubidge & F. Abdala.
5. PENN-CLARKE, C. (Full time, first registration January 2012). *Basin Analysis, Palaeontology and Biostratigraphy of the Early to Middle Devonian aged Bokkeveld Group (Cape Supergroup), Western Cape, South Africa.* Supervisors: B Rubidge, Z Jinnah, J.N. Almond. (upgraded to PhD July 2013, having been awarded his MSc with distinction)
6. JIRAH, S. (Part-time, first registration June 2010, graduated Nov 2013). Stratigraphy and sedimentology of the Tapinocephalus Zone (Abrahamskraal Formation) in the area around Merweville. Supervisor: B.S. Rubidge.NXUMALO, V. (Part-time, first registration January 2008, submitted December 2010, graduated 2011). Stratigraphic correlations and 3-dimensional modelling of the Kalahari-Karoo sub-basins in Southwest Botswana, Southeast Namibia and the Northern Cape Province of South Africa. Supervisors: B.S. Rubidge, G. Drennan and J. Neveling.
7. NORTON, L. (Full time, first registration 2008, submitted February 2012, graduated 2012). Relative growth and skull variability in Aelurognathus (Reptilia: Gorgonopsia). Supervisors: B.S. Rubidge and F. Abdala.

8. MASON, R. (Full time, first registration 2004, graduated 2007). A synthesis of the stratigraphy and biostratigraphy of the Ecca-Beaufort contact in the Eastern Cape Province, South Africa. Supervisors: B.S. Rubidge and P.J. Hancox.
9. PITCHER, A.M. (Full time, first registration 2002, graduated 2004). Morphology, variation and ontogeny in Lydekkerina huxleyi (Lydekker 1889) Amphibia, Temnospondyli. Supervisors: R. Damiani and B.S. Rubidge.
10. RUTHERFORD, A. (Part-time, first registration 2002, graduated 2009). Geology, stratigraphy and palaeoenvironment of the area around Thaba 'Nchu, Free State. Supervisors: B.S. Rubidge and P.J. Hancox.
11. GOVENDER, R. (Full time, first registration February 2000, graduated 2002). A Comparative description of the postcranial anatomy of the most basal tapinocephalid dinocephalian Tapinocaninus pamelae Rubidge (Amniota, Therapsida). Supervisors: B.S. Rubidge and A. Renaut.
12. MUNYIKWA, D. (Part-time, first registration 1998, graduated 2001). Dinocephalian mammal-like reptiles from Madumabisa Mudstone Formation (Permian) Hwange, Zimbabwe. Supervisors: B.S. Rubidge and M.A. Raath.
13. RENAUT, A. (Full time, first registration 1995, completed 1999 and upgraded to PhD). A re-evaluation of the cranial morphology and taxonomy of the Triassic dicynodont Kannemeyeria. Supervisors: B.S. Rubidge and P.J. Hancox.
14. ROSSOUW, L. (Part-time, first registration 1996, graduated cum laude 2001). The taxonomic status of Antidorcas australis as reflected by its postcranial osteomorphology. Supervisors: B.S. Rubidge and J.S. Brink.
15. NEVELING, J. (Full time, first registration 1996, completed 1998 and upgraded to PhD). A palaeontological, stratigraphic and palaeoenvironmental synthesis of the Triassic contact between the Lystrosaurus and Cynognathus Assemblage Zones of the Beaufort Group, South Africa. Supervisors: B.S. Rubidge and P.J. Hancox.
16. VAN ROOYEN, J.M. (Part-time, first registration 1988, graduated 1990). The osteology and functional anatomy of the postcranial skeleton of Gorgonops torvus. Owen (Gorgonopsia: Therapsida). Supervisors: S. Fourie and B.S. Rubidge.

Doctoral Students

1. GROENEWALD, D. (Full time, first registration June 2017, upgraded from MSc. A litho- and biostratigraphic analysis of the Lower Beaufort Group, Karoo Supergroup, in the central Free State Province, South Africa. Supervisors B.S. Rubidge & M. Day.
2. VAN DEN BRANDT, M. (Full time, first registration January 2017). *Cranial and postcranial anatomy of Middle Permian pareiasaurs.* Supervisors B.S. Rubidge & J. Benoit.
3. JIRAH, S. (Part-time, first registration Sept 2014). Middle Permian diversity of large herbivores: Taxonomic revision of the Titanosuchidae (Therapsida, Dinocepahlia) of the Karoo Basin, South Africa. Supervisor: B.S. Rubidge & F. Abdala.
4. PENN-CLARKE, C. (Full time, first registration Jan 2012, upgraded from MSc, graduated 2017). Stratigraphy and sedimentology of the Bokkeveld Group, Cape Supergroup in the Koue Bokkeveld. Supervisors: B.S. Rubidge and Z. Jinah. (Upgraded to PhD July 2013, awarded his MSc with distinction).

5. NORTON, L. (Full time, first registration 20013). *Tooth replacement patterns in Eutheriodontia from South Africa*. Supervisors: F. Abdala, B.S. Rubidge, & J. Botha-Brink.
6. VIGLIETTI, P. (Full time, first registration Jan 2013; Graduated 2016). *Sedimentology and Palaeontology of the Late Permian Barberskrans Member (Beaufort Group): Implications for Karoo Basin Evolution.* Supervisors: B.S. Rubidge & R.M.H. Smith.
7. DAY, M. (Full time, first registration January 2010, graduated Nov 2013). Middle Permian continental biodiversity changes as reflected in the Beaufort Group of South Africa: A bio- and lithostratigraphic review of the Tapinocephalus and Pristerognathus assemblage zones. Supervisor: B.S. Rubidge.
8. BARBOLINI, N. (Full time, first registration January 2010, graduated July 2014). Gondwanan correlations of upper Karoo vertebrate biozones using palynology. Supervisors: M.K. Bamford and B.S. Rubidge.
9. GUVEN, S. (Full time, first registration 2008). Taxonomic revision of the tapinocephalid dinocephalian subfamilies Moschopinae, Tapinocephalinae and Reibeeckosaurinae – the key to understanding Middle Permian tetrapod biodiversity. Supervisors: B.S. Rubidge and F. Abdala.
10. GESS, R. (Part-time, first registration 2005, submitted January 2011, graduated 2011). A taxonomic, biogeographic, biostratigraphic and palaeoecological synthesis of the Famennian Witpoort Formation of South Africa (Cape Supergroup, Witteberg Group). Supervisors: B.S. Rubidge and M. Coates.
11. CISNEROS, J-C. (Full time, first registration 2003, graduated 2007). Cranial anatomy of the South African genus Procolophon. Supervisors: B.S. Rubidge and R. Damiani.
12. NICOLAS, M. (Full time, first registration 2003, graduated 2007). Tetrapod biodiversity through the Permo-Triassic Beaufort Group (Karoo Supergroup) of South Africa. Supervisor: B.S. Rubidge.
13. LATIMER, E.M. (Full time, first registration 1994, upgraded to PhD 1995). A revision of Karoo amphibians of the family Rhinesuchidae, and an assessment of their biostratigraphic significance. Supervisor: B.S. Rubidge.
14. NEVELING, J. (Part-time, first registration 1995, upgraded to PhD 1998, graduated 2002). The biostratigraphy and palaeontology of the contact area between the Lystrosaurus and Cynognathus Assemblage Zones (Beaufort Group: Karoo Supergroup). Supervisors: B.S. Rubidge and P.J. Hancox.
15. FOURIE, H. (Part-time, first registration 1993, graduated 2001). Morphological, functional and systematic study of the postcrania of selected genera of Therocephalia (Amniota: Therapsida). Supervisors: B.S. Rubidge and G.M. King.
16. RENAUT, A. (Part-time, first registration 1999, graduated 2001). A re-evaluation of the cranial morphology and taxonomy of the Triassic dicynodont Kannemeyeria. Supervisors: B.S. Rubidge and P.J. Hancox.
17. BORDY, E. (Full time, first registration February 1998, graduated April 2001). Sedimentology of the Karoo Supergroup in the Tuli Basin (Limpopo River Area, South Africa). Supervisors: O. Catuneanu and B.S. Rubidge.
18. BENDER, P.A. (Part-time, first registration 1995, graduated 2000). Paleoniscid fish of the Lower Beaufort Group, South Africa. Supervisors: B.S. Rubidge and J. Long.
19. HANCOX, P.J. (Part-time, first registration 1994, graduated 1998). A stratigraphic, sedimentological and palaeoenvironmental appraisal of the Triassic Beaufort-Molteno contact in the vicinity of Sterkstroom, Eastern Cape Province. Supervisor: B.S. Rubidge.

Postdoctoral Fellows

1992–1994	D.W. Dilkes
1994	M.A. Shishkin (Wilson Travel Fellowship)
1995	M.A. Shishkin (NRF Fellowship)
1998–2000	S.P. Modesto
1999–2004	R. Damiani
2002–2008	F. Abdala
2002–2004	E. Bordy
2003–2004	A. Yates
2005–2006	P.J. Hancox
2006–2008	R. Govender
2008–2009	R. Mutter
2011–2012	V. Fernandez
2012–2013	R. Gess
2013-	M. Day.
2014-2017	J. Benoit.
2016-	K. Rey
2018-	M. Romano

2.7 ORCID number of the Director

http://orcid.org/0000-0003-2477-1873

2.8 Grant Details

Table 7. Grant details

The reference number of the original application	NA
Year of award	2013
Year of reporting	2018
Cycle	6th year
Grant UID(s)	86073
Short title	Palaeosciences
Name of Chair / Centre	
NFR Programme in which the grant was award	Centres of Excellence
Institution	University of the Witwatersrand
Discipline	Natural Sciences
Tier Level of Research Chair	Tier 1
Request a Tier 2 Chair upgrade	No

2.9 Research Highlights

Below research highlights are described by each grantee in their own words.

Theme: Evolutionary Process

Professor Ackermann, Rebecca
The University of Cape Town, Dept of Archaeology

Title of project: New mammal models for hybridisation in human evolution

Summary of the project: The research described here aims to quantify how gene flow shapes magnitudes and patterns of variation in the skeleton of mammalian taxa, ultimately to identify when and where hybridisation occurred in the human fossil record. This project is a continuation of ongoing research. Here, we continue to investigate morphological variation in hybrids using both field and laboratory-based mammalian model, expanding the previous investigation considerably to new mammalian taxa with different histories and morphologies. Research approaches involve quantification of skeletal variation, supplemented with genetic and other data where appropriate/available to:

- investigate the role of hybridization in shaping crania and postcrania in our newly-established collection of macaque hybrids;
- examine the effects of gene flow among North American canids (e.g. coywolves), in order to establish a new model for considering hybridization in a widely dispersed and continuously hybridizing lineage;
- determine the role of gene flow in shaping skeletal and external variation in our large sample of inter- and intra-specific laboratory-bred mice and a complimentary museum collection of mice bred from wild strains to tease apart the potential effects of inbreeding/outbreeding versus gene flow on phenotypes of hybrids.

All of these models will help in considering trait variation in the human fossil record.

Research highlights:

- The funding requested from CoE was for a trip for data collection to California for my postdoctoral fellow. However, she deferred taking up the postdoc until the end of 2018, and the research trip rescheduled for early 2019.

Dr Avery, Margaret
Iziko Museums of South Africa

Title of project: A fossil history of southern African land mammals

Summary of the project: There is an ever-growing wealth of mammalian fossil material is collected from palaeontological and archaeological sites in southern Africa. This reference provides comprehensive information on the taxonomy and distribution in time and space of all currently recognised southern African fossil mammals. After an introductory background chapter on southern Africa, mammals, sites and dating, the following chapters are presented by epoch, covering the Eocene, Miocene, Pliocene, Pleistocene and Holocene. Individual maps provide information on where in the landscape specific taxa have been found, and a comprehensive index lists all the fauna and site locations. The book ends with a chapter on how it can be used, and lines of future research.

Collecting a vast amount of information together in an accessible format, this is an essential reference for non-specialist taxonomists and palaeontologists, as well as for those using fossil data for other applications, such as archaeology, neontology and nature conservation.

Research highlights:

- This comprehensive compilation of mammalian records brings together data from sites in southern Africa south of the Kunene–Zambezi Rivers, i.e., about 15°S.
- Data on 675 faunal samples were obtained for all epochs from the Eocene to Holocene apart from the Oligocene for which there is only one doubtfully-dated sample.
- The current taxonomic status of all taxa represented is provided, together with information on the author and publication details of original descriptions.
- As expected, most Eocene taxa, including three of eight Orders, are extinct. Perhaps less expected is the presence of five extinct species in Holocene samples.
- Several Holocene taxa were introduced to the region by humans within the recent past while several families and genera no longer occur in the region although they are still extant elsewhere.

Dr Benoit, Julien
Evolutionary Studies Institute, University of the Witwatersrand

Title of project: From sprawling to erect: Neurological adaptation to postural changes in synapsids

Summary of the project: To document the evolution of an erect, parasagittal posture (with limbs below the body supporting its weight like pillars) is critical for understanding the origin of modern mammalian biology and energetic physiology. However, an understanding of the transition from a sprawling to an erect posture in mammalian ancestry is limited by the paucity of post-cranial material and complete articulated skeletons in the fossil record. Fortuitously it is possible to reconstruct posture and locomotion in extinct species using the skull only by analysing the morphology of the lateral semicircular canal (LSC) of the osseous capsule of the inner ear (bony labyrinth) contained within the dry skull. Using CT-scanning, this project had four primary aims:

- To quantify the variation in the orientation of the LSC in a wide variety of living mammals.
- to use this dataset to compare LSC orientation with field observations of posture and locomotion of the same taxa.
- To statistically address how the LSC morphology relates to sprawling and parasagittal gait.
- to apply this knowledge to extinct synapsids in order to reconstruct the evolutionary transition from a sprawling to an erect posture.

Since this project aims at collecting an unprecedented vast amount of data on mammalian head posture and LSC orientation, so far, the work is still in the data collecting phase. Preliminary results already indicate that LSC orientation might be governed by factors other than head posture alone. This would question a hundred century of an assumed linear relationship between the two metrics. Such a result, if confirmed, would strongly impact the field and thus requires more investigations.

Research highlights:

- In the year, I acquired the CT-scans of almost 200 dry skulls, representing some 130 modern species. This was achieved with the help of my collaborators Paul Manger (School of Anatomical Sciences, Wits University, South Africa), Andrew Farke (Alf Museum of Paleontology, Claremont, USA) and James Neenan (University of Oxford, UK). A collaboration that I started with Bastien Mennecart (Natural History Museum Basel, Switzerland) should bring a further 20 scans of species that are missing from my dataset. After this, my CT

dataset will be complete. This dataset comprises mammals with a nearly horizontal head orientation and sprawling posture (e.g. platypus) and mammals with a nearly vertical head orientation and parasagittal posture (e.g. warthog).

- So far, 80% of the specimens scanned have been digitally treated, and their endocast and bony labyrinth segmented out, reconstructed in 3D and measured using the software AVIZO 9 (FEI VSG, Hillsboro OR, USA).
- Regarding field data, four South African institutions (Pretoria zoo, Johannesburg Zoo, Lory Park Zoo, Monte Casino Bird Garden) and two French institutions (Menagerie du Jardin des Plantes, Zoo of Paris) were visited, and head posture was documented in 83 species. I just received fundings from the COE in order to document head posture in the species which I have CT scanned, but for which field data are still missing (about 50 species).
- The first results unexpectedly suggest that despite a hundred years of an assumed linear relationship between the two metrics, LSC orientation might not be correlated to head posture in mammals. Though unexpected, this is a fascinating result that may lead to the questioning of a long-standing paradigm. A possible effect of body mass has been detected since small taxa seem to hold their head more horizontal than larger ones. A phylogenetic effect is not ruled out.
- Going back to the published literature I quickly realised that, though commonly accepted, the assumption that head posture and LSC orientation are correlated has never been adequately addressed or statistically tested on a large sample of mammals. This will be the next step of this project. The outcomes may invalidate some papers, including recent ones, and may durably impact the field of vertebrate palaeontology as well as zoology and behavioural ecology. I am thus confident that this study will lead to an impactful publication.
- Alternatively, if the relationship between the two metrics is confirmed (or refined) as formerly expected, the project will follow its normal course toward the application of this knowledge to non-mammalian therapsids, which will also lead to publishable results. Therefore, whatever the outcome, this project will be successful. The first results should be ready for presentation at the International Congress of Vertebrate Morphology in July 2019 which will be held at Prague.

Professor Berger, Lee
PVT Chair in the Evolutionary Studies Institute

Title of project: Malapa and Rising Star Excavations

Summary of the project: Karst landscapes have proven to be a rich source of fossils; however, more exploration is required with the aim of finding more such sites. The exploration research project aims to discover new major sites in karst landscapes both within and outside of the Cradle; this will include identification and mapping of potential paleontological sites of interest in sub-equatorial Africa. Systematic re-examination of known fossil sites will continue and identify missed fossils within. Study and analyses of collected fossil material are underway. Research within Palaeoanthropology ranges from the description of all fossil materials recovered, analysing the form and function of the skeletal elements recovered of not only the hominins uncovered but also the associated fauna. An essential part of the research will also aim to reconstruct the palaeo-environments in which these early ancestors lived. These and other projects form part of an on-going, multi-disciplinary study. The Exploration and Laboratory teams are a vital part of our research as they are responsible for the discovery, recovery and preparation of the fossils. The more sites that are discovered and studied the better our understanding of the Cradle of Humankind and the hominins fossils found there.

Research highlights:

- The Rising Star and Malapa sites continue to produce fossils of *Homo naledi* and *Au. sediba* respectively. Excavation work has continued at Malapa and within the Dinaledi chute and Chamber. The current research has been focused on the form and function of various aspects of the *naledi* remains. This has resulted in not only publications but also some conference presentations on these subjects. Our paper on the endocast of *Homo naledi* provided some interesting insights into the potential cognitive capabilities of this fossil species. This year also saw papers being published on the dentition of *Homo naledi*.
- The Rising Star team undertook another round of excavations in the Dinaledi Chamber. The purpose of this three-week-long expedition was to determine whether or not the volume and density of the material from the original excavations continued in the rest of the chamber floor.
- More than 200 fossil specimens collected and many more yet to be recovered. A few of the more spectacular pieces include a well-preserved proximal femur, numerous large long-bone shafts and two halves of a small mandible that, although badly crushed, maybe virtually "reconstructible" using photogrammetry software.
- Excavations at Malapa are progressing at a steady pace, with 17 (1mx1mx10cm) squares having been excavated. The main focus of the current phase of the excavations has been on the main pit (location of the original discovery in 2008). This area is characterised by a 3 level descend to the bottom of the pit, that currently represents the lowest level of the old cave system.
- 3D modelling project currently underway at Malapa. These models (when combined with the complete 3D model created of the main pit) allows for a precise (within 0.05mm) layer by layer reconstruction of the excavations.
- The extent and degree of 3D modelling already undertaken at Malapa is a first for any archaeological or palaeontological site in South Africa and makes Malapa one of the best-documented heritage sites in southern Africa.
- The breccia block that is being worked on at Maropeng has revealed many new hominin fossil pieces. The degree of preservation in the block is high, and it currently appears that the block might contain the whole spinal column of *Australopithecus sediba*.
- We have also added some new fossils to the collection including a large amount of material associated with the Dinofelis group of extinct felid predators. It currently appears that Malapa might have material associated with two different Dinofelis species.
- We have also added 684 new breccia pieces to the collection. With the addition of this material the Malapa Collection's catalogue currently stands on 5063 specimen numbers.

Professor Bordy, Emese
Dept of Geological Sciences, University of Cape Town

Title: Stratigraphic framework of the Uitenhage Group, South Africa: Invertebrate biostratigraphy and zircon geochronology

Summary of Project: The Jurassic - Cretaceous Kirkwood Formation, a major and widespread terrestrial constituent of the Uitenhage Group, has a rich fossil heritage however none of its fossils is sufficiently age-diagnostic, and thus the generally accepted early to mid-Valanginian age of the Formation is, to date, unconfirmed. To refine its age, and therefore constraints on the age of the Uitenhage Group, we did (a) apply zircon geochronology to its tuffaceous beds as well as (b) established its preliminary chronostratigraphic framework by determining the stratigraphic position of fossiliferous beds relative to its lithostratigraphic boundaries. This improved age control allowed

the quantification of the evolutionary rates in the physical sedimentary processes and helped explain the spatiotemporal variation in the sedimentary architecture of the Uitenhage Group. Ultimately all this quantifies the palaeo-ecosystem diversity in time and space within the Jurassic - Cretaceous of southern Africa and helps understand better the evolution of life and land in SW Gondwana in the Mesozoic. The results will imply the understanding of the paleontological and geological evolution of the southern Cape from the post-Triassic (i.e., Early Jurassic onwards) as well as break up of SW Gondwana. The project is a game-changer in our thinking about the major life and earth science events in this area for the middle to late Mesozoic.

Dr Botha-Brink, Jennifer
National Museum, Bloemfontein

Title of Main Project: The effect of lifestyle on vertebrate life history

Summary of Project: This research aimed to assess the influence of environmental variation and habitat preference on the life history of vertebrates. Taxa with biomechanical adaptations to burrowing were the main focus of the research. The objectives were to identify osteohistological markers in extant burrowing mammals and apply the results to extinct vertebrates living during the Early Triassic post-extinction recovery period following the Permo-Triassic mass extinction. I obtained a postdoctoral fellow to examine the modern aspect of the project, and several burrowing taxa including the aardvark, North American badger, nine-banded armadillo, meerkat, mongoose and molerat have been thin sectioned, and the data are currently being analysed. The aim of accumulating all this data is to measure a set of microanatomical characters such as bone compactness, which will then be included in a comparative phylogenetic analysis to test for correlation with fossorial lifestyle and metabolism. The results obtained from examining the aardvark were worthy of a separate paper, which has been published. At least three papers will emanate from this project, two of which have been published.

Research highlights:

- Journal of Vertebrate Paleontology publication on the description of a juvenile *Lystrosaurus curvatus* skeleton within a fossilized burrow. This paper discussed the implications of a burrowing ecology as a survival strategy in Triassic *Lystrosaurus* (published in 2017).
- PeerJ publication with a postdoctoral fellow, Lucas Legendre, on the limb bone osteohistology of the aardvark (*Orycteropus afer*). The aardvark is insectivorous and the largest extant burrowing mammal, and because of the rarity of the material, its bone microstructure has never been examined. During Dr Legendre's postdoc, we had the opportunity to thin section the limb bones of several adults and uncovered a remarkable condition of its bone tissues. Most of the cortex comprises compacted coarse cancellous bone, which contrasts with most large mammals where this tissue type is usually resorbed or remodelled during early ontogeny. The presence of this tissue typed may be the result of physiological constraints due to both extensive digging behaviour and strong metabolic restrictions. Paper downloaded 194 times from PeerJ site (published in 2018).
- PeerJ publication with collaborators Marina Bento Soares and Agustín Martinelli on the osteohistology of Late Triassic prozostrodontian cynodonts from Brazil, which revealed that although the Prozostrodontia acquired increasingly mammalian features during their evolution, including rapid juvenile growth, the small brasilodontid prozostrodontians, which are the sister group to mammals, still show an extended growth period compared to similar-sized living mammals. Media release on Facebook and 275 downloads of the paper from the PeerJ site (published in 2018).

- [not related to project, but noteworthy] Current Biology publication with Blair McPhee, Roger Benson, Emese Bordy and Jonah Choiniere on a giant dinosaur from the Earliest Jurassic of South Africa and the transition to quadrupedality in early sauropodomorphs. This paper was on a new species of giant sauropodomorph and a new method for determining posture in extinct tetrapods. I conducted the osteohistological analysis and found that its bones grew similarly to other non-sauropodan sauropodiforms, but also showed aspects of the more derived sauropod dinosaurs in having higher growth rates during the unfavourable growing season.
- News mentions = 149, social media comments = 645 (published in 2018).

Professor, Choiniere Jonah
Evolutionary Studies Institute, University of the Witwatersrand

Title: Finding the End-Triassic Extinction in the mid-Zambesi Basin

Summary of Project: The Triassic and Jurassic deposits in the Mid-Zambesi basin of Zimbabwe are underexplored relative to their correlative strata in the Main Karoo Basin. The Mid-Zambesi deposits are important, however, because they were laid down at a lower palaeolatitude than those of the Main Karoo, and thus can inform us about the effects of the end-Triassic Extinction Event in more temperate areas and about the latitudinal biodiversity gradient in Triassic/Jurassic times. In 2017, my research team used funding from the Centre of Excellence Palaeosciences to explore the Zimbabwean shoreline of Lake Kariba, searching for new Stormberg-equivalent fossil deposits. Our discoveries included a dramatically revised stratigraphic position for the basal sauropod *Vulcanodon*, a promising new Early Jurassic locality on Spurwing Island, and surprisingly abundant phytosaur material from Matusadona National Park. The latter discovery is especially important – phytosaurs are high-precision biogeographic markers that signify Late Triassic-age deposits, and they are previously unknown from sub-Saharan Africa. This project seeks to: 1) revisit these promising localities to excavate significant fossil material; 2) and to collect geological data sufficient to establish a regional stratigraphic column with taxon ranges, and 3) to independently test the age of these deposits with radiometric methods.

Research Highlights:

- We discovered two new fossil tetrapods in the red bed sequences on the shores of Kariba, including an articulated hind limb and an associated but disarticulated axial column and limb material. We do not yet know what these pertain to.
- We found abundant new phytosaur and metoposaur material, sufficient to complete a research publication describing the first phytosaur material from southern Africa
- We have completed revised the stratigraphy of the area, finding that areas previously identified as being in the Forest Sandstone are much older and belong in the poorly understood Tashinga Formation, and we have obtained an LA-ICPMS date from detrital zircons showing that the strata we are working in are approximately 207mya.

Dr Durand, Pierre
Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg.

Title of project: Environmental and group level adaptations en route to multicellularity in the volvocines

Summary of the project: The volvocine green algae are a model lineage for investigating the evolution of multicellularity. This project examined the genetic and genomic basis for the evolution

of multicellularity as well as the key role played by programmed cell death (PCD). This was done by decoding the genomes of the volvocine organisms that are most basal in the colonial forms. The organisms examined are those who represent the earliest steps en route to multicellular forms such as the 4-celled *Tetrabaena socialis* and the 16-celled *Gonium pectorale*. The primary aims were to identify the contraction and expansion of gene families; the emergence of new gene families and changes in genomic architecture that are associated with the evolution of multicellularity. In addition to the genomic data, a philosophical understanding of what PCD fundamentally is was required. The PCD trait has been enigmatic to evolutionists studying single-celled organisms, and a philosophical and conceptual examination of the nature of PCD addressed a significant gap in knowledge. In 2018, the genome of *Tetrabaena socialis*, the simplest colonial member (4-celled) of the volvocine lineage, was reported. The data revealed many of the key steps that would have been required at a molecular level for multicellularity to emerge. The expansion and contraction in specific gene families were identified, and several lines of evidence pointed to the emergence of the proteasomal degradation pathway as being a key step for coloniality. A philosophical treatment of the nature of PCD led to the conceptualisation of evolutionary definitions of cell death. These will hopefully provide a framework for investigating the different kinds of death and the role they played in the evolution of multicellularity.

Research highlights:

- Highlight 1 (publication 1). The publication of the *T. socialis* genome is the simplest multicellular form of life that has been reported and decoded. This work was performed by a PhD student in my lab (first author), with myself as the last author. I think the most important finding was that the evolution of a ubiquitin-protein degradation pathway appears to be have been a key innovation for the integration of groups of cells and the emergence of colonial cellular life. The publication reporting these findings is also a departure from the lines of enquiry to date, which have generally examined the changes at the level of gene families. Our work suggests that, what was perhaps more important and has certainly been neglected to date, was the increase in the complexity of the protein-protein interactions. This work was reported on in the popular press and scientific media.
- Highlight 2 (publication 2). The publication of the 'nature of PCD' was a personal highlight because this was the first philosophical treatment of this enigmatic phenomenon and maybe a reference point for future evolutionary-based studies of PCD. Researchers have almost entirely made use of mechanistic definitions, and there have been several explicit calls in the last few years to provide a general framework for understanding what PCD fundamentally is, as opposed to how it is realised. Three evolutionary definitions, as opposed to the mechanistic ones used to date, were conceptualised. 1. *Incidental death* is the form of death that occurs due to extrinsic processes and initiated by physical and chemical events. It has no evolutionary history associated with it. 2. *Ersatz PCD* is due to genetic programmes that have not themselves been selected for but is a by-product of other selection pressures. 3. *True PCD* (or just PCD), is an adaptation to abiotic and biotic stresses that lead to the death of the cell. These definitions will hopefully be used by others in the field to frame some of the evolutionary ecology questions in this field.
- Highlight 3 (publication 3). This was an unexpected outcome. While analysing and interpreting the data obtained from the *Tetrabaena socialis* genome, we began to appreciate the complexity of the different ontogenetic programmed found in different volvox species. This line of enquiry led us to the work of a South African phycologist (Mary Agard Pocock) from the 1930s-60s, who made a seminal contribution to this field. Her work has not been given the recognition it deserves in SA, although internationally she continues to be cited, and her insights and predictions still hold. I decided it would be opportune to record, explicitly, her

major contributions to this field in a publication and build awareness of her accomplishments in the South African scientific community. Not being an expert in this aspect of volvocine research, I enlisted the help of a Russian phycologist who is an expert in volvocine ontogeny.

Dr Gess, Robert
Albany Museum, Makhanda

Title: High Latitude marginal marine and terrestrial Devonian Ecosystems
Summary of project: Whereas almost all well studied Devonian (419-359 mya) ecosystems are from tropical and subtropically deposited strata, those of the Cape Supergroup were deposited at high latitude - within the Antarctic circle by the end of the Period. This provides a unique opportunity to test biogeographic theories regarding the Devonian and the setting of terrestrialisation. For example, recent description of Late Devonian (Famennian) tetrapod remains from Waterloo Farm contradicts the previously accepted view that these taxa were obligatory tropical.

This ongoing project explores the influence of palaeolatitude and palaeoclimate on marginal marine and early terrestrial South African Devonian ecosystems, and the effects of the End Devonian Extinction Event.

The primary emphasis remains the latest Devonian Waterloo Farm lagerstätte near Makhanda in the Eastern Cape; however, fieldwork in other Famennian, as well as early- and mid-Devonian rocks of the Cape Supergroup is yielding important comparative material.

At the depositional locus of the Waterloo Farm lagerstätte, sediment deposited in an estuarine marginal marine environment provided perfect conditions for preserving delicate seaweeds, land plants, invertebrates, fish and even four-legged pre-amphibians. These derive from both estuarine and adjacent terrestrial ecosystems. Exceptional preservation of soft tissues, including body outlines, fins, skin and cartilage provides the only known examples of such from an end Devonian coastal ecosystem in the world. As almost all taxa discovered are formerly undescribed genera and species, a necessary preliminary is the diagnosis and analysis of new species, which also provides important insights into the evolution of some lineages. Twenty-two taxa so far diagnosed from the Waterloo Farm palaeoenvironment represent about 40% of its discovered fauna and flora.

Detailed ecological understanding of the environment derived from holistic study results in it being the environmentally best understood Devonian tetrapod-bearing site in the world.

Research highlights:

- A major highlight for the project this year was the release of a paper in Science announcing the first known Devonian tetrapods from high latitude setting (all previous examples having been derived from tropically deposited strata). Also, these represent the oldest four-legged animals from Africa by at least 80 million years, and the 2nd and 3rd Devonian tetrapod species known from the whole of Gondwana (a single jaw ramus from eastern Australia being the only other example). The press release held at Wits, organised by the CoE was attended by the Minister of Science and Technology as well as representatives of Wits, the NRF and SANRAL, to name a few. It resulted in an overwhelming media response and public interest which have served to soundly reinforce the importance of our Late Devonian palaeontological heritage in the minds of multitudes of South Africans, as well as the international scientific community. Discover magazine, in its 2018 wrap up “Year in Science” has chosen to include the publication of the Waterloo Farm tetrapods in its summary of the 100 top science stories of 2018. Congratulation on the discovery was included in the minutes of the South African cabinet meeting of 20 June 2018.

- Professor Per Ahlberg's visit between 11 and 21 April was extremely productive. Gess and Ahlberg managing to make a composite reconstruction of most of the skull and shoulder girdle of a new species of the Tristichopterid *Hyneria*, a genus formerly only known from the Late Devonian palaeotropical Red Hill, Pennsylvania site (that also contains remains of at least two species of tetrapod).
- During work on the Tristichopterid it also became clear that certain large Sarcopterygian skull bones did not belong to it and a small collection of skull and jawbones were identified as belonging to a rhizodont, a group never before recorded from a high latitude locality. Professor Ahlberg intends to return to South Africa to help with a description thereof.
- During fieldwork in December in early Devonian strata, Dr Gess unexpectedly discovered remains of a small undescribed Eurypterid. Formerly South Africa has only two known Eurypterid species. Eurypterids are generally very rare in Gondwanan strata before the amalgamation of Pangea – their major radiation having been in Laurussia.

Dr Matthew, Thalassa
Iziko Museums of South Africa

Title of project: Fossil microfaunas: probing palaeoenvironments and climate change

Summary of the project: This proposal covers the third year of a three year project plan which encompasses several archaeological and palaeontological fossil sites from the south coast, three west coasts, and east coast, as well as Cooper's Cave, and covers glacial/interglacial epochs from MIS (Marine Isotope Stage) 6 to MIS 1. Frogs are highly sensitive to fluctuations in moisture levels and temperature while micromammals respond more to changes in vegetation - thus used in tandem these taxa are highly complementary for palaeoclimatic and palaeoenvironmental reconstruction. Despite this fact, the fossil anuran (frog) component from archaeological or palaeontological sites typically remains unanalysed due to a lack of specialist knowledge. The research aims to unravel the interwoven threads of climate change, geomorphology, and oceanography, by utilising taxonomic and taphonomic studies of fossil micromammal and frog assemblages to study the response of terrestrial ecosystems to glacial/interglacial cycles along the South African coast, and interior. This research will also elucidate patterns of micromammalian and anuran (frog) evolution and migration from the early Pliocene to the present.

Research highlights:

- I have done a review on frog ilia from extant southern Africa in order to facilitate the identification of fossil frog fauna. This paper is in the process of submission – I am just awaiting uploading of the online files by my co-authors. I collaborated with Dave Blackburn (University of Florida) to get access to ilia that I did not have, and we are loading the STL files of CT scanned ilia online for open access by researchers. I learned a lot about frog morphology during this research. This paper will be submitted to Zoologischer Anzeiger in December.
- I have also clearly established that the enigmatic frog ilia I found at both Langebaanweg and Cooper's Cave are unlike all extant frog lineages and show some remarkable and unique features. I have a draft paper which should be ready for submission shortly on these ilia.
- I have completed a review paper on micromammal research carried out on four sites from Pinnacle Point (Mossel Bay), and the Knysna Eastern Heads site, KEH1. This paper indicates some exciting changes in the distribution of murid and soricid taxa, and shows remarkable adaptability and plasticity in murid and soricid taxa to changes in dominant vegetation type, to shifting sea levels and different exposures of the paleo-Aghulas plein, and to changes in rainfall amount and seasonality. This plasticity indicates that using the current biogeography

of murids and soricids for climatic and populations modelling is a potential source of error and that micromammals may be remarkably resilient to climatic change. Micromammal distribution change was more marked in the Holocene than in the mid to terminal Pleistocene.

I have found a vlei rat – identified by its teeth - in both the fossil and modern owl pellet collections which have an undocumented distribution. It (*Otomys sloggetti*) is currently cited as being a high altitude endemic, found only in the Drakensberg and a couple of mountain tops in the Karoo, yet I have found it in west and south coast fossil deposits, and in modern owl pellet collections from the west and south coasts. It is a cryptic species which looks like *O. irroratus* or *O. karoensis* and so has not been identified, or even noticed. This is an exciting find and an unusual situation – I plan to publish on it very shortly. I have already CT scanned specimens for this proposed article.

Dr Taylor, Wendy
Dept of Geological Sciences, University of Cape Town

Title of project: Palaeontology and stratigraphy of Late Ediacaran fossil assemblages of the Nama Group, Northern Cape, South Africa

Summary of project: In order to locate and characterise the fossil assemblages within the Late Ediacaran Kuibis and Schwarzrand Subgroups, Nama Group, we proposed a series of stratigraphic and micro-palaeontological research goals for our work in 2018. My research in 2018 has allowed me to connect with colleagues in Australia at the South Australia Museum (Adelaide, South Australia) and the Queensland Museum (Queensland, Australia). These collaborations are focused on the comparative study of Nama specimens from RSA with very similar Australian specimens in central and southern Australia. I recently travelled to Australia (Nov/Dec 2018) and spent a week working with Dr Peter Haines (Australian palaeontologist/geologist) on this project. We visited two museum collections to examine and photograph the Australian specimens. We will be analysing this material in the coming months and comparing it with 30 specimens that I have collected (2016-2017) from the Northern Cape, RSA. Our goal is to submit a manuscript Nature Scientific Reports in early 2019.

My continued work on the Nama Group in RSA has helped establish a new collaboration on the radiometric dating of possible tuffs of Nama equivalent rocks of the Vanrhynsdorp Group in RSA. These rocks were the focus of my earlier work on the Nama (with BSc Honors/MSc student, Bianca Harrison), but my Nama research had shifted to focus to new fossil discoveries made in the Northern Cape in 2016-2017 This also changed with the completion of B. Harrison's MSc project. Myself and local collaborator, Dr John Almond, is working with colleagues from Johns Hopkins University (USA) who visited South Africa in June/July 2018 to collect tuff samples from both the Western and Northern Cape sites and who are now using ID-TIMS U-Pb geochronology to date the samples. With luck, we will have new radiometric dates in 2019 for critical parts of the Nama sequence in RSA.

Palaeo-environments & Palaeoclimates

Professor Bamford, Marion
Director, Evolutionary Studies Institute, University of the Witwatersrand

Research highlights:

- PPP-G fieldwork in Gorongosa National Park, Mozambique, in August yielded more silicified wood but also charcoal samples from a cave setting. The samples will be exported to the ESI early in 2019 for analysis.

- Grass Ridge Shelter, just north of Queenstown, Eastern Cape Province, has identifiable charcoal from the Pleistocene and Holocene layers. The preliminary results will be presented at the Paleoanthropology Society conference in April 2019 and also at INQUA, in Dublin in July 2019.
- Triassic and Jurassic woods from Darwin's Fossil Forest, Atacama Desert, Chile. I visited the site with local palaeobotanist Prof Teresa Torres and collected samples from the trunks that are more than 1m in diameter, and we will publish the identifications in 2019 (new project and a result of the PPP-G project).
- *Molteno project with Dr Heidi Anderson, Dr Keith Holmes, Dr John Anderson and Dr Maria Barbacka (Hungary) – the first of three papers has been accepted for publication in Alcheringa; the second has been submitted, and the third should be submitted in early 2019. Funding from CoE in 2017 and again for 2019.
- International Palaeontology Congress, Paris 8-14 July 2018 – I was invited to give one of the Plenary Talks on the first day.

Dr Rosemary Prevec
Head of Dept, Albany Museum

Title of Project: Palaeoecological reconstructions of early to middle Permian ecosystems of the Karoo Basin: an investigation and comparison of the plant and insect life in fluviodeltaic settings along the northern and southern shorelines of the continental Karoo Sea

Project Summary: It is perhaps once in a palaeontologist's career that an opportunity arises to study a new fossil Lagerstätte. This is precisely what the Onder Karoo plant and insect fossil locality near Sutherland are proving to be. During a total of six weeks of excavations between 2016 and 2018, the Albany Museum Team has collected approximately 800 insect specimens! The site has yielded an incredible abundance and diversity of insects, including wings and many-body fossils, of insects at various ontogenetic stages. The sheer abundance of material we have been finding is unparalleled for the Permian of South Africa, and the site promises to be productive for several years to come. Most of our knowledge of insects in the Karoo Basin has come from studies of collections from the Upper Permian Normandien Formation of KwaZulu-Natal, and the Lower Permian Whitehill Formation of the Western Cape. The Onder Karoo locality represents the first collection of insect fossils from the middle Permian. Together with the beautifully preserved plant material at the site, which also shows abundant evidence of plant-insect interactions, we are in a unique position to conduct a palaeoecological study of a lakeshore environment, with both terrestrial and aquatic elements represented. We have the materials to reconstruct at least a part of an ancient food web. This work is going to shift perceptions of Permian insect communities in Gondwana, through the description of new taxa, range expansions of taxa, phylogenetic analyses including modern and fossil groups, and the unique opportunity to study many components of a Permian ecosystem. These insect fossils also have the potential to provide input on palaeoclimate, biostratigraphy, and palaeobiogeography, through comparisons with faunas in other parts of the world, and with extant members of the groups.

Research Highlights:

- Our field trip in May was enormously productive, and we collected many more insect and plant fossils. It was the largest group I have taken into the field, and the students benefitted enormously from some hands-on field experience. I think this was an excellent opportunity for all to realise the amount of work entailed in finding fossils, even in a highly fossiliferous deposit such as the Onder Karoo locality. We collected many more insect nymphs, wings,

mites, a larval insect and even a possible annelid worm. It seems we may have a wasp wing, which is hugely important, along with many other insects we have not seen previously. We also have some new plant fossils, including a new moss species and two new Dictyopteridean glossopterid fructifications.

- The discovery of 5 more water mites from the Onder Karoo site brings the total to 11. These are the oldest water mites in an extremely sparse fossil record, expanding their known temporal range by 150 million years. We are working on these with experts in Germany, and look forward to producing a high profile publication on these results.
- The Onder Karoo locality has also produced an astounding profusion of fertile glossopterid organs, including both the male and female cones. This is the first occurrence of its kind. The only other female glossopterid cone we know of was described at the IPC conference in Paris (2018) and is a single permineralised structure from Australia. We now have hundreds of impression fossils of *Lidgettonia* fructifications attached in short shoots, which represents a significant contribution to our understanding of glossopterid reproduction and affinities. These are also the oldest known *Lidgettonia* fossils, and our work is demonstrating that this genus formed a major component of the floras from the middle to the latest Permian of South Africa.

Cultural & Behavioural Evolution

Dr de la Peña Alonso, Paloma
Evolutionary Studies Institute, University of the Witwatersrand

Title: Cultural Evolution for the Middle Stone Age: Understanding Technological Variability in Homo sapiens

Summary of the project: My research is to test the lithic technological variability associated with the Middle Stone Age (MSA) in the Eastern part of Southern Africa. This is the area where I have worked the most, and it is particularly interesting for several reasons. First, it has specific, unique biomes. Secondly, it is under-researched because it is not the traditional research area for MSA in South Africa and, thirdly, analysis of its technocomplexes will provide a link to the evolution of the MSA in areas farther north, particularly in Zimbabwe, Mozambique and Swaziland. The North-Eastern part of South Africa is also interesting because a techno-tradition different from others in Southern Africa was first recognised here at the beginning of the twentieth century: the so-called Pietersburg Industry. Currently, I am working to establish whether this techno-tradition can be recognised as a distinct regional entity because most of the research in Southern Africa has as its focus the MSA of the Western Cape.

Research highlights :

- Preliminary analyses and publication of Mwulu's Cave project. This publication is the result of two previous operational support funding of the CoE to Paloma de la Peña Alonso: *Luminescence dating for the Middle Stone Age site of Mwulu's Cave (2018) and Excavation of Mwulu's Cave, a Middle Stone Age site in Limpopo (2017)*. In the first paper published on Mwulu's Cave, we present a revised stratigraphy and results of preliminary analyses of the archaeological material. This arises from two excavation campaigns conducted in 2017, 71 years after Philip V Tobias initially investigated the site.
- Tobias. This cave, located in Limpopo Province (South Africa), preserves one of the few known Middle Stone Age sequences in the northeastern part of the country. Here, we revisit the stratigraphic sequence of the site and provide new analyses of sediments, palynomorphs,

phytoliths, ochre and lithics. The renewed excavations and reappraisal of the archaeological material from

- Mwulu's Cave forms part of a larger research project exploring Middle Stone Age variability in the northeastern part of South Africa, with a specific focus on the so-called Pietersburg industries.
- See publication: de la Peña, P.; Val, A.; Stratford, D.; Esteban, I.; Fitchett, J.; Matembo, J.; Moll, R.; Hodgkiss, T.; Colino, F. (2018). Revisiting Mwulu's Cave: New insights into the Middle Stone Age in the southern African savanna biome. Archaeological and Anthropological Sciences. https://doi.org/10.1007/s12520-018-0749-9
- Excavation of Olieboospoort (Limpopo) October 2018, in collaboration with Aurore Val; and Border Cave (KwaZulu Natal) April-May 2018 in collaboration with Lucinda Backwell. I have collaborated in the two field campaigns of these two caves as an experienced field archaeologist and because I am planning to study the Middle Stone Age lithics of these two sites in order to compare with Mwulu's Cave (see aims of my project).
- First prospection survey of the Stormberg area (Eastern Cape), May 2018. As a long term project, I am developing different archaeological prospection surveys in interior areas of Southern Africa.

Dr Reynard, Tamaryn

Origins Centre, School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg

Title of project: Does location influence ochre use strategies: Comparing ochre use at Rose Cottage Cave during the Late Pleistocene with the use of ochre at coastal sites.

Summary of project: The Late Pleistocene is a time of significant behavioural developments, with important cognitive implications for *Homo sapiens*. Rose Cottage Cave is an inland archaeological site that contains Middle Stone Age (MSA) and Later Stone Age material covering the Late Pleistocene and Holocene periods. The long MSA sequence, dated from ~96 000 to 30 000 years ago, makes the site valuable in our understanding of the material culture and subsistence changes through time. Ochre pieces and evidence of ochre processing feature throughout the sequence. The physical and mineralogical qualities of the pieces have been studied in detail. By comparing the Rose Cottage ochre assemblage with other well-studied South African MSA ochre assemblages near to or at the coast, such as Sibudu Cave, Blombos Cave and Diepkloof Shelter, we can obtain a greater understanding of ochre use across the landscape.

Research highlights:

- The research for the conference presentation made me aware of the difficulties in making site comparison when there is no consistency in how ochre assemblages are analysed and published. Through the research, I had further conversations with researchers who have worked on ochre assemblages – creating a reasonable basis for ochre research going forward. I gained wider awareness of other sites that are being studied in Africa through presentations by postgrads students and researchers; I was able to network with many of them.
- After my presentation at the conference, I was asked to analyse the Grassridge ochre assemblage. This assemblage is from an inland Middle Stone Age site – sites that are often not focused on in that period since so many of the well- studied sites are situated on or near the coast. This analysis has been mostly completed and will be published as part of a paper describing the excavations and site assemblage at Grassridge, in March/April 2019.
- I received an invitation to present in a session at the Society for American

Archaeologists (SAA) in Albuquerque, New Mexico, the USA on April2019.

Dr Val, Aurore
Evolutionary Studies Institute, University of the Witwatersrand

Title of project: Excavations of the Middle Stone Age layers at Olieboomspoort, Limpopo Province

Summary of project: This project focuses on one of the few large rock shelters in the Waterberg, Limpopo, preserving rich archaeological deposits: Olieboomspoort Shelter. The funding required will be entirely used for fieldwork at the site and luminescence dating of the deposits (OSL/TL). R. Mason was the first to excavate the site in the 1950s, revealing a ~2-meter deep sequence preserving Later, Middle, and Early Stone Age layers (Mason, 1962). Van der Ryst undertook subsequent excavations in 1997 (van der Ryst, 2007) and focused exclusively on the Later Stone Age units. While the latter has been well studied and well-dated, very little is known on the Middle Stone Age (MSA) layers, besides an age greater than 33 ka (since falling beyond the range of radiocarbon dating) and the attribution of the lithics they yielded to the poorly known 'Pietersburg' techno-complex. This multi-disciplinary project, involving various specialists (of lithics, faunal and archaeobotanical remains, geoarchaeology, and dating), as well as students, aims at: (1) obtaining a new, finely excavated sample of archaeological material from the MSA layers, (2) providing a better chronological framework those layers, and (3) investigating the formation processes at play in the accumulation of the archaeological deposits.

Research highlights:

- The relatively good preservation and abundance of fossil faunal remains in the Middle Stone Age layers were not expected. It will allow us to gain some new insights into the palaeoenvironmental conditions around the site during the Pleistocene, in a part of South Africa where little is known in that respect. It will also allow us to combine Electron-Spin-Resonance dating on a couple of large ungulate teeth with Optically-Stimulated-Luminescence dating of rocks and sediments (working with one of the world-leading laboratories in Luminescence dating in Denmark). Dating the Middle Stone Age layers from the site is a key aspect in this project as, to date, only two sites for the whole of Savannah Biome characterised by the Pietersburg industry are securely dated (Bushman Rock Shelter and Border Cave).
- Accumulation of archaeological deposits and post-depositional processes are more complicated than we thought. A detailed taphonomic study of the lithic and faunal assemblage, coupled with ongoing geoarchaeological analysis of the sediments is needed. The 2018 fieldwork campaign allowed us to identify several processes, including deflation, erosion, bioturbation and possibly transport by water, that seem to have contributed to the formation of the site but more work is required. I have offered an MSc project in collaboration with Dr Jerome Reynard to study the taphonomic characteristics of the faunal assemblage recovered during the 2018 campaign, and we are currently looking for a South African student.
- Unlike what the data from previous excavations at the site led us to think, the bedrock has not yet been reached in the test-trench, implying that archaeological deposits go deeper than expected. The morphology of the bedrock underneath the sediments in the test-trench in particular and the shelter, in general, is currently unknown. We have decided to involve Dr Susan Webb from the School of Geoscience at the University of the Witwatersrand with one of her honours students to conduct Ground-Penetrating-Radar and other resistivity exploration to evaluate the depth of remaining sediments as well as the general morphology of the shelter. This will be conducted in May/June 2019.

Dr Wilkins, Jayne
Dept of Archaeology, Human Evolution Research Institute, University of Cape Town

Title of project: A multidisciplinary investigation of early human foraging adaptations in the southern Kalahari Basin

Summary of project: With COE funds in 2018, I collected five OSL samples with OSL specialist Luke Gliganic from Ga-Mohana Hill North Rockshelter. These samples are currently being analyzed at the University of Innsbruck, Austria. Results will be available in early 2019. The team associated with this project, which includes UCT students and collaborators, presented at several national and international conferences. Other accomplishments this year include a significant amount of material sorting and analyses and the submission of a peer-reviewed manuscript that is currently being revised.

Dr Wurz, Sarah
Archaeology Department, School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand

Title of project: New excavations at Klasies River

Summary of the project: Klasies River main site is one of the key Middle Stone Age sites in South Africa. It has an extensive and rich archaeological record coupled to human remains dating to the crucial period during which complex behavioural patterns of anatomically modern humans manifested in the southern Cape. Previous research has established this much, but more remains to be done to more extensively develop the potential from Klasies River. This project entails four goals: refining the temporal and geomorphological context using cutting edge methods; analysing the extensive collections using multidisciplinary methods; generating new data to help interpret the current collections and finally, integrating and comparing this data to other contemporaneous sites. Operational funding from the COE was sought to obtain additional U-series dates from Dr Robyn Pickering, UCT and her postdoc, Helen Green

Research highlights:

- The first article on the New Excavations at Klasies River was published in *Quaternary International*
- An excavation season was completed
- New dates from Robyn Pickering were obtained, enabling the refinement of the chronological structure, and writing of the Klasies River context paper

Applications & Innovations

Dr Pickering, Robyn
Dept of Geological Sciences, Human Evolution Research Institute, University of Cape Town

Title of project: Out of the caves: U-series dating pedogenic and lacustrine carbonates

Summary of the project: The last decade's worth of development of U-series dating (U-Th and U-Pb dating) has seen this method reach a level of maturity where it can be applied routinely, precisely and efficiently to generate ages for cave carbonates, known as speleothems. This has had a profound impact on studies of palaeoclimatology, landscape development and, particularly in the South African context, human evolution (see Woodhead and Pickering, 2012 for a full review). The

next challenge is to move this method out of the caves and adapt it to apply to pedogenic (soil) and lacustrine (lake) carbonates. Pedogenic carbonates, or calcretes, are ubiquitous features to open-air archaeological sites in South Africa and have the dual utility as potential targets for dating and, together with lacustrine carbonates, as palaeoclimate archives. This proposal seeks funding to support two students' work on dating existing collections of pedogenic and lacustrine carbonates from two critical archaeological and palaeoenvironmental sites in the Northern and Eastern Cape Provinces, South Africa. The ultimate goal is to provide a precise new U-series chronology for both sites to establish when our early human ancestors were active on these landscapes, as well as understand the palaeo-hydrological conditions under which these deposits formed.

Research highlights:

- Identification and collection of samples for U-Th dating from massive tufa deposits at Ga-Mohana Hill in the Northern Cape. New U-Th ages hint that their deposition is limited to MIS 3, which has interesting palaeohydroclimate implications. Further dating, with the support of this CoE-PAL grant, will be undertaken in February 2019.
- U-Th dating the surface samples collected from the Kalkkop meteorite crater lake sediments confirmed the ~250 ka age of the deposits suggested by previous workers (Reimold et al., 1998), as opposed to an age of ~6 Ma (Mthembi et al., 2016). Older ages of ~500 ka hint at the antiquity of the deposits (although not as old as 6 Ma!) and we are very excited about re-drilling the entire sequence in February 2019.
- Both students associated with this project, Jessica von der Meden and Zoë Decker, presented their work at the Geological Science Africa meeting in Johannesburg on July 2018 and received excellent feedback.

Professor Sealy, Judith
SARCHl Chair, Dept of Archaeology, University of Cape Town

Research highlights:

- Lehmann et al. (2018) used strontium isotope analyses of tooth enamel from large herbivores at Elandsfontein (ca. 0.6 – 1 mya) to show that habitation patterns of megafauna were surprisingly localised; animals did not migrate across different geological substrates to seek food or other resources. We have no modern analogue for that environment, but it was clearly more nutrient-rich than today.
- Completion and acceptance for publication of Emma Loftus's important study using $^{18}O/^{16}O$ measurements of archaeological shells to reconstruct the seasonal scheduling of shellfish collection along the south coast in the Middle and Later Stone Ages. In this region, the timing of MSA shellfish collection depended on the interaction between several environmental and cultural factors, rather than a single variable such as population growth.
- Work with Julie Luyt (CoE-supported postdoc mid-2017 to mid-2018) and Vincent Hare is for the first time quantifying the effects of changes in atmospheric pCO_2 during the Pleistocene on $\delta^{13}C$ of plants and animals. This will enable much better estimates of the uncertainties associated with our palaeoclimatic and palaeoenvironmental reconstructions.

Palaeosciences & its Publics

Dr McKay, Ian
Centre of Excellence in Palaeosciences & Evolutionary Studies Institute, University of the Witwatersrand

Summary of project: Dr Grizelda van Wyk is conducting (as part of a second PhD, part-time) a study on of the impact of curriculum-related workshops and tours to the Evolutionary Studies Institute/Kitching Gallery. The Sections of the Life Science Curriculum covered include Strand 4: Diversity, Change and Continuity in Grades 10 and 12. These are the topics of South African Palaeontology, Evolution and Human Evolution. We know from literature, and even more from our own experience that teachers do not teach these topics. They prefer either not present them at all, or leave them to the students for self-study. The reasons for this lack of interest are a complex-intermix of fundamentalist religious views, weak content knowledge, and possibly even interpretation of evolution as having some racist hidden agenda. Grizelda hypothesises that by having learners together, with their teachers, participate in a carefully structured hands-on workshop with exposure to real fossils, and strategies to deal with language and other learning issues it will be possible to encourage the teaching of palaeontology in schools and improve school marks in this area. Ideally, the workshop should be accompanied by a visit to the fossil preparator's laboratory, the Kitching Gallery and possibly even a shortened version of the PAST play. Not much research was conducted into the effectiveness of natural history visits in a South African context, and internationally, the impact of a hands-on workshop as part of a museum visit has not been assessed hence this study should contribute to new knowledge. The second aspect of Grizelda's research is how a Natural History Museum can add value to formal schooling and visa-versa, such that a sustainable relationship can be built up between the two organisations.

Dr Tawane, Mirriam
Curator & Head of Plio-Pleistocene Collections, Ditsong National Museum of Natural History

Title of project: Taking Palaeosciences to schools in the city of Tshwane and the Cradle of Humankind

Summary of the project: Evolution became part of the national curriculum in 2008. It is a complex topic that is misunderstood by teachers and learners. Teachers still raise concerns about the lack of knowledge on the subject and are often struggling to teach it. The inadequacy of the teachers' training by the Department of Education exacerbates the situation. Learners struggle to grasp the concept of evolution and are usually left more confused after lessons. This project aimed to teach human evolution at schools within the vicinity of the heritage sites, and those within the vicinity of a natural history museum. Schools around the Cradle of HumanKind and the ones located within the City of Tshwane were visited. This exercise had the capability of remedying the situation regarding Palaeosciences.
We aim to visit the schools and have human evolutionary lectures and workshops with learners. The focus of the workshop will be centred on well-known hominin fossil-bearing sites in South Africa. The specific educational programme was developed and implemented at the schools. These were used to dispense the relevant information regarding the discovery of the skull, scientific information as well as the significance of the finds. A day was dedicated to two schools at a time. The target audience at the schools were Grade 12 learners. Six schools were visited, and two were transported to the museum, and the workshop was delivered in the museum, and it was expanded with the touring of the museum. The project reached out to more than 500 learners from eight schools. There is still more work to be done in schools, as much as there is a need for the general community also to be accommodated in these activities. The workshop presented at schools will be much more suitable presented early in the year, and more time is needed to be spent with teachers as they are the ones presenting it to scholars. Their understanding of the subject matter is very crucial. The

human evolution teaching set was donated to schools. These consisted of *Homo sapien*, *Australopithecus africanus* (Mrs Ples and Taung Child), *Homo naledi*, *Australopithecus sediba*, *Pan troglodytes*, *Gorilla gorilla.* These were accompanied by workbooks for teachers and scholars, to use as learning materials.

Research highlights:

- The misconception about evolution is still very prevalent in some of the schools that were visited. Teachers are still in need of proper training of the subject matter. Mostly raised concerns regarding the complex subject they are expected to teach, without proper training in the subject matter themselves. More interactions in the form of extensive workshops at the beginning of the year are needed.
- The learners indicated that they need an intervention of this sort lasting for more than a day, and it needs to be presented to them before they tackle the subject in class.
- The schools close to those that were workshopped, but could not be included in the project due to the limited availability of funds, are calling requesting to be accommodated in the following year.

2.10 Challenges

2.10.1 Natural History Museums as Partners

The future of research at South African Natural History Museums is an important issue which needs to urgently be addressed for the future wellbeing of the Centre of Excellence in Palaeosciences and indeed maintaining the internationally leading profile of South Africa in research relating to the discipline. The Natural History Museums curate the excavated South African palaeoscience record (fossils and artefacts) and were set up to undertake this critical function. In the past, they employed the largest number of palaeoscientists in the country. As a result of the Natural History Museums, which curate palaeoscience collections, were specifically chosen as partners under the CoE-Palaeo. However, the past five years have witnessed a dramatic decline in palaeoscience research undertaken by the museums, which would have been even more devastating had the CoE-Palaeo not intervened. Despite this intervention, the administrators of our partner Museums do not seem to have an understanding of the requirements to nurture natural history research in a museum environment.

Research traditionally is undertaken by natural science museums, by utilising and building up their biological reference collections through multidisciplinary research programmes, offer answers to the impact of climate change in any specific country. Apart from research, these collections play a vital role in education. For the public, seeing real objects at proximity has an incredibly powerful effect on people. The power of this authenticity is emphasised in an increasingly virtual world. Up to date, high impact museum exhibits are the products of research undertaken by scientists using the scientific collections curated in the museum. Increasingly around the world, museums are requiring collections curators to have a PhD degree and to conduct research in addition to curation.

A worrying trend in South Africa has been the steady decline in palaeoscience research productivity of all the museums, over the past 15 years – ever since the establishment of the Flagship museums. This decline in research productivity is linked to the decrease in the number of palaeontologists employed particularly at Iziko and Ditsong Museums. This trend is not only reflected in the palaeontology departments of these museums but all the other natural science departments as well, where there are less senior scientists employed to curate the collections, and this task is being left to the technical staff that lack the necessary qualifications and experience. Sadly the number of

palaeontological technical staff employed and paid by these museums has also declined, and the position for palaeosciences would be dire if the NRF had not established the African Origins Programme, which has made it possible for museums to employ technical staff.

The research productivity of the Centre is dependent on the accessibility of the palaeontological and archaeological collections of these museums, and also the resident and relevant scientific expertise linked to each of these collections. It is essential that museums employ scientists who are internationally competitive to maintain and expand these collections by actively researching the palaeoscience record of the country.

A decade ago the NRF launched an audit into the state of Natural Science Museum Collections in the country. To rectify the poor state of many of the collections the NRF provided funding for the curation of museum collections over three years, and the Natural Science Collections Facility (NSCF) launched as part of the Department of Science & Technology's South African Research Infrastructure Roadmap (SARIR). The NSCF will support securing collections by improving their storage, digitisation of collections and communication and outreach, and provide some opportunities for enhancing research. The NSCF cannot, however, appoint or employ permanent scientists at these institutions, and the research capacity at museums remains a risk to initiatives like the NSCF and the Centres of Excellence.

A major problem of museums in recent years is the non-competitive salaries paid to highly qualified museum scientists. As a result, highly productive scientists are not being attracted to apply for positions at museums. The lack of competitive salaries has a downward spiral effect with active research staff leaving museums and not being replaced by the best possible people. Another problem is the increasingly bloated administrative capacity of museums, especially the flagship museums, with less funding available for the natural science departments. In many cases, DAC Central administration, inappropriate Councilors and Directors of Natural Science Museums of South Africa have no experience in our understanding of natural science research. Thus they do not understand the opportunities and challenges relating to natural science research and are not in a position to develop research projects, identify possible research collaborations, and so miss out on the opportunity to raise additional research funding through local and international research collaborations. The management and encouragement of Natural History Research require constant nurturing and reassurance by Council and Directorate. Currently, natural science museum researchers are spending too much time complying with bureaucratic legislation and policies that very little research is conducted. A recent advert for a Director (CEO) for one of the sizeable natural science museums of the country does not list research as a priority, and the skills and knowledge required for the position do not include research experience or even exposure.

The fact that the major natural history museums of the country do not prioritise research as a critical function creates a significant problem for the CoE-Palaeo, which is dependent on research productivity for its survival. Currently, the Centre expects each of its member scientists to produce about five research publications per year. All museum staff produce much less than those researchers in an academic institution. The lack of research priority is the direct result of fewer scientists employed by the museums. In addition the low salaries fail to attract highly productive scientists. Furthermore, there are no incentives to produce publications in high ranking international journals, and little or no support from management to create an environment that is conducive to research.

The greatest crisis facing Earth is the biodiversity crisis, as Earth experiences global warming, climatic change and a massive decline in biodiversity, the so-called sixth extinction. The future of humanity

on earth is dependent on the preservation of biodiversity. The biodiversity of South Africa, Africa, and indeed all countries, is curated by natural history museums where all the type and reference specimens curated. Accordingly, these collections are essential to undertake audits of biodiversity and global climate change. And research productivity coming from these museums is essential to understanding the complexities of biodiversity and how changes to biodiversity can affect our modern world.

Now is the time that the precious collections of the natural history museums reflecting the past and current biodiversity of our country, which have been built up over many decades and even centuries, need to be nurtured and researched, yet it appears that research is no longer a priority. This appalling state requires urgent rectification. Possibly a way to begin is to re-assess the appropriateness of the Department of Arts and Culture (DAC) as a governance structure for institutions responsible for scientific research. Additionally, there needs to be engagement with museums to find a way of addressing declining capacity and creating a strong research culture.

2.10.2 Transformation

Our Centre is proud of its achievements in attracting ever-increasing numbers of black female postgraduate students to the palaeosciences. Our Centre has established several initiatives to address this imbalance. These include but are not limited to:

1. Develop an Emerging Researcher Grant to black female researchers
2. Developed a special postgraduate bursary with funding support in collaboration with Palaeontological Scientific Trust to support an excellent black student in combination with excellent supervision
3. Increasing public awareness especially at all levels of education
4. Encourage academics who teach undergraduate courses, to be on the lookout for potential students from historically disadvantaged backgrounds
5. Developing a programme that brings students into the field or is involved with an ongoing research project

The biggest challenge facing South African palaeontology is the lack of finance to employ young palaeontologists at museums and academic institutions. Good students are trained, but there are limited positions available in South Africa. When there are positions, the salaries are on the same scale as a secretary. Offering a low salary to highly skilled individuals is an insult. Many good African researchers leave the field to pursue other fields that have higher earning power. Also, the downgrading of the research function at South African museums in recent years has dramatically affected the discipline of palaeontology and led to the attrition of palaeontological positions and expertise at museums. As discussed many times in Steering Committee meetings, there is a lack of research capacity at our museum partners. The MoA between Department of Science of Technology and the Department of Arts and Culture for the support of Natural History Museums requires urgent follow-up.

Other factors that hinder improved inclusiveness within the field of palaeosciences:

- Few students see palaeosciences as a viable career path that earns a competitive salary, where other sciences with a BSc degree would earn competitive industry salaries
- Reduced funding availability from Government

- The downturn of the economic climate, locally and globally. The climate for palaeo careers at academic institutions are constrained by economic downturn, in turn reduces the number of academic positions locally and globally
- Increase stress of working at academic institutions

Where there is a wall, break it down or go around it! The Centre makes every effort to resolving these surmountable issues by:

- In the short-term - attract more promising young scholars from historically disadvantaged groups into the palaeosciences and to provide them with necessary postgraduate training to become proficient independent researchers. This will require the Centre to offer competitive bursary opportunities to postgraduates.
- Medium-term - to encourage the NRF and other bodies to make postdoctoral fellowships available to promising young PhD candidates to continue working in South Africa or, if necessary, to pursue postdoctoral research overseas to gain more experience
- The long-term - to create more jobs for PhD-level palaeoscientists in South Africa; this is achieved by establishing a National Institute for Palaeosciences. The Universities of Johannesburg, Sol Plaatjie, and Nelson Mandela Metropolitan (Universities which have not previously undertaken palaeoscience research) have recently employed palaeoscientists. Museums need to step-up their game and employ the necessary scientists to curate and conduct research on the large collections curated at these institutions. This will require a change of thinking in the way national history museums are run by DAC and the current short-sighted approach in not supporting natural history research. Also, positions to undertake Palaeontological Impact Assessments need to be exploited by PhD graduates, and opportunities can also be made available to young scientists through palaeo-tourism ventures.

2.10.3 Establishment of a National Institute for Palaeosciences

Successive Ministers of Science and Technology, realising the global importance and significance of the South African palaeoscience record and the considerable interest in it manifested by the participation of scientific collaborators from every continent of the world (even Antarctica), suggested that a “Smithsonian type institute” be established for the palaeosciences. The DST, in turn, has recommended that National Institutes be established to ensure the longevity of productivity for successful centres of excellence. The CoE for Palaeosciences has demonstrated the national and international interest in southern African palaeosciences, its great scientific productivity, and the ability of the discipline of palaeosciences to capture the imagination of the public and to engage young people in considering science as a career.

Although the Director and staff of the CoE-Palaeo have been able to raise additional funding for the Centre, this is not an easy task for a discipline such as palaeosciences, which will always be dependent on some level of state funding as has been recognised internationally. In its short, existence the CoE-Palaeo has demonstrated the capacity of the discipline to catapult South Africa as an important and major player in the forefront of the international scientific arena, and thus the establishment of a multidisciplinary National Institute for the palaeosciences is a logical follow-on to enhance the high level of productivity achieved so far.

The question is to decide whether to establish a single building to house the national institute or to run the institute as a virtual centre, with a hub, much like the current CoE-Palaeo model. This issue will require the input of the South African palaeoscience community together with the DST and NRF. The final configuration with depending very much on the future management of natural history

museums, the curation of their precious and internationally famous palaeoscience collections, and their capacity to participate as full partners in the productivity of the National Institute.

2.10.4 Current Funding Climate

1. Our practice is to ensure that, for the funding received; we try to make the most impact in the fields of research, training of students, curation of collections and public outreach. As the CoE would like to make bursaries available to a greater number of students, we need to find ways to increase the number of bursaries by supplementing bursaries made available via other NRF programmes.
2. The NRF African origins Platform has in the past supported most of South Africa's flagship palaeoscience projects, and this support, together with funding from the CoE resulted in the surge in the international significance of South African palaeoscience discoveries and research output. Internationally it has been shown that it is difficult to secure large funding for the palaeosciences from the private sector. The CoE has been able to secure substantial support from the Millennium Trust to support research on the Devonian of South Africa, and additional funding has been raised from the Norwegian government for the South African based Middle Stone Age SapiensCE project run by Professor Chris Henshilwood.

2.11 Aims & Objectives

South Africa's unique combination of a rich palaeontological and archaeological heritage, together with research excellence and experience in the field, positions this South Africa to take the lead in international research in Palaeosciences. The enabling research environment created by the CoE-Palaeo builds on opportunities provided by the temporally diverse southern African record and will develop new research linkages and collaborations, enabling us to attain far higher levels of research accomplishment. Excellent internationally competitive research is the cornerstone of the Centre activities and is nurtured as this determines the nature of future international research collaboration and expansion.

The diverse projects undertaken by the CoE-Palaeo include research involving the earliest tools of hominins, the emergence of behavioural complexity and material culture, faunal analysis, bone taphonomy, taxonomy and palaeobiogeography of therapsids and dinosaurs. Palaeobotanical work includes the description of fossil pollen of varying ages, Palaeozoic and Mesozoic woods, and palaeobotany of fossil hominin sites in East Africa. The above are traditional areas of South African palaeoscience research strength, but to broaden its scope, the Centre has also funded additional areas in which South Africa has potential important fossil resources, e.g. Late-Precambrian origins of metazoan life, Ordovician-Carboniferous invertebrate and fish diversification. Palaeontology is also used in broader multidisciplinary studies to understand climate and biodiversity change, stratigraphy and basin development studies.

The research programme comprises five themes which address research questions relating to the South African palaeosciences heritage record at different intervals of the stratigraphic succession:

1. *Evolutionary Processes:* This theme includes increasing knowledge of southern African palaeobiodiversity; study the timing of evolutionary events in major clades and significant climatic events; characterise the global geographic distribution of fossil taxa; investigate the nature of functional morphology and critical innovations in morphological evolution.

2. *Cultural and Behavioural Evolution: Material Culture and Behaviour:* This theme aims to explain key long-term transitions in hominid behaviour and how they led to modern human behaviour.
3. *Palaeo-environments and Palaeoclimates:* Earth systems change dynamically, and when stretched beyond certain thresholds lead to changes (and potentially collapses) in ecosystems and biodiversity. This theme will uncover variability in the resilience of past ecosystems to fluxes through space and time.
4. *Applications and Innovations:* This theme focuses on applying technologies to maximise the use of heritage objects through expanded efforts to discover, conserve, augment, and study them. Of vital importance is pursuing new, innovative means of information extraction and analysis.
5. *Palaeosciences and its Publics:* To redefine the ways in which we communicate the palaeosciences and re-associate the palaeosciences with a sense of value and prestige in the minds of South African public, there is a need to acknowledge, understand and be attentive to the different sectors of society and their attitudes towards and understanding of the deep past. South Africa's unique combination of a rich palaeontological, palaeoanthropological, and archaeological heritage, together with research excellence and experience in the field, positions this country to take the lead in international research in palaeosciences. The enabling research environment created by the CoE-Palaeo builds on opportunities provided by the temporally diverse southern African record and will develop new research linkages and collaborations, enabling us to attain far higher levels of research accomplishment.

The above themes pertain to areas where the palaeoscience record of South Africa gives us a geographic advantage, particularly the Cape and Karoo Supergroups, the Tertiary and Quaternary fossil record including the cultural and behavioural evolution of *Australopithecus* and *Homo* and the development of Oldowan, Acheulean, and Middle Stone Age industries. Also of significance is research into establishing effective mechanisms of knowledge brokerage and information dissemination about the palaeosciences, particularly in a South African context. In addition to these "traditional" areas of research of the South African palaeo record, the Centre has encouraged exploration into the origins of life and multicellularity (including investigation of the Precambrian Nama and Vanrynsdorp Groups) and has inspired a strong focus on the Devonian biodiversity of the Cape Supergroup.

The CoE-Palaeo is committed to the development and strengthening of Palaeoscience in South Africa meeting the objects outlined by the Department of Science and Technology, National Research Foundation and its Programmes (Centres of Excellence, the South African Strategy for the Palaeosciences, African Origins Platform) and the Science and Technology White Paper.

The National Research and Development Strategy (NRDS) has identified a number of knowledge fields in which South Africa should aim at achieving international research excellence because of our geographical position and natural or cultural heritage. The Palaeosciences are areas in which South Africa has a competitive and geographical advantage, owing to the quantity and diversity of finds within our national borders. The strategy addresses **five goals** which recognise the need for a holistic approach to the development of palaeosciences. This Progress Report highlights these objectives.

- To transform the minds of South Africans so as to instill a sense of pride and provide the intellectual content to their African heritage so as to make them informed and responsible citizens, and to engage all sectors of society in palaeoscience matters, through information on discoveries that will allow them to appreciate the special place of South Africa in the story of life and humanity on Earth.

- Support the country's universities to produce a critical mass of palaeoscience researchers with a range of research, technical, curatorial, public engagement and managerial skills and drive knowledge production and exploitation to make South Africa a world centre of scientific excellence in the palaeosciences.
- Enhance the capacity of museums to curate, conduct and support research in palaeosciences in ways that inform South Africans and the world.
- Ensure that South Africa's palaeoscience heritage is well managed to attain international standards of heritage management and ensure that the country's palaeoscience heritage is well managed and used for the benefit of current and future generations.
- Make South Africa the destination of choice for palaeo-tourism by building a network of site displays and interpretative centres which are managed in a socially responsible and sustainable manner.

The DST-NRF funded Centre of Excellence in Palaeosciences is one of the ways to realise the goals of this strategy.

The enduring commitment of the Centre to intellectual excellence and public engagement is embraced through the following values: independent enquiry and trust, intellectual excellence and integrity, debate and critical engagement, and academic freedom. The success of all phases of the development of the CoE-Palaeo depends on relationships between the partner institutions, collaborating with individuals and institutions in South Africa and internationally. The goals outlined above are the driving aims and objectives of the CoE-Palaeo.

The structure of the Centre is intended to accomplish the following:

- Establish a single organisational identity with latitude for independent, focused research, curation and outreach projects.
- Provide flexibility to allow growth and shifts in disciplinary emphasis.
- Retain the strengths, structures and reputations of the existing projects.
- Provide rigorous financial controls and governance.
- Offer the framework for multi-disciplinary and interdisciplinary interaction.
- Minimise bureaucracy while maintaining clear lines of responsibility and accountability.

2.11.1 Vision

The DST-NRF supported the Centre of Excellence in Palaeosciences to develop a unique Centre to promote and undertake the comprehensive study of the evolution of life on Earth.

The CoE-Palaeo is built on the foundation of research in the palaeosciences by the partner institutions on the exceptional palaeontological and archaeological resources available in South Africa. From this base, it will expand to embrace all forms of academic endeavour for the advancement and dissemination of knowledge of the development of life over time.

2.11.2 Mission

The CoE-Palaeo will, in collaboration with its partner institutions, provide the infrastructure, and resources in which excellence in the palaeosciences is stimulated and flourish.

The mission and vision are achieved in five stages of development, each focusing on deliverables appropriate for that stage of development: Forming, Storming, Norming, Performing and Exiting.

Deliverables are defined in the Service Level Agreement and entail activities in five key performance areas: research, education and training, information brokerage, networking, and service rendering.

2.12 Human Capacity Development (KPA: Education and Training)

The CoE-Palaeo, via our partner universities and museum institutions, continue the aim of the Centre to achieve an unrivalled position in South Africa in the research training of postgraduate students in its focus. Many different approaches have and are being used to build capacity and competence to meet the needs of Academia, Museums, Tourism Industry, Environmental Impact Assessment, Government, as well as the students themselves.

Education and training form a central component of the CoE in Palaeosciences. Our funding supports postgraduate students from Honours to Doctoral level through bursaries. Also, we support Postdoctoral Fellows and research. The last five years have seen an increase in the number of female and black postgraduate students. We are confident that through our proactive transformation strategies, we are transforming the landscape of palaeoscience to be more diverse and inclusive.

Student and Scholar Training

Recognising the urgent need to be transformative in palaeosciences in South Africa, we support postgraduate students and develop programmes that improve equity and diversity in our science community. Our goal is to attract postgraduate students who represent South Africa's diversity. However, many undergraduate students do not choose careers in palaeosciences because they do not view palaeosciences as a path to a permanent position because of the paucity of positions in South Africa and inadequate levels of remuneration. To address this, the CoE in Palaeosciences supports the *Undergraduate Accelerator Programme* developed by one of our grantees, Prof Jonah Choiniere with the support of his postdoctoral fellows and postgraduate students. The programme identifies high performing undergraduate black females in their 2nd year of study. The students join a supplementary academic programme for six hours per week for 14 weeks, where they learn transferable skills such as GIS data collection and analysis, palaeosciences legislation, three-dimensional data collection and analysis (e.g., CT-scanning), and palaeontological fieldwork methods. The students collect and analyse data as part of a larger palaeontological study which will lead to publication in peer-reviewed journals. During their last field trip, the students made a scientifically significant discovery of dinosaur eggs in the Elliot Formation near Clarens in the Free State Province. Currently, this programme has been initiated only at the Evolutionary Studies Institute at the University of the Witwatersrand. In the future, the Centre hopes to inspire other universities and museums to develop more programmes of this nature.

The CoE-Palaeo, through our Education Outreach Officer, engages with the Department of National Education to develop curriculum-based palaeosciences and evolution courses for school learners at both junior and senior school level, as well as for tourism guides. These courses are presented annually at numerous venues in South Africa. Our Education Officer has worked hard to engage with the education departments of our partner museums to increase the reach of the programmes on offer, which in turn enhances national pride in the remarkable palaeoscience record of South Africa.

The CoE-Palaeo is proud of the grantees we support for their academic excellence and for the number of public awareness programmes and science communication initiatives they have implemented.

Museums

In the last five years, the Centre has been increasing awareness of and troubled by the relatively low research output of our museum partners and the lack of interest of museum management in understanding the significance of research to their collections and for the development of relevant exhibits which will attract public attention. To this end, the Centre initiated a three-year postdoctoral fellowship with an additional research grant to exceptional researchers to help to boost research productivity within our South African Natural History Museums.

Mentors

Many of our grantees are researchers in diverse fields within palaeosciences. Not only are they intellectual leaders in their respective research fields, but also provide an encouraging and supportive environment with strong mentorship. We have developed three mentorship programmes designed to assist postgraduate students and emerging researchers in achieving their career goals:

1. Career Mentorship – advice on careers with palaeosciences degrees
2. Peer to Peer Mentorship – students supporting each other
3. Mentorship to Publication – development doctoral to produce manuscripts through to publication with a mentor assisting throughout the process. Through this programme, we strongly encourage supervisors to publish with their students.

Enhanced education and training continue to achieve in a variety of ways:

1. Seminar series are presented by visiting scientists and students under the auspices of the CoE-Palaeo.
2. CoE-Palaeo Members present courses at undergraduate level and supervise postgraduate research.
3. The CoE-Palaeo provides support to grantees to attend both local and international conferences, allowing them the opportunity of presenting their work and interacting with leaders in their respective fields. A goal of the CoE-Palaeo is that all students should be able to attend at least one international conference during their studies.
4. To further develop skill sets needed in an academic field, we developed a grant writing workshop and “how-to present” seminar at a conference or to a potential donor.
5. As appropriate, postgraduate students have been supported to conduct research in overseas laboratories with international collaborators for short periods. This has very beneficial outcomes, not only for the work undertaken but also good contacts for the students.
6. The CoE-Palaeo has and will continue to, play a significant role in developing a new cohort of leaders in the field. Special effort is made to address historical imbalances. The Centre, through various initiatives, makes substantial efforts to attract and retain black South African postgraduate students, as well as female postgraduate students (see Figure 3).
7. Research in palaeoscience can be expensive, depending on the amount of field or lab work required. Our Centre encourages students and researchers to leverage their CoE-Palaeo funding to look for other potential funders. Weekly, our Centre sends notices from other potential funders to members of the CoE-Palaeo.

Technical staff and tourism guides

A significant outcome of the programme is human capital development at different levels (semi-skilled to professional), and the creation of expertise and careers in newly developed areas of the knowledge economy such as palaeo-tourism, virtual imagery, data management, and GIS. Fossil

preparation and casting offer job opportunities to skilled technicians. Through our Partners, fossil preparators and casters are given in-house training in these critical skills, which is equated to the highest international standards. All of our Partners employ technicians to assist with excavations, preparation and lab work. Through our Education Outreach Officer, the Centre has been actively involved in the ongoing training of tour guides for the Cradle of Humankind (CoH) and Nieu Bethesda heritage sites.

A feature of the CoE-Palaeo is the excellent degree of collaboration between members of the Centre from different South African institutions (museums and universities) as well as the strong international presence and collaborations with researchers from around the world. Many of the discoveries made and research conducted were with the assistance of skilled technical support. However, we realised that skill sets across Africa were not the same. The Centre, in collaboration with the National Museums of Kenya, continues to run a *Pan African Palaeosciences Knowledge Exchange Workshop*. The talks and demonstrations were given by the technical staff from South Africa, Kenya, Tanzania and Uganda. Workshops included Micro CT scanning, curation management of fossils and large data sets, preparation techniques of fossils, casting of fossil specimens for research and the classroom, new equipment used in the field (drones, EDMs, photo imaging), and outreach initiatives.

In 2019, we will be offering conference funding to technical support staff at our Partner Institutions. These grants are given to travel locally and internationally to present technical knowledge in:

- the preparation of fossil
- displaying collections for museum displays
- collection management
- big data storage
- casting fossils
- use of new field technology to locate fossils
- use of new lab techniques
- the importance of science communication
- palaeotourism

In July 2020 at the biennial conference of the Palaeontological Society of South Africa (PSSA), the Centre, in association with all our partners, will be highlighting the contributions made by the technical staff member that has made significant contributions to the field of palaeosciences.

Supported Students/Researchers/Other

Table 8. Supported researchers, postdoctoral fellows, and postgraduate students

Surname	Initials	Grant1	Status	Graduated
Jirah	S	Operational Support - Collections	ongoing	
Beaudet	A	Operational Support - Conference	completed	
Benoit	J	Operational Support - Conference	completed	
Botha-Brink	J	Operational Support - Conference	completed	
Chinsamy-Turan	A	Operational Support - Conference	completed	

McKay	I	Operational Support - Conference	completed	
Prevec	R	Operational Support - Conference	completed	
Tommy	K	Operational Support - Communications	completed	
Choiniere	J	Operational Support - Education	ongoing	
de la Peña	P	Operational Support - Emerging Researcher	ongoing	
Ackermann	R	Operational Support - Research	ongoing	
Avery	M	Operational Support - Research	completed	
Bordy	E	Operational Support - Research	ongoing	
Durand	P	Operational Support - Research	ongoing	
Gess	R	Operational Support - Research	ongoing	
Jakata	K	Operational Support - Research	ongoing	
Matthews	T	Operational Support - Research	ongoing	
Penn-Clarke	C	Operational Support - Research	ongoing	
Pickering	R	Operational Support - Research	ongoing	
Prevec	R	Operational Support - Research	ongoing	
Reynard	J	Operational Support - Research	ongoing	
Reynard	T	Operational Support - Research	ongoing	
Sealy	J	Operational Support - Research	ongoing	
Tawane	M	Operational Support - Research	completed	
Taylor	W	Operational Support - Research	ongoing	
Val	A	Operational Support - Research	completed	
Wilkin	J	Operational Support - Research	ongoing	
Wurz	S	Operational Support - Research	ongoing	
Berger	L	Operational Support - Technical	ongoing	
Molefyane	T	Operational Support - Technical	ongoing	
Louw	B	Operational Support - Technical	ongoing	
Nkosi	B	Operational Support - Technical	ongoing	
Ndaba	F	Operational Support - Technical	ongoing	
Mithi	D	Operational Support - Technical	ongoing	
Maphosa	I	Operational Support - Technical	ongoing	
Arriaza	MC	Postdoctoral Fellowship	ongoing	
Bhat	MS	Postdoctoral Fellowship	ongoing	

Caruana	M	Postdoctoral Fellowship	completed	
Codron	J	Postdoctoral Fellowship	completed	
Cohen	B	Postdoctoral Fellowship	ongoing	
Esteban	I	Postdoctoral Fellowship	completed	
Herber	A	Postdoctoral Fellowship	Ongoing	
Kruger	A	Postdoctoral Fellowship	completed	
Moyo	S	Postdoctoral Fellowship	completed	
Murungi	M	Postdoctoral Fellowship	ongoing	
Penn-Clarke	C	Postdoctoral Fellowship	completed	
Romano	M	Postdoctoral Fellowship	ongoing	
Val	A	Postdoctoral Fellowship	completed	
Valenciano	A	Postdoctoral Fellowship	ongoing	
Viglietti	P	Postdoctoral Fellowship	completed	
Warren	K	Postdoctoral Fellowship	ongoing	
Abrahams	M	Doctoral Bursary	Ongoing	2019
Chapelle	K	Doctoral Bursary	Ongoing	2019
Dollman	K	Doctoral Bursary	Ongoing	2019
Dosi	B	Doctoral Bursary	Ongoing	2019
du Toit	C	Doctoral Bursary	Ongoing	2020
Groenewald	D	Doctoral Bursary	Upgraded	2020
Hlazo	N	Doctoral Bursary	ongoing	2020
Iqbal	S	Doctoral Bursary	completed	2018
Matiwane	A	Doctoral Bursary	Ongoing	2019
Mavuso	S	Doctoral Bursary	Ongoing	2021
Mnguni	S	Doctoral Bursary	Ongoing	2020
Moll	R	Doctoral Bursary	Ongoing	2020
Muir	R	Doctoral Bursary	completed	2019
Puech	E	Doctoral Bursary	Ongoing	2020
Reid	M	Doctoral Bursary	Ongoing	2020
Shadrach	K	Doctoral Bursary	Ongoing	2020
Van den Brandt	M	Doctoral Bursary	Ongoing	2019
Achieng	P	Masters Bursary	Ongoing	2019

Davids	L	Masters Bursary	Discontinued	2019
Haupt	T	Masters Bursary	completed	2018
Kirkaldy	B	Masters Bursary	Ongoing	2019
Makalima	S	Masters Bursary	Ongoing	2019
Maringa	M	Masters Bursary	Ongoing	2019
Matlhoko	K	Masters Bursary	Ongoing	2019
Mdekazi	C	Masters Bursary	Ongoing	2019
Mdludlu	A	Masters Bursary	Ongoing	2019
Mosweu	K	Masters Bursary	Ongoing	2019
Powell	L	Masters Bursary	ongoing	2019
Radermacher	V	Masters Bursary	Ongoing	2019
Rampersadh	A	Masters Bursary	Ongoing	2019
Sambo	R	Masters Bursary	Ongoing	2019
Smith	C	Masters Bursary	Ongoing	2019
Tolchard	R	Masters Bursary	Ongoing	2019
von der Meden	J	Masters Bursary	Ongoing	2019
Cawood	R	Honours Bursary	Completed	2018
de Cerff	C	Honours Bursary	Completed	2018
Hatton	A	Honours Bursary	Completed	2018
Khumalo	W	Honours Bursary	Completed	2018
Khuzwayo	N	Honours Bursary	Completed	2018
Mataboge	B	Honours Bursary	Completed	2018
Nxumalo	M	Honours Bursary	Completed	2018
Robinson	M	Honours Bursary	Completed	2018
Woolley	MR	Honours Bursary	Completed	2018

Summary of Students per Level

Table 9. Summary of postgraduate students.

		Black		Coloured		Indian/Asian		White	
Level	TOTAL	Female	Male	Female	Male	Female	Male	Female	Male
Research	**30**	3	2	1	1	1	0	16	6
Postdoctoral	**16**	1	1	0	0	0	1	8	5
Doctoral	**17**	3	2	1	0	2	0	6	3
Masters	**17**	7	1	4	1	0	1	0	3
Honours	**9**	2	2	0	1	0	0	3	1
TOTAL		**16**	**8**	**5**	**3**	**3**	**2**	**33**	**18**
Technical	**7**	2	5	0	0	0	0	0	0

2.13 Research Outputs (KPA: Research/Knowledge Production & Service Rendering)

The palaeoscience record of South Africa gives us a geographic advantage, particularly the Cape and Karoo Supergroups, the Tertiary and Quaternary fossil record including the cultural and behavioural evolution of *Australopithecus* and *Homo* and the development of Oldowan, Acheulean, and Middle Stone Age Industries. Also of significance is research into establishing effective mechanisms of knowledge brokerage and information dissemination about the palaeosciences, particularly in a South African context. In addition to these "traditional" areas of research of the South African palaeorecord, the Centre has encouraged exploration into the origins of life and multicellularity (including investigation of the Precambrian Nama and Vanrynsdorp Groups) and has inspired a strong focus on the Devonian biodiversity of the Cape Supergroup.

This review provides an outline of the research undertaken by members of the CoE in Palaeosciences in 2018. It is gratifying to see the significant increase in research productivity in peer-reviewed research outputs as the Centre has become established. Many of the papers published are in high impact journals for palaeosciences (impact factor ≥ 3). Also, many of our grantees attend both local and international conferences, giving them the opportunity to showcase their research to the broader palaeocommunity and to interact and build collaborations.

Articles in Refereed/Peer-reviewed Journals

The CoE in Palaeosciences contributed to 142 peer-reviewed journal publication, 16 chapters in books, and one book.

Table 10. Summary of productivity

Category	**Articles in Refereed/Peer-reviewed journals**	**Chapters in Books**	**Books**	**Other recognised research output**
Directly supported	96	10	1	1
Indirectly supported	46	6	0	0

Total	**142**	**16**	**1**	**1**
PI/Operational Support Grantee	193	12	1	0
PostDoc	70	6	0	2
Doctoral	18	1	0	0
Masters	9	0	0	0
Wits ESI	175	7	0	1
Wits GAES	37	2	0	0
Wits Geosciences	0	0	0	0
Wits APES	0	0	0	0
UCT Arch	22	6	0	0
UCT Geo	11	0	0	0
UCT Bio	0	0	0	0
Iziko Museum	11	3	1	0
National Museum	10	1	0	0
Ablany Museum	8	0	0	0
Ditsong Musuem	2	0	0	0
Female	117	11	1	1
BlackF	5	0	0	0
BlackF postgrad/doc	2	0	0	0
BlackM	19	0	0	0
BlackM Postgrad/doc	9	0	0	0
Evolutionary Process	83	8	1	1
Cultural & Behavioural Evolution	31	6	0	0
Palaeoclimate & Palaeo-environment	15	1	0	0
Innovations & Applications	13	0	0	0
Palaeosciences & It's Public	0	0	0	0

Table 11. Articles in refereed/peer-reviewed journals

Articles in Refereed/Peer-reviewed Journals
Arriaza Mari Carmen; Julia Aramendi; Miguel Ángel Maté-González; José Yravedra; Enrique Baquedano; Diego González Aguilera; Manuel Domínguez Rodrigo (2018). Geometric-morphometric analysis of tooth pits and the identification of felid and hyenid agency in bone modification. Quaternary International https://doi.org/10.1016/j.quaint.2018.11.023.
Arriaza Mari Carmen; Elia Organista; José Yravedra; Manuel Santonja; Enrique Baquedano; Manuel Domínguez-Rodrigo (2018). Striped hyenas as bone modifiers in human to carnivore experimental models Archaeological and Anthropological Sciences https://doi.org/10.1007/s12520-018-0747-y.
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Chapters in Books and Books

Table 12. Chapters in books and books

Chapters in books and books
Avery, M. (2018) A fossil history of southern African land mammals. Cambridge: Cambridge University Press.
Caruana, Matthew V. & Herries, Andy I. R. An Acheulian Balancing Act: A Multivariate Examination of Size and Shape in Handaxes from Amanzi Springs, Eastern Cape, South Africa. Accepted. Untitled volume in honour of John A. J. Gowlett. Edited by James A. Cole.
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Wurz, S. 2019. Human evolution, archaeology and the South African landscape during the last 100 000 years. In: Knight, J. & Rogerson, C. The Geography of South Africa - Contemporary Changes and New Directions. pp. 125-132. Springer, Cham.
Ackermann RR and L Schroeder. The emergence of complexity and novelty in the human fossil record. In: Humility, Wisdom and Grace in Deep Time. A Fuentes and C Deane-Drummond, Eds. Preprint *AfricArxiv* DOI: 10.31730/osf.io/k39h2
Athreya S and **RR Ackermann**. Colonialism and narratives of human origins in Asia and Africa. In: Interrogating Human Origins: Decolonisation and the Deep Past. M Porr and J Matthews, Eds. Archaeological Orientation Series. Routledge: Abingdon. (Series editors: Christopher Witmore and Gavin Lucas). Preprint *AfricaArxiv* DOI: 10.31730/osf.io/jtkn2
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Choiniere, Jonah N., Zanno, Lindsay E., and Balanoff, Amy B. Basal Maniraptora. *In Prep (invited paper). The Dinosauria, 3rd Edition. Cambridge University Press.*

Abella, J., and **Valenciano, A.** (2018). Úrsidos: *Indarctos arctoides* (Ursids: *Indarctos arctoides*). La colina de los Tigres Dientes de sable. Los yacimientos miocenos del Cerro de los Batallones (Torrejón de Velasco, Comunidad de Madrid) [Catálogo de la exposición]. -The hill of the saber-toothed cats. The Miocene sites of Cerro de los Batallones (Torrejón de Velasco, Community of Madrid)[exhibition catalog] (In Spanish)-. Edited by Jorge Morales. ISBN: 978-84-451-3692-8, published by Museo Arqueológico Regional, Comunidad de Madrid. Pp 71-73.
Valenciano, A. (2018). Mustélidos y Mefítidos (Mustelids and Mephitids). La colina de los Tigres Dientes de sable. Los yacimientos miocenos del Cerro de los Batallones (Torrejón de Velasco, Comunidad de Madrid) [Catálogo de la exposición]. -The hill of the saber-toothed cats. The Miocene sites of Cerro de los Batallones (Torrejón de Velasco, Community of Madrid)[exhibition catalog] (In Spanish)-. Edited by Jorge Morales. ISBN: 978-84-451-3692-8, published by Museo Arqueológico Regional, Comunidad de Madrid. Pp 81-83.
PUECH E., 2018, Anthracological analyses of the Later Stone Age sequence: Some methodological approaches. In : Porraz G. (dir.), Projet Bushman 2018 (Limpopo, République d'Afrique du Sud) : rapport sur les travaux.

Keynote/Plenary Address

Table 13. Keynote or plenary address

Last name	Grant received	Title
B Rubidge	Director	Rubidge, B.S. (2018). South Africa's remarkable fossil record: the take-home lesson for humanity's survival. Keynote address at the SAN Parks Honorary Rangers Conference, Mountain Zebra National Park, Cradock, 6-9 September.
L Berger	Operational Support	Public Communication of Science and Technology Conference, Dunedin, New Zealand
P Durand	Operational Support	"Programmed cell death and the evolution of multicellularity". The University of Copenhagen. Denmark, 24 September 2018
P Durand	Operational Support	"Evolutionary transitions and the search for LUCA". International Council on Systems Engineering. The 14th annual conference, CSIR International Convention Centre, SA. October 2018.
P Durand	Operational Support	Phycological Society of Southern Africa, July 2018: Johannesburg, SA. "The Evolution of Multicellularity in The Volvocine Algae".
R Gess	Operational Support	Gess, R.W. (2018). Africa's Earliest Four-Legged Animals by 80 million Years, the World's Only Known High Latitude Devonian Tetrapods: Communicating an Exciting Discovery in the Contemporary Communications Environment. Keynote address at the South African Museums Association National Conference, 22-25 October, National English Literary Museum, Makhanda (Grahamstown).

Other Significant Conference Outputs

The CoE in Palaeosciences grantees contributed to 241 local and international conferences. Of these, 50 postdoctoral fellows and 65 postgraduate students presented a poster or talk.

Table 14. Other Significant Conference Outputs.

Last name	Grant Received	Title
Rubidge	Director	Cisneros, J.C., Day, M.O., Rubidge, B.S. Small tetrapod and fish trace fossils from the Middle Permian of the South African Karoo. October 2018. 78th Annual meeting of the Society of Vertebrate Paleontology, Albuquerque, USA. 17-20 October.
Rubidge	Director	Van Den Brandt, M.J., Rubidge, B.S., Benoit, J, Abdala, F. Understanding Middle Permian pareiasaur diversity: the cranial morphology of Nochelesaurus alexanderi and Embrithosaurus schwarzi. October 2018. 78th Annual meeting of the Society of Vertebrate Paleontology, Albuquerque, USA. 17-20 October.
Rubidge	Director	Day, M.O., Rubidge B.S. The mid-late Permian transition and the Capitanian mass extinction among tetrapods. July 2018. 5th International Paleontological Congress, Paris, France.
Rubidge	Director	Rey, K., Day, M.O., Amiot, R., Rubidge, B.S. Stable isotope record implicates aridification in late Guadalupian mass extinction. July 2018. 5th International Paleontological Congress, Paris, France.
Rubidge	Director	Benoit, J., Ruf, I., Fernandez, V., Rubidge, B.S., Is the infraorbital foramen homologous in non-mammaliaform cynodonts and mammals? Implications for the evolution of whiskers. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Day, M.O., Rubidge, B.S., Biesiespoort revisited: a case study on the relationship between tetrapod assemblage zones and Beaufort lithostratigraphy south of Victoria West. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Duhamel, A., Benoit, J., Day, M.O., Fernandez, V., Rubidge, B.S., Juvenile biarmosuchians from the Karoo Beaufort Group shed new light on basal therapsid ontogeny. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Groenewald,D., Rubidge, B.S.,Day,M.O., Litho- and biostratigraphy of the Lower Beaufort Group in the northeastern part of the Main Karoo Basin – Preliminary results. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Harris, C., Gess, R.W., Rubidge, B.S., Penn-Clarke, C.R., Coombs Hill: a new Devonian fossil-bearing locality in the Witpoort Formation, Eastern Cape, South Africa. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Jirah, S., Rubidge, B.S., Taxonomic revision of the Titanosuchidae (Therapsida, Dinocephalia) of the Karoo Basin, South Africa: a key to understanding middle Permian tetrapod diversity. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.

Rubidge	Director	Rey, K., Day, M.O., Amiot, R., Goedert, J., Lécuyer, C., Sealy, J., Rubidge, B.S., Stable isotope record implicates aridification without warming during the late Capitanian mass extinction. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Rubidge, B.S., Day, M.O., Angielczyk, K., Ramezani, J., Bowring, S., Jirah, S., Middle Permian dicynodont stratigraphic ranges coupled with ID-TIMS dates from the Karoo Basin have implications for broad-scale stratigraphic correlation. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Van den Brandt, M.J., Rubidge, B.S., Benoit, J., Abdala, F., Understanding middle Permian pareiasaur diversity: the cranial morphology of *Nochelesaurus alexanderi* and *Embrithosaurus schwarzi*. July 2018. 20th PSSA Conference, University of the Free State, Bloemfontein.
Rubidge	Director	Groenewald D.P., Rubidge, B.S. & Day M.O. Litho- And Biostratigraphy of the lower Beaufort Group in the northeastern part of the main Karoo Basin – Preliminary Results. July 2018. Geocongress 2018, University of Johannesburg, Johannesburg. 18-20 July.
Rubidge	Director	Hancox, J. & Rubidge, B.S. Mid-Late Triassic Beaufort-Stormberg Contact – Implications for Triassic Karoo basin development. July 2018. Geocongress 2018, University of Johannesburg, Johannesburg. 18-20 July.
Rubidge	Director	Rubidge B. S., Day M. O., Angielczyk K. Ramezani,J., Bowring, S. & Jirah S. Ranges of Mid Permian Dicynodonts coupled with U-Pb ID-TIMS dates have implications for Karoo stratigraphic correlation and basin development. July 2018. Geocongress 2018, University of Johannesburg, Johannesburg. 18-20 July.
Rubidge	Director	Viglietti, P., Smith, R.M.H. & Rubidge, B.S. Changing palaeoenvironments and tetrapod populations in the *Daptocephalus* Assemblage Zone (Karoo Basin, South Africa) indicate the early onset of the Permo-Triassic mass extinction. July 2018. Geocongress 2018, University of Johannesburg, Johannesburg. 18-20 July.
Rubidge	Director	Groenewald D.P., Rubidge, B.S. & Day M.O. Litho- And Biostratigraphy of the lower Beaufort Group in the northeastern part of the main Karoo Basin – Preliminary Results. July 2018. Geocongress 2018, University of Johannesburg, Johannesburg. 18-20 July.

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Ackerman	Operational Support	Hlazo N, T Ritzman, L Schroeder, RR Ackermann. The role of selection in shaping the craniomandibular morphology of *Paranthropus*. *Am J Phys Anth*, Supp 64. AAPA Annual Meeting, Austin, TX, April 2018.
Ackerman	Operational Support	Powell L, RR Ackermann. Detecting migration and admixture in South African Holocene human crania. *Am J Phys Anth*, Supp 64. AAPA Annual Meeting, Austin, TX, April 2018.
Bamford	Operational Support	Bobe, R., Alemseged, Z., Bamford, M., Carvalho, S. 2018. New Miocene fossil sites from Gorongosa and the biogeography of hominin origins. International Primatology Conference, Nairobi, Kenya, 18-23 August 2018. Abstract volume page. ..
Bamford	Operational Support	Singh, M., Fitchett, J., Bamford, M., 2018. A Holocene palaeoenvironmental reconstruction of the Okavango source wetlands in Angola. Abstract p. 31.Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July 2018.
Bamford	Operational Support	Adigu, K., Bamford, M.K., 2018. Palynological analysis of a short core from the Holocene of the Angolan highlands. Abstract p. 7. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July 2018
Bamford	Operational Support	Bamford, M.K., Kock, S., 2018. Taxonomy and climate implications of Permian and Triassic fossil woods from Zambia, Abstract P 8; Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July 2018
Bamford	Operational Support	Bamford, M.K., 2018. Plenary lecture: Diversity of Gondwanan fossil woods from southern Africa and palaeoclimate implications. 5th International Palaeontology Congress, Paris, 6-13 July. Abstract, page

Benoit	Operational Support	Van Den Brandt M.J., Rubidge B.S., Benoit J., Abdala F. (2018) Understanding middle Permian Pareiasaur diversity: the cranial morphology of Nochelosaurus alexanderi and Embrithosaurus schwarzi. 78th Annual Meeting of the Society of Vertebrate Paleontology, 17-20 October 2018, Albuquerque, USA.
Benoit	Operational Support	Angielczyk K.D., Otoo B.K., Benoit J.B., Sidor C.A., Nesbitt S.J., Smith R.M., Steyer J.-S., Tsuji L.A. (2018) A new cryptodont dicynodont (Therapsida, Anomodontia) with a novel palatal morphology from the upper Permian Usili Formation (Ruhuhu Basin, Tanzania). 78th Annual Meeting of the Society of Vertebrate Paleontology, 17-20 October 2018, Albuquerque, USA.
Benoit	Operational Support	Benoit J., Manger P.R., Fernandez V., Rubidge B.S. (2018) The origin of hair and whiskers as inferred from palaeoneurology of South African non-mammalian Synapsida. 5th International Palaeontological Conference, July 2018, Paris, France.
Benoit	Operational Support	Benoit J., Tabuce R., Obada T., Mararescul V., Manger P.R. (2018) The evolution of endocranial size in Proboscidea. 5th International Palaeontological Conference, July 2018, Paris, France.
Benoit	Operational Support	Duhamel, A., Benoit, J., Day, M.O., Fernandez, V., Rubidge, B.S. (2018) Juvenile biarmosuchians from the Karoo Beaufort Group shed new light on basal therapsid ontogeny. 20th Biennial Conference of the Palaeontological Society of Southern Africa, July 2018, Bloemfontein, South Africa.
Benoit	Operational Support	Tolchard, F., Butler, R.J., Abdala, F., Hendrickx, C., Benoit, J., Choiniere, J.N. (2018) A new cynodont from *Cynognathus* Subzone C and its implications on body size recovery in tetrapods following the Permo-Triassic mass extinction. 20th Biennial Conference of the Palaeontological Society of Southern Africa, July 2018, Bloemfontein, South Africa.
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Benoit	Operational Support	Nxumalo, M.P., Benoit, J. (2018) The phylogenetic classification and locomotion of a non-mammaliaform cynodont *Lumkuia fuzzi* (Probainognathia, Cynodontia) based on CT-tomography of the postcranial skeleton. 20th Biennial Conference of the Palaeontological Society of Southern Africa, July 2018, Bloemfontein, South Africa.

Benoit	Operational Support	Benoit, J., Ruf, I., Fernandez, V., Rubidge, B.S. (2018) Is the infraorbital foramen homologous in non-mammaliaform cynodonts and mammals? Implications for the evolution of whiskers. 20th Biennial Conference of the Palaeontological Society of Southern Africa, July 2018, Bloemfontein, South Africa.
Benoit	Operational Support	Schrein C.M., Thackeray J.F., Benoit J., Dykes S. (2018) "Sigma taxonomy" and the lack of a clear boundary between *Australopithecus* and *Homo*. 87th Annual Meeting of the American Association of Physical Anthropologists, April 2018, Austin, Texas, USA.
Berger	Operational Support	Spatial taphonomy and post-mortem disarticulation patterns of the Homo naledi assemblage from the Dinaledi Chamber, Rising Star Cave. A. KRUGER, P. RANDOLPHQUINNEY, M. ELLIOTT, J. HAWKS, L.R. BERGER.
Berger	Operational Support	Femoral neck and shaft structure in Homo naledi. L. FRIEDL, A.G. CLAXTON, C.S. WALKER, S.E. CHURCHILL, T.W. HOLLIDAY, J. HAWKS, L.R. BERGER, J.M. DESILVA, D. MARCHI.
Berger	Operational Support	Patterns of lateral enamel growth in Homo naledi as assessed through perikymata distribution and number. D. GUATELLI-STEINBERG, M. O'Hara, A. LE CABEC, D.J. REID, L.K. DELEZENE, M.M. SKINNER, L.R. BERGER
Berger	Operational Support	Mandibular molar root morphology in Homo naledi. K. KUPCZIK, M.M. SKINNER.
Berger	Operational Support	The endocast of LES1, Homo naledi. S.D. HURST, R.L. HOLLOWAY, H.M. GARVIN, W.B. VANTI, J. HAWKS, L.R. BERGER.
Berger	Operational Support	Three-dimensional morphology and comparative anatomy of the Australopithecus sediba scapula. D.J. GREEN, S.E. CHURCHILL, M.E. MACIAS, P. GUNZ, K.J. CARLSON, P. SCHMID, L.R. BERGER.
Berger	Operational Support	L.R. BERGER, M.C. ELLIOTT, B. PEIXOTTO, H. MORRIS, E.M. FEUERRIEGEL, S.J. TUCKER, A. KRUGER, R. HUNTER, D. VAN ROOYEN, M. RAMALEPA, M. TSIKOANE, E. ROBERTS, C. SPANDLER, P. DIRKS, J. HAWKS.A New Naming Scheme for the Dinaledi Chamber System and Associated Antechambers and Passages of the Rising Star Cave System, South Africa.
Berger	Operational Support	New fossil material of Homo naledi from the Dinaledi Chamber, South Africa. J. HAWKS, M.C. ELLIOTT, E.M. FEUERRIEGEL, N. HLOPHE, R. HUNTER, H. MORRIS, B. PEIXOTTO, M. RAMALEPA, M. TSIKOANE, S. TUCKER, D. VAN ROOYEN, L.R. BERGER.
Berger	Operational Support	Hominin material recovered from the base of the Chute in the Hill Antechamber, in the Dinaledi Chamber System of the Rising Star Cave. M.C. ELLIOTT, B. PEIXOTTO, H. MORRIS, E.M. FEUERRIEGEL, S. TUCKER, R. HUNTER, M. RAMALEPA, M. TSIKOANE, E.M. ROBERTS, C. SPANDLER, J. HAWKS, L.R. BERGER.

Berger	Operational Support	3D Mapping of the Hominin-Bearing Deposits and Associated Passages and Chambers of the Rising Star Cave System, South Africa. S.J. TUCKER, A. KRUGER, M.C. ELLIOTT, B.PEIXOTTO, D. VAN ROOYEN, M. TSIKOANE, M. RAMALEPA, R. HUNTER, E. ROBERTS, P. DIRKS, J.HAWKS, L.R. BERGER.
Berger	Operational Support	New craniodental remains of the type specimen of Australopithecus sediba. D.J. DE RUITER, J.K. BROPHY, R. VAN DER MERWE, J.S. SMILG, S.E. CHURCHILL, L.R. BERGER
Botha-Brink	Operational Support	Choiniere, J., B. W. McPhee, J. Botha-Brink, E. M. Bordy and R. B. J. Benson. 2018. A novel method infers tetrapod limb posture using proportional limb robusticity. 2nd Joint Congress on Evolutionary Biology, Montpellier, France.
Botha-Brink	Operational Support	Botha-Brink, J, M. Bento Soares and A. Guillermo Martinelli. 2018. Non-mammaliaform cynodont osteohistology and implications for the evolution of mammalian growth patterns. 5th International Palaeontological Congress, Paris, France.
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Botha-Brink	Operational Support	Botha-Brink, J, M. Bento Soares and A. Guillermo Martinelli. 2018. Non-mammaliaform cynodont osteohistology and implications for the evolution of mammalian growth patterns. 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, South Africa, Bloemfontein, South Africa, 10.
Choiniere	Operational Support	Hendrickx, Christophe, Abdala, Fernando, Choiniere, Jonah N., Benson, Roger B.J. the dentition in Gomphodontia (Cynodontia, Cynognathia): disparity, the rate of evolution, and dental complexity through time. Society for Vertebrate Palaeontology, October 16–20, Albuquerque, USA.
Choiniere	Operational Support	2018. Radermacher, Viktor J., Choiniere, Jonah N., Chapelle, Kimberley E.J., de Klerk, William J. Novel postcranial features in a new specimen of *Heterodontosaurus* (Dinosauria, Ornithischia) revealed by synchrotron x-ray computed tomography. Society for Vertebrate Palaeontology, October 16–20, Albuquerque, USA.
Choiniere	Operational Support	2018. Chapelle, Kimberley E.J., Choiniere, Jonah N., Benson, Roger B.J., Otero, Alejandro. Locomotory shifts in dinosaurs during ontogeny. Society for Vertebrate Palaeontology, October 16–20, Albuquerque, USA.

Choiniere	Operational Support	2018. Dollman, Kathleen N., Choiniere, Jonah N., Clark, James M., Viglietti, Pia A., Norell, Mark A., and Xu, Xing. Secondary palate evolution in early crocodylomorphs: functional and phylogenetic implications. Society for Vertebrate Palaeontology, October 16–20, Albuquerque, USA.
Choiniere	Operational Support	2018. Meso, Jorge G., Baiano, M.A., Canale, Juan I., Salgado, Luis, Pereyra, C., Choiniere, J. N. , and Brusatte, Stephen L. Phylogenetic relationships of a new alvarezsaurid (Dinosauria: Coelurosauria) from the Allen Formation (Upper Cretaceous). Reunion de Communicaciones de la Associacion Paleontologica Argentina. Puerto Madryn, 21–23 November.
Choiniere	Operational Support	2018. Meso, Jorge G., Baiano, M.A., Canale, Juan I., Salgado, Luis, Pereyra, C., Choiniere, J. N. , and Brusatte, Stephen L. Modification and reduction of the forelimbs of the alvarezsaurids (Theropoda: Coelurosauria). Reunion de Communicaciones de la Associacion Paleontologica Argentina. Puerto Madryn, 21–23 November.
Choiniere	Operational Support	2018. Neenan, James M., Chapelle, Kimberley E. J., and Choiniere, Jonah N. *Massospondylus* inner ear ontogeny suggests a decoupled form-function relationship with locomotory performance in dinosaurs. International Paleontological Congress, July 9–13th, 2018, Paris.
Choiniere	Operational Support	2018. Seerane, Thabile, Viglietti, Pia A., Chapelle, Kimberley E. J., Dinter, Cory M., McPhee, Blair W., and Choiniere, Jonah N. Dinosaur body size evolution across the Triassic Jurassic boundary in South Africa's Elliot Formation. GeoCongress, University of Johannesburg, July 12–14th, 2018.
Choiniere	Operational Support	2018. Dollman, Kathleen N., Choiniere, Jonah N., Clark, James M., and Viglietti, Pia A. The crocodylomorphs of southern Africa and their geographic and stratigraphic distributions. Palaeontological Society of Southern Africa, Bloemfontein, July 4–6th.
Choiniere	Operational Support	2018. Robinson, Mathew, and Choiniere, Jonah N. Taxonomic affinities of large-bodied sauropodomorph dinosaurs from South Africa's lower Elliot Formation. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
Choiniere	Operational Support	2018. Radermacher, Viktor J., Chapelle, Kimberley E. J., de Klerk, William J., Fernandez, Vincent, and Choiniere, Jonah N. Novel postcranial features in a new specimen of *Heterodontosaurus* (Dinosauria: Ornithischia) revealed by synchrotron X-ray computed tomography: implications for ornithischian physiology, evolution, and systematics. Society for Vertebrate Palaeontology, October 16-20, Albuquerque, USA.

Choiniere	Operational Support	2018. Neenan, James M., Chapelle, Kimberley E. J., and Choiniere, Jonah N. *Massospondylus* labyrinth geometry through ontogeny suggests a decoupled form-function relationship with locomotory performance in dinosaurs. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
Choiniere	Operational Support	2018. Munyikwa, Darlington, Viglietti, Pia A., Barrett, Paul M., Broderick, Timothy, Chapelle, Kimberley E. J., Sciscio, Lara, Dollman, Kathleen N., Zondo, Michel, Edwards, Steven, Glynn, David, Mbambo, Edward, Tolan, Stephen, and Choiniere, Jonah N. New Triassic–Jurassic (upper Karoo Group) fossil localities on the margin of Lake Kariba, Zimbabwe. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
Choiniere	Operational Support	2018. Mdekazi, Cebisa N., Dollman, Kathleen N., and Choiniere, Jonah N. Locomotory evolution in Crocodylomorpha: insights from *Litargosuchus leptorhynchus*. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
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Choiniere	Operational Support	2018. Tolchard, Frederick, Butler, Richard J., Benoit, Julien, Hendrickx, Christophe, Abdala, Fernando, and Choiniere, Jonah N. A new cynodont from Cynognathus Subzone C and its implications on body size recovery in tetrapods following the Permo-Triassic mass extinction. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
Choiniere	Operational Support	2018. Choiniere, Jonah N., Barrett, Paul M., Chapelle, Kimberley E. J., Tolchard, Frederick, Desojo, Julia, and Butler, Richard J. A unequivocal rauisuchian from the Elliot formation of South Africa. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
Choiniere	Operational Support	2018. Viglietti, Gina, Chapelle, Kimberley E. J., and Choiniere, Jonah N. The inner ear morphology of *Prolacerta broomi* and its significance for understanding basal archosaur evolution. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.
Choiniere	Operational Support	2018. Dollman, Kathleen N., Choiniere, Jonah N., Clark, James M., and Viglietti, Pia A. The crocodylomorphs of southern Africa and their geographic and stratigraphic distributions. Palaeontological Society of Southern Africa, Bloemfontein, July 4-6th.

Durand	Operational Support	Durand PM. Perspectives on programmed cell death in microbial communities: group selection, niche construction and phenotypic plasticity. Talking Evolution – on principles and advances in evolutionary thinking. Max Planck Institute for Evolutionary Biology. Ploen, Germany. 26-28 September 2018.
Durand	Operational Support	K. van Zyl and P Durand. The sociobiology of programmed cell death in microbial communities. Montpellier. Evolution2018. 14-18 August 2018.
Durand	Operational Support	A. Ndhlovu and P Durand. Programmed cell death and harmful algal blooms. Phycological Society of Southern Africa, July 2018: Johannesburg, SA.
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Gess	Operational Support	Harris, C. and Gess, R.W. (2018) A monotaxic brachiopod bed provides information on palaeoenvironments in the Upper Devonian Witpoort Formation Witteberg Group, Cape Supergroup, South Africa. *Proceedings of the 5th International Palaeontology Conference, Paris (France), July 9th – 13th, 2018.*
Gess	Operational Support	Harris, C. and Gess, R.W. (2018) *Archaeopteris*, the earliest tree in South Africa. *Proceedings of the 5th International Palaeontology Conference, Paris (France), July 9th – 13th, 2018.*
Gess	Operational Support	Gess, R.W. (2018) New clues to the origin of tetrapods from the South African Upper Devonian. *Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, July 4th – 6th, 2018.*
Gess	Operational Support	Harris, C. and Gess, R.W. (2018) New information on *Archaeopteris notosaria* – southern Africa's earliest known tree from the Upper Devonian (Famennian). *Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, July 4th – 6th, 2018.*
Gess	Operational Support	Harris, C. and Gess, R.W. (2018) Coombs Hill: A new Devonian fossil-bearing locality in the Witpoort Formation, Eastern Cape, South Africa. *Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, July 4th – 6th, 2018.*
Henshilwood	Operational Support	Henshilwood, C.S. van Niekerk, K.L. 2018. North South collaborations. SANORD conference, Jyväskylä, Finland, 15-17 August 2018.
Henshilwood	Operational Support	Sobolowski, S., Henshilwood, C.S., Jansen, E. 2018. The Centre for Early Human Behaviour (EHB) at the University of Bergen: A transdisciplinary exploration into the evolution of homo sapiens behaviour. EGU General Assembly Conference Abstracts 19, 18644

McKay	Operational Support	MCKAY I.J. & LELLIOTT, 2018. Homo naledi and humanity vs dinaledi and the SKA: communication or persuasion? Science communication and democratic South Africa: prospects and challenges. The University of Stellenbosch. 5 – 7 November 2018.
McKay	Operational Support	MCKAY I.J. 2018. Are you related to a cabbage? The evidence for evolution. International Webinar on ancient-origins.net. info@ancient-origins.net, 30 August 2018
McKay	Operational Support	MCKAY, I. M. Mudau, R. Prevec, R. Gess, C. Harris. 2018. Collaborative palaeosciences engagement: Sci-fest Africa as a case study. Palaeontological Society of Southern Africa, University of the Free State, Bloemfontein, 4 – 6 July 2018
Pickering	Operational Support	The geology and dating of the South African early hominin bearing cave deposits: 80 years of endeavour, 1. July 2018 Geocongress
Pickering	Operational Support	Frequency and duration of U-Pb dated flowstone growth intervals in South African early hominin caves reflect Early Pleistocene climate variability. Poster (with J von der Meden): U-series dating calcrete: a new palaeohydrological tracer for Middle Stone Age archaeological sites in the Northern Cape, South Africa, 2. April 2018 Paleoanthropology Society Meeting
Pickering	Operational Support	Geology and uranium-lead dating of the South African Paranthropus-bearing cave deposits. Poster (with J von der Meden): The micromorpholgy and U-series dating of calcretes: a new chronometer for open air hominin and archaeological sites, 3. April 2018 American Association of Physical Anthropology, Austin, U.S.A.
Prevec	Operational Support	Matiwane, A., Prevec, R. 2018. A new approach to Glossopteris leaf taxonomy embracing morphometric analysesThe Fossil Week: the 5th International Palaeontological Congress, Paris, France (July). Oral paper.
Prevec	Operational Support	Moyo, S., Prevec, R., Matiwane, A., Kirkaldy, B., Nel, A. 2018. Preliminary report on the first mid--Permian ecosystem from South Africa, as revealed by a new Lagerstätte near Sutherland, Northern Cape. The Fossil Week: the 5th International Palaeontological Congress, Paris, France (July). Oral paper.
Prevec	Operational Support	Prevec, R., Matiwane, A. 2018. A missing link in *Glossopteris* evolution: new species of *Lidgettonia* from a middle Permian Lagerstätte in South Africa. The Fossil Week: the 5th International Palaeontological Congress, Paris, France (July). Oral paper.
Prevec	Operational Support	Kirkaldy, B.P, Prevec, R., Barber-James, H., Holland, A.J., Nel, A. 2018. Exploring the biogeography and ecology of extant Plecoptera of South Africa with reference to ancient middle Permian fossil forms from the Onder Karoo locality. Joint XV International Conference on Ephemeroptera, XIX International Symposium on Plecoptera. 03-08 June 2018, Aracruz, Brazil (June). Poster paper.

Prevec	Operational Support	Cawood, R., Moyo, S., Prevec, R, Nel, A. 2018. Palaeoenvironmental reconstruction of middle Permian ecosystems, inferred from insect fossils of ice crawlers (Grylloblattodea) from the Onder Karoo, South Africa. Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Poster paper.
Prevec	Operational Support	Davids, L., Prevec, R., Matiwane, A., Nel, A. 2018. Insect fauna and associated plant–insect interactions at the Ouberg Pass and Onder Karoo locality: implications for the evolution of insect utilisation of plants in the middle Permian of the Karoo Basin of South Africa. Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Oral paper.
Prevec	Operational Support	Kirkaldy, B.P., Prevec, R., Barber James H.M. and Holland, A.J. 2018. The past meets the present: exploring the phylogenetics of extant Plecoptera of South Africa with reference to ancient middle Permian fossil forms from the Onder Karoo locality near Sutherland. 20th Conference of the Palaeontological Society of Southern Africa. 4-6th July 2018. Oral paper.
Prevec	Operational Support	Matiwane, A., Prevec, R. 2018. A new approach to Glossopteris leaf taxonomy embracing morphometric analyses. Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Oral paper.
Prevec	Operational Support	McKay, I., Mudau, M., Prevec, R., Gess, R.W., Harris, C. 2018. Collaborative palaeosciences engagement: Grahamstown Science Festival as a case study. Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Oral paper.
Prevec	Operational Support	Moyo, S., Prevec, R., Matiwane, A., Nel, A., Garrouste, R., Day, M.O. 2018. Preliminary report on the first mid-Permian ecosystem from South Africa, as revealed by a new Lagerstätte near Sutherland, Northern Cape. Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Oral paper.
Prevec	Operational Support	Prevec, R., Matiwane, A. 2018. A missing link in Glossopteris evolution: new species of Lidgettonia from a middle Permian Lagerstätte in South Africa. Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Oral paper.
Prevec	Operational Support	Zozo, E., Nel, A., Garrouste, R., Moyo, S., Bellingan, T.A., Villet, M.H., Prevec, R. 2018. Phylogenetic relationships of the Permian 'cicada-like' family Pereboriidae (Insecta: Hemiptera: Pereborioidea). Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July. Poster paper.

Reynard	Operational Support	Beard, T. & Reynard, J.P. Fauna from the Later Stone Age at Grassridge Rockshelter: Palaeoenvironment change in the southern African Holocene. In: 24th Biennial Meeting of the Society of Africanists Archaeologists (SAfA); 18-21 June 2018; Toronto, Canada. Abstract number: RL0717.
Reynard	Operational Support	Smith, A. & Reynard, J.P. Taphonomy of unidentified fauna from the Later Stone Age levels of Grassridge Rockshelter, Eastern Cape, South Africa. In: 24th Biennial Meeting of the Society of Africanists Archaeologists (SAfA); 18-21 June 2018; Toronto, Canada. Abstract number: RL0716
Reynard	Operational Support	Hodgskiss, T. 2018. Does location influence ochre use strategies? Comparing ochre use at Rose Cottage Cave during the Late Pleistocene with the use of ochre at coastal sites. 24th Biennial meeting of the Society of Africanist Archaeologists (SAfA) in Toronto, Canada, 18-21 June 2018.
Sealy	Operational Support	Pfeiffer, S.K., Cameron, M., Sealy, J. & Beresheim, A. Dietary sufficiency and bone histomorphometry assessed in rib tissue of Later Stone Age southern African foragers (oral presentation), *87th annual meeting of the American Association of Physical Anthropologists (AAPA), Austin, Texas, 11-14 April*
Sealy	Operational Support	House, M., Chirikure, S. & Sealy, J. Straight from the cow's mouth – reconstructing herd management strategies at Great Zimbabwe (oral presentation), *24th biennial conference of the Society for Africanist Archaeologists (SAfA), Toronto, Canada, 18-21 June*
Sealy	Operational Support	Loftus, E., Lee-Thorp, J. & Sealy, J. Exploring Later Stone Age shellfishing and local climate shifts on the South African west coast (oral presentation), *24th biennial conference of the Society for Africanist Archaeologists (SAfA), Toronto, Canada, 18-21 June*
Sealy	Operational Support	Luyt, J. & Sealy, J. Oxygen isotopes in mammalian enamel: an aridity indicator in the South African winter and year round rainfall zone (oral presentation), *24th biennial conference of the Society for Africanist Archaeologists (SAfA), Toronto, Canada, 18-21 June*
Sealy	Operational Support	Sealy, J., Luyt, J., Eichhorn, B., Hensel, E., Ossendorf, G. & Schmidt, I. Palaeoenvironmental information from $\delta^{13}C$ and $\delta^{18}O$ of ostrich eggshell from Pockenbank and Apollo 11, southern Namibia (oral presentation), *24th biennial conference of the Society for Africanist Archaeologists (SAfA), Toronto, Canada, 18-21 June*
Sealy	Operational Support	Hare, V.J., Atmospheric CO_2 effect on stable carbon isotopes and implications for proxy records of Quaternary African palaeoclimates (oral presentation), *2nd International Conference on The African Quaternary: environments, ecology and humans (AfQUA), Nairobi, Kenya, 14-22 July*

Sealy	Operational Support	Hare, V.J. Different responses of terrestrial C_3 plant groups to paleo-pCO_2, pO_2, and implications for photosynthetic fractionation of stable carbon isotopes (poster presentation), *Goldschmidt Conference, Boston, USA, 12-17 August*
Sealy	Operational Support	Hutten, L. & Sealy J. The use of dental morphology and stable isotopes to distinguish between indigenous sheep and goat breeds in Southern Africa (oral presentation), *13th Conference of the International Council for ArchaeoZoology (ICAZ), Ankara, Turkey, 2-7 September*
Sealy	Operational Support	Richardson, L. New analysis of seal remains from Nelson Bay Cave, South Africa (oral presentation), *13th Conference of the International Council for ArchaeoZoology (ICAZ), Ankara, Turkey, 2-7 September*
Sealy	Operational Support	House, M. Using serial samples of *Bos taurus* inorganics to identify resource management at Great Zimbabwe (oral presentation), *Workshop 'Isotope Approaches in Archaeology', Max Planck Institute for the Science of Human History, Jena, Germany, 17-18 September*
Sealy	Operational Support	Sealy, J. Some thoughts on tracking migration: successes and stumbling blocks (oral presentation), Workshop 'Isotope Approaches in Archaeology', Max Planck Institute for the Science of Human History, Jena, Germany, 17-18 September
Sealy	Operational Support	Dlamini, N., Sealy, J. & Mayor, A. Understanding individual dietary shifts in the Dogon country (Mali) through $\delta^{13}C$ and $\delta^{15}N$ analysis of incremental dentine collagen (poster presentation), *8th International Symposium on Biomolecular Archaeology (ISBA), Jena, Germany, 18-21 September*
Sealy	Operational Support	Pfeiffer, S., Harrington, L. & Sealy, J. An unusual group burial from the late Holocene, South African Cape coast (oral presentation), *46th Annual Meeting of the Canadian Association of Physical Anthropologists (CAPA), London, Ontario, Canada, 31 October – 3 November*
Wurz	Operational Support	Rusch, N. & Wurz, S. 2018. The !goin !goin and sounds of the past. African Bioacoustics Community Conference, 2-7 December, Cape Town.
Wurz	Operational Support	Brenner, M. & Wurz, S. 2018. MIS 5 at Klasies River through a magnifying glass: high resolution change in lithic technology, Pecha Kucha presentation, European Society for the Study of Human Evolution (ESHE) Faro, Portugal, 13-15th September.

Wurz	Operational Support	Akuku, P., Cutts, R,Muschinski, J. Hlubik, S., Braun, D., Reynard, J., Wurz, S. 2018. Comparing Naturally Weathered Basalt Fractures, Lithic Angular Fragments and Experimentally Derived Thermal Curved Fractures: Similarities and Distinctions in Morphology. The African Quaternary: environments, ecology and humans (AFQUA), 14-22 July, Nairobi, Kenya.
Wurz	Operational Support	Brenner, M. & Wurz, S. 2018. Early MIS 5 lithic technology at Klasies River - a re-evaluation of variability and conventions based on new data from current excavations. 18th IUPPS world congress Paris (France), 3 - 9 June 2018.
Wurz	Operational Support	Bentsen, S.E. & Wurz, S. 2018. Red alert? The colors of heat-affected quartzite from the Eastern Cape, South Africa. African Conference on Experimental Archaeology (ACE), Johannesburg, South Africa, 20-22 March 2018.
Wurz	Operational Support	Kumbani, J., Bradfield, J. Rusch, N. & Wurz, S. 2018. Musical instruments from the Later Stone Age at Klasies River and Matjes River. African Conference on Experimental Archaeology (ACE), Johannesburg, South Africa, 20-22 March 2018.
Beaudet	Postdoctoral Fellowship	Mataboge B., Beaudet A. & Stratford D. - A microtomographic study of the StW 669 hominin molar from the Milner Hall, Sterkfontein Caves, South Africa, 2nd University of Johannesburg Palaeo-research symposium (Johannesburg, 01/11/18)
Beaudet	Postdoctoral Fellowship	Pereira-Pedro A.S., Beaudet A. & Bruner E. - Parietal surface variation in cercopithecoid endocasts. 2nd Biennial Meeting of Cortical Evolution (Las Palmas, 4-6/6/2018)
Beaudet	Postdoctoral Fellowship	Dumoncel J., Subsol G., Durrleman S., Oettlé A.C., Lockhat Z., Suleman F.E., de Jager E. & Beaudet A. – A quantitative comparison of the brain and the inner surface of the cranium. 10ème Symposium national de Morphométrie et Evolution des Formes (Bordeaux, 18-20/6/2018)
Beaudet	Postdoctoral Fellowship	Beaudet A., Clarke R.J., Carlson K.J., Crompton R., de Beer F., Dhaene J., Heaton J.L., Jakata, K., Jashashvili T., Pickering T.R. & Stratford D. - Exploring the inner cranial anatomy of “Little Foot”: a comparative study of the endocast, and of the bony labyrinth.
Beaudet	Postdoctoral Fellowship	Bouchet F., Ribéron A., de Beer R., Jakata K., Tawane M., Tenailleau C., Zipfel B. & Beaudet A. - The internal craniodental anatomy of the Papio specimen UW 88-886 from Malapa, Gauteng, South Africa. 8th Annual Meeting of the European Society for the Study of Human Evolution (Faro, 13-15/9/2018)

Beaudet	Postdoctoral Fellowship	Crompton R., McClymont J., Heaton J.L., Pickering T.R., Sellers W., Thorpe S., Pataky T., Stratford D., Carlson K., Jashashvili T., Beaudet A., Elton S., Bruxelles L., Goh C., Kuman K. & Clarke R.J. - Ecomorphology of the Australopithecus prometheus skeleton, StW573 3.67 Ma, from Sterkfontein Caves, South Africa. 8th Annual Meeting of the European Society for the Study of Human Evolution (Faro, 13-15/9/2018)
Beaudet	Postdoctoral Fellowship	Zanolli C., Pan L., Skinner M.M., Dumoncel J., Beaudet A., de Beer F., Hoffman J., Jakata K., Macchiarelli R., Reddy S., Tawane M. & Zipfel B. - What is South African early Homo? New insights from the molar endostructural signature. 8th Annual Meeting of the European Society for the Study of Human Evolution (Faro, 13-15/9/2018)
Beaudet	Postdoctoral Fellowship	*Mataboge B., Stratford D. & Beaudet A. - A microtomographic study of the StW 669 hominin molar from Milner Hall, Sterkfontein, South Africa. 20th Biennial Meeting of the Palaeontological Society of Southern Africa (Bloemfontein, 4-6/7/2018)
Beaudet	Postdoctoral Fellowship	Stratford D., Clarke R., Bruxelles L., Pickering T., Heaton J., Carlson K., Jashashvili T., Beaudet A. & Crompton R. - The complex taphonomic history of the StW 573 Australopithecus skeleton (Sterkfontein, South Africa) as revealed by high-resolution computed tomography data. 20th Biennial Meeting of the Palaeontological Society of Southern Africa (Bloemfontein, 4-6/7/2018)
Beaudet	Postdoctoral Fellowship	Beaudet A., Carlson K.J., Clarke R.J., de Beer F., Dierick M., Heaton J.L., Pickering T.R. & Stratford D. - The taxonomic diagnosis of the StW 578 cranium from Jacovec Cavern, Gauteng (South Africa): integrating inner and outer morphology. 87th Annual Meeting of the American Association of Physical Anthropologists (Austin, 11-14/4/2018)
Beaudet	Postdoctoral Fellowship	de Jager E., Van Schoor A.N., Hoffman J.W., Oettlé A.C., Fonta C. & Beaudet A. - Sulcal pattern variation in extant human endocasts. 87th Annual Meeting of the American Association of Physical Anthropologists (Austin, 11-14/4/2018)
Beaudet	Postdoctoral Fellowship	Beaudet A., Heaton J.L., Pickering T.R. & Stratford D. - Hominin cranial fragments from Milner Hall, Sterkfontein, South Africa. Annual Meeting of the Paleoanthropology Society (Austin, 10-11/4/2018)
Beaudet	Postdoctoral Fellowship	Beaudet A. - Comment reconstructive l'histoire évolutive du cerveau hominine à partir du register fossile? Limites et perspectives en paléoneurologie humaine. Journées Annuelles de la Société d'Anthropologie de Paris (Poitiers, 24-26/1/2018):
Beaudet	Postdoctoral Fellowship	Beaudet A. – Human brain evolution: what can fossils tell us? The seminar entitled "The Evolution of the brain, from pre-mammalian reptiles to humans" at the Origins Centre (Johannesburg, 11/8/2018)

Beaudet	Postdoctoral Fellowship	Beaudet A. – Paléobiologie et évolution des hominines du Plio-Pléistocène en Afrique du Sud. Scientific meetings of the UMR 7194 (Paris, 6/9/2018)
Beaudet	Postdoctoral Fellowship	Beaudet A. – Human Evolution in South Africa. Seminar at the University of the Witwatersrand (Johannesburg, 1/8/2018)
Beaudet	Postdoctoral Fellowship	Bouchet F. & Beaudet A. - A microtomographic study of the Papio specimen UW 88-886 from Malapa, Gauteng, South Africa.Seminar at the University of the Witwatersrand (Johannesburg, 6/4/2018)
Beaudet	Postdoctoral Fellowship	Bouchet F. & Beaudet A. - A microtomographic study of the Papio specimen UW 88-886 from Malapa, Gauteng, South Africa. Seminar at the University of the Witwatersrand (Johannesburg, 6/4/2018)
Caruana	Postdoctoral Fellowship	Presented original research at 1st African Conference on Experimental Archaeology (ACE), Wits University, South Africa. Title: “Characterising Bipolar Knapping at Swartkrans Cave.”
Cohen	Postdoctoral Fellowship	Cohen, B.F., Stynder, D., Smith, R.H. (2018). A new perspective on the taphonomy of The Langebaanweg vertebrates. Proceedings of the Biennial Conference of the Palaeontological Society of Southern African, Bloemfontein (4-6 July 2018). Palaeontologia Africana, 53: 1-45.
Cohen	Postdoctoral Fellowship	Cohen, B.F., & Kibii, J.M. (2018). Wild dog (Lycaon pictus) as a bone accumulator? Experimental taphonomic analysis of a large canid on leporid prey. Proceedings of the African Conference on Experimental Archaeology, Johannesburg (20-22 March 2018). *
Cohen	Postdoctoral Fellowship	Cohen, B.F., & Kibii, J.M. (2018). Workshop on carnivore taphonomy in Africa: Experimental protocols, referential frameworks and knowledge gaps. Proceedings of the African Conference on Experimental Archaeology, Johannesburg (20-22 March 2018).
Cohen	Postdoctoral Fellowship	African Conference on Experimental Archaeology, Johannesburg, South Africa (20-22 March 2018): “Wild dog (Lycaon pictus) as a bone accumulator? Experimental taphonomic analysis of a large canid on leporid prey”.
Cohen	Postdoctoral Fellowship	20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein (4-6 July 2018): “A new perspective on the taphonomy of the Langebaanweg vertebrates”.
Esteban	Postdoctoral Fellowship	Esteban, I. Depicting the Fynbos biome through the phytolith record. 11th International Meeting on Phytolith Research. China University of Geosciences (Wuhan, China) – September 2018
Esteban	Postdoctoral Fellowship	Barton, C.M., Ullah, I.IT., Gauthier, N., Miller, N., Snitker, G., Esteban, I., Bernabeu Auban, J., Heimsath, A. Digital Proxies' for Validating Models of Past Socio-Ecological Systems in the Mediterranean Landscape Dynamics Project. 24th European Association of Archaeologists Annual Meeting. University of Barcelona, Barcelona, Spain – September 2018.

Esteban	Postdoctoral Fellowship	Esteban, I. Recent advances in phytolith studies in the archaeological and palaeontological record: a review. 20th Biennial Conference of the Palaeontological Society of Southern Africa. National Museum (Bloemfontein, South Africa) – July 2018.
Esteban	Postdoctoral Fellowship	De la Peña, P., Esteban, I., Reynard, T., Fichet, J., Moll, R., Matumbo, J., Val, A., Stratford, D. Mwulu's Cave revisited: Some thoughts on the Pietersburg Industry. 24th Biennal Meeting of the Society of Africanist Archaeologists. Victoria College, University of Toronto (Toronto, Canada) – June 2018.
Kruger	Postdoctoral Fellowship	Kruger, A., Randolph-Quinney, P., Elliott, M., Hawks, J. & Berger, L. R. Spatial taphonomy and post-mortem disarticulation patterns of the *Homo naledi* assemblage from the Dinaledi Chamber, Rising Star Cave. American Journal of Physical Anthropology 2018 Austin, Texas. Wiley, 147-147.
Kruger	Postdoctoral Fellowship	Berger, L. R., Elliott, M. C., Peixotto, B., Morris, H., Feuerriegel, E. M., Tucker, S. J., Kruger, A., Hunter, R., Van Rooyan, D. & Ramalepa, M. A New Naming Scheme for the Dinaledi Chamber System and Associated Antechambers and Passages of the Rising Star Cave System, South Africa. American Journal of Physical Anthropology 2018 Austin, Texas. Wiley-Blackwell, 25-26.
Kruger	Postdoctoral Fellowship	Tucker, S. J., Kruger, A., Elliott, M. C., Peixotto, B., Van Rooyen, D., Tsikoane, M., Ramalepa, M., Hunter, R., Roberts, E. & Dirks, P. 3D Mapping of the Hominin-Bearing Deposits and Associated Passages and Chambers of the Rising Star Cave System, South Africa. American Journal of Physical Anthropology 2018 Austin, Texas. Wiley, 278-278.
Luyt	Postdoctoral Fellowship	Luyt, J and Sealy, J. (2018). 'Oxygen isotopes in mammalian enamel: an aridity indicator in the South African winter and year-round rainfall zone. 24th Biennial Conference of the Society for Africanist Archaeologists (SAfA). 18 June – 21 June 2018: Toronto, Canada. Oral presentation.
Murungi	Postdoctoral Fellowship	13th – 15th September 2018: Presented my PhD research and part of my post-doc work in a poster at the 8th meeting of the European Society for the Study of Human Evolution (ESHE) in Faro, Portugal.
Penn-Clarke	Postdoctoral Fellowship	*Penn-Clarke, C., Vorster, C., Dixon, R. 2018. Basin analysis and palaeogeography of the Clanwilliam Sub-basin during the Early-Middle Devonian Period. Insights from detrital zircon geochronology and sedimentology of the Emsian-Eifelian Bokkeveld Group. Geocongress (Johannesburg, 18-20 July 2018).

Penn-Clarke	Postdoctoral Fellowship	Penn-Clarke, C., Browning, C., van der Westhuizen, J., Deacon, J., du Plessis, R., Nieuwoudt, J. 2018. The Cederberg, sentinels of geological, palaeontological, archaeological, natural and cultural heritage in the Western Cape for the last 500 million years. Geocongress (Johannesburg, 18-20 July 2018).
Penn-Clarke	Postdoctoral Fellowship	Penn-Clarke, C. 2018. Relative sea-level driven palaeoenvironmental change at high palaeolatitudes during the Devonian of South Africa. Geocongress (Johannesburg, 18-20 July 2018).
Penn-Clarke	Postdoctoral Fellowship	Penn-Clarke, C. 2018. The Rise and Fall of the Malvinokaffric Realm in South Africa. 5th International Palaeontological Congress (Paris, France, 9-13 July 2018).
Penn-Clarke	Postdoctoral Fellowship	Penn-Clarke, C. 2018. Palaeoenvironments and sequence analysis of the Early-Middle Devonian Bokkeveld Group of South Africa. 5th International Palaeontological Congress (Paris, France, 9-13 July 2018).
Val	Postdoctoral Fellowship	Val, A. Oral presentation (10-14 September 2018). *Subsistence strategies associated with the Middle Stone Age 'Pietersburg' techno-complex at Bushman Rock Shelter, South Africa*. 15th Congress of the PanAfrican Archaeological Association (PANAF). Rabat, Morocco.
Val	Postdoctoral Fellowship	Val, A. Oral presentation (10-14 September 2018). *Which role in the human diet for small mammals during the Middle Stone Age? A case study from Diepkloof Rock Shelter, Western Cape, South Africa.* 15th Congress of the PanAfrican Archaeological Association (PANAF). Rabat, Morocco.
Val	Postdoctoral Fellowship	de la Peña, P., Val, A.; Stratford, D., Esteban, I., Fitchett, J., Hodgkiss, T., Matembo, J., Moll, R. and Colino, F. Oral presentation (10-14 September 2018). *Mwulu's Cave revisited 71 years later. A Middle Stone Age sequence in southern Africa (Limpopo)*. 15th Congress of the PanAfrican Archaeological Association (PANAF). Rabat, Morocco.
Val	Postdoctoral Fellowship	Val, A., Tribolo, C., Mercier, N., Haaland, M., Igreja, M., Miller, C.E., de la Peña, P., Schmid, V.C. and Porraz, G. Oral presentation (18-21 June 2018). *New technological, chronological and cultural data on the Pietersburg from Bushman Rock Shelter, Limpopo Province, South Africa*. Society of Africanist Archaeologists (SAFA) 24rd Biennial Meeting, Toronto, Canada.
Val	Postdoctoral Fellowship	Douze, K., Igreja, M., Val, A. and Porraz, G. Oral presentation (18-21 June 2018). *Technology and use-wear of MIS 5 triangular tools at Bushman Rockshelter (Limpopo, South Africa) in the context of Middle Stone Age convergent tool productions in Africa*. Society of Africanist Archaeologists (SAFA) 24rd Biennial Meeting, Toronto, Canada.

Val	Postdoctoral Fellowship	Martin, L., Galy, A., Brutel, N., Taris, M., Pecheyran, C., Douville, E., Pons-Branchu, E., Conard, N., Porraz, G., Val, A., Mercier, N., Tribolo, C., Lefrais, Y., Cantin, N., Pechev, S. and Lebraud, E. Oral presentation (18-21 June 2018). *New methodology of icp-ms for femtosecond laser ablation for direct dating of ostrich eggshells via u-series disequilibrium*. Society of Africanist Archaeologists (SAFA) 24rd Biennial Meeting, Toronto, Canada.
Valenciano	Postdoctoral Fellowship	Valenciano, A., & Govender, R. (2018). Forty years after Hendey's mustelids from Langebaanweg (South Africa, Early Pliocene): state of the art. 1st Palaeontological Virtual Congress. Valencia, 1-15 th December 2018. (Conference slide mode participation.)
Valenciano	Postdoctoral Fellowship	Martín-Perea, D., Aldama, J., Domingo, M.S., Valenciano, A., Abella, J. and Morales, J. (2018). 3D Reconstruction of the carnivoran-dominated assemblage of Batallones-3 (late Miocene, Madrid Basin, Spain). II Encuentro de Paleoarte, Madrid, 26-27th April, 2018. Poster. Abstract: Insight into Paleoart. Anson, M & Garcia P. (eds) ISBN: 978-84-09-02286-1, pp 59-62
Valenciano	Postdoctoral Fellowship	Martín-Perea, D., Domingo, M.S., Valenciano, A., Abella, J. and Morales, J. (2018). Preliminary taphonomic study of the carnivoran-dominated assemblage of Batallones-3 (late Miocene, Madrid Basin, Spain). 61st Annual Meeting of the Palaeontological Association (Palass Meeting 2017). London, 17-19 the December 2017. Poster.
Viglietti	Postdoctoral Fellowship	Viglietti, P. A., Benson R. B. J., McPhee B. W, Dollman, K. N., Choiniere, J. N. (2018). Was the Triassic-Jurassic extinction event a catalyst for tetrapod evolution? Findings from South Africa's Karoo Basin (Stormberg Group). II Joint Congress on Evolutionary Biology in Montpellier, France (oral).
Viglietti	Postdoctoral Fellowship	Viglietti, P. A., Smith, R. M. H., Rubidge, B. S. (2018). Changes to palaeoenvironments and faunal communities across the *Daptocephalus* Assemblage Zone (Karoo Basin, South Africa) supports phased extinctions across the Permo-Triassic Boundary. Geocongress, the University of Johannesburg (oral).
Viglietti	Postdoctoral Fellowship	Viglietti, P. A., Barrett, P. M., Jones, A., Chappelle K. J., Munyikwa, D., Broderick, T., Zondo, M., Choiniere, J. N. (2018). The first Phytosaur from Sub-Saharan Africa: Implications for Phytosaur distribution and regional correlation of Zimbabwe's Mid-Zambezi Basin. Proceedings of the 20th conference of the PSSA, Bloemfontein (oral).
de la Peña	Emerging Researcher	Mwulu's Cave revisited 71 years later: a Middle Stone Age sequence in Southern Africa (Limpopo) 15th Congress of PanAfrican Archaeological Association for Prehistory and Related Studies (PanAf) Rabat, Morocco, between 10-14 September 2018 Oral presentation. Co-authors: Val, A.; Stratford, D.; Esteban, I.; Fitchett, J.; Matembo, J.; Moll, R.; Hodgkiss, T.; Colino, F.
de la Peña	Emerging Researcher	Crystal quartz bipolar reduction: Results of a knapping experiment concerning Southern African Stone Age contexts. First African Conference on Experimental Archaeology (ACE2018). 2018 Oral presentation. Co-author: Justin Pargeter

de la Peña	Emerging Researcher	Trampling vs retouch in a lithic assemblage: A case study from a Middle Stone Age site, Steenbokfontein 9KR (Limpopo, South Africa). First African Conference on Experimental Archaeology (ACE2018). 2018 Oral presentation. Co-author: David Witelson.
Abrahams	Doctoral Bursary	Abrahams, M*., Bordy, E.M., Sciscio, L., Knoll, F. 2018. Morphometric evaluation of Early Jurassic tridactyl dinosaur tracks at Lephoto, Lesotho. Geocongress 2018, University of Johannesburg, 18–20 July 2018, p. 3.
Abrahams	Doctoral Bursary	Sciscio, L., Bordy, E.M., Abrahams, M., Knoll, F., McPhee, B.W. 2018. The Roma Giant: large theropod tracks in the Lower Jurassic Upper Elliot Formation in Lesotho. Geocongress 2018, University of Johannesburg, 18–20 July 2018, p. 227.
Abrahams	Doctoral Bursary	Abrahams, M*., Bordy, E.M., Sciscio, L., Knoll, F. 2018. Morphometric evaluation of Early Jurassic tridactyl dinosaur tracks at Lephoto, Lesotho. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4–6 July 2018, p. 7. http://www.nasmus.co.za/sites/default/files/Louise/PSSA-2018- BOOK-OF-ABSTRACTS.pdf
Abrahams	Doctoral Bursary	Bordy, E.M., Abrahams, M., Rampersadh, A., Haupt, T., Head, H. 2018. The Fire Walkers: tracking the last Karoo dinosaurs. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4–6 July 2018, p. 9. http://www.nasmus.co.za/sites/default/files/Louise/PSSA-2018-BOOK-OF-ABSTRACTS.pdf
Abrahams	Doctoral Bursary	Sciscio, L., Bordy, E.M., Abrahams, M., Knoll, F., McPhee, B.W. 2018. The Roma Giant: large theropod tracks in the Lower Jurassic Upper Elliot Formation in Lesotho. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4–6 July 2018, p. 31. http://www.nasmus.co.za/sites/default/files/Louise/PSSA-2018-BOOK-OF-ABSTRACTS.pdf
Banele	Doctoral Bursary	Primate Ecology and Genetics Group SA annual conference* Nelson Mandela University, Port Elizabeth: 10 – 12 July.
Chapelle	Doctoral Bursary	Chapelle, K. E. J., Choiniere, J. N., Benson, R. B. J., Otero, A., Stiegler, J & Zhao, X. 2018. Locomotory shifts in dinosaurs during ontogeny. Oral presentation to be given at the 78th Annual Meeting of the Society of Vertebrate Paleontology, Albuquerque, United States of America (October 17-20, 2018).
Chapelle	Doctoral Bursary	Chapelle, K. E. J., Choiniere, J. N. & Fernandez, V. 2018. The evolution of embryonic development in Archosauria. Oral presentation at the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, South Africa (4-6 July 2018).
Dollman	Doctoral Bursary	Dollman, K.N., Choiniere, J.N., Clark, J.M., Viglietti, P.A., Norell, M.A., Xu, X. Secondary palate evolution in early crocodylomorphs: functional and phylogenetic implications.Society of Vertebrate Paleontology, Albuquerque, New Mexico. (talk)
Dollman	Doctoral Bursary	Dollman, G.J., Dollman, K.N., Choiniere, J.N. Raising future prospectors within rural Communities. Palaeontological Society of Southern Africa, The National Museum, Bloemfontein. (talk)

Dollman	Doctoral Bursary	Dollman, K.N.*, Choiniere, J.N., Clark, J., Viglietti, P.A., The crocodylomorphs of southern Africa and their geographic and stratigraphic distributions. Palaeontological Society of Southern Africa, The National Museum, Bloemfontein. (talk)
Dollman	Doctoral Bursary	Mdekazi, C.*, Dollman, K.N., Choiniere, J.N. Locomotory evolution in Crocodylomorpha: insights from Litargosuchus leptorhynchus. Palaeontological Society of Southern Africa, The National Museum, Bloemfontein. (talk)
Dollman	Doctoral Bursary	Munyikwa, D., Viglietti, P.A.*, Barrett, P.M., Broderick, T., Chapelle, K.E.J., Sciscio, L., Dollman, K.N., Zondo, M., Edwards, S., Glynn, D., Mbambo, E., Tolan, S., Choiniere, J.N., New Triassic–Jurassic (Upper Karoo Group) fossil localities on the margin of Lake Kariba, Zimbabwe. Palaeontological Society of Southern Africa, The National Museum, Bloemfontein.
du Toit	Doctoral Bursary	International Ornithological Congress: Good vibrations: a link between the morphology of the mechanosensory bill-tip organ, sediment usage and foraging behaviour of ibises (2018)
du Toit	Doctoral Bursary	BirdLife South Africa's Learn About Birds Conference: Mechanosensory structures in the bill-tips of ibises (Threskiornithidae) about their foraging ecology (2018)
Greenwald	Doctoral Bursary	Groenewald, D.P., Rubidge, B.S. & Day, M.O. 2018: Litho- and biostratigraphy of the lower Beaufort Group in the northeastern part of the Main Karoo Basin – Preliminary results. In: Proceedings of the 20th biennial conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4-6 July 2018, p.16.
Greenwald	Doctoral Bursary	Groenewald, D.P., Rubidge, B.S. & Day, M.O. 2018: Tetrapod trackways and the Permian Ecca-Beaufort contact in the Estcourt District, Kwazulu Natal Province, South Africa. In: Bordy EM. (ed.) Proceedings of the 2nd International Conference of Continental Ichnology (ICCI 2017), Nuy Valley (Western Cape Winelands), 1-8 October 2017.
Hlazo	Doctoral Bursary	October 2018 - Centre of Excellence (Palaeosciences) Seminar lectures, Johannesburg. N Hlazo, L Schroeder, Terrence Ritzman, RR Ackermann. 2019. The role of selection in shaping the craniomandibular morphology of Paranthropus.
Hlazo	Doctoral Bursary	April 2018 - American Journal of Physical Anthropology, Supplement 66. AAPA Annual Meeting, Austin, TX, N Hlazo, L Schroeder, T Ritzman, RR Ackermann (2018). The role of selection in shaping the craniomandibular morphology of Paranthropus.
Iqbal	Doctoral Bursary	Poster presentation for the 5th International Palaeontological Congress: 9th-13th July held at the Pierre and Marie Curie University (France).
Matiwane	Doctoral Bursary	Matiwane, A. Prevec, R. 2018. A new approach to Glossopteris leaf taxonomy embracing morphometric analyses. Palaeontological Society of Southern Africa. Bloemfontein, South Africa
Matiwane	Doctoral Bursary	Matiwane, A. Prevec, R. 2018. A new approach to Glossopteris leaf taxonomy embracing morphometric analyses. 5th International Congress of Palaeontology. Paris, France.
Matiwane	Doctoral Bursary	Palaeontological Society of Southern Africa in Bloemfontein (Oral Presentation)
Matiwane	Doctoral Bursary	5th International Palaeontological Congress in Paris (Oral Presentation)

Matiwane	Doctoral Bursary	The First South African Fossil Hunters Conference (Oral Presentation)
Mnguni	Doctoral Bursary	Mnguni, S., Heshula, L.U.P, Paterson, I.D. & Coetzee, J.A. 2018. Reproductive isolation mechanisms of two cryptic species of *Eccritotarsus* (Hemiptera: Miridae), biological control agents of water hyacinth, *Eichhornia crassipes* (Martius) Solms-Laubach (Pontederiaceae). *5th Centre of Excellence in Palaeosciences Seminar Series*. Ekudeni Game Reserve, 28-31 August.
Muir	Doctoral Bursary	Muir, R., Bordy, E.M., Frei, D., Mundil, R., 2018. Recalibrated breakup history of SW Gondwana from the southern Cape of South Africa: New constraints from U-Pb zircon geochronology. Geocongress 2018, University of Johannesburg, 18–20 July 2018, p. 226.
Muir	Doctoral Bursary	Muir, R., Bordy, E.M., Frei, D., Mundil, R., 2018. Long-lived Mesozoic palaeoenvironments nested in the Cape Fold Belt. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4–6 July 2018, p. 24. http://www.nasmus.co.za/sites/default/files/Louise/PSSA-2018-BOOK-OF-ABSTRACTS.pdf
Shadrach	Doctoral Bursary	15th Congress of Pan-African Archaeological Association for Prehistory and Related Studies (PAA) in Rabat, Morocco. Paper title: Toward a definition of the Fauresmith: the view from Canteen Kopje, Northern Cape, South Africa. Poster title: A geoarchaeological and techno-typological investigation of the new P4W Fauresmith from Canteen Kopje, South Africa
Shadrach	Doctoral Bursary	24th Biennial Meetings of the Society of Africanist Archaeologists (SAfA) in Toronto, South Africa Paper title: Investigating the Fauresmith stone tool industry from Canteen Kopje, Northern Cape Province, South Africa
Shadrach	Doctoral Bursary	Northern Branch Archaeological Society (ArchSoc) Lecture. Paper title: Canteen Kopje: Stone Age & Geoarchaeology
Van den Brandt	Doctoral Bursary	Society of Vertebrate Palaeontology (SVP), 75th Annula Conference, 17-21 October 2018, Albuquerque, USA. UNDERSTANDING MIDDLE PERMIAN PAREIASAUR DIVERSITY: THE CRANIAL MORPHOLOGY OF NOCHELESAURUS ALEXANDERI AND EMBRITHOSAURUS SCHWARZI
Van den Brandt	Doctoral Bursary	Palaeontological Society of Southern Africa (PSSA), 20th Biennial Conference, Bloemfontein, South Africa, 4-7 July 2018. UNDERSTANDING MIDDLE PERMIAN PAREIASAUR DIVERSITY: THE CRANIAL MORPHOLOGY OF NOCHELESAURUS ALEXANDERI AND EMBRITHOSAURUS SCHWARZI
Achieng	Masters Bursary	2018-Author poster; Assessing the fracture patterns of thermally altered stone: Experimental evidence for distinct fracture patterns
Kirkaldy	Masters Bursary	Conference Proceedings of the Palaeontological Society of South Africa Biennial Meeting 2018. Impact of volcanic ash and anoxia on invertebrates: an inference from consumers in the middle Permian (Ca. 265 Ma) (*)
Kirkaldy	Masters Bursary	Conference Proceedings of the Palaeontological Society of South Africa Biennial Meeting 2018. The first middle Permian lake shore from Southern Africa
Kirkaldy	Masters Bursary	International Conference on Ephemeroptera and Plecoptera 2018 (Poster, Presented by Helen James)
Makalima	Masters Bursary	GSSA conferences, University of Johannesburg. Jessica von der Meden, Robyn Pickering, Jayne Wilkins, Benjamin J. Schoville, Kyle S. Brown and Simangaliso MakalimaPalaeohydrology of Gamohana Hill investigated through U-series dating and micromorphology of tufas: relevance for Middle Stone Age occupation*

Makalima	Masters Bursary	SAFA Conference, University of Toronto, Canada. Jayne Wilkins, Benjamin J. Schoville, Kyle S. Brown, Robyn Pickering, Benjamin Collins, Simangaliso Makalima, Jess von der Meden. Pleistocene archaeology in the Kalahari Basin: An investigation of Middle Stone Age deposits at Gamohana Hill North Shelter
Makalima	Masters Bursary	ACES2108 Conference, Unversity of the Witwatersrand. Simangaliso Makalima, Jayne Wilkins, Ben Schoville, Kyle Brown, Robyn Pickering, Khumo Matlhoko, Jessica Von Der Meden. Evaluating and comparing raw material edge durability: A preliminary experimental study of raw materials collected from near Gamohana Hill, Northern Cape, South Africa
Matlhoko	Masters Bursary	MAKALIMA, S., MATLHOKO, K., MDLUDLU, A., RICHARDSON, L. & WILKINS, J 2017. Investigating the Howiesons Poort at Kathu Pan 6 Northern Cape: A quantitative comparative study with published results from Sibudu Cave (KwaZulu Natal), Rose Cottage Cave (Free State), and Klipdrift Rockshelter (Western Cape). Poster presented at Association of Southern African Professional Archaeologists (ASAPA) Conference in Pretoria (University of Pretoria) 2017.
Mdekazi	Masters Bursary	Oral presentation at the Biennial Palaeontological Society of Southern Africa (PSSA)
Mdludlu	Masters Bursary	*Ayanda Mdludlu, Jayne Wilkins, Benjamin Collins & Christopher Ames: Temporal Change in Lithic Technology at Grassridge Rockshelter, Eastern Cape presented at the Society of Africanist Archaeologists 18-22 June 2018, Toronto Canada.
Powell	Masters Bursary	I presented a poster on my research at the American Association of Physical Anthropology in Austin this year (2018).
Radermacher	Masters Bursary	20th Palaeontological Society of Southern Africa Biennial Meeting, Bloemfontein, South Africa. Here I presented the updated results of my Honours research on Heterodontosaurus.
Radermacher	Masters Bursary	79th Annual meeting for the Society of Vertebrate Palaeontology, New Mexico, United States of America. I presented a novel hypothesis for the respiratory mechanism in ornithischian dinosaurs and how South Africa's Heterodontosaurus provides a rare transitionary exemplar between the basal archosaur condition and more derived members of this clade.
Rampersadh	Masters Bursary	Rampersadh, A. and Bordy, E. M. Dinosaur footprints from a dynamic Early Jurassic Aeolian palaeoecosystem, Clarens Formation, Ha Talimo, Lesotho. Geocongress 2018; 18–20 July 2018; University of Johannesburg.
Rampersadh	Masters Bursary	Rampersadh, A. and Bordy, E. M. Dinosaur footprints from a dynamic Early Jurassic Aeolian palaeoecosystem, Clarens Formation, Ha Talimo, Lesotho. 20th Biennial Conference of the Palaeontological Society of Southern Africa; 4–6 July 2018; Bloemfontein.
Rampersadh	Masters Bursary	Rampersadh, A., Mokhethi, M., Bordy, E. M., Sciscio L., Abrahams, M., Reid, M. and Haupt T. Dynamics of Early Jurassic lacustrine palaeo-ecosystem: sedimentology and ichnology of the uppermost Elliot Formation in Lesotho. 2nd International Conference of Continental Ichnology (ICCI 2017); 1-8 October 2017; Nuy Valley (Western Cape Winelands).
Smith	Masters Bursary	Humeral histology of Giraffa camelopardalis. Presented as a poster at the UCT Bio Research Day, 2018

T'Nielle	Masters Bursary	Haupt*, T; Bordy, E.M. 2018. Palaeo-environmental change from the Hettangian to Toarcian in southwestern Lesotho. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4–6 July 2018, p. 17. http://www.nasmus.co.za/sites/default/files/Louise/PSSA-2018-BOOK-OF-ABSTRACTS.pdf
T'Nielle	Masters Bursary	Haupt*, T; Bordy, E.M. 2018. Palaeo-environmental change from the Hettangian to Toarcian in southwestern Lesotho. Geocongress 2018, University of Johannesburg, 18–20 July 2018, p. 101.
T'Nielle	Masters Bursary	Bordy, E.M., Abrahams, M., Rampersadh, A., Haupt, T., Head, H., 2018 The Fire Walkers: tracking the last Karoo dinosaurs. Proceedings of the 20th Biennial Conference of the Palaeontological Society of Southern Africa, Bloemfontein, 4–6 July 2018, p. 9. http://www.nasmus.co.za/sites/default/files/Louise/PSSA-2018-BOOK-OF-ABSTRACTS.pdf
T'Nielle	Masters Bursary	Haupt*, T, Brody, E.M, Reid, M, Abrahams, M, Sciscio, L. 2018. Early Jurassic palaeoenvironmental change in Moyeni, SW Lesotho: from Hettangian dinosaur trampled surfaces to Toarcian flood basalts. in Bordy, EM (ed.) Proceedings of the 2nd International Conference of Continental Ichnology (ICCI 2017), Nuy Valley (Western Cape Winelands), 1-8 October 2017. Palaeontologia africana 52, p. 166 — ISSN 2410-4418 https://hdl.handle.net/10539/24150
T'Nielle	Masters Bursary	Rampersadh, A, Mokhethi, M, Bordy, E.M., Sciscio, L, Abrahams, M, Reid, M, Haupt, T. 2018. Dynamics of Early Jurassic lacustrine palaeo-ecosystem: sedimentology and ichnology of the uppermost Elliot Formation in Lesotho. in Bordy, EM (ed.) Proceedings of the 2nd International Conference of Continental Ichnology (ICCI 2017), Nuy Valley (Western Cape Winelands), 1-8 October 2017. Palaeontologia africana 52, p. 185 — ISSN 2410-4418 https://hdl.handle.net/10539/24150
Tolchard	Masters Bursary	Palaeontological Society of Southern Africa (PSSA) 2018 conference: oral presentation.
Tolchard	Masters Bursary	IMGRAD 2017 conference: poster presentation.
von der Meden	Masters Bursary	Geological Society of South Africa (GSSA) Geocongress at University of Johannesburg Oral presentation: von der Meden, J., Pickering, R., Wilkins, J., Schoville, B., Brown, K.S., Makalima, S. Palaeohydrology of Ga-Mohana Hill, Northern Cape, investigated through U-series dating and micromorphology of tufas: relevance for Middle Stone Age occupation
von der Meden	Masters Bursary	American Association of Physical Anthropologists (AAPA) in Austin, Texas. Poster: von der Meden, J. and Pickering, R. The micromorphology and Useries dating of calcretes: a new chronometer for open-air hominin and archaeological sites
von der Meden	Masters Bursary	Palaeoanthropological Society meeting in Austin, Texas. Poster: von der Meden, J., Pickering, R., Wilkins, J., Schoville, B., Brown, K.S., Makalima, S. U-series dating tufa: a new palaeohydrological tracer for MSA archaeological sites in the Northern Cape, South Africa
Cawood	Honours Bursary	Poster presented at the PSSA 2018 conference on the Grylloblattodea fossils found at Onder Karoo, near Sutherland, Northern Cape.

Hatton	Honours Bursary	Applying The Edge Damage Distribution Method To Map Use-Wear On Archaeological And Experimental Shell Beads. Honours thesis preliminary results presented at: Centre of Excellence in Palaeosciences 5th Annual Lecture Series. Johannesburg August 2018
Hatton	Honours Bursary	A Quantitative Approach to Studying Wear on Marine Shell Beads. Honours thesis presentation at the University of Cape Town.
Mataboge	Honours Bursary	PSSA Bloemfontein 2018 Poster presentation
Mataboge	Honours Bursary	SECOND UJ PALAEO-RESEARCH SYMPOSIUM presentation

Conferences, Workshops, and Courses the CoE-Palaeo had supported in 2018

- The First African Conference of Experimental Archaeology (ACE), University of the Witwatersrand, Johannesburg.
- Palaeontological Society of South Africa, National Museum, Bloemfontein.
- The First South African Fossil Hunters: The Antiquity of Palaeo-sciences in Africa, University of the Witwatersrand, Johannesburg.

Service Rendering

The Centre has established itself as a source of information to its stakeholders and the broader scientific community using a variety of approaches. Our members know the importance of Academic Service to their institutions and the broader community from editorships to policymakers. The Centre and its members have established a tradition of service to science and technology and the community in a variety of ways. It encompasses a vast range of activities, both locally and internationally. Our Centre and its Partners provide input in many ways: serving as editors, on committees, undertaking reviews, board memberships, and input on government policies and heritage management.

The CoE runs a very extensive outreach programme which provides lectures, guided tours and workshops at various locations in South Africa, but mostly in Johannesburg. This programme physically reaches more than 400 000 learners annually.

2.14 Leveraging Funds

2.14.1 CoE-Palaeo Leveraged Funds

The CoE-Palaeo and its members have received substantial funding through its duration, ranging from DST-NRF Centres of Excellence Grant to various grants and donations awarded to the Centre's members (Table #). The Centre provides seed funding to its members to enable them to undertake research, but they are expected to use this funding to leverage additional research funding. Also, the CoE has leveraged substantial funding from the Millennium Trust to support a 3-year research programme on the Devonian of South Africa.

Table 15. Leveraged funds.

Source	Source Type	Amount	Period
Palaeoentological Scientific Trust	Non-profit	R86 240.00	2018
Prof B Rubidge RINC 7814	Wits	R32 509.00	2018
Dr C Steininger	Wits	R2 242.00	2018
Bergen University SAPIENS CE	EU Grant	R16 977 847.00	2018-2027
Prof B Rubidge AOP	NRF	R1 670 000.00	2018
Dr C Steininger AOP	NRF	R455 000.00	2018
Millennium Trust Grant	Non-profit	R2 143 000.00	2017-2019

Millennium Trust

In 2017, the Centre received three years of funding from the Millennium Trust to support the *Origin of Land Ecosystems – The South African Story Project* (Table 6). The project supports the salary of Dr Robert Gess who is employed by the Albany Museum and is making groundbreaking discoveries of the plant, early fish and basal tetrapod fauna from the Devonian aged Witteberg Group. Several of his findings have been, and continue to publish in the prestigious journals of Nature and Science. The rest of the funds are used to develop and hire technical staff to curate the extensive and expanding the Devonian collection.

SapienCE

The CoE-Palaeo developed a close collaboration with the Professor Christopher Henshilwood, Director of Norwegian Centre of Excellence in Modern Human Behaviour (SapienCE) at the University of Bergen and Professor at the ESI. Over the next ten years, SapienCE will provide the CoE-Palaeo R16 977 847 towards personnel, research, and excavations conducted at Blombos Cave, Klipdrift Cave and Klasies River Cave (Table 7). These series of caves have yielded significant Middle Stone Age archaeological finds that have pushed back the dates of novel human innovations such as art, ornamentation, production of tools, and hunting strategies.

2.15 Alignment to National Imperatives (with justification for selection)

2.15.1 Alignment with NRF Broad Categories

Biological, Chemical, Earth and Marine

South Africa's unique biodiversity and its exceptional fossil heritage is globally recognised and accorded recognition as a geographic advantage in the National R&D Strategy, and is among South Africa's Science Missions.

2.15.2 Alignment to National Priorities

Transformation

Addressing racial and gender transformation to unlock the full potential of South African society.

One key focus of our Centre is the promotion of black women in palaeosciences and training the next generation of African leaders and explorers. This is achieved in the following ways: Women lead expeditions, training of future Career Scientist, provide opportunities for accessing grants and facilitating research and career opportunities.

Science communication is an important mechanism to involve previously disadvantaged communities in the wonder of science. We offer training opportunities to people at various levels of the job market, eg. As technicians, palaeoguides, and postgraduate students.

Job Creation

We offer training opportunities to people at various levels of the job market, e.g. academic, heritage practitioners, museum curators/collection managers, field and lab technicians, palaeo-guides, and other related fields in palaeo-tourism. We are developing the next stage of creating a National Institute which will create jobs in palaeosciences.

2.15.3 Alignment to National Strategies

Geographic Advantage – Human Palaeontology

The *South African National Research and Development Strategy* (2002) prioritises areas of research that are potentially world-class and could contribute towards 'leading-edge global knowledge'. The *DST's Ten-Year Innovation Plan* (2008) agrees with this analysis and identifies palaeontology as being one of South Africa's Key Science Missions, in which it is possible to "exploit South Africa's 'living laboratories' of local resources and geographic advantage".

The DST Strategy plan for 2015-2020 lists Palaeosciences as a priority science area of South Africa for promoting globally competitive research, innovation and training of people while pursuing excellence throughout their careers.

Geographic Advantage – Biodiversity

Palaeosciences is the only discipline which studies past and modern biodiversity of plants, insects, marine, and land mammals, including humans. Palaeosciences details and research how biodiversity has changed in South Africa, Africa and worldwide.

Grand Challenge – Global Change

The time expansive South African fossil and geological record which includes four of the significant five mass extinctions, provides a unique opportunity to better understand past climate change with the view to better interpret the effects of climate change on extant biodiversity and extinction of species. Palaeosciences is the only discipline which studies past biodiversity.

2.15.4 Alignment to Sustainability Development Goals

- Quality Education - Our partner academic institutions provide the best palaeoscience education in Africa and globally.

- Gender Equality - We have implemented policies that help women pursue a career in palaeosciences that is inclusive and representative.
- Decent Work and Economic Growth - We provide training for individuals to pursue careers in academia, lab & field technicians, heritage practitioners, palaeo-tourism.
- Climate Action - Our Centre provides a unique opportunity to better understand past climate change with the view to better interpret the effects of climate change on extant biodiversity and extinction of species.
- Life on Land - Palaeosciences is the only discipline which studies past and modern biodiversity of plants, insects, and land mammals, including humans. Palaeosciences details and research how biodiversity has changed in South Africa, Africa and worldwide.

2.16 Core Team Members

Table 16. Core team members

Title	Surname	Citizenship	Race	Gender	Type of Collaboration	NRF Rating
Prof	Abdala	Argentina	White	Male	Collaborator	B2
Prof	Ackermann	USA	White	Female	Principal Investigator	B3
Dr	Avery	United Kingdom	White	Female	Principal Investigator	B
Dr	Backwell	South Africa	White	Female	Principal Investigator	C1
Dr	Badenhorst	South Africa	White	Male	Principal Investigator	C
Prof	Bamford	South African permanent Resident	White	Female	Principal Investigator	B1
Dr	Benoit	France	White	Male	Principal Investigator	Y
Prof	Berger	South Africa	White	Male	Principal Investigator	B1
Prof	Bordy	Hungary	White	Female	Principal Investigator	C2
Dr	Botha-Brink	South Africa	White	Female	Principal Investigator	B3
Dr	Brink	South Africa	White	Male	Principal Investigator	C
Prof	Carlson	USA	White	Male	Collaborator	B2
Prof	Chinsamy-Turan	South Africa	Indian	Female	Principal Investigator	A2
Prof	Choiniere	South African permanent Resident	White	Male	Principal Investigator	P

Prof	Clarke	South African permanent Resident	White	Male	Principal Investigator	C
Dr	Codron	South Africa	White	Female	Principal Investigator	not rated
Dr	Cohen	South Africa	White	Female	Postdoctoral Fellow	not rated
Dr	Day	UK	White	Male	Collaborator	NA
Dr	de la Peña	Spain	White	Female	Principal Investigator	Y
Dr	Durand	South Africa	White	Male	Principal Investigator	C1
Dr	Fitchett	South Africa	White	Female	Principal Investigator	P
Dr	Gess	South Africa	White	Male	Principal Investigator	not rated
Dr	Govender	South Africa	Coloured	Female	Principal Investigator	not rated
Prof	Henshilwood	South Africa	White	Male	Principal Investigator	A2
Dr	Jakata	South African permanent Resident	Black	Male	Principal Investigator	not rated
Dr	Jinnah	South Africa	Coloured	Male	Principal Investigator	not rated
Mr	Jirah	Zimbabwe	Black	Male	Collections Manager	not rated
Dr	Kibii	South Africa	Black	Male	Collaborator	not rated
Ms	Luyt	South Africa	White	Female	Postgraduate Bursary	not rated
Dr	Matthews	South Africa	White	Female	Principal Investigator	C2
Dr	McKay	South Africa	White	Male	Principal Investigator	not rated
Dr	McLoughlin	Norway	White	Female	Principal Investigator	B2
Mr	Molefyane	South Africa	Black	Male	Technical Support	NA
Dr	Penn-Clarke	South Africa	White	Male	Principal Investigator	not rated
Dr	Pickering	South Africa	White	Female	Principal Investigator	P
Dr	Prevec	South Africa	White	Female	Principal Investigator	not rated
Dr	Reynard, J	South Africa	Coloured	Male	Principal Investigator	C

Dr	Reynard, T	South Africa	White	Female	Principal Investigator	not rated
Dr	Rossouw	South Africa	White	Male	Principal Investigator	not rated
Prof	Rubidge	South African	White	Male	Principal Investigator	A2
Ms	Scott-Turner	South Africa	White	Female	Financial Officer	NA
Prof	Sealy	South Africa	White	Female	Principal Investigator	B1
Mr	Shaw	South Africa	White	Male	Postgraduate Bursary	NA
Prof	Smith	South Africa	White	Male	Principal Investigator	A2
Dr	Steininger	South African permanent Resident	Coloured	Female	Principal Investigator	not rated
Dr	Stratford	South Africa	White	Male	Principal Investigator	C2
Dr	Stynder	South Africa	Coloured	Male	Principal Investigator	C1
Dr	Tawane	South Africa	Black	Female	Principal Investigator	not rated
Dr	Taylor	USA	White	Female	Principal Investigator	not rated
Ms	Tommy	South Africa	Coloured	Female	Postgraduate Bursary	NA
Prof	Wadley	South Africa	White	Female	Principal Investigator	A1
Dr	Wilkin	USA	White	Female	Principal Investigator	C
Prof	Wurz	South Africa	White	Female	Principal Investigator	C2
Dr	Zipfel	South Africa	White	Male	Principal Investigator	C2

2.17 Collaborations (KPA: Networking)

A feature of the CoE-Palaeo is the excellent degree of collaboration between members of the Centre from different South African institutions (including collaboration between museums and universities) as well as the strong international presence and collaborations with researchers from around the world. A glance at the publication list will show the large number of collaborating scientists from all the continents of the world (including people working on Antarctica) who collaborative with the CoE.

Active research collaborations are in place and are expanding as this programme continues. Use of South Africa's large fossil and archaeological collections is enhanced through the development of a shared digital database of CoE-Palaeo partner institutions which enables long-lasting network and collaboration.

Curatorial efficiency has been increased by the development of a Pan-African curatorial network. We commit to expanding our collaborative horizons to include researchers in education facilities, Southern African Association of Science and Technology Centres (SAASTEC), South African Museums Association (SAMA), South African Agency for Science and Technology Advancement (SAASTA) and South African Heritage Resource Agency (SAHRA).

How networking was achieved:

1. Through research collaborations of the members of the CoE-Palaeo at various institutions in South Africa, beneficial synergies and co-operation are being actively encouraged and planned. It is anticipated that these types of collaborative projects will continue, and new ones initiated.

2. A feature of the CoE-Palaeo is the number of partner institutions, particularly museums that form a valuable formal network of researchers in the palaeosciences. It is the policy of the Centre to involve other Partners as the opportunity arises. The Centre also has an extensive network of collaborations both abroad and locally which is encouraged to expand. Attention is given to supporting researchers on the African continent to engage in collaborative programmes with the CoE-Palaeo.
    - Efforts in this direction include projects in East Africa such as the Olduvai Landscape and Palaeo-anthropology Project (OLAPP) and the multinational team working at Laetoli, Tanzania.
    - There are currently three separate projects running in Kenya at Koobi Fora, East Turkana Basin, Rusinga and Mfwangano and Lukeino. All the projects include local and international collaborators.
    - A new project has been initiated at Mhengere in Mozambique. Other projects include prolific research in Mali, Angola, Zimbabwe, Botswana and Namibia. Links already exist between the CoE-Palaeo and a range of African museums, universities and institutions, particularly those in Botswana, Egypt, Ethiopia, Kenya, Namibia, Tanzania, Uganda, Zambia, and Zimbabwe.
    - The CoE-Palaeo developed a close collaboration with Professor Christopher Henshilwood, Director of Norwegian Centre of Excellence in Modern Human Behaviour (SapienCE) at the University of Bergen and Professor at the ESI.

3. Continued collaborations with palaeoscientists at various institutions around the world are in place. This includes, but not limited to: MIT, University of Washington, SUNY at Stony Brook, Field Museum in Chicago, University of Chicago, Rutgers University, University of Georgia, Colby College, John Hopkins University, University of Milwaukee, University of Minnesota, Oxford University, George Washington University, University of North Carolina, American Museum of Natural History, University of Bergen, Natural History Museum in London, University of Toulouse, CNRS (Paris), Palaeontological Institute in Moscow and Institute of Vertebrate Palaeontology and Palaeo-Anthropology (China)].

4. Centre of Excellence in Palaeosciences and Centre of Excellence in Mineral and Energy Resource Analysis formed a partnership to provide funding for outstanding research to lead an area of research that is under-represented in South Africa yet holds some of the richest records of Precambrian life. Dr Nicola McLoughlin will lead South Africa's Precambrian Record of Early Life project.

5. Funding permitting, it is intended to increase the number of researchers engaging in short-term visits to the Centre to enrich our research programmes and broaden the perspectives of our postgraduate students. Researchers are encouraged to use their extra funds as well, be they from the NRF or industry-based. This is in part preparation for the long-term sustainability of the Centre.

6. The attendance of conferences and workshops both locally and abroad and the presentation of papers is encouraged and supported. We are trying to expand this, particularly for postgraduate students, thereby broadening their perspectives and contacts. An increased number of short and long-term visits to institutions abroad will enhance the international research co-operation of the CoE-Palaeo. Similarly, more researchers based overseas are attracted to collaborate with CoE-Palaeo members, further improving the opportunity of engaging in high standard research.

7. The CoE-Palaeo website will continue to facilitate the expansion of its interactions locally and abroad. Where possible, other forms of publicity will continue to be employed to enhance the image and prominence of the Centre.

8. Wits and other partner institutions already have numerous regional, national, continental and international partnerships and involvement with established institutions of higher learning with the aim of promoting better diffusion and exploitation of the knowledge produced by tertiary institutions. Our palaeo-anthropologists, palaeontologists, and archaeologists thus actively collaborate with reputable individuals and groups that add value to this field of knowledge and will continue to negotiate and cement additional partnerships. There is a diversity of skills among those who participate in local and international consortia and who serve on government bodies and management committees.

2.18 Science Engagement (KPA: Information Brokerage)

The CoE-Palaeo makes a special effort to communicate the results of its research to the broader public. The widespread popular appeal of visual representations of heritage objects (e.g., 3D renderings of fossils) means that the media is a crucial element of information brokerage. The information gained is disseminated for public awareness through the CoE-Palaeo website, other social media outlets, science communication, workshops and by participation in scientific conferences.

The CoE-Palaeo engages in knowledge brokerage in some ways:

1. The CoE-Palaeo community is conducive to knowledge generation and transfer by interactions. This is promoted by meetings, conferences, workshops, colloquia and working together on collaborative projects.
2. CoE-Palaeo publications, including research papers in international and local journals, books and conference proceedings all form essential vehicles for knowledge brokerage.
3. The CoE-Palaeo encourages palaeoscience consulting and participation of our members in Heritage Impact Assessments.
4. Courses are presented to undergraduate and postgraduate students at South African Institutes and Universities.
5. Members visit international institutions for research and attend conferences, and in the process, promote the work done by the CoE-Palaeo.

6. Members of the Centre produce popular articles, media and social media outputs relating to new research findings.
7. Members in the CoE-Palaeo play significant roles in the organisation of both local and international conferences and workshops, as well as giving presentations (both oral and posters) with the CoE-Palaeo logo prominently displayed, and acknowledgements given to our sponsors.
8. A CoE-Palaeo website has been set up and is currently undergoing revamp for our 5th Anniversary celebration. The website and our other social media platforms have and will continue to highlight the research undertaken by our members. All our grant applications are on the site for members and new members to access.

Community outreach and science engagement is an important function of CoE-Palaeo, and our programme has expanded every year. On average, our palaeoscience outreach programme reaches more than 400 000 learners, teachers and members of the public per annum. The emphasis of the programme is on making contact with members of the public, school learners and teachers as it is felt that although more and more South Africans are becoming connected to the internet, most still need to be physically exposed to palaeontology before they are likely to go and look for it online. Our Centre, through our Science Communications Officer, Ms Kimberleigh Tommy has expanded our digital footprint using web pages (https://www.wits.ac.za/coepalaeo/), Facebook (https://www.facebook.com/coepal/), Twitter (@CoE_Palaeo), Instagram (@CoE-Palaeo) and YouTube with great success. The Centre supports the bi-annually produced *PalNews Letter* that is distributed to the palaeo-community locally and internationally. Apart from the outreach programme run by Dr Ian McKay, most of the CoE-Palaeo partners and members including postgraduate students and postdoctoral fellows are committed to this important function. Each member of our Centre contributes to various creative and productive ways. In media announcements during 2018, the CoE-Palaeo had an Advertising Value Equivalency (AVE) of over Rand equivalent of 4 million. The programme also continues to support the management of the Kitching Fossil Exploration Centre in Nieu-Bethesda as well as training guides. The Centre provides input to the various tourist and outreach-related activities of the Cradle of Humankind and the West Coast Fossil Park. Our members also assist with and maintain the programmes of the Cradle of Humankind exhibition centres.

Our outreach programme continues to be developed. Interest in the field at school level is nurtured using curriculum-based targeted education outreach programmes run by our partners. This is achieved by:

1. Invitations to school pupils and their teachers to visit the Origins Centre at Wits University and participate in our outreach programme.
2. The CoE-Palaeo strongly supports open Days at universities.
3. Visits to South African schools and universities highlight research being conducted by our researchers and students. This may ignite interest in pursuing a degree in palaeosciences.
4. Development of sustainable palaeo-tourism and heritage ventures is supported and encouraged.

The CoE-Palaeo is very active in the following areas of science engagement:

1. In collaboration with the Wits University Media Department, the CoE-Palaeo makes use of every opportunity to provide the press with information on discoveries and developments to inform and excite the public of South Africa on this important part of our heritage.

2. All members of the Centre (scientists and students) are expected to be involved in science engagement activities, and these are reported in their annual progress reports. The types of activities range from lectures at schools, museums, public venues, talks to civic organisations and academic organisations.

3. Because research activities of the Centre involve fieldwork, many scientist and students engage with schools and the public in the rural areas where they work. Some spend a great deal of time educating farmers and farm hands-on how to search for fossils and what to do if they discover fossils. This has paid huge dividends in the past, and many exciting discoveries have been made by interested members of the public, who then inform the scientists.

4. The CoE-Palaeo organises outreach activities aimed mainly at school learners at various venues.
    - Rand Show
    - Grahamstown Foundation (Grahamstown Science Festival)
    - Sci-Bono Science Centre
    - School of Animal, Plant, and Environmental Sciences, Wits University (Yebo Gogga Exhibition)
    - Unizul Science Centre- Zulu Fest Richards Bay
    - SAASTA (South African Agency for Science and Technology Advancement)- National Science Week
    - Gauteng Department of Education
    - Marang Centre, Faculty of Education, University of the Witwatersrand
    - Origins Centre, National Health Laboratory, Genetics Days
    - Origins Centre, Kitching Gallery, combined tours with ESI
    - Centres of Excellence Directors Forum

5. Kitching Fossil Exploration Centre (KFEC). This rural palaeo-tourism venture, which offers employment to four members of the local community, is getting ever closer to its goal of financial sustainability. The success of the KFEC may be ascribed to external funding raised on an annual basis, the strong long-term partnership with the Owl House Foundation, and enthusiastic management team which includes the University of the Witwatersrand, the Albany Museum, and private individuals. The KFEC building, made available through the efforts of a private benefactor, Mr Ross Foxton, is well maintained. This is a model of the type of self-sustaining palaeo-tourism ventures which should be set up in rural parts of the country to enhance palaeo-tourism in the nation.

6. In 2018, the Centre hired a temporary Science Communication Officer to revamp the website for our 5th Anniversary and to ignite our social media platforms. In 2018, we had over 4000 followers on our Facebook page. Along with some of our Partners, we have initiated a twitter, Instagram, and YouTube page. Also, we are developing content in various indigenous languages to reach more South Africans.

2.19 Financials

A significant portion of the DST-NRF Centres of Excellence grant to the CoE-Palaeo goes towards bursaries to postgraduate students from Honours to Doctoral, Postdoctoral Fellowships, and Operational Support grants (research, conferences/workshops, programmes, and outreach). As agreed upon, the award provides funds for core staff: Director, Manager, Financial Officer, Collection

Manager, Scan Manager, Education Outreach Officer, a temporary Science Communication Officer and six technical support staff. As of 2019, the CoE-Palaeo Host institution, the University of the Witwatersrand, will provide 10% of the total DST-NRF contribution to the CoE-Palaeo.

2018 Grants

Table 16. Grants allocated.

Level	Amount
Honours	340 000
Masters	970 000
Doctoral	1 320 000
Postdoctoral Fellowship	3 863 566
Operational Support Grants	2 339 960
TOTAL	8 833 526

Cash Flow

Table 17. Cash flow

Description	TOTAL for 2018
Balance brought forward	3 978 997.89
NRF	12 762 816.00
Interest	91 833.15
Other	-
TOTAL INCOME	16 833 647.04
Salaries - S	5 788 297.98
Student costs - C	6 531 613.76
Conferences and related travel - D	420 368.35
Equipment - E	-
Running - R	2 580 644.11
TOTAL EXPENSES	15 320 924.20
NET SURPLUS / DEFICIT FUNDS	1 512 722.84

The surplus funds as outlined in our 2019 Business Plan approved by the Steering Committee will be used to initiate projects for student training, exhibitions and funding to train technical support and to send technicians to conferences. We want to use this funding for grants to support 2 Black Female Emerging Researchers for two years.

2.19.1 Gender impact of research

Every effort is made to ensure that the students are representative of the demographics of South Africa. Already in the short existence of the Centre, the number of students from designated groups has dramatically increased. While the CoE-Palaeo has limited input in staff recruitment in a previously white male-dominated field, significant advances have been made in the employment of research staff from designated groups at all our partner institutions. Vigorous efforts will continue to be made to address race and gender imbalances. This is being done by:

1. Collaborating with other funding bodies and industry (e.g. Palaeontological Scientific Trust) to increase bursaries amounts for black female postgraduate students.
2. Developed two Emerging Researcher Grants for Black Female Researchers
3. Encourage our academic staff to lecture undergraduate courses. Many students are shown a path to a career in palaeosciences from some of our dynamic researchers who have taught courses in biology, geology, climatology, botany, geography, and anatomy.
4. Assist our academic staff in finding additional sources of funding for students interested in Palaeosciences.
5. To support our grantees to give talks to schools across South Africa.
6. Continue with our extensive public engagement and science communication activities.

The CoE-Palaeo is making great efforts to increase the participation of women in science teams, leadership roles, and in evaluation panels. We are looking into new ways to include gender dimensions into the content of research. This approach to science has a powerful way of seeing new perspectives, particularly in the fields of palaeosciences.

The CoE-Palaeo supported in 2018:

- Over 17 Operational Support Grants are given to women who are the principal investigators of research projects in palaeosciences.
- It has granted 10 Masters and 11 Doctoral Grants to women.
- The Centre has granted 8 Masters and 5 Doctoral Grants to black women.

SARCHI Chairholder

- Prof Judith Sealy, Dept of Archaeology, UCT

A-rated NRF scientist:

- Professor Lyn Wadley
- Professor Chinsamy-Turan

B rated NRF Scientist:

- Prof Rebecca Ackermann
- Dr Margaret Avery
- Prof Marion Bamford
- Dr Jennifer Botha-Brink
- Prof Judith Sealy

Grantees with present and past leadership roles:

- Professor Marion Bamford, Evolutionary Studies Institute, Wits - Director
- Prof Rebecca Ackerman, Dept of Archaeology, UCT- Deputy Dean of Transformation
- Prof Anusuya Chinsamy-Turan, Dept of Biological Sciences, UCT – Head of Dept

- Dr Rosemary Prevec, Head of Palaeontology, Albany Museum – Head of Dept
- Dr Jennifer Both-Brink, Head of Karoo Palaeontology, National Museum – Head of Dept
- Dr Mirriam Tawane is the new Curator at the Ditsong Museum – Head of Plio-Pleistocene Collections

Principal Investigators and Directors of Excavations:

- Prof Marion Bamford, Olduvai Gorge
- Prof Kathleen Kuman, Sterkfontein & Swartkrans
- Dr Christine Steininger, Gondolin & Cooper's Cave
- Dr Sarah Wurz, Klasies River
- Dr Aurore Val, Bushman Rock Shelter
- Dr Lucinda Backwell, Border Cave
- Dr Rosemary Prevec, Karoo Palaeobotany
- Dr Emese Bordy, Karoo Sediments
- Dr Paloma de La Penya, a new middle stone site in the Limpopo
- Dr Romola Govender, Langebaan marine quarry
- Dr Thalassa Matthews, Pinnacle Point & Langebaan

2.19.2 Return on research investment

The superb palaeoscience- bearing a sedimentary succession of South Africa have not yet been fully explored to their full potential and is one of the goals of the CoE which has greatly enhanced the scope of the palaeoscience footprint in South Africa and over the reporting period has resulted in:

1. World-class collaborative, multidisciplinary research and numerous publications in internal peer-reviewed journals.

2. International collaborative research projects being set up based on the palaeoscience resources of Southern Africa. The project has required the collaboration of more than 100 scientists from around the world, apart from the interest it has generated for other scientists from around the world to research the rocks and fossils of South Africa. The number of international visiting scientists to South Africa to study these rocks has greatly increased in recent years because of the exciting discoveries being made by South African scientists.

3. Setting up a GIS system of fossils from the Karoo Supergroup. This is the first database of this type for tetrapod faunas of the Permian-Jurassic and is being utilised by international scientists to understand past terrestrial palaeoecology and biodiversity.

4. Increasing understanding of the remarkable internationally significant palaeoscience resources of South Africa has the potential to develop national pride in the important role South Africa has in understanding the origin of various life forms leading to current biodiversity. Important fossil discoveries from South Africa include the earliest land-living plants, the earliest land-living invertebrate in the southern hemisphere, the earliest fossil lamprey showing that these jawless fish were already parasitic in the Devonian, the earliest ancestor of tortoises, the earliest dinosaur faunas and the oldest dinosaur eggs, the world's most comprehensive record (via

therapsids) of the ancestry of mammals and the oldest fossil mammal – our most distant ancestor, the remarkable history of human origins and culture.

5. As is evident from this report, the CoE runs a very diverse and extensive palaeoscience outreach programme which targets all levels of society, and particularly previously disadvantaged communities.

6. Development of Human Resource Capacity through outreach, casting and palaeotourism programmes.

7. Training of expertise for the job market - this project has trained people at various academic levels including junior and senior school, diploma, undergraduate, postgraduate and postdoctoral.

2.19.3 Commercialization

- Mobile Exhibits
- Courses for Adults
- Tourism
- Products
- Field Excursions

2.19.4 Job creation

The establishment of palaeotourism ventures in South Africa and the development of job opportunities. This venture has a snowball effect, and once a few palaeotourism projects have been established, it will result in a growing tourism market and the possibility to greatly enhance job creation possibilities in the economically deprived vast rural areas of South Africa. Other areas of job creation:

- Heritage
- Tourism
- Academic
- Education/Teaching
- Legal
- Government
- Consultant
- Big Data
- Financial
- Consultant
- Marketing
- Science Writer
- Education Outreach
- Science Communications
- Entrepreneur
- Artist
- Chemistry
- Technology (i.e. 3D scanning, drones, LADAR)

- Climate Modelling
- Environmentalist
- (Micro) Biology
- Space Science (first early life)
- Grant writer
- Project/Research Manager
- Fundraiser

2.19.5 Data storage, utilizations and accessibility

Curation of Collections

Data is made available via our numerous scientific publications. The ESI has set up a GIS database recording all fossils collected from the rocks of the Karoo Supergroup in South African collections. This database is available to all bona fide scientists wishing to utilise it.

Morphobank: A long-term project was initiated by Prof Abdala to upload an extensive data matrix of Eutheriodonts onto the MorphoBank. The aim is to include the large quantity of data concerning cynodonts and therocephalians to provide an extensive cladistic analysis.

Fossil and modern Collections

All of our museum partners have collections in their care and are utilised by our members and collaborators and all palaeoscience heritage material collected through our research programmes is stored in these collections, and their information is stored in electronic databases. These fossils and the database are available to all bona fide researchers and students.

The NRF has made funds available to museums to improve infrastructure. The Iziko, National and Ditsong Museums were successful in their applications. Currently, Iziko Museum is revamping their collection space, and collections have been hard to access. The palaeontology and modern human section have been very accommodating in this transitional time.

The staff of the curatorial section of the ESI comprising Dr Bernhard Zipfel (curator) and Mr Sifelani Jirah (collections manager) carried out a general reorganisation of the fossil collection in order to streamline future management. This essential development has boosted the curation capacity of the CoE-Palaeo.

Wits Satellite Archaeological Laboratory, Buitenkant Street, Cape Town

Archaeological material collected from Blombos Cave, Klipdrift Cave, Klipdrift Shelter, Klipdrift Cave (Lower) under the direction of Prof C. Henshilwood is curated at this facility. In the long term, the material will be incorporated into the collections of Iziko Museum, Cape Town, as stipulated by the collecting permit from SAHRA.

Wits Virtual Microfocus CT Facility

The CoE-Palaeo partially supports the running of these facilities. Both local and international scientists have utilised these facilities. This facility comprises the Micro-CT scanner and the Virtual Image Processing (VIP) Laboratory that is operated by Mr Kudakwashe Jakata, Scan Manager. Mr Jakata is physics' doctoral student. He has just submitted his thesis for examination.

Mr Jakata has been able to keep the microCT lab equipment working. This has allowed him to assist scientists who require CT scans to give insight into their research. The facility has performed scans for 48 requests from scientists working at the University of the Witwatersrand, the CSIR, the University of the Free State, Albany Museum, and from Institutions in France, the USA and Canada. These came from research fields such as Palaeontology, Paleoanthropology, Archeology, Geoscience, Metallurgy and Mining Engineering. Over a quarter-million rands have been generated from the use of scanning facility.

All the raw CT scan data generated in our laboratory is stored on a 100 TB server. This data is available to other researchers upon request through our fossil collections curator, Dr B. Zipfel. The data are then transferred via FTP or if the researcher is available in the country then using a portable hard disk drive. We store all the data in order to reduce the need for handling fossils.

Administration Data Storage

Our administration documents are stored on an external hard drive and Wits back-up. Back-up is completed daily.

2.19.6 Retention strategy

In a time of global change, South Africa faces significant challenges in respect of its climate and resources, but there is uncertainty, mainly because it is difficult to predict the future. The Palaeosciences is the only discipline which offers the opportunity to look back in time to study the interaction between past biodiversity and environmental change. The extensive geological and palaeontological record of South Africa offers unique opportunities to understand the effects of at least four of the significant five global mass extinctions.

The South African National Research and Development Strategy (NRDS) and South African Research Infrastructure Roadmap (SARIR) have identified the palaeosciences as a discipline where this country has a geographic advantage because of its natural palaeoscience resources, internationally significant collections, relatively good scientific infrastructure which has made this country an international leader in the field. The establishment of the CoE for Palaeosciences which has built on this infrastructure has dramatically enhanced palaeoscience research productivity, improved research infrastructure, an enhanced human capital development plan that incorporates capacity development at multiple levels including Honours, Masters, Doctoral students, Postdoctoral Fellows, research, support staff and tour guides.

Because of the geographic advantage of the South African natural palaeoscience resources and the tremendous strides in the development of multidisciplinary research and the incorporation of technology made by the CoE in Palaeosciences in its relatively short existence, the palaeoscience is a logical contender for development as a National Facility as the next stage in its development.

2.20 National Infrastructure Platforms

Reporting on equipment and data accessed outside the Centre – National Science Collection Facility (through SANBI)

- National Infrastructure Platform
- Types of Platform

- Value of Usage

2.21 Possible Reviewers

Request Steering Committee advice

2.22 Exclude Reviewers

None

2.23 Institutional Support

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Development of a scientific foundation and expertise in the discipline within the institution

The CoE has six partner institutions in South Africa including two Universities and four museums and is currently setting up agreements with a further two universities. Although the largest Centre for palaeoscience research and training is the University of the Witwatersrand, the CoE has gone out of its way to building capacity at its partner institutions, and also to create “national palaeoscience facilities” and the expertise to run them which are available to the broader palaeoscience community. An example is the Micro-CT scanning facility at Wits University; the CoE has also funded the curation and management of museum collections.

Because of the antiquity of its rock record, South Africa has fossil-bearing sedimentary rocks of the diversity of ages containing some of the oldest evidence of life up to the origins of humans and human culture. The CoE funds projects relating to the internationally renowned iconic areas of the palaeoscience record to ensure that our country remains an international leader in these areas of research. These are: Cape Supergroup and the radiation of invertebrates, fishes, land plants and tetrapods; Karoo Supergroup and origins of terrestrial ecosystems including the origins of tortoises, dinosaurs and mammals; Langebaanweg and early mammalian faunas; Cradle of Humankind and the early origin of hominins and; the Middle Stone age and the origins of human cognition and art.

The CoE has also gone out of its way to encourage new areas of endeavour including the origin of life; early multicellular life; and also research on the most effective way of undertaking palaeoscience outreach. The CoE encourages big science projects looking into biodiversity radiation, the development of ecosystems and their response to periods of environmental stress leading to extinction events and understanding climate change in the distant past. Crucial is an understanding of the drivers of these processes. The palaeoscience record of South Africa, perhaps more so than any other single country, has the potential to answer these important questions posed by the current sixth extinction, and the CoE is addressing them.

The CoE has been responsible for discovery, for the first time of: Ediacaran faunas in South Africa; developing a sequence stratigraphic framework for the Devonian Bokkeveld Group with support from invertebrate fossils; discovering a broad diversity of Devonian fish including the first tetrapod from Africa and the earliest forest on land, which are all remarkable as they lived in high latitudes close to the polar region; recognition of *Eunotosaurus* from the Karoo as the oldest tortoise ancestor using evidence from palaeontology, comparative anatomy, embryology and genetics; understanding the radiation of the earliest "reptile"-bearing ecosystems in Gondwana and the recognition, quantification and dating of the end Capitanian extinction; The discovery of a diverse Capitanian fossil insect fauna with the oldest records of many families; understanding biodiversity change resulting in the End Permian mass extinction and the subsequent recovery event; making major new dinosaur discoveries including the oldest gigantic dinosaur; continuing research at several sites in the Cradle of Humankind, the discovery of new mammal species and also the discovery of several hominin fossils.

A breakthrough of the CoE in Palaeosciences has been the development of high precision dates for particularly the rocks of the Karoo and the Quaternary Cave deposits, as well as Middle Stone Age sites.

As is evident from the above, the CoE covers a large subject area, but in all the projects it subscribes to the principle of excellence, and this has been achieved in many areas with good productivity of papers in highly rated international journals.

As required by the African Origins Strategy Document, the CoE has developed expertise in palynology and invertebrate palaeontology. Also, through the large cohort of students in the programme, the CoE-Palaeo is not only training a younger generation of scientists to fill the shoes of ageing scientists but also training people who are equipped to lead the utilisation of technology to achieve their research aims.

The success of the programme is evidenced by a large number of quality publications published with a broad range of multidisciplinary collaborators from many countries of the world. The CoE has been in operation for only 5.5 years, and already its impact on the development of the palaeoscience record according to the guidelines of the Palaeo Strategy Document is evident. Of great importance is the growing number of students from previously disadvantaged communities. The CoE-Palaeo makes dedicated initiatives to attract students into an area where there are not many job prospects, but opportunities to create them

Establishment of intra-disciplinary and inter-institutional research collaborations

The CoE for Palaeosciences funds a core of about 56 researchers who are responsible for generating the research and initiating projects. During 2018 more than 190 researchers from different institutions in South Africa and abroad participated in the production of 160 publications. This attests to the high degree of inter-institutional research collaboration and increasing more projects are being undertaken with colleagues from other African countries, including Namibia, Zimbabwe, Mocambique, Kenya, Tanzania, Zambia and Malawi.

Training and mentoring of quality postgraduate students and postdoctoral fellows

Realising the importance of introducing the palaeosciences to the general public to encourage school learners to consider palaeosciences as a career option, the CoE invests considerable time and funds to showcase the excitement of its research findings through press releases to the media, and also runs an extensive outreach programme which reaches about 400 000 learners annually. In the past few years, there is an increasing number of students undertaking postgraduate degrees in palaeosciences.

The CoE, via partner universities and museums, has continued to focus on research training of postgraduate students to build capacity and competence to meet the needs of academia, museum, tourism industry, environmental impact studies and government. In 2018 the CoE supported 16 postdoctoral fellows, 17 doctoral, 17 masters, and nine honours students. It is interesting to note that through the various collaborations, out of the 158 DE recognised publications published by the CoE in 2018, 76 had postdocs as collaborations which are an indicator of the extent of CoE mentorship to postdocs.

As the discipline of palaeontology has in the past attracted mainly white males, the CoE has proactively initiated strategies to rectify this imbalance through several interventions which are detailed in the report. The situation has now changed, and in 2018, more than 57% of the postgraduate students funded by the CoE were from previously disadvantaged backgrounds, and 55% of the students funded were women.

Established strategic and valuable networks of collaborators and donors

Support of South Africa's flagship projects has resulted in a surge of international interest in the significance of South African palaeoscience discoveries and research output. Internationally it has been shown that it is difficult to secure large funding for the palaeosciences from the private sector. The Palaeontological Scientific Trust (PAST) has been exploring and utilising most of these resources from South Africa and aboard.

Despite this, the CoE has secured substantial support from the Millennium Trust to support research on the Devonian of South Africa, and additional funding has been raised from the Norwegian government for the South African-based Middle Stone Age SapiensCE project run by Professor Christopher Henshilwood.

The CoE has a very extensive and impressive list of collaborators from institutions, not only in South Africa but also around the world.

Any innovative outputs emanating from activities

Because the CoE is involved with several "big science" projects which require a multidisciplinary approach to answer their research questions, the Centre is increasingly looking to the application of technology to undertake this research, and this has resulted in numerous interdisciplinary partnerships with disciplines not previously involved in palaeoscience research. This is particularly

pertinent in the fields of tomography, 3-D modelling of cave deposits, big data, geochronology, isotopes, climatology, environmental change, and statistics.

Despite these innovations, the strength of South African palaeoscience is the geographic advantage our country has with its fossil-rich sedimentary deposits in rocks covering a wide diversity of ages. Thus the palaeoscientists of this country are continuously discovering exciting new species and making unprecedented discoveries relating to the origins of human culture. These include:

1. New Ediacaran fossils
2. Discovery of new Devonian fishes, the oldest trees, and tetrapods, for the first time, discovered in high latitude areas.
3. Discovery and publication of new dinosaur, therapsid and parareptile species from the Karoo.
4. Discovery of, and publications on, trackways and burrows to better understand the palaeobiology of extinct species such as dinosaurs. A significant new contribution is the description of a juvenile *Lystrosaurus* specimen in a burrow.
5. Discovery of the first phytosaur fossil in Zimbabwe.
6. Discovery of new mammal species from the Cradle of Humankind as well as new and more complete hominid fossils.
7. Unprecedented discoveries relating to the development of modern human culture in the Middle stone age, including the oldest bedding, oldest toolkits, use of ochre in painting and personal adornment.

A significant contribution the South African fossil record offers, because of its time expansive fossiliferous sedimentary deposits, is the opportunity to study the causes and effects of biodiversity change in the past. This is especially relevant today as humanity grapples with understanding the causes and effects of the current so-called sixth extinction. South African palaeoscientists are currently undertaking groundbreaking work on the following mass extinctions: End Devonian; End Captitanian; End Permian and end Triassic where the geological and palaeontological record of our country offers a unique geographic advantage. South African palaeoscientists working on these questions are international trailblazers.

Additional benefits and challenges

The University of the Witwatersrand has a long history of research in the palaeosciences, and to its credit continued (at the great institutional expense) to fund palaeoscience research in the apartheid years when this area of endeavour was not encouraged by the government of the day. Recently Wits has streamlined its palaeoscience activities by combining its palaeoscience endeavour in a single palaeoscience Institute (Evolutionary Studies Institute (ESI)) which has world-class facilities. This has enabled more effective use of financial resources and equipment. Wits host the Centre, and its facilities are shared with our CoE partners and the international palaeoscience world.

A major problem at the ESI, which directly affects the output of the CoE, is the funding of fossil preparators, which cannot be accommodated in the University Funding Model.

To alleviate this problem over the past 15 years, the DST and NRF have assisted in funding the Wits preparators. This move was initiated by Wits to solve an ongoing problem in palaeosciences.

From 2018 the NRF is no-longer funding the preparators at the ESI, but are funding them at museums and other institutions. This is a major calamity as the Wits preparators, who have received world-class training over many years and serve the entire palaeoscience community, will now have to be retrenched. This will result in the collapse of palaeoscience output, not only from Wits which currently produces more than 75% of the palaeoscience output of the country, but also other collaborating institutions. Running a palaeoscience department without preparators is impossible.

Wits benefits by hosting the CoE in Palaeosciences in that a large percentage of the Centre's budget reaches Wits researchers and students, but this is to be expected as Wits has the largest palaeoscience Institute and postgraduate training facility in the country. What needs to be taken into account is that much of this funding which comes to Wits is to maintain "national facilities" such as the CT scanner, Cradle of Humankind sites curated by Wits and the fossil collections.

Institutional research strategy

In the University's *Strategic Research Plan,* "Evolution of the Species and National Heritage" is identified as a research priority area. Wits are currently the leading Centre in the world for research into many facets of this priority area. This has been achieved by a series of public-private partnerships and a commitment by the University, over many years, to develop and to sustain world-class research capacity in this field. Large fossil collections and databases have been built up to the extent that Wits currently has some of the largest and most important collections of this aspect of heritage in the world.

The CoE has a very positive effect on the development of palaeosciences at Wits. Even although the funding resources of the CoE are spread amongst all its partners throughout South Africa because Wits employs the largest number of palaeoscientists and has the greatest number of postgraduate students it has greatly benefitted financially in the ESI and the School of Geography Archaeology and Environmental Studies. This has also led to a great increase in palaeoscience research output from Wits. Of the 142 DE recognised research publications and the 16 chapters in books produced by the CoE in 2018, Wits was responsible for the production of at least 75% (because of inter-institutional collaboration this is difficult to quantify more accurately).

Also because Wits owns and maintains large collections and databases, as well as a CT scanner as a "national facility" in palaeosciences, the CoE does assist with the maintenance of these facilities for the benefit of the country.

2.24 Grant Administration Survey

2.24.1 What did we do right?

The Department of Science and Technology, the National Research Foundation and the RCCE are all supportive and encouraging. They have given helpful advice since the beginning of the conceptualisation of our Centre.

2.24.2 What did we do wrong?

NRF Online System

- One size does not fit all with Centres of Excellence. All Centres are highly productive with individual strengths and challenges. Reporting is limited in space and does not capture the total impact of our Centres.
- ORCID should be linked to the researcher's outputs so researchers can just state which research output is linked to the grant given instead for each NRF grant received by researchers. Unfortunately, at the moment, each researcher has to manually input their research outputs manually. Some researchers had to do this three times for different grants. Some might have more than one grant linked to a project. Moreover, some have lost all their research output and had to retype this information again for their profile page. This should be a more straightforward process.
- Some of our Centres, like ours, has hundreds of collaborators. An attachment option should be available.
- Our Centre is big on education outreach, science communication, science awareness which all our grantees are involved in. An attachment option should be available.
- A glitch in the system causes lengthy downtime hindering the Centres and our researcher's access
- Not enough space for some of our reporting
- For the 'Excluding Researcher' section, there should be an option for none
- Finance
    - Students are supposed to be linked to the nomination, but not all of them are present, and amounts are all 0. We were unable to change it on the system.
    - Running cost should have different categories, or there should be allowances to insert different categories; it should be more of a cash flow sheet similar to the ones we have to submit to the NRF quarterly.

3 INTO THE FUTURE

It has shown that the geographic advantage offered by the extensive palaeoscience record of South Africa is worthy of a world-class national institute for palaeosciences. It is not possible to write a comprehensive document on the development of life without referring extensively to the South African fossil and archaeological record.

Our Centre has an extensive network of collaborators who significantly enhance the quality and scope of research projects the Centre undertakes, and also provides a superior training experience to students. The Centre adopts a multi- and interdisciplinary approach to interpret our unique South African Fossil Heritage. Use of South Africa's large fossil and archaeological collections is enhanced through the development of a shared digital database of CoE-Palaeo partner institutions which enables long-lasting network/collaboration. Curatorial efficiency has been increased by the development of a Pan-African curatorial network. We commit to expanding our collaborative horizons to include researchers in education facilities, Southern African Association of Science and Technology Centre's (SAASTEC), South African Museums Association (SAMA), South African Agency for Science and Technology Advancement (SAASTA) and South African Heritage Resource Agency (SAHRA).

This APR detailed the philosophy and achievements of the CoE-Palaeo in 2018. The Centre and its Partners are looking forward to the next five years and as a move towards a strategy for developing a National Institute that further promotes South African Palaeosciences to the highest international ranking.

In summary, the South African fossil and archaeological record is of great international importance and plays a pivotal role in the palaeoscience output of South Africa, and indeed in Africa, in a wide variety of spheres facilitating research; expansion and custodianship of SA fossil collections; palaeoscience training at various levels (tourism guides, technicians, schools, undergraduate students, postgraduate students, postdoctoral fellows, emerging researchers); science communication and developing sites for palaeotourism. By international standards, it is a leading Centre for research and training in the palaeosciences, including international collaboration with some of the world's leading palaeoscientists, and has world-class research facilities which are utilised by palaeoscientists and students from many continents.

It is self-evident that the far-sighted vision of the DST and NRF to establish a Centre of Excellence in Palaeosciences has paid off in many different spheres. It has dramatically enhanced the palaeoscience research output of South Africa and resulted in numerous local and international research collaborations. Also, it has greatly increased the cohort of MSc and PhD graduations and is address the skills shortage of South Africa. The extensive Science Engagement Programme of the CoE-Palaeo has led to much greater science awareness by the public and resulted in more young people considering science as a profession. Now that the foundation is laid, future phases of the CoE in Palaeosciences will achieve even greater success.

Appendix 1: Service Level Agreement update

Modified SLA targets as per suggested by Steering Committee Meeting on 17 Oct 2018.

SERVICE LEVEL AGREEMENT, STAGE 4
January 2019

This Service Level Agreement is linked to the Memorandum of Agreement between the National Research Foundation and the University of the Witwatersrand.

Stage/Gate

This CoE is currently in Stage 3, the Norming Stage and is moving to Stage 4, the Performing Stage.

Timeframes

- The pending Gate review (Gate 4) shall take place during October of each year.
- Two CoE Steering Committee (virtual or real) meetings should take place per year: Typically during March and October.

Student Training Categories	SLA Stage 4, 2nd year
Honours Students	12
Masters Students	14
Doctoral Students	14
Total Postgraduate Students Supported (Masters & Doctoral)	≥ 28
Female Postgraduate Students (Masters & Doctoral)	≥ 55%
Black Postgraduate Students (Masters & Doctoral)	≥ 80%
*Total RSA Postgraduate Students	87%
*Total SADC Postgraduate Students	5%
*Total Other African Postgraduate Students	4%
*Total Foreign Postgraduate Students	4%
Masters Graduations	≥12
Doctoral Graduations	≥8
Average Masters Duration (months)	≥ 2 years/24 months

Average Doctoral Duration (months)	≥ 3 years/36 months
Average Duration of submitted PhD degrees (upgraded from Masters)	≥ 4 years/60 months
Postdoctoral Fellows	≥ 15
Female Postdoctoral Students	≥ 40%
Black postdoctoral fellows	≥ 20%
Research Initiative Categories	**SLA Stage 4**
Core team members undertaking at least one scientific review per annum on behalf of the NRF	100%
Number of peer-reviewed publications	≥ 120
[1]Number of joint venture postgraduate student training initiatives	2
[2]Number of local conference/workshop organised	≥ 2
[3]Number of international conference/workshop organised	≥ 2
[4]Number of educational outreach events	≥ 8

* Based on the Ministerial Guidelines for Improving Equity in the Distribution of the DST-NRF Bursaries and Fellowships.

Activities related to the Current Stage

- The CoE should have solidified and maintained its intended research themes and projects by the end of this stage.
- The CoE shall provide to the NRF a list of students that are being supported by the Centre by October of each year, using the student nomination platform on the NRF online submission system. Additional students can be appended to this list as and when they arrive.
- The CoE shall make available to the NRF, every quarter (March, June, September and December), current "nuggets" of information for publication on the CoE website.

Financial responsibilities

- The CoE shall present an audited set of financial statements at the April of each year at the Steering Committee meeting reflecting the financial situation of the CoE during the previous financial year (January to December).
- The CoE shall submit monthly cash-flow statements within 15 days of the end of each calendar month, indicating expenditure and commitments in their first year of funding, after that quarterly from the second year onwards.

Reports due in this Stage

- The CoE shall submit Annual Progress Report documentation by no later than April of each year to be reviewed by the CoE Steering Committee

- The CoE shall submit a Statement of Compliance by no later than April of each year referring to Stage 4.

Standard Output Targets per annum in the Current Stage

The CoE-Palaeo undertakes to the best of our ability into this funding programme in accordance with the *Ministerial Guidelines for Improving Equity in the Distribution of the DST-NRF Bursaries and Fellowships*.

Special Output Targets for the Current Stage

- Fine-tuned strategy to increase research and other output from the key performance areas.
- Form Partnerships with Historically Black Universities in South Africa.
- At least one team activity to further encourage team spirit with our Partners.
- The CoE in Palaeosciences shall demonstrate a sound working relationship between the CoE host institution and the satellite institutions.
- The development and implementation of Publication Mentorship Programme to assist Doctoral, Postdoctoral Fellows and Emerging Researchers to publish.
- Introduce Palaeosciences to students from previously disadvantaged backgrounds.
- Develop PhD academics from designated (formerly disadvantaged) groups.
- Provide three new Master's Bursaries for Science Communication, Heritage Management and Education (Palaeosciences in the classroom).
- Maintain a strong Public Engagement and Science Communication profile.

Long-term Outputs Targets for the Current Stage

- Increase Human Research Capacity at Natural History Museums.
- Develop and implement a strategic plan for increasing our funding base.
- Develop a strategy to move towards a National Institution.

Appendix 2: Key Performance Area Targets and Achievements.

Postgraduates Students	2018 Acheivement
Honours Students	9
Masters Students	17
Doctoral Students	17
Total Postgraduate Students Supported (Masters & Doctoral)	34
Female Postgraduate Students (Masters & Doctoral)	67.6%
Black Postgraduate Students (Masters & Doctoral)	61.7%
Total RSA Postgraduate Students (Masters & Doctoral)	97.7%
Total SADC Postgraduate Students (Masters & Doctoral)	2.30%
Total Other African Postgraduate Students (Masters & Doctoral)	0
Total Foreign Postgraduate Students (Masters & Doctoral)	0
Honours Graduation	9
Masters Graduations	1
Doctoral Graduations Graduations	2
Average Masters Duration (post Honours) (year/months)	2
Average PhD Duration (months)	3
Average Duration of submitted PhD degrees (upgraded from Masters)	0
Postdoctoral Fellows	
Postdoctoral Fellows	13
Female Postdoctoral Fellows	76.90%
Black Postdoctoral Fellows	23%
Core Team	
Core team members received operational support	30
Core team members	56
Core team members with NRF Rating	33
Number of South African collaborators/partners (associates with research projects)	46
Number of other African collaborators/partners (associates with research projects)	12
Number of other International collaborators/partners (associated on research projects)	456
Total Collaborators	514
Core team members undertaking at least on scientific review per annum on behalf of the NRF = 100%	100%
Publications	
Number of peer-reviewed publications	158
Total peer-review published articles/books with postgraduate students	58
Total peer-review articles with female students	34
Total peer-review articles with black students	5
Books	1
Chapters in books	16
Peer-review published abstract	0
Keynote talks	6
Conference abstracts (not DE submissiable)	203
Journals (not DE)	1
Books (not DE)	0
Book chapters (not DE)	0
Editorialships	>50

Social Responsibility	
Number of joint venture postgraduate student training initiatives	3
Number of local conference/workshop/symposia/lectures organised	3
Number of international conference/workshop organised	0
Number of educational outreach events through outreach officer	>17
Number of attendants	>400K
Number of outreach initiatives by members	>350
Number of social media posts	>2500
Total reach from social media posts	>50000
Number of data sharing events	1
Number of staff training initiatives	2

Special Output Targets in the Current Stage	
2018- Fine-tuned strategy to increase research and other output from the key performance areas	Yes
2018 - At least one full CoE team activity to further encourage team spirit	Yes
2018 - The CoE shall demonstrate a sound working relationship between the CoE host institution and the satellite institutions	Yes
2018 - Develop at least two PhD academics from designated (formerly disadvantaged) groups	Yes
A comprehensive strategy to increase research output	Yes
Roadmap for career development implemented	Yes
Number of prestigious international partnerships established or developed	Yes
Number of emerging researchers given specific support	Yes
Short courses	Yes
2018 - Form Partnerships with Historically Black Universities in SA	No, but continue to work on it
2018- Development and implementation of Publication Mentorship Programme to assist Doctoral, Postdoctoral Fellows and Emerging Researchers to publish.	Yes
2018- Introduce Palaeosciences to students from previously disadvantaged backgrounds.	Yes
2018 - Provide three new Master's Bursaries for Science Communication, Heritage Management and Education (Palaeosciences in the classroom	No, but continue to work on it
2018 - Maintain a strong Public Engagement and Science Communication profile.	Yes
Long-term Output Targets in the Current Stage	
2018 - Increase Human Research Capacity at Natural History Museums.	No, but continue to work on it
2018 - Develop and implement a strategic plan for increasing our funding base.	No, but will be ready by the end of 2020
2018 - Develop a strategy to move towards a National Institution.	No, but will be ready by the end of 2020