A NOTE FROM THE PRESIDENT

2015 has been a busy year for the members of the society, starting with the AfQUA conference in Cape Town in January, several other conferences and then INQUA in Japan in July/August. Research by South Africans and on South Africa is presented and published internationally - read inside for the details! We have lost one quiet but key member, Dave Roberts, whom many of us knew and worked with. Our sympathy is extended to his family. Fortunately young people are interested in the science and we have a number of new members joining the society and actively participating in research. 2016 promises to be another busy year for all of us so enjoy the newsletter and remember to report back to inform and inspire your colleagues.

Professor Marion Bamford

Evolutionary Studies Institute, University of the Witwatersrand
UPCOMING EVENTS: 35th IGC, 2016
International Geological Congress

ABSTRACT SUBMISSION DATE EXTENDED TO 29 FEBRUARY

The Scientific Programme Committee of the 35th IGC invites authors to submit their abstracts. The deadline for abstract submission has been extended: Monday 29 February at midnight, UTC/GMT +2 hours.

For details and submissions: [http://www.35igc.org/Verso/211/Submit-an-Abstract](http://www.35igc.org/Verso/211/Submit-an-Abstract)

ANNOUNCING PLENARY SPEAKERS

This presentation will be the biennial AL DU TOIT MEMORIAL LECTURE which is arranged through the Geological Society of South Africa

Prof Chris Hawkesworth (University Of Bristol)

BREACHING THE BOUNDARIES BETWEEN SCIENCE AND PROFESSION – AN IMPERATIVE FOR GEOSCIENCE IN THE SERVICE OF SOCIETY

Ms Ruth Allington (GWP Consultants)

AFRICA - HUMANS AND THE GLOBAL CLIMATE

Prof Bob Scholes (University of The Witwatersrand)

MINING INDUSTRY AND SOCIETY - THE NEW CHALLENGING FRONTIER

Prof Michel Jebrak (University Of Quebec, Montreal)

AFRICA ALIVE CORRIDORS - A 4 BILLION YEAR GEOLOGICAL, BIOLOGICAL AND CULTURAL BIOGRAPHY OF AFRICA

Dr John Anderson (Nelson Mandela Metropolitan University)

DRILLING BENEATH THE HYPE - TECHNICAL CHALLENGES FOR THE EXPLORATION OF SHALE GAS

Prof Joe Cartwright (University Of Oxford)

GRAND CHALLENGES IN THE MINERAL LIFE CYCLE

Prof Thomas Graedel (Yale University)

DAMAGING EARTHQUAKES IN AFRICA - THEIR SEISMOTECTONIC BACKGROUND AND SEISMIC HAZARD IMPLICATIONS

Prof. Mustafa Meghraoui (Strasburg University)
WORKSHOPS BOOKING OPENS
Workshop and short course registration opened on 25 January 2016. Hosted over two days, immediately prior to start of the Congress (27-28 August 2016). 2-, 1- or half-day offerings may encompass, but will not be limited to, conference themes.

Booking for non-registered congress attendees will open 1 June.
For details and bookings: http://www.35igc.org/Verso/210/Professional-Development-Workshops-Short-Courses

PUBLICATIONS
We will be launching the “Geoheritage of Africa” book comprising forty four chapters which aims to expose the wealth of geological heritage sites that could support Geotourism through recognition as Geosites or as part of Geoparks.

The book “Mineral Fields of Africa” comprising twenty four chapters will highlight the mineral resources of Africa. Half the conference papers will be published in a special, 35th IGC edition of the IUGS journal, Episodes. The remaining papers will be published as a special issue of the Geological Society of South Africa journal, South African Journal of Geology.

Queries: Genevieve Pearson (gpearson@phoenixgeoconsulting.com)

STAMPS
A special issue of ten stamps and two first-day covers will be released by the South African Philatelic Bureau for the 35th IGC. These stamps will feature the most impressive geological superlatives in South Africa and will commemorate the third IGC to be held on the African Continent.

FIELD TRIP BOOKING OPENS 15 FEBRUARY
For details: http://www.35igc.org/Verso/173/Field-Trips

CALL FOR GEOHOST APPLICATIONS
Do you need assistance to attend the 35th IGC? Are you a young scientist? Have you applied for the GeoHost program?
For details and applications: http://www.35igc.org/Verso/41/GeoHost Application closes: 29 February 2016

REGISTRATION
Early Bird Registration is open until 1 June 2016.
Register here: http://www.35igc.org/Verso/60/Registration

ACCOMPANYING PERSON BOOKING OPEN
We have an exciting selection of day tours for accompanying persons - all bookings must be booked via the conference website to qualify for these preferential tour rates. Registered delegates may book using their current profile.
Book here: http://www.35igc.org/Verso/60/Registration

ACCOMMODATION BOOKING OPEN
We have negotiated preferential rates for registered conference attendees - all bookings must be booked via Appointed Housing Agent to qualify for these reduced rates.
Book here: http://www.35igc.org/Accommodation

DAY TOURS BOOKING OPEN
We have negotiated preferential rates for conference attendees - all bookings must be booked via the conference website to qualify for these preferential tour rates. Registered delegates may book using their current profile.
Book here: http://www.35igc.org/Verso/216/Tours

SPONSORSHIP PACKAGES
The Organizing Committee would like to extend to you an invitation to participate in the conference by sponsoring. For details: http://www.35igc.org/Verso/45/Sponsors
Support here: https://www.allevents.co.za/ei/getdemo.ei?id=358&s=_4MG10LNEI

EXHIBITION & ADVERTISING
The Organising Committee of the 35\textsuperscript{TH} International Geological Congress extends an invitation to you to participate in exhibiting at the congress.

For details: \url{http://www.35igc.org/Verso/44/Exhibitors-Advertisers}

Book Here: \url{https://allevents.eventsa.com/ExhibitionPortal/Account/Login?ReturnUrl=%2FExhibitionPortal%2F35igc%2Fexhibition}

**TRAVEL**

 Preferential rates for 35\textsuperscript{TH} IGC delegates/exhibitors have been negotiated on South African Airways during travel dates 5 August to 30 September 2016 and Emirates Airline during travel dates 22 August 2016 to 9 September 2016. On payment of your registration fees you will receive promotional codes for website booking.

Register here: \url{http://www.35igc.org/Verso/60/Registration}

**GENERAL ENQUIRIES**

Greg Botha  
Secretary General  
\url{gabotha@geoscience.org.za}

Danie Barnardo  
Secretary  
\url{barnardo@geoscience.org.za}

Juanita van Wyk  
Secretary  
\url{juanitaw@geoscience.org.za}
SA-INQUA and INQUA News

INQUA CONGRESS XIX, 2015
The INQUA Congress took place in Nagoya in Japan in July-August 2015. Marion Bamford attended the INQUA International Council meetings as the South African Voting Delegate. As President, Margaret Avery chaired these meetings. Margaret’s term as President has now come to an end, after having made the SASQUA community proud for the last four years, but Brian Chase has been nominated as Secretary-General.

SA-INQUA COMMITTEE
Prof Marion Bamford (University of the Witwatersrand): Chair
Prof Mike Meadows (University of Cape Town)
Dr Lynne Quick (University of Cape Town)
Dr Hayley Cowthra (Council for Geoscience, NMMU)
Dr Margaret Avery (Iziko Museums of South Africa)
Dr Greg Botha (Council for Geoscience)
Dr Brian Chase (Centre National de la Recherche Scientifique (CNRS))
Dr Jemma Finch (University of KwaZulu-Natal)
Ms Lynn Ngwenya (NRF)

CONTACT WITH INTERNATIONAL UNIONS
Mike Meadows (UCT) is the Secretary-General of the International Geographical Union (IGU).

Brian Chase and Alex Mackay have an INQUA grant for a project entitled ‘Context and controls on modern human behaviour in southern Africa: human environment interactions in the late Pleistocene’.

Brian Chase and Mike Meadows are engaged in the INQUA funded project “Southern Hemisphere Assessment of PalaeoEnvironments” (SHAPE).
OBITUARY
IN MEMORIAM

DR DAVID LESTER ROBERTS 14 May 1949 – 25 September 2015

Written by his friends and colleagues & compiled in the Council for Geoscience Bellville office, Cape Town

It is with great sadness that we have to report that Dr Dave Roberts passed away in Cape Town on the 25th of September 2015 in a tragic accident at his home in Noordhoek. Dave was born in London on 14 May 1949. His parents immigrated to South Africa when he was six years old. He always recalled fondly the trip over from England in one of the old mail-ship ocean liners, with him and his brother Andrew having the time of their lives.

Dave matriculated in 1969 at Franklin D. Roosevelt School in Johannesburg. He completed his BSc at Wits in 1975 and got a job at Soekor where he worked as a well-site geologist (he was reportedly asked to leave after taking one too many swims off the side of the floating drill rig - something which was "strictly against the rules" - the sort of phase Dave never had much time for. He also worked as a geologist at Gencor (1978 - 1980) and Western Areas Gold Mine (1981 - 1982). Always an academic at heart, Dave left work on the mines to pursue post graduate research at the University of Natal where he was awarded his MSc (1981) and PhD ("Depositional framework and controls on peat accumulation in the Vryheid Formation of Northern Natal (Utrecht and Newcastle areas") in 1985. During his PhD fieldwork he developed an abiding interest in archaeology and palaeontology. This part-time research culminated in his discovery of ‘Eve’s Footprints’ in the West Coast National Park in 1995. The discovery made world headlines.

Dave got a job at the Council for Geoscience (CGS) in Pretoria in 1986 where he worked in the Fossil Fuels (coal) Section before transferring to the Cape Town office in 1993. Here he started a research program on Cenozoic geology. His interests also included the palaeoenvironments and palaeoclimates of the Neogene, Pleistocene and Holocene. During this period he undertook extensive field work on the coastal deposits of South Africa and developed new ideas and avenues of research into the Quaternary geology and coastlines of southern Africa. Establishing a marine terraces chronology using OSL dating was one of his major contributions to geoscience. In this regard he distinguished himself as a top-rate geoscientist, making significant contributions to our understanding of the geology of the region both nationally and internationally. This knowledge was invaluable in his neotectonic studies for the determination of seismic hazard in the Eskom Nuclear New Build Programme, the results of which supported a stable continental setting for Southern Africa. His research also linked with, and contributed substantially to, archaeological stone-age research on the west and south coasts of South Africa. Dave will be remembered as the discoverer and preserver of ‘Eve’s footprints’, a popular name for the set of fossilized footprints found on the shore of Langebaan Lagoon, in 1995. They are thought to be those of a female human and have been dated to approximately 117,000 years ago. This makes them the oldest known footprints of an anatomically-modern human. Dave also worked in Gabon and Madagascar - he was always in search of new scientific challenges and ways to forward our understanding of the recent evolution of our planet and the evolution of paleoclimates.
Dave was a man with an abiding passion for the great outdoors, with hiking in his beloved Cape Mountains, and trout fishing in its crystal streams, being amongst his favourite weekend activities. He was always environmentally conscious and was intensely involved in clearing alien vegetation in the Noordhoek area, and surrounds. Dave kept himself in good shape and was a keen runner, having completed several Comrades ultra-marathons in his younger days.

Dave had recently retired from CGS and was looking forward to continuing his research as a Research Fellow at the Department of Geography, University of the Free State, and had several new projects and publications in the pipeline. He was involved in many diverse research initiatives which ranged from archaeology, Miocene palaeoenvironments, to contributing to a paper on the evolution of the white rhino, as well as assorted geological projects. His contributions to the sciences were substantial and his insights will be greatly missed.

Dave was admired by his colleagues and students for his passion and dedication to science and his ability to explain complex concepts simply. As a person he kept himself extremely fit and trim with all his outside activities, and his appearance and demeanour belied his 66 years. Dave’s youthful vigour and vitality makes his passing so much the harder to assimilate. Dave was a man with an impish sense of humour and a keenly attuned sense of the ridiculous. He had no time for humbug and ceremony at all and remained as refreshingly informal in manner and dress as a second year geology student, even when he became a member of the CGS staff. He was a cheery person for whom the phase “do your own thing” might have been invented. He will be sadly missed by the many friends and colleagues whose lives he enriched along the way.
Research highlights

I have been involved for some considerable time on a project entitled ‘Southern African terrestrial mammals in the past: a survey of palaeontological and archaeological evidence’. I keep coming across published faunal lists, not to mention taxonomic papers, that I have not previously seen and will have to stop soon but if anyone has published something I may not have seen I should really appreciate a pdf to dmargaretavery@yahoo.co.uk. I am covering all periods; the only criterion is that the material has been excavated. If in doubt, please drop me line. The following draft Abstract provides an indication of what is covered.

Abstract: This paper provides a comprehensive taxonomic survey of terrestrial mammalian genera or species recorded from excavations in palaeontological and archaeological sites in Africa south of the Cunene and Zambezi Rivers, approximately 15°S. Entries for each taxon comprise taxonomy, authorship and citation, any supplementary taxonomic references, relevant synonyms, type locality when in southern Africa, distribution maps grouped by degree squares and epoch, as well as any further comments. Two appendices provide detailed information by degree square (epoch, sites and taxa recorded) and site (degree square, epoch and source references). These data are intended to complement previously published works on historical records and modern distributions.

Conference attendance

I attended the 20th INQUA International Congress in Japan last July and chaired various meetings as President. We were honoured by the presence of the Emperor and Empress at the opening ceremony. They are most gracious and it was very hard to remember that they are such august personages. (Sorry about the lack of photographic proof but we are still waiting to be sent the official photographs about which there is a protocol.) The Congress was very well organised and, as far as I could tell, most attendees found it worthwhile. The range of topics seems to get greater and greater so that I am sure Quaternary science is alive and well around the well. Although I was not able to attend too many sessions, those I did were most interesting. Others will doubtless report in more detail on this. The next Congress will take place in Dublin in 2019.

INQUA

I completed my term of office as INQUA President at the conclusion of the Congress but remain on the Executive Committee for as Immediate Past President for the next Inter-Congress period. Although the task is generally not too onerous the last year was especially full of responsibility and I am happy the buck no longer stops with me but has passed to Allan Ashworth of the USA. It is great that our very own Brian Chase was elected Secretary-General so the SASQUA connection continues even if he is an American representing France! See http://www.inqua.org/index.html for more details on INQUA activities.

One important development, of which I am very proud, is the formal constitution of the INQUA Early Career Researchers (ECR) Group. Their Chairperson is now part of the extended Executive Committee. I urge all ECRs (up to eight years post-PhD) to get involved and see what is in it for them. See http://www.inqua.org/ecr.html.

Publications


Marion Bamford
Evolutionary Studies Institute, University of the Witwatersrand

Pollen coring in KwaZulu Natal

In June 2015 Dr Frank Neumann, Dr Greg Botha, Mawande Ncume (intern from the Council for Geoscience) and I met up near Winterton to take pollen cores from two wetlands, one Ntsikeni and one at Umgeni. Even though it was winter and the previous summer had been rather dry the wetlands were still quite wet and muddy. Nonetheless we managed to extract several cores by hand – we could not use a generator because of the breeding wattled cranes. A few times we almost lost the rods but Frank and Wangi managed to save them! In 2016 a masters
I attended the INQUA conference in Nagoya and presented a paper on my research on the flora from Lukeino in Kenya. Travel funding was received from the NRF-ICSU grant. There were over 2000 delegates from more than 50 different countries with about a dozen South Africans. It was a very efficiently run conference with the main complaints being the excessive heat and humidity outside – nobody’s fault – and the small lunches – so nothing serious. I attended the INQUA Council meetings as the South African representative with Margaret Avery as the President. The next conference will be in 2019 in Dublin.


Mark Bateman
Sheffield University

I ran a successful session at the INQUA conference in Japan on Land-Ocean transitions. South African Quaternary featured prominently including new work I have been doing with Andrew Carr (Leicester) and Judith Seely (UCT) looking at the aeolianite and dune records in and around Nelsons bay Cave on the Robberg peninsula. 2015 also saw the publication of two papers using portable luminescence equipment, one of which is applied to dating parts of the Namib Sandsea and a third relating to sea levels reconstructed from a beached whale in the Persian Gulf.

Publications


James Brink
Florisbad Quaternary Research Department, National Museum, Bloemfontein & Centre for Environmental Management, University of the Free State

Projects:

1. Early & Middle Pleistocene evolution of large mammal faunas and modern landscapes in southern Africa

We spent two field seasons at the Cornelia-Uitzoek fossil vertebrate locality - in June and in September 2015. We re-opened and cleaned out the basin in which the c. 1.0 Ma bone bed was deposited in order to map the floor in 3-D. John Gowlett (Liverpool) joined us again to continue his study of the Acheulean...
stone tools from the excavations and from the upper levels of the Cornelia Beds. John found *in situ* Early Stone Age artefacts high up in the sequence, confirming that the bulk of the depositional sequence predates the MSA. We also continued surveying a nearby drainage, the Venterspruit, that contains younger deposits with MSA materials. In September Graham and Margaret Avery joined us at Uitzoek and we spent an afternoon in the Venterspruit dongas, where Graham found a small Acheulean biface, the first ESA from this area. John Hancox also visited us and gave valuable insight into the sedimentary history of the exposed sections.

During August I spent two weeks in the National Museums of Kenya, Nairobi, working on antilopines from East Turkana. Preliminary results suggest a greater biogeographic similarity between southern and East Africa in earlier Pleistocene times.

2. Proceedings of the Louis Scott Tribute Conference (held in July 2014)

Three issues of publications followed on the conference and have now appeared in print, two in the Transactions of the Royal Society of South Africa and one in The Palaeoecology of Africa.

3. Micromorphology of the Florisbad sedimentary deposits

During 2014 Michael Toffolo (now at Tuebingen) sampled a number of exposures at Florisbad for micromorphology. The first paper has appeared. It gives support to the site formation hypothesis, based on the taphonomy of the vertebrate fossils, i.e. that the spring was the focal point and an important factor in allowing fossil preservation. Michael is now in the process of putting together the second manuscript, aimed at the details of sedimentary history and site formation.

Publications:

Abstract: Kilombe is an extensive late Lower Pleistocene Acheulean site complex in the Rift Valley in Kenya. Its area offers the chance of building a stratigraphic column through much of the last million years. With its position near the Equator the site is close to the geographic and chronological heart of the Acheulean, and ideally suited to investigations of landscape – within the complex to explore its structure of variation, on a regional scale of site catchment, and then externally to help evaluate issues across the greater Acheulean world. Research has concentrated on exploring this balance, noting the importance of the observation that variation within a site complex can be as great as variation between even far distant sites. The context thus highlights different scales of landscape.


Abstract: A reconstruction of the skull of the giant alcelaphine bovid, Megalotragus priscus, is provided based on a brain case and horn cores discovered and excavated at the late Florisian locality of Erfkroon on the Modder River, central Free State Province, South Africa. The sedimentary context of the M. priscus specimen can be correlated with fluvial deposits dated previously by luminescence to the Last Interglacial. Electron Spin Resonance (ESR) analyses of dental specimens from various localities at Erfkroon indicate a terminal Middle Pleistocene and Late Pleistocene age for these deposits. The skull reconstruction of M. priscus is aided by an upper jaw and mandible from the Late Pleistocene locality of Mahemspan. The M. priscus materials from Erfkroon, Mahemspan and other localities allow a re-evaluation of the morphological affinities of the species and it appears to be closer to wildebeest-like alcelaphines (genus Connochaetes) than to hartebeest-like alcelaphines (genera Alcelaphus and Damaliscus). Variability in the fossil horn cores suggests sexual dimorphism and some degree of territorial behaviour. It also suggests geographic variability in the populations of M. priscus in central southern Africa during the later part of the Middle Pleistocene and Late Pleistocene, before its extinction at the end of the Late Pleistocene and early Holocene.


Abstract: In the early 1930s an upper right third molar (M3) together with a calotte and fragmented facial bones of anadult fossil hominin was recovered during
excavations at Florisbad. The M3 is one of the few well-dated teeth associated with cranial remains from the late Middle-Pleistocene in southern Africa and as such provides a valuable addition to the fossil dental record of this region. Here we provide a detailed description of the tooth based on standard measurements and 3D images derived from high resolution micro-high resolution micro-focus X-ray tomography. Our results show that the Florisbad M3 falls within the size range of African Homo erectus. It is slightly larger than other peri-contemporary M3s known from Africa that date from the Middle to Late Pleistocene. Like them, however, it also falls within the size range of recent, large-toothed African populations. These results suggest the maintenance of selective pressures favouring large teeth in some African populations until the present.


Abstract: The Middle to Late Pleistocene spring site of Florisbad, South Africa, is the name site of the Florisian Land Mammal Age (LMA), and it has produced a large collection of fossil bones from different sedimentary contexts. The largest of these faunal assemblages derives from vertically intrusive dormant spring vents and is taphonomically distinct from specimens associated with a Middle Stone Age occupational horizon. The Florisbad faunal assemblages include several extinct and extant animal species, mainly grazing ungulates that represent a highly productive open grassland environment. The Florisian LMA was characterized by substantially wetter conditions compared to the Holocene. Geomorphological evidence at Florisbad and the characteristic occurrence of water-dependent species, such as lechwe, waterbuck, hippopotamus and a variety of water birds, reflect the presence of a vast intermittent paleolake forming during the wet phases of the Middle and Late Pleistocene. During dry phases, the area of spring activity was not inundated and provided a suitable habitat for both humans and animals. Bones collected from different sedimentary contexts exhibit a number of post-depositional alterations that reflect specific diagenetic processes, which led to fossilization. Two contrasting hypotheses regarding these processes, based on morphological studies of bones and groundwater chemistry, were proposed in the past. The first identified spring water as a major fossilization agent, whereas the second saw it as a medium conducive to bone dissolution. Using Fourier Transform infrared spectrometry (FTIR) and micro-spectrometry (μFTIR), we determined the mineralogical composition of these bones. We show here that specimens from inactive pale-spring vents are characterized by the formation of carbonate fluorapatite on the outer surface of cortical bone, and locally exhibit authigenic calcite crystals, as opposed to bones collected from non-spring contexts at the site. The nucleation of carbonate fluorapatite is linked to the high fluoride content of the alkaline spring water, thus confirming its key role in the fossilization process of bones recovered from paleo-spring vents. Therefore, our results support the first of the two hypotheses advanced in the past.


Abstract: The Baden-Baden spring mound is one of the extremely scarce archaeological sites in the dry central and western interior of South Africa, where fossil fauna and also palaeobotanical material are preserved. This is the first and preliminary summary of ongoing palaeoenvironmental research at this spring mound complex, which is situated 70 km northwest of Bloemfontein near Dealesville. Topographic mapping, radiocarbon and OSL dating complement the archaeological, faunal and palynological records from Baden-Baden and compare it to other spring, pan and alluvial sites in the region like Florisbad, Deelpan and Erfkroon. OSL and radiocarbon dating places the available sequences within the last ~160 ka. Holocene archaeological and faunal remains were recovered from several excavations on the east side of the primary mound. These materials provide unique insights into prehistoric human adaptations in the grassveld. Pollen, extracted from a peat mound and buried organic layers beneath sand accumulations, suggests cooler, moist conditions during the late Pleistocene and drier conditions in the Holocene. These palaeoenvironmental proxy indicators offer the potential for better understanding of long-term climate and vegetation changes in the western Free State.


Abstract: We describe and discuss the large vertebrates recovered from the basal layers (Strata 12 and 11) of Excavation 1 at Wonderwerk Cave, a site located in the Kuruman Hills, Northern Cape Province, South Africa. Stratum 12 is associated with a small core and flake Oldowan assemblage while Stratum 11 contains some Acheulean material. Based on palaeomagnetism the time span covered by these Strata is estimated to date to c.1.8 - 1.1 million years.
ago. Taxa identified include late Makapanian forms, such as Procavia transvaalensis, P. antiqua, a hipparionine and an unnamed species of large caprine, also found in the Makapan Limeworks deposits, confirming the antiquity of these layers. The bones are highly fragmented due to the action of multiple agencies, both pre- and postdepositional, which prevented diagnosis in many cases to lower levels of taxonomy. In support of other palaeo-environmental proxies from Strata 12 and 11, the large mammal remains reflect a semi-arid ecotone palaeo-environment, consisting of a mix of taxa associated with broken, montane habitat and semi-arid grassland-savanna plains habitat.


Abstract: Southern Africa is differentiated from other centres of aridity in Africa by the presence of an extended island of elevated, essentially treeless habitat in the central interior, known as the Highveld and the Karoo. This area coincides botanically with the Nama-Karoo and the Grassland Biomes. The large geographic extent of this habitat is unique to southern Africa, since it has no exact equivalent in modern-day East or North Africa. This is reflected in the large herbivores of the central interior, the grazers and mixed feeders adapted to permanently available open habitat, which define the endemic faunal character of the subregion. This contribution presents some of the faunal evidence for the appearance of permanently open habitat in central southern Africa, a process that formed part of a longer-term trend of faunal adaptation to aridification and global cooling. It is recorded in the time younger than c. 1.0 million years ago, a time known as the Cornelian Land Mammal Age (LMA). A secondary and overlapping theme deals with the appearance of lakes and wetlands on a subregional scale during the Florisian LMA, which lasted from c. 0.6 Ma to the end of the Pleistocene and early Holocene. The end of the Florisian LMA coincided with the regional extinction of the wetland faunas in the interior and with the extinction of a series of specialised grazing ungulates over the entire subregion, leading into the semi-arid conditions seen today in the larger part of modern-day southern Africa.

Sallie Burrough
University of Oxford, Environmental Change Institute.
Research Activities

Extracting short cores from the Makgadikgadi basin with a vibracorer (many thanks for the loan UCT and to Mike Meadows and Lynne Quick for very helpful advice in the field).

1. Megalake records of Kalahari climate change.
Funded by National Geographic we are pilot testing the potential of lacustrine mud-deposits from the Makgadikgadi basin to provide a much needed record of long-term rainfall and vegetation change from the southern African interior. In collaboration with Jess Tierney at the University of Arizona we will ascertain the potential of leaf wax hydrogen and carbon isotope signals to provide records of past rainfall/vegetation with a dual OSL and radiocarbon chronology developed at Oxford University. The project is in partnership with the Geological Survey of Botswana. Project members: Sallie Burrough, Jess Tierney, David Thomas, Jem Perkins

2. Testing the importance of lake-climate feedbacks for African hydroclimate variability.
Funded by the Leverhulme Trust this project is a collaborative effort between Reading and Oxford, headed up by Dr Joy Singarayer. The project seeks to improve the robustness of climate projections for Africa. The idea is to produce an Earth System model that can dynamically form lakes and wetlands over Africa and which interacts with the wider climate system. Our key aims are to test (including for key periods of the last 20 krys: (1) whether surface hydrology feedbacks are critical amplifying factors of hydroclimate change, (2) whether feedbacks add complex spatial patterning and are therefore important for regional climate predictions, (3) how these feedbacks modify the inertia of the climate system to external forcing and (4) whether their inclusion can improve UKESM1’s representation of hydroclimate interannual variability. Project
members: Joy Singarayer, Sallie Burrough, Simon Dadson, Emily Black, Charlie Williams.

3. Landscape archaeology of the Kalahari: How did major hydrological shifts affect Stone Age environmental use in the late Quaternary?

We have been awarded funding (Leverhulme Trust) to systematically investigate the Stone Age archaeology of the Makgadikgadi basin and its relationship to the landscape evolution of the Okavango-Makgadikgadi system in the middle Kalahari. The project will classify, characterise and date the abundant lithic artefact scatters associated with the megalake system; use geochemical data and a database of silcrete outcrop geochemistry to investigate the source location of the tools; and determine whether and how the prevailing palaeoenvironmental conditions impacted human use of the landscape. The project commences in 2016. Project Members: David Thomas, Sallie Burrough, David Nash, Sheila Coulsen, Sigrid Staurset.

See also: Burrough SL, (in press) Late Quaternary environmental change and human occupation of the southern African interior in Jones, S & Stewart B (Eds) Africa from MIS 6-2: Population Dynamics and Paleoenvironments. Springer (out in February apparently after a few years delay!)

Publications
Singarayer JS and Burrough SL, (2015) Interhemispheric dynamics of the African rainbelt during the late Quaternary. Quaternary Science Reviews 124, 48-67. DOI: 10.1016/j.quascirev.2015.06.021; http://dx.doi.org/10.1016/j.quascirev.2015.06.021

Abstract: The spatial pattern of precipitation variability in tropical and subtropical Africa over the late Quaternary has long been debated. Prevailing hypotheses variously infer (1) insolation-controlled asymmetry of wet phases between hemispheres, (2) symmetric contraction and expansion of the tropical rainbelt, and (3) independent control on moisture available in Southern Africa via sea surface temperatures in the Indian Ocean. In this study we use climate-model simulations covering the last glacial cycle (120 kyr) with HadCM3 and the multi-model ensembles from PMIP3 (the Palaeoclimate Model Intercomparison Project) to investigate the long-term behaviour of the African rainbelt, and test these simulations against existing empirical palaeohydrological records. Through regional model-data comparisons we find evidence for the validity of several hypotheses, with various proposed processes occurring concurrently but with different regional emphasis (e.g. asymmetric shifts at the seasonal extremes and symmetric expansions/contractions towards West equatorial regions). Crucially, variations in rainfall are associated with multiple forcing mechanisms that vary in their dominance both spatially and temporally over the glacial cycle; an important consideration when interpreting and extrapolating from often relatively short palaeoenvironmental records.
Within the paper we explore using the HadCM3 model how and why SST’s correlate to rainfall over the last 120kyrs. [Land-only mean annual precipitation vs. sea surface temperatures in the East African region (30e60oE, 10oSe0oS average) from the ORB-ONLY (green), ORB-GHG (orange), and ALL (blue) experiments in HadCM3. The circled blue points correspond to glacial time slices between 100 and 12 kyr BP for the ALL experiment where there are significant reductions in global sea level due to continental ice-sheet expansion. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)]

Burrough SL, Willis KJ; (2015) Ecosystem resilience to late-Holocene climate change in the Upper Zambezi Valley. The Holocene
DOI: 10.1177/0959683615591355 EID: 2-s2.0-84944621799;
URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-84944621799&partnerID=MN8TOARS

Abstract: Peat deposits from wetlands in the Upper Zambezi Valley provide an important long-term window on ecosystem dynamics in the Kalahari basin during the late Holocene. We use fossil pollen and macro-charcoal extracted from peat cores contained in three wetland sites to examine the response of vegetation to regional climate change. We find that during the last 6 ka, internal ecosystem dynamics are more important than climate, as observed by independent records, in determining vegetation assemblage change. Fire was found to be a persistent and important component of this savanna landscape for the duration of the ecological record, but biomass burning has increased markedly over the last 1000 years. The vegetation of the Upper Zambezi Valley appears to have a larger grassland component in the last few hundred years suggesting a more open landscape today than at any other time in the last 6000 years.

DOI: 10.1002/jqs.2757 EID: 2-s2.0-84925066646;
URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-84925066646&partnerID=MN8TOARS

Abstract: A series of small, shallow seasonally, or interannually, waterlogged depressions (dambos) in the upper Zambezi Valley in western Zambia hold shallow peat deposits and are bounded on their western margin by sandy lunette dunes. Using luminescence dating of sands, fossil pollen analyses and the macrocharcoal record from cored peat, the long-term stability of these landforms and the vegetation they now support is investigated at a site east of the upper Zambezi. Although the upper lunette dune sediments accumulated between 14 ± 2 and 6 ± 1 ka, the onset of peat accumulation and preservation within the dambo did not occur until 2800 cal a BP, suggesting that only from this point onwards were conditions stable and wet enough year-round to allow the formation and preservation of peat. Results from this study indicate that the long-term behaviour of the dambo conforms to a cut-and-fill dynamic, where under more arid conditions the dambo becomes a dry pan, providing a sediment source for the adjacent lunette dune. In contrast, during wetter times, when the dambo holds surface water year-round, it becomes an organic-rich sediment repository preserving a fossil pollen record of long-term vegetation change.

http://dx.doi.org/10.1016/j.quaint.2015.10.044

Abstract: The INQUA Dunes Atlas project has developed a global digital database of chronological information for periods of inland or continental sand dune accumulation and stabilization. The database comprises information on the site location (including coordinates), dune type, and stratigraphic context, pertinent analytical information (e.g. luminescence procedures), and literature citations to the original data source. This paper discusses the background to the project, the concept and structure of the chronologic database that forms its core, and gives some examples of the scope of the database and ways in which it can contribute to greater understanding of the spatial and temporal variability in dune development

See also: Thomas DSG, Burrough SL (in press, available online from 2014) Luminescence-based

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**Hayley Cawthra**  
Council for Geoscience Geophysics Competency; Nelson Mandela Metropolitan University Centre for Coastal Palaeoscience

I continue to work on the SACP4 and Palaeoscape projects focused on the South Coast, in conjunction with PI Curtis Marean and collaborators from numerous institutions. We received NSF funding in 2014 and a Templeton Grant in 2015 to continue work in Pondoland, testing hypotheses for the development of coastal foraging (PI Erich Fisher). The new Centre for Coastal Palaeoscience at NMMU, under the guidance of Richard Cowling, is proving our group with synergy in South Africa. I have been working on the bilateral German-South African RAiN project, in collaboration with Bremen University, University of Jena, UCT and UKZN to tie marine core records into a continental shelf stratigraphic model for the South Coast. We will spend the month of February at sea, poking some more holes in the seafloor. A new project which will soon be published and will continue through 2016 is focused on Neogene sediments with Frank Neumann, Louis Scott, Marion Bamford and Richard Cowling, building on a study we started with Dave Roberts. Lastly, I've become quite involved in the South African extended shelf claim and the International Seabed Authority, on matters related to Ocean Governance.

**Current involvement in projects:**
- South African Coast Palaeoclimate, Palaeoenvironment, Palaeoecology, Palaeoanthropology (SACP4)
- Developing and Testing an Integrated Palaeoscape Model for the early Middle and Late Pleistocene of the South Coast of South Africa
- Pondoland Palaeoclimate, Palaeoenvironment, Palaeoecology, Palaeoanthropology (P5)
- Regional Archives for Integrated Investigations (RAIN)

**Conferences and workshops attended in 2015:**
- AFQUA conference and workshops, January - February 2015 in Cape Town.
- Sensitization seminar on the work of the International Seabed Authority. DIRCO, Tshwane, March 2015.
- Palaeoanthropology Society Meeting (Paleos), San Francisco, April 2015.
- XIX INQUA Congress, Nagoya, Japan, July - August 2015.
- Hydro2015, Cape Town, November 2015.

**Commissions/committee membership:**
- ICSU/SANC-INQUA committee member
- SASQUA committee member
• South African delegation to the International Seabed Authority (partnerships with DIRCO, PASA and DMR)

Publications

Abstract: Coastal geomorphic systems have been studied widely to understand the responses of shorelines to fluctuating sea levels. Submerged shorelines, remnant of Pleistocene sea-level lowstands, are well preserved on the South African continental shelf. This paper describes work undertaken to better understand offshore coastal environments now submerged by high sea levels off the South African south coast near Mossel Bay, offshore of the Pinnacle Point archaeological locality. Multibeam bathymetry and side-scan sonar reveal evidence of past sea-level fluctuations and submerged coastal landscape features on the seabed. These results form the basis of an ongoing palaeoenvironmental reconstruction for this part of the shelf. We describe seven significant geomorphic features that show a submerged environment which differs significantly to the immediate adjacent coastal plain. However, these features are comparable to other stretches of the present South African shoreline which serve as modern analogues. We propose that features on the continental shelf primarily reflect geological substrate, gradients and Pleistocene sea-level fluctuations. Early modern humans would likely have a different set of resources to use in this Pleistocene landscape compared to those available along the presently exposed coast.


Abstract: Paleoanthropologists (scientists studying human origins) universally recognize the evolutionary significance of ancient climates and environments for understanding human origins.1–6 Even those scientists working in recent phases of human evolution, when modern humans evolved, agree that hunter-gatherer adaptations are tied to the way that climate and environment shape the food and technological resource base. The result is a long tradition of paleoanthropologists engaging with climate and environmental scientists in an effort to understand if and how hominin bio-behavioral evolution responded to climate and environmental change. Despite this unusual consonance, the anticipated rewards of this synergy are unrealized and, in our opinion, will not reach potential until there are some fundamental changes in the way the research model is constructed. Discovering the relation between climate and environmental change to human origins must be grounded in a theoretical framework and a causal understanding of the connection between climate, environment, resource patterning, behavior, and morphology, then move beyond the strict correlative research that continues to dominate the field.


Abstract: The coastline to the east of the Monwabisi Beach tidal pool has been subject to substantial visible coastal erosion. Monwabisi is located near the City of Cape Town and is situated along the northern coastline of False Bay. The erosion that has occurred has raised concern as it is damaging local infrastructure. The coastline retreat to the east of Monwabisi was investigated through analysis of aerial photographs and wave data to establish whether there is a relationship between dynamic wave action that this bay is subjected to, and the observed erosion within the study area. The maximum lateral coastal erosion at the Monwabisi study area from 2003 until 2014 was approximately 30m in a landward direction. Based on the correlation of the results between the rate of coastline retreat and the wave data, the study has concluded that the extreme rates of coastline retreat experienced within the study area at Monwabisi is most likely a direct result of a combination of influences including the number and height of big wave events, waves coming from a more southerly direction, the underlying geological substrate of the study area, and the impact that the local infrastructure has had on the geological substrate. Three time periods of maximum monthly erosion rates occurred from June 2008 to November 2009, March 2010 to March 2011 and April 2011 to June 2012.

Abstract: Historical and recent evidence recorded along the South African coast suggests that five tsunami events have occurred since 1960. These were mostly associated with trigger mechanisms associated with sources of remote submarine seismicity along far-field subduction zones and local atmospheric disturbances (meteotsunami). The passive margin of the South African West Coast, and the broad Agulhas Bank spanning the South- and Southeast coasts, have contributed to an increased susceptibility to inundation of waves in the adjacent low-lying coastal areas in these regions. In the published models and empirical studies for South Africa, the bathymetry and orientation of Port Elizabeth Bay is seen to amplify effects of a tsunami wave. Other regions including the Cape Town and St Helena Bay areas are also vulnerable to coastal inundation through the data generated in this study. The methodology presented here provides a simple means of determining the susceptibility of coastal areas to significant inundation by far-field tsunamis.


Abstract: Coastal vulnerability is the degree to which a coastal system is susceptible to, or unable to cope with, adverse effects of climate change. One of the most widely used methods in assessing risk and vulnerability of coastlines on a regional scale includes the calculation of vulnerability indices and presenting these results on a vulnerability map. These maps can assist coastal managers, planners, landowners and stakeholders identify regions of greater risk to coastal hazards and ultimately better inform mitigation and development strategies. This paper discusses the creation of a coastal vulnerability map for South Africa. The criteria used included elevation to chart datum, beach width, tidal range, wave height, geology, geomorphology, anthropogenic activities, distance to 20m isobaths and relative sea level change. The values of these parameters were divided into classes and the various classes ranked on a scale of 1 (very low vulnerability) to 5 (very high vulnerability) using examples from literature and expert knowledge. The layers were combined using the spatial overlay (map algebra) technique to create the final map. The results highlight the most vulnerable areas along the coastlines as the areas surrounding the City of Cape Town (the west coast) and the regions close to East London and Port St. Johns on the east coast. This can be mainly attributed to the type of geology and the anthropogenic activities in these areas.


Abstract: The South African coastline is variable in geomorphic character, but at least two thirds of the coastline is dominated by sandy and part-lithified sandy intertidal shorelines. Part-lithified sandy intertidal shorelines consist of a mosaic of rocky outcrops on dominantly sandy beaches. The rocks on these mixed shores are generally composed of cemented Quaternary deposits. Carbonate cemented Quaternary aeolianite/beachrock complexes are relatively common along the South African coastline and on the continental shelf, where they form prominent reefs. The Quaternary deposits along the coastline are characterised mainly by transgressive dune cordons. These systems record sensitive palaeoenvironmental fluctuations, as archived in their structure, diageneric history, and relationship to past sea levels and ancient shorelines.

Brian M. Chase
Director of Research, Centre National de la Recherche Scientifique (CNRS)
Institut des Sciences de l’Evolution-Montpellier, Palaeoclimate Research Team

So much urine...
Once again, my time has been devoted to obtaining detailed records of past climate and vegetation change from increasingly substantial accumulations of fossilised urine. With an extension of the ERC funded HYRAX project, we will continue this focus until at least November 2016, but considering the quality and quantity of the records being obtained you are likely to be seeing papers come out for many years to come… Apart from the work on hyrax middens, the project is also advancing our efforts to synthesise and quantify records from the many excellent (and not so excellent) pollen records from across southern Africa. Manuel Chevalier (now Dr. Chevalier (congrats Manu!)) has picked up the torch passed by Loïc Truc and completed a synthesis of summer rainfall zone sites that will certainly be a key reference moving forward. 2016 promises sub-decadal records from the southern Cape, and a series of records extending back to 50 cal kBP and further. As always, watch this space…
A large pile of southern Cape urine.

Publications


Abstract: South Africa’s southwestern Cape occupies a critical transition zone between Southern Hemisphere temperate (winter) and tropical (summer) moisture-bearing systems. In the recent geological past, it has been proposed that the relative influence of these systems may have changed substantially, but little reliable evidence regarding regional hydroclimates and rainfall seasonality exists to refine or substantiate the understanding of long-term dynamics. In this paper we present a mid-to late Holocene multi-proxy record of environmental change from a rock hyrax midden from Katbakkies Pass, located along the modern boundary between the winter and summer rainfall zones. Derived from stable carbon and nitrogen isotopes, fossil pollen and microcharcoal, these data provide a high resolution record of changes in humidity, and insight into changes in rainfall seasonality. Whereas previous work concluded that the site had generally experienced only subtle environmental change during the Holocene, our records indicate that significant, abrupt changes have occurred in the region over the last 7000 years. Contrary to expectations based on the site’s location, these data indicate that the primary determinant of changes in humidity is summer rather than winter rainfall variability, and its influence on drought season intensity and/or length. These findings are consistent with independent records of upwelling along the southern and western coasts, which indicate that periods of increased humidity are related to increased tropical easterly flow. This substantially refines our understanding of the nature of temperate and tropical circulation system dynamics in SW Africa, and how changes in their relative dominance have impacted regional environments during the Holocene.


Abstract: Climate change during the last deglaciation was strongly influenced by the ‘bipolar seesaw’, producing antiphase climate responses between the North and South Atlantic. However, mounting evidence demands refinements of this model, with the occurrence of abrupt events in southern low to mid latitudes occurring in-phase with North Atlantic climate. Improved constraints on the northsouth phasing and spatial extent of these events are therefore critical to understanding the mechanisms that propagate abrupt events within the climate system. We present a 19,400 year multi-proxy record of climate change obtained from a rock hyrax midden in southernmost Africa. Arid anomalies in phase with the Younger Dryas and 8.2 ka events are apparent, indicating a clear shift in the influence of the bipolar seesaw, which diminished as the Earth warmed, and was succeeded after ~14.6 ka by the emergence of a dominant interhemispheric atmospheric teleconnection.


Abstract: Late Quaternary climate variability in the southern African subtropics is still only poorly resolved, with significant complexity and apparent contradictions in the regional dataset. To more effectively interpret and synthesize key regional records, we reanalysed the data from 13 pollen sequences from the summer rainfall zone of South Africa spanning the last 45,000 years, obtaining directly comparable quantitative reconstructions of mean annual temperature and summer rainfall. Temperature reconstructions from across the region provide consistent results, with all sites reflecting trends observed in southwest Indian Ocean sea-surface temperatures in the adjacent Mozambique Channel. Precipitation reconstructions are more heterogeneous, with two distinct subregions being
identified. In the northeast, long-term trends in precipitation are determined by sea-surface and continental temperature trends, revealing a positive relationship between temperature and rainfall. This long-term pattern appears to be primarily driven by high northern latitude mechanisms, with direct local insolation being subordinate. Their relative impact reversed during terminal glacial period/early Holocene, at which time direct insolation forcing became the main driver of rainfall variability. Further south, in central South Africa, precipitation variability appears also to be influenced by the latitudinal position of the Southern Hemisphere westerlies, which combine with tropical flow to create tropical-temperate trough, advecting moisture into the interior. In this region, periods of maximum precipitation coincide with periods of elevated SSTs and equatorward expansions of the westerly storm track. This study allows for a fully constrained understanding of climate dynamics along the eastern African margin for the last 45,000 years, linking dynamics to drivers and describing how the climate systems evolved across the last glacial-interglacial transition.


Abstract: Antarctic ice cores show that a millennial-scale cooling event, the Antarctic Cold Reversal (14,700 to 13,000 years ago), interrupted the last deglaciation. The Antarctic Cold Reversal coincides with the Bølling–Allerød warm stage in the North Atlantic, providing an example of the inter-hemispheric coupling of abrupt climate change generally referred to as the bipolar seesaw. However, the ocean–atmosphere dynamics governing this coupling are debated. Here we examine the extent and expression of the Antarctic Cold Reversal in the Southern Hemisphere using a synthesis of 84 palaeoclimate records. We find that the cooling is strongest in the South Atlantic and all regions south of 40S. At the same time, the terrestrial tropics and subtropics show abrupt hydrologic variations that are significantly correlated with North Atlantic climate changes. Our transient global climate model simulations indicate that the observed extent of Antarctic Cold Reversal cooling can be explained by enhanced northward ocean heat transport from the South to North Atlantic, amplified by the expansion and thickening of sea ice in the Southern Ocean. The hydrologic variations at lower latitudes result from an opposing enhancement of southward heat transport in the atmosphere mediated by the Hadley circulation. Our findings reconcile previous arguments about the relative dominance of ocean and atmospheric heat transports in inter-hemispheric coupling, demonstrating that the spatial pattern of past millennial-scale climate change reflects the superposition of both.


Abstract: We present an 8000-year biomarker and stable carbon isotope record from the Verlorenvlei Estuary, South Africa. We assessed how leaf wax lipids, insoluble macromolecular organic matter, bulk C/N data and compound-specific stable carbon isotopes were linked to the site’s palynological record and to evidence for regional sea level and environmental change. Down-core trends in bulk δ13C are closely coupled to trends in pollen types from salinotolerant taxa. These trends are mirrored by variations in the incorporation of reduced sulphur into macromolecular organic matter. This process, quantified with the thiophene ratio, is closely associated with periods of higher sea level 8,000–4,300 cal yr BP. We propose the thiophene ratio is a proxy for relative marine influence within (peri)estuarine sediments. All measured variables indicate differences between early- middle Holocene (8,000–4,300 cal BP) and late Holocene conditions at Verlorenvlei. The former period was more saline and preserves more labile macromolecular organic matter. Marine influence declined after 4,300 cal yr BP, and although the abundance of short-chain-length n-alkanes suggests continued presence of wetland flora until 2,500 cal yr BP, organic matter preservation became poorer and a drying trend was inferred, most notably for the interval 2,500–900 cal BP. Increasing freshwater inundation is apparent during the last 700 cal yr, consistent with several records from this region. Leaf wax n-alkane distributions are largely uncorrelated with bulk organic matter variables, with the exception of the abundance of C31 and C33 n-alkanes, which are negatively correlated with δ13C-TOC. Furthermore, C31–C33 n-alkane δ13C values are uncorrelated with C29–C29 δ13C and δ13C-TOC. They are also higher than our newly measured terrestrial (C3) vegetation C29 and C31 end-member values of -35 ± 2 and -34 ± 1 %, respectively. These
patterns are best explained by a dominant contribution of local riparian vegetation to the \( C_{23} \text{–} C_{29} \) \( n \)-alkanes, but time-varying contributions of non-local leaf waxes to the \( C_{31} \text{–} C_{33} \) signals. This renders inferences concerning regional environmental change from long-chain leaf waxes potentially challenging in this setting.

Richard Cowling
Nelson Mandela Metropolitan University Centre for Coastal Palaeoscience

Opening of the Centre for Coastal Palaeoscience at Nelson Mandela Metropolitan University

Given the unique geographical position of Nelson Mandela Metropolitan University (NMMU) – situated at the possible ground-zero of human cognitive origins and other biotic radiations – the university is ideally situated to engage in national and international collaboration to investigate fundamental evolutionary questions. In order to capitalise on this opportunity, NMMU opened the Centre for Coastal Palaeoscience (CCP) in June of 2015 under the directorship of Richard Cowling.

A major aim of the CCP will be to formalise and strengthen the existing collaborations between NMMU and the other institutions, both nationally and internationally, that have cognate research interests. Our initial focus will be on reconstructing the Quaternary palaeo-landscape and seascape (“palaeoscape”) of the south and southeast coasts. This reconstruction will enable the development of testable hypotheses on the selective regimes that shaped the region’s biota, including modern humans. No region anywhere else in the world offers such an opportunity.

The geographical domain of the CCP incorporates the seascapes and landscapes of South Africa’s south and southeast coasts. This region encompasses much of the Greater Cape Floristic Region and Maputaland-Pondoland-Albany biodiversity hotspots, and supports an extraordinarily rich array of Middle and Later Stone Age archaeological sites.

2015 was a successful year for the neonate centre and resulted in a range of conference presentations and publications, many with collaborations with the members of the SACP4 project led by Curtis Marean (Arizona State University), that provide a broad overview or examples of the Centre’s direction and exemplifies the focus on collaborations (Cowling et al., 2015; De Vynck et al., 2015; Duker et al., 2015; Franklin et al., 2015; Marean et al., 2015; Potts et al., 2015; Shook et al., 2015; Cawthra et al., 2015; Singels et al., 2015; De Vynck et al., 2016).

A significant part of the reconstructing the palaeoscape is the need to understand the links between vegetation and the environment, importantly climate. A special issue of the South African Journal of Botany, guest edited by Richard Cowling, William Bond and Alastair Potts, was published in November 2015 on the topic of Biome Boundaries of South Africa. This issue highlights some of the great strides that ecologists have made towards understanding the drivers of boundary shifts in the prominent vegetation types of South Africa, and is relevant to understanding past vegetation shifts.

We look forward to growing the Centre’s footprint in the field of South African palaeoscience, and welcome anyone interested to know more or to investigate potential collaborations to email Richard (Richard.Cowling@nmmu.ac.za) or Alastair (Alastair.Potts@nmmu.ac.za)

* SACP4: South African Coastal Palaeoclimate, Palaeoenvironment, Palaeoecology and Palaeoanthropology

Publications


Leon Jacobson
Dept Geology, UFS

Conference attendance
On the 11th December 2015, the iThemba Labs, Faure, held a symposium to mark the coming shutdown of the Van de Graaff Accelerator that had seen service for some 50 years. It is due to be replaced during 2016 with a new accelerator. I presented a short outline of the work that had been carried out since 1977 on archaeological and heritage issues and which resulted in 24 papers and a number of conference presentations and popular articles. Materials researched included ceramics and clays, rock art paint, ostrich eggshell, glass, gold, stone patinas, paper and ink. The outcomes we were researching included provenance, conservation, production and authentication issues. Once the new accelerator is up and running, especially the microprobe, it should provide scope for innovative projects in Quaternary studies.

Reference

Cape Glass or imported? (Jacobson et al 1983)
Antonieta Jerardino
ICREA/Pompeu Fabra University, Barcelona, Spain

South African archaeology taught in Historical Ecology course imparted in Chile

I had the great privilege to be invited by the members of the Faculty of Marine Sciences at the Northern Catholic University of Chile to spend two months (Aug. & Sept. 2015) there teaching a course on Historical Ecology, establishing collaborative ties and giving seminars as well as a public talk. Much of the course contents were based on research done on the West Coast of South Africa. Analogous Holocene environmental variability (past and present) and parallels in prehistoric cultural trajectories between Chile and South Africa were apparent to both students and faculty staff. This initial and fruitful encounter foreshadowed another initiative (“Bridging the Atlantic: Human Palaeodemography in the Drylands of the Southern Hemisphere”) with the recent award of funds from the Leverhulme Trust to Prof. Peter Mitchell (U. of Oxford). This unique opportunity will bring together archaeologists from South Africa, Chile and Argentina in a series of workshops and site visits in both countries for the purpose of comparative studies on a range of currently debated topics.

Publications
Jerardino, A. (in press). Water-worn shell and pebbles in shell middens as proxies of palaeoenvironmental reconstruction, shellfish procurement and their transport: a case study from the West Coast of South Africa. Quaternary International, Special Issue on ‘Methodological issues in archaeomalacological studies’, A. Jerardino, P. Faulkner, C. Flores [Eds.]). http://dx.doi.org/10.1016/j.quaint.2015.06.057

Abstract: Geoarchaeological studies today are a vital component of archaeological research. The sedimentary environments of coastal settings in particular are highly dynamic and governed by a variety of factors among which changes in sea level changes play an important role. Archaeomalacological studies conducted on shell middens along the West Coast of South Africa in the last two decades have identified the presence of additional natural components that became incorporated into archaeological sites through active but inadvertent human agency. These sediments are relatively large particles (2–20 mm) of water-worn shells and water-worn pebbles (WWSP) that became entangled among
the byssus threads that rocky shore mussels use for attaching themselves to hard substrate. Prehistoric shellfish foraging and subsequent transport of rocky shore mussels along with their byssus contents to campsites ensured their inclusion into archaeological middens. This study shows that WWSP abundances and the proportion of their organic fraction (water worn shell) can be used as proxies for coastal palaeoenvironmental reconstruction and as a complement to archaeomalacological studies for inferring technologies involved in shellfish collection and transport.

Changes in the average percentages and standard errors through time of water-worn shell (%WWS) from shell assemblages recovered from archaeological sites located in the Lamberts Bay and Elands Bay areas, and results on best fitting linear models (logarithmic) derived from regression analyses; a) means and standard errors calculated on counts of sediment particles; b) means and standard errors calculated on mass of sediment particles.


Abstract: Explicit conceptual frameworks for understanding the evolutionary context of coastal adaptations are being developed. Finding out when and where systematic use of aquatic resources took place and what constitutes a well-developed coastal adaptation requires a corpus of data that can offer insights into the organization of marine resource procurement. The earliest evidence for the exploitation of marine coastal habitats in the world is found in southern-most Africa (≤164 ka), where the most evident and abundant material expression of such foraging adaptation is revealed by marine molluscs found in mid to late Pleistocene archaeological sites. Hence, it becomes imperative to understand what can be meaningfully inferred from the variable quantities of such a significant component of early marine aquatic exploitation. This paper approaches the issue of aquatic resource use by investigating one of the most frequently employed quantitative measure for inferring such behaviour, namely shell density. Holocene assemblages from the South African west coast are used as a case study. It is found that shell densities can be misleading for inferring intensity of coastal resource use, and that deposition rates of marine shell is a better proxy for comparison between sites and through time.

Above: Plot of shell weight densities as a function of average distances (km) between location of sampled sites and nearest rocky shore. Data point symbols vary according to average % black mussels in shell samples (triangles: 0–33.3%, squares: 34–66.6%, and circles: 67–100%).

Abstract: The search for human origins in Africa has partly narrowed down to probing into the origins of the modern human lineage and the identification of a set of behaviours that characterises it. Much research effort is now dedicated to coastal southern African Middle Stone Age (MSA) sites. This record is still relatively small compared with the Middle Palaeolithic of Europe, and much of the original sites have been lost due to erosional sea level changes tied to glacial to interglacial cycles. However, more explicit conceptual frameworks for understanding coastal adaptation and its evolutionary role in this region have recently been put forward. Partly stimulated by human nutrition studies, coastal resources, especially shellfish, have acquired an unchecked high status in research agendas. Limited local ethnography on coastal foragers and a lack formalised methodologies for inter-site comparison on coastal resource procurement are evident. In this paper, aspects unique to coastal adaptation with particular reference to shellfish collection are explored. Models on the origin and evolution of coastal adaptations must consider cross-cultural ethnographic studies, move away from the simplistic use of shell densities for evaluating procurement intensity and use the much richer Later Stone Age record as a profitable source for testing hypotheses.

Below: Comparison of deposition rates of Later Stone Age (LSA, grey bars) and Middle Stone Age (MSA, black bars) sites. West coast assemblages are represented by the more numerous set of bars to the left and south coast assemblages to the far right. Note that MSA sites exhibit much slower deposition rates than LSA sites, suggesting that a full expression of a coastal adaptation in southern Africa was a late Holocene phenomenon.

Mike Meadows
Department of Environmental and Geographical Science, University of Cape Town

Publications


Eze, P and Meadows, ME 2015 Geochemistry and palaeoclimatic reconstruction of a palaeosol sequence at Langebaanweg, South Africa. Quaternary International 376: 75-83.


David J. Nash
School of Environment & Technology, University of Brighton, UK and School of Geography, Archaeology & Environmental Studies, University of the Witwatersrand, South Africa
The last year has seen a continuation of my research into climates of the past 2000 years, including further results from the recently completed ENSOAfrica project, funded by The Leverhulme Trust. Nash et al. (2015) presents the first seasonal and annual reconstruction of historical rainfall variability over KwaZulu-Natal for the 19th century, through the analysis of various colonial and missionary sources. I have also continued to work on aspects of geomorphology relevant to southern African researchers. Nash and Eckardt (2015) presents an analysis of the topographic properties of the main fossil and ephemeral drainage systems in the Kalahari Desert, based on SRTM data. Nash (2015) presents a review of the main geomorphological features (valleys, dunes and pans) of the southwest Kalahari Desert in South Africa. In contrast, Ullyott et al. (2015) focuses on the interpretation of cap structures within silcrete, a micro-scale feature often (incorrectly) considered as diagnostic of silicification in a pedogenic environment.

Publications


Abstract: Analyses of historical patterns of rainfall variability are essential for understanding long-term changes in precipitation timing and distribution. Focussing on former Natal and Zululand (now KwaZulu-Natal, South Africa), this study presents the first combined annual and seasonal reconstruction of rainfall variability over southeast Africa for the 19th century. Analyses of documentary sources, including newspapers and colonial and missionary materials, indicate that the region was affected by severe or multi-year drought on eight occasions between 1836 and 1900 (the rainy seasons of 1836-38, 1861-63, 1865-66, 1868-70, 1876-79, 1883-85, 1886-90 and 1895-1900). Six severe or multi-year wet periods are also identified (1847-49, 1854-57, 1863-65, 1879-81, 1890-91 and 1892-94). The timing of these events agrees well with independent reconstructions of 19th century rainfall for other parts of the southern African summer rainfall zone (SRZ), suggesting subcontinental scale variability. Our results indicate that the relationship between El Niño and rainfall in southeast Africa was relatively stable, at least for the latter half of the 19th century. El Niño conditions appear to have had a more consistent modulating effect upon rainfall during the 19th century than La Niña. The rainfall chronology from this study is combined with other annually-resolved palaeoclimate records from mainland southern Africa and surrounding oceans as part of a multi-proxy rainfall reconstruction for the SRZ. This reconstruction confirms (i) the long-term importance of ENSO and Indian Ocean SSTs for modulating regional rainfall; and (ii) that summer precipitation has been declining progressively over the last 200 years.


Abstract: The Kalahari Desert contains extensive networks of ephemeral and fossil drainage which are potential indicators of past and present neotectonic activity and climate-driven environmental change. An absence of topographic data has hindered our understanding of their development. We present long-profile information for twenty-nine valley networks derived from Shuttle Radar Topographic Mission (SRTM) digital elevation data. In total, 8354 km of valley talweg was measured for x, y and z information. Most valleys exhibit concave-up profiles. Fifty-five previously unknown knickpoints were identified. The majority coincide with lithological boundaries or fractures, but many developed in response to Neogene uplift and/or downwarping or occur where valleys cross palaeolake shorelines. The headwaters of four valleys cross the Kalahari–Limpopo drainage divide and predate the presumed Miocene uplift of the Kalahari–Zimbabwe axis, suggesting that they are of considerable antiquity.


Abstract: Cap structures within silcretes have long been used as a diagnostic indicator of pedogenic silicification. However, a growing number of studies of the micromorphology of non-pedogenic silcretes indicate that this may no longer be appropriate. This paper presents the first systematic investigation of the micro-fabric, geochemistry and mineralogy of cap structures in groundwater silcretes, through an analysis of conglomeratic varieties (puddingstones) from the southern UK. Our results suggest that cap structures in groundwater silcretes fall within a spectrum of types, related to the degree of sorting in the inter-gravel host sediment. At one end of this spectrum are well-defined caps within otherwise well-sorted, overgrowth-dominated silcretes. These caps exhibit a grain-supported fabric, are cemented by micro- and/or cryptocrystalline silica, and contain

Abstract: The combination of vegetated orange–red dunes, seasonal pans and dry valleys in the Kalahari creates a landscape with outstanding scientific and aesthetic value. This chapter describes the geomorphological features of the Kalahari Desert within South Africa and adjacent areas of Botswana and Namibia, with a special emphasis on aspects that make the landscape unique. The Kalahari is an arid to semi-arid region underlain by Cretaceous to recent Kalahari Group sediments, including a surface blanket of unconsolidated Kalahari sands. The landscape is dominated by three sets of landforms: (a) dry valley systems, including the Auob, Nossob, Kuruman and Molopo rivers; (b) partially vegetated linear dunes, which stretch in a broad zone from Upington on the Orange River into Botswana and Namibia; and (c) seasonally flooded pans. The importance of the long-term geological history of the Kalahari for understanding the present landscape is also discussed.

Frank H. Neumann
1. Forschungsstelle für Paläobotanik, University of Münster
2. Evolutionary Studies Institute, University of the Witwatersrand

My studies in the Quaternary, apart from my still ongoing projects in Israel, focused 2015 on the submission of a paper (first author Dave McWethy, Montana State University) dealing with the late Pleistocene-Holocene palaeoecology of a site at Mount Gorongosa, a sacred mountain massif in Mozambique. Additionally Greg Botha, Marion Bamford, a student and me were drilling wetlands in Ntsikeni Nature Reserve and Umgeni Vlei Nature Reserve in the Drakensberg region. Together with Marion Bamford I published a review paper about the Neogene shaping of the modern South African biomes. In cooperation with her and several colleagues in South Africa and abroad, amongst them Hayley Cawthra, Louis Scott, Ernest Durugbo, Marc Humphries, Andy Carr, Richard Cowling and Chiedza Musekiwa, I am working on a paper on the palaeoenvironmental fluctuations during a late Oligocene-early Miocene transgression in the Cape region. However, this project –like so many others–suffered greatly from the loss of recently deceased Dave Roberts.

Publications


Lynne Quick  
Department of Environmental and Geographical Science, University of Cape Town

The major highlight for me for 2015 was hosting the inaugural AFQUA conference and workshop series. The resounding success of AFQUA really kick-started the academic year. In terms of my research, 2015 marked the second and final year as a postdoctoral researcher within the RAiN project. Besides spending a lot of time looking down the microscope, I finally managed to finish writing up two papers using data from my PhD (see details of these below).

Conferences attended in 2015:

- AfQUA 2015: The African Quaternary Conference and workshops, Cape Town, South Africa.
- XIX INQUA Congress 2015: Nagoya, Japan.

Commissions/committee membership:

- ICSU/SANC-INQUA committee
- Secretary of SASQUA
- AFQUA steering committee

Publications


Abstract: The southern Cape is a key focus for southern African palaeoenvironmental research as it represents the transitional region between temperate westerlies and sub-tropical rainfall sources. This study presents pollen, plant biomarker, geochemical and charcoal data preserved in the Rietvlei wetland. The bulk of the record spans the last 16 ka, but it also provides rare insights into late Marine Oxygen Isotope Stage (MIS) 3 (ca. 35–30k cal a BP). The data suggest that during the Pleistocene the development and permanence of this wetland was probably influenced by sea-level change via control on the local water table; notably lower sea levels within MIS 2 resulted in very limited wetland productivity. The MIS 3 section provides evidence both supporting previous suggestions of relatively humid conditions, but also some indication of periodic arid phases. The Holocene record suggests clear contrasts between the early (11–7k cal a BP; relatively humid), mid-Holocene (7–3.3k cal a BP; more arid, less productive wetland conditions) and latest Holocene (last 2k cal a BP; resurgence in both fynbos and aquatic/riparian pollen). While isolating the roles of winter/summer rainfall remains challenging, these data clarify the nature of change during key episodes in the regional palaeoenvironmental record.


Abstract: Despite the southern Cape's great climatic and botanical significance (occupying the transition between the temperate and subtropical circulation systems and forming part of a global biodiversity hotspot), palaeoenvironmental data for this region of southern Africa is limited. This study presents pollen, charcoal and sedimentological data preserved in the Vankervelsvlei wetland, situated in the modern year-round rainfall zone at the ecotone between the Fynbos and Afrotemperate Forest biomes. Combining optically stimulated luminescence and radiocarbon dating techniques, it was possible to establish a chronology for a sediment sequence spanning the last 140,000 years, the longest record yet produced in the region. The data suggest that MIS 5d was relatively warmer (low fynbos pollen percentages and Pentzia-type pollen) than later MIS 5, MIS 4 and most of MIS 3 (~96-37 ka), which were characterised by decreased temperatures (dominance of ericaceous fynbos). The pollen data indicate a complex response to the change from interglacial to glacial conditions, and suggest an important threshold is crossed in regional ecological dynamics. We postulate that during MIS 5d increased summer rainfall under warmer conditions may have offset increased potential evapotranspiration, allowing for the development of more extensive forests. During its early stages of development Vankervelsvlei was more open (increased aquatics and coarse sediment), trapping more longer-distance pollen (Podocarpus). As the mire became more closed, local elements dominated; a succession that is reflected in significant changes in the pollen assemblage, as Podocarpus remains only in trace percentages, but pollen of Canthium and Morella, which occupy nearly identical climatic niches as Podocarpus, increase in abundance. It is suggested that drought stress remains limited during the last glacial period as a result of reduced temperatures, compensating for what may have been a more seasonal winter-dominated rainfall regime, and that changes in the pollen record relate to vegetation succession and the development of the wetland rather than to major changes in moisture availability. Due to the virtual absence of palaeodata
from the southern Cape covering MIS 5 to MIS 3, the establishment of this record provides an important contribution to the overall palaeoenvironmental history of the region.


Abstract: The Cederberg forms part of the western branch of the Cape Fold Belt (CFB), a mountain range that resulted from orogenic (mountain-building) processes in the Permo-Triassic (~300–230 Ma ago). After deposition, the Ordovician to Carboniferous sandstones and shales of the Cape Supergroup were subjected to faulting, folding and subsequent weathering which has produced a rugged mountainous terrain characterised by a sequence of elevated ridges and peaks (up to 2,027 m a.s.l.) separated by broad linear valleys. The geomorphology of the region is strongly controlled by these bedrock structures, which illustrates the close relationship between geologic and geomorphic patterns of landscape evolution over long timescales. The topography of the region has also exerted control on the Cederberg’s Mediterranean climate, with winter rains that support the fynbos and Succulent Karoo biomes. The interlinked geology, geomorphology and ecology are protected as part of the Cederberg Wilderness Area, which is a significant geotourism and geoheritage region, rich in archaeological remains.

Louis Scott
Department of Plant Sciences, University of the Free State, Bloemfontein.

News
Magdalena Sobol (University of Toronto, Canada) visited the pollen laboratory at the UFS to work on the palynology of an excavation at Kathu Pan (with Michael Chazan) and together with Andri van Aardt, Louis Scott, Linde de Jager and a friend collected spring deposits at Baden-Baden near Dealesville in the Free State.

The proceedings of the conference that was held at the University of the Free State, Bloemfontein in 2014, “Past to Present: Changing Climates, Ecosystems and Environments of Arid Southern Africa. A Tribute to Louis Scott”, were published and spread in three different volumes viz.: Transactions of the Royal Society of South Africa volumes Volume 70, Issues 2 and 3 (edited by Liora Kolska Horwitz & Peter Holmes) (http://www.tandfonline.com/loi/ttrs20?open=70&re petition=0#vol_70) and Palaeoecology of Africa Volume 33 (https://www.crcpress.com/Changing-Climates-Ecosystems-and-Environment) (edited by Jürgen Runge).

Abstract: Wonderwerk Cave, Northern Cape Province (South Africa) is one of few sites in the subcontinent where fossil pollen has been preserved in Holocene cave floor deposits. With the exception of biogenic deposits and stalagmite layers near the cave opening, older material has yielded no pollen. Pollen recorded in previous and new samples from late Pleistocene-Holocene deposits in Excavation 1 at the cave are combined in a calibrated age model based on a selection of published radiocarbon dates. The results confirm patterns observed previously by the late E. M. van Zinderen Bakker, but a new interpretation of the environmental implications and history of the pollen sequence at the site is proposed, viz., dry karroid vegetation in the early Holocene and relatively humid grassy conditions between ca. 5,500 and 4,400 cal yr BP. The results are consistent with those of microfaunal and isotopic studies, and form part of growing proxy evidence for past environmental conditions in the South African interior.


Abstract: Horizontal cores from a large stalagmite and two tufa deposits in the entrance to Wonderwerk Cave, South Africa, dated by radiocarbon methods, have provided climate proxy data on late Holocene environments near the cave. The 618O and 613C time series from stalagmite Core WW1–3 and tufa Core WW3 correlate well with isotope records for other sites in the summer rainfall zone of southern Africa and suggest that late Holocene warm periods in the Northern Hemisphere, including the MedievalWarm period, RomanWarm period, and MinoanWarm period, were times of increased moisture in this rainfall zone. In contrast, late Holocene cold intervals in the Northern Hemisphere, including the Dark Ages Cold period and Sub-Atlantic Cold Wonderwerk records with information on human settlement patterns, agricultural expansion or decline, and population growth or decline, shows that growth occurred preferentially during wetter climate periods and declines, including the abandonment of the important town of Mupungubwe in the Shashe-Limpopo area of northeast South Africa and the fall of Great Zimbabwe, which occurred during periods of low precipitation.


Abstract: Modern and fossil pollen grains extracted from bat guano in Arnhem Cave are evaluated for their potential as a palynological archive and the possible influence of insectivorous bat behaviour on the pollen contents of their dung. Four out of seven fossil guano samples from this cave were productive. The inconsistent preservation of pollen in bat guano layers may be due to deterioration through various mechanisms, including combustion. The samples that did contain pollen support previous conclusions, derived from pollen in spring deposits, about Holocene palaeoenvironmental changes in central Namibia. Two samples of modern bat dung yielded pollen spectra with a greater proportion of woody plant pollen than grass pollen in comparison with the fossil guano material, indicating denser tree cover than in the past, which may be due to the possible effect of modern farming practices. Differences in the pollen composition in dung of different bat species foraging in a relatively homogenous African savanna suggest that the behaviour of likely bat populations should be accounted for when using bat guano as a palynology source for environmental reconstruction.

Below: Covers of volumes with Past to Present conference (Bloemfontein 2014) proceedings.
Abi Stone  
Lecturer in Physical Geography - School of Environment, Education and Development, University of Manchester, UK. & Visiting Research Associate- SoGE, University of Oxford, UK.

Research in sandy drylands

In 2015 I continued my research into both the Namib Sand Sea and the southwest Kalahari dunefield in southern Africa. This involves using optically stimulated luminescence (OSL) dating to assess the Quaternary dynamics of dunefields. I developed an easy-to-use calibration between portable luminescence signals and full OSL ages for samples from the Namib Sand Sea with Mark Bateman (University of Sheffield, UK), which can be used to estimate sample ages from future portable reader measurements made in the field. In August 2015, I worked with Dr Lee Arnold and Dr Martina Demuro (in the Environmental Luminescence Facility, School of Earth and Environmental Science at the University of Adelaide) on the luminescence properties of those pesky and peculiar grains of quartz whose natural signals do not intercept the luminescence growth curve. We benefited from the expertise of Don Creighton and Prof. Nigel Spooner in learning to use the 3D TL spectrometer to try to gain some insight into the possible luminescence mechanisms behind this behaviour.

The second approach I have been developing is the use of chemical tracers in pore moisture in sand dunes to produce hydrostratigraphies, which record past fluctuations to moisture availability in the surface zone. This is the continuation of research undertaken by the late Mike Edmunds, a renowned hydrogeologist, valued colleague and dearly missed friend. Our paper is on the other side of the review process, and will appear in 2016 in Earth Science Reviews. We had also recently reported the patchy presence of naturally high nitrate in the pore moisture in dune sediments about the Stampriet Artesian Basin in the southern Kalahari (Stone and Edmunds, 2014). A pilot study in February 2015 with the NERC Isotopes Geosciences Laboratory in Keyworth, UK in February established the suitability of these samples for isotopic analysis. I will now be working with Tim Heaton on an awarded facilities grant (IP-1542-0515) to further investigate the source of nitrate in this landscape: ‘Nitrate beneath the surface in drylands. Can we connect the gap between high groundwater nitrate and surface sources?’ I am planning fieldwork for 2 weeks in March 2016, from around the 7th or so, for this and am currently recruiting for a field assistant if any of the SASQUA community would like an expenses paid trip to the Kalahari!

From January 2016, I will be editing the Quaternary Newsletter of the UK Quaternary Research Association (QRA). Please contact me with any reports if you are already a QRA member and please have a look here at details on this website you might like to join the QRA https://www.qra.org.uk

Conference Attendance

January couldn’t have ended in a better location, at the inaugural continent-wide AfQUA conference in Cape Town. Thanks to all for arranging an excellent meeting, I presented a poster ‘Rapid assessment of luminescence ages: Testing a portable luminescence reader against full OSL dating.’, which got an updated airing in July at the UK Luminescence and ESR Meeting in Glasgow in Scotland. In April I presented Unsaturated zones as archives of past climates: a review of progress in providing a novel approach for dryland continental regions at the 3rd Oxford Deserts Conference, in Oxford, UK. July was the 4 yearly INQUA Congress, at which I presented both oral and poster presentations. In November Martina Demuro presented out research on ‘Initial results of 3D spectral measurements on handpicked sedimentary quartz grains with diverse OSL behaviours’ at the 4th Asia Pacific Luminescence and Electron Spin Resonance Dating Conference in Adelaide, Australia.
Abstract: A rapid assessment of burial age for sedimentary materials is useful to aid in-situ interpretation of sites and sequences during fieldwork. This can assist with targeted field sampling strategies for full dating back in the laboratory, for example when the study is concerned with reconstructing landscape dynamics during a specific time period. Field-based luminescence measurements are possible using a portable luminescence reader; the challenge is translating relative portable luminescence reader signal intensities of samples into an estimate of age. This study uses a portable luminescence reader for the first time in the analysis of African dunefield sediments. Samples from the Namib Sand Sea (NSS) with established luminescence ages are used to assess what in-situ information about relative sample age can be gleamed at and between sites using the portable luminescence reader, and to establish whether first-order estimates of sample age can be obtained. Two sites in the NSS, which are of modern, very late Holocene and last interglacial age were selected for this assessment and a simple calibration between portable luminescence reader signals and sample age is made. Results show that portable luminescence reader signals differ by over two orders of magnitude between late Holocene and last interglacial age samples and that useful relative-age information can be established using bulk material in the field. Predicted ages from portable luminescence reader signals using a linear regression appear to be indicative and useful. Further development of this calibration using a wider range of sample ages would confirm its applicability in the NSS, and a similar approach is applicable to other sand sea environments.

Abstract: Natural chemical tracers contained in moisture within unsaturated zone (USZ) sediments have very significant potential as a novel archive of past climate and palaeoenvironmental conditions in dryland environments. However this potential has yet to be fully realised. The tracer signature is established in the near-surface zone, with evapotranspiration processes enriching the concentration inherited from input from atmospheric deposition (predominantly rainfall). This pore-moisture tracer signature then moves vertically through the USZ sediments towards the water table, producing a hydrostratigraphy that, with increasing depth, records changes to the moisture balance at the surface through time. The small fluxes of water through the USZ in dryland climates means that this hydrostratigraphy approach is particularly valuable in these environments to provide climate records longer than the instrumental data period. This paper sets out the current state of the art in the use of the USZ as an archive. We explain the nature of the USZ and the basis of the tracer technique and also the field and sampling methodologies. Examples of application worldwide by broad geographic region are also evaluated. This shows that the USZ hydrostratigraphy approach can be used across three key timescales: (i) decadal to multi-decadal resolution records covering hundreds of years that provide information about recent climate fluctuations and patterns of land-use change; (ii) multi-decadal through to millennial scale length records which may record wetter and drier events down to decadal scale resolution and (iii) Last Interglacial through to the Holocene records of lower resolution that indicate broad shifts over multi-millennial timescales. We also explore the questions and challenges surrounding the depositional flux of tracer inputs and the extent to which infiltration is non-uniform, before setting the agenda for their
future potential use alongside related proxies for palaeohydrology.


Abstract: Elevated groundwater nitrate levels are common in drylands, often in excess of WHO guidelines, with concern for human and animal health. In light of recent attempts to identify nitrate sources in the Kalahari this paper presents the first unsaturated zone (USZ) nitrate profiles and recharge rate estimates for the important transboundary Stampriet Basin, alongside the first rainfall chemistry records. Elevated subsurface nitrate reaches 100–250 and 250–525 mg/L NO$_3$–N, with NO$_3$–N/Cl of 4–12, indicating input above evapotranspiration. Chloride mass balance recharge rates range from 4 to 27 mm/y, indicating a vertical movement of these nitrate pulses toward the water table over multi-decadal timescales. These profiles are sampled from dune crests, away from high concentrations of animals and without termite mounds. Given low-density animal grazing is unlikely to contribute consistent spot-scale nitrate over decades, these profiles give an initial estimate of naturally-produced concentrations. This insight is important for the management of the Stampriet Basin and wider Kalahari groundwater. This study expands our knowledge about elevated nitrate in dryland USZs, demonstrating that it can occur as pulses, probably in response to transient vegetation cover and that it is not limited to long-residence time USZs with very limited downward moisture flux.

Francis Thackeray
Evolutionary Studies Institute, University of the Witwatersrand

In London in September 2015, Francis Thackeray attended the ESHE conference (the European Society for the Study of Human Evolution), at the British Museum. He presented his statistical (probabilistic) definition of a biological species, applied to evidence suggesting that there is not a clear boundary between *Australopithecus africanus* and *Homo habilis* (perhaps we should see this transition in the context of a chronospecies). See Thackeray, J.F. 2015. *Homo habilis and Australopithecus africanus*, in the context of chronology and climatic change. In: Runge, R., (ed.) Changing climates, ecosystems and environments within arid southern Africa and adjoining regions. *Palaeoecology of Africa* 33:53-58. The ESHE conference coincided with the announcement of *Homo naledi*, the new species described by Lee Berger and his colleagues at Maropeng on September 10, 2015. (Francis was the only South African palaeoanthropologist at the simultaneous ESHE conference, in London, and was besieged with questions!). As yet there appears to be no certainty about the age of these fossils, but using his morphometric technique Francis has estimated an age of 2 million years, as a ball-park approximation. See Thackeray, J.F. 2015. Estimating the age and affinities of *Homo naledi*. *South African Journal of Science* 111 (11-12): 3-4.

Stephan Woodborne
iThemba LABS

Palaeoclimates from trees: testing climate models
A project focussed on reconstructing past rainfall variability using isotopes in tree rings is in its second year of three. This is a program that has partners in Namibia, Botswana, Madagascar, Germany, England, Romania and Sweden. During 2015 we published a 1000-year proxy record from baobabs that we sampled in the Pafuri region (see figure below). The focus on baobabs was motivated by their extraordinary age: we have dated several baobabs that are older than 1400 years. When we started to date the trees we got some extraordinary patterns with age inversions, and a major breakthrough came when we worked out that these megalithic trees typically have multiple stems that are fused together. Living trees are sampled using an increment borer.

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Initially we relied on a 60cm long borer that removed a 5mm diameter core from the trees. This obviously limits the ability reach the older part of the trees that may be 4-6m in diameter (we have subsequently acquired a 1.5m borer that extracts a 10mm diameter core – much better) We also sampled a few trees that had fallen over. These trees ferment and rot and reduce to dust within a few years, and so we took the opportunity to sample them using a chainsaw. The isotope analysis is calibrated against the instrumental rainfall record, which verifies that this is a rainfall proxy. It shows drier conditions during the Little Ice Age and wetter conditions during the Medieval Warm Period.

We have several other records from other sites. A record from Mapungubwe baobabs will be directly relevant to the Iron Age trajectory in the Limpopo River Valley. We have another 1000-year record from a yellowwood from KwaZulu Natal, and another 1000-year record from baobabs at Epupa on the Namibia/Angola border. The analysis of another boabab from Linyati in Botswana is nearing completion. The combination of these records is starting to yield a time/space matrix of rainfall variability over the subcontinent. We have augmented the isotope record with the limited number of ring width climate reconstructions. The longest is that from cedar trees in the western Cape published in 1980 (Dunwiddie & LaMarche 1980, Nature) which is about 400 years. Although shorter in duration than the baobab and yellowwood records, it provides an important record of winter rainfall variability where the baobabs offer up the summer rainfall variability. The time/space matrix of rainfall variability does not present a coherent picture of regional drying or wetting trends. There is a complex interplay in which changes in rainfall in different regions are out of phase with one another. We have been focussing our efforts on understanding what forces these changes: the El Nino Southern Oscillation, Indian Ocean Dipole and Sea Surface temperatures are among the drivers that have been identified. This presents an excellent opportunity to test if climate models are able to recreate the observed variability. Preliminary analyses are extremely promising, although accuracy of the models to simulate past climate gives us confidence in the future forecasts, and those future forecasts are a scary prospect.

We are continuing to refine the spatial and temporal resolution of this record. We have sampled a transect of kameeldoring from the central and southern regions of the Namib Desert, and we have dates that suggest that this record will extend to 1000 years too. Our work has demonstrated that isotopes in kameeldoring trees are also an excellent proxy for rainfall. We also sampled baobabs and kameeldoring trees along an aridity gradient transect from the north to the south of Botswana. The Botswana transect included trees from river flood plains (complacent trees) and from drylands, and the comparison between these will be used to reconstruct past flow regimes in and around the Okavango Delta. We also have a Ph.D. candidate working on baobab trees from Madagascar.

The project is yielding excellent results, but the scope is possibly too large to complete in the next year (after that funding runs out unless we attract more). There are exciting possibilities for graduate students who want to use this platform for their graduate projects.

A 1000-year proxy for rainfall derived from isotopic analyses of baobabs in the Pafuri region of South Africa.

Update on the AMS
The Tandem EN accelerator at iThemba LABS in Gauteng is currently being upgraded to do AMS measurements. The system comprises 4 components: prep labs, a low energy injection system, the accelerator, and the high energy detection system (see some pictures below). There has been progress on all of these components, but with some unforeseen problems that have caused delays in the commissioning. We have completed the carbon prep laboratory with a state-of-the-art prep line designed to grafitise carbon from organic and inorganic samples. This is designed to allow two users access at a time, and it is likely that we will be able to prepare 24 or more samples a day. This is still less than the accelerator can measure so the prospect of doing many more dates at a reasonable price looms. We have almost completed a cosmogenic isotope prep lab, and await only an acid-proof fume hood. On the accelerator we have managed to measure $^{14}$C in the detectors, so the high energy side of the system is working and so is the accelerator. Unfortunately the ability to measure mass 14 in the detector led to the discovery that there is a $^{14}$N leak in the system. This is a problem that is not easy to diagnose: It prompted a
shut-down of the accelerator and we await the delivery of new cryo-pumps. Running a particle accelerator is expensive: the pumps cost about kR250 each. We need many, but by the time that you read this the first consignment should have been installed, and hopefully we will be able to do the measurements.

The AMS team has also grown. Dr. Vela Mbele took up a permanent position in 2015, and we were joined by Dr. Stephan Winkler. Both are focussed on cosmogenic dating applications while I will focus on $^{14}$C. The presence of Dr. Winkler is a coup as he has extensive experience on running Tandem EN accelerators at ANSTO in Australia, and VIERA in Austria.

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**Publications**


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SASQUA MEMBERSHIP 2015

**Southern Africa:**
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- Dr Graham Avery
- Ms Andrea Baker (S)
- Dr Marion Bamford
- Mr Oliver B Barker
- Mr Luke Bodmann (S)
- Dr Hayley Cawthra
- Dr CK 'Bob' Brain
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