SASQUA 2022

XXIII Biennial Congress
ST LUCIA, SOUTH AFRICA

Southern African climates and environments in a changing world: A view from the Quaternary

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Compiled by L.J. Quick

Welcome

On behalf of the organising committee, we welcome you to the 23rd biennial SASQUA 2022 Congress. We trust you will enjoy this meeting in St Lucia, the hub of the magnificent iSimangaliso Wetland Park – a World Heritage site.

Venue

The St Lucia Ecolodge is nestled between the St. Lucia Estuary, the Indian Ocean and the iSimangaliso Wetland Park.

Presentations

Oral papers: 12 minutes will be allocated per paper, followed by 3 minutes for discussion.

Posters: Posters should be put up for display as soon as possible. These are A0 portrait orientation. A formal poster session, where presenters will have 3 minutes to introduce their work will be held on Monday the 25th September.

Lunches

Lunches are included for registered delegates.

Social Functions

Sunday 25 September 15:00: Registration and Ice breaker.
For the Hippo and Croc Boat Cruise Ice Breaker: vehicles will depart from the conference venue at 15:45. Coffee, tea and rusks will be provided, and there is a cash bar available.

Thursday 27 September 18h30: Conference dinner (informal dress) at the St Lucia Ski Boat Club.

Field Excursion

Wednesday 28 September: Vehicles depart from conference venue at 07:00 sharp

7:00 Depart St Lucia EcoLodge, enter Eastern Shores via Bhangazi Gate. Morning drive to Catalina Bay, then on past Mfabeni overview to Cape Vidal beach for a snack break and to view beachrock. Then head over the Bhangazi berm and take the grassland loop road round the western margin of Mfabeni and to Mission Rocks for a late lunch.

Stops en route: Catalina Bay Lookout, Mfabeni Lookout, Cape Vidal beach (snack stop), Bhangazi lookout, Emboveni Sands, Mfabeni drainage channel, Mission Rocks Beach (short walk) for lunch stop.

After lunch we will return to St Lucia and then enter the Dukuduku Gate into Western Shores and drive to the Makakatana Overview, then return via St Lucia to the Western Shores. Western Shores reserve with stops at Makakatana overview, Pliocene beach, then back to St Lucia.

Stops en route: Makakatana Overview, Tree house viewing platform, Pliocene Beach, view of floodplain

Reserve gates close at 18h00, and we should be prepared for a long day in the field.

What to bring: Hat, Water bottle, Sunglasses, Sunscreen, Jacket, Rain jacket, Walking shoes

Optional: Camera, Binoculars, Swimwear (for the beach)

What to expect: We will be travelling in open game vehicles throughout the day, and making stops and short walks to visit points of interest. We will stop for lunch at Mission Rocks. Given that we are in open vehicles, it's worth preparing for different weather conditions, exposure to wind, sun and possibility of rain. We will provide drinks, snacks and lunch, but please bring plenty of drinking water for yourself.

Local Organising Chair:
Dr Jemma Finch
School of Agricultural, Earth and Environmental Sciences
University of Kwazulu-Natal

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PROGRAMME

Sunday 25 September	
15:00 - 19:00	Registration and Ice breaker
	Vehicles depart from conference venue at 15:45 for Hippo and Croc Boat Cruise. Coffee, tea and rusks will be provided, and there is a cash bar available.

Monday 26 September	
8:30 - 9:00	Registration & Coffee
9:00 - 9:15	Welcome by the SASQUA President & Local Organising Committee Chair
Session 1	
9:15 - 10:15	**PLENARY: J. T. Faith:** An updated synthesis of the paleoenvironmental records from Boomplaas Cave, South Africa
10:15 - 10:30	**G. Poretti**, V.J. Hare, J. Pargeter and A. House: Investigating the potential of intra-'ring' carbon isotopes in Protea charcoal as a rainfall seasonality proxy
10:30 - 11:00	Coffee break
Session 2	
11:00 - 11:15	**J. Luyt**, T. Faith, D. Braun and J.C. Sealy: Can seasonal environmental signals be obtained from high resolution intra-tooth isotopic analyses of herbivores?
11:15 - 11:30	**D.D. Stynder**: What did Theropithecus oswaldi leakeyi eat at the South African middle Pleistocene site of Elandsfontein?
11:30 - 11:45	**L.J. Quick**, S. Manzano, M.S. Humphries, B.A. Grobler, M. Chevalier, M.E. Meadows, P.T. Gama and B.M. Chase: Palaeoenvironments of the Cape Floristic Region: New research & current developments
11:45 - 12:00	**S. Manzano**, L.J. Quick, B.M.Chase, M.T. Hoffman and L. Gillson: Changes in rainfall seasonality drive long-term vegetation dynamics in highly biodiverse Mediterranean ecosystems of the Cape Floristic Region (South Africa)
12:00 - 12:15	**S.G. Mosher**, M.J. Power, L. J. Quick, T. Haberzettl, T. Kasper and J.T. Faith: High-resolution sedimentary charcoal records of fire illustrate linkages between burning, climate and people in the Fynbos Biome, South Africa
12:15 - 12:30	**A. Dabengwa**: Heads or tails? Consistency needed when applying data-model frameworks to assess long-term drivers of open ecosystem states

12:30 - 14:00	Lunch
	Poster session
14:00 - 15:30	**J. Baverstock**: Revisiting the dendroclimatological potential of Afrocarpus falcatus, South Africa **G.A. Botha**, M. Nkosi, S Noruka and R.G. Singh: A set of 18 new lithostratigraphic geological maps covering the Maputaland region **G.A. Botha** and M. Havenga: Re-interpretation of the Cenozoic lithostratigraphy of the Maputaland coastal plain: Integration of field mapping and high resolution airborne radiometrics **D. Claassen**, G.A Botha and B. Linol: Drivers of Recent Rates of Gully Expansion, Eastern Cape, South Africa **S.E. Clark** and P.P. Steyn: Algoa Bay seaweed diversity and thermal shock responses **J.M. Finch**, H. Cawthra, D. Dreyer, T. Haberzettl, K. Kirsten, N. Mkhonza, L. Pretorius, F. Viehberg, Jive Media Africa and the participants of the 2021 Train-ME2 CONNECT Summerschools: Research-led community engagement in the palaeosciences: A case study presenting a Science Spaza educational comic and activity worksheet, and supporting short videos **M. Govender**, S. Manzano, B.M. Chase and L.J. Quick: Using an 8000-year-old fungal spore record from Whale Rock wetland to assess changes in herbivory along the southern Cape coast of South Africa during the Holocene **E. Hilmer**, A.C.M. Julier, B.A. Grobler and L.J. Quick: Establishing connections between contemporary vegetation distributions, modern pollen representation and the fossil pollen record in the Cape Floristic Region **G.A. Langa**, S. Manzano, B.M. Chase and L.J. Quick: Assessing herbivory impacts in the Baviaanskloof during the Holocene using coprophilous fungal spores from hyrax middens **N. Mtshali**: Using Salt Marshes to Understand Long-Term Sea-Level Variability on The Berg River Estuary on the western coast of South Africa **L.S. Nel**, L.J. Quick and S. Manzano: A study of the palynological differences between two dominant Asteraceae species within the southern Cape: *Osteospermum moniliferum* and *Metalasia muricata* **A. Ntsondwa**, S. Manzano, M.S. Humphries and L.J. Quick: Reconstructing the fire history and palaeoenvironment at Thyspunt, southern Cape coast, Eastern Cape **S. Reddy**, J.M. Finch, J. Wood and M. Grenfell: Holocene Reconstruction of vegetation and fire history, Lake Futululu, northern KwaZulu-Natal **L. Rossouw**: Phytolith size as indicator of grass leaf width: a potentially new method for inferring past environmental conditions

	R.G. Singh, G. Chiiza, N. Hicks, M. Ncume, S. Diop, D. Lombard, C. Mudzielwana, G.A Botha and L. Mashiloane: Recent landslide mapping in the eThekwini region, KwaZulu-Natal, South Africa **K. Sokolowski**, A. Barr and J.T. Faith: Evaluating environmental drivers of late Quaternary mammal extinctions in the Cape Floristic Region, South Africa **B. Zwane** and M. Bamford: The landscapes of Sibudu and Border Caves, South Africa, at the time of the youngest Toba super-eruption and a thousand years later
15:30 - 16:00	Coffee break
16:00 - 17:30	**INQUA Mapping Ancient Africa & INQUA SPLOSH Sessions**

Tuesday 27 September	
8:30 - 9:00	Registration & Coffee
Session 3	
9:00 - 10:00	**PLENARY: J.C. Sealy:** Stable Isotopes and Palaeoenvironments in southern Africa
10:00 - 10:15	**L. Richardson**, J.C. Sealy and S. Wurz: The role of seals and birds in coastal hunter-gatherer subsistence strategies at Klasies River: Preliminary results from Cave 1A
10:15 - 10:30	**L.R.G. DeSantis**, D.D. Stynder, K. O'Brien, E. Mueller, K. Koehler, K. Powell, S. Johnson, B. Davies, D. Braun and J.T. Faith: What were all those grazers eating? Dental microwear texture analysis of Pleistocene herbivores from the southwestern Cape, South Africa
10:30 - 11:00	Coffee break
Session 4	
11:00 - 11:15	**F. H. Neumann**, T. Rassalle, Y.Shivtiel, S. Muenger, M. Belmaker, P. Bes and J. Zangenberg: The curious case of Horvat Kur (Galilee, Israel): A cistern beneath an ancient synagogue reveals a past landscape from the Roman period
11:15 - 11:30	**T. Onyeogu**, Z. Jinnah and T. Makhubela: Stratigraphy and facies characterization of Lefika la Noka tufa deposit in the Cradle of Humankind, South Africa
11:30 - 11:45	**M. Malherbe**, M. Hauesler, D.D. Stynder and R. Pickering: The Time Has Come: Revisiting the South African Plio-Pleistocene Faunal Record
11:45 - 12:00	B. Davies, A. Norwood, J. Luyt, J.C. Sealy, D. Braun and **J.T. Faith**: Simulating death assemblages of herbivore teeth to improve expectations for intra-tooth isotopic analysis of fossil samples

12:00 - 12:15	**B. Hlophe** and M.K. Bamford: Reconstructing Late Holocene Vegetation and Climate of Wonderwerk Cave, South Africa, from Charcoal
12:15 - 12:30	**B.M. Chase**, A.S. Carr, S.J. Birkinshaw, P.J. Holmes, M. Rabumbulu, A. Feak and B.A. Stewart: Dating, hydrological modelling and palaeoecological implications of late Pleistocene palaeolakes in the Nama Karoo of South Africa
12:30 - 14:00	Lunch
Session 5	
14:00 - 14:15	**E. Razanatsoa**, M. Virah-Sawmy and L. Gillson: Understanding vegetation change and their response to past land use and rainfall variability in southwest Madagascar during the last 2000 years
14:15 - 14:30	**G.A. Botha**, N. Porat, L. Maré and M. Ncume: Pleistocene dune-dammed palaeolake and palustrine deposits in the southern Kalahari region
14:30 - 14:45	**F.O. Randriatsara**: Reconstruction of vegetation and conservation management plan of the dry forest in north-western Madagascar using palaeoecological approaches
14:45 - 15:00	**L.B Ajikah**, M.K. Bamford, E.Phiri and O.T Ogundipe: Palynological Reconstruction of the Late Holocene Lagos Coastal Environment, Southwestern Nigeria
15:00 - 15:15	E.N. Githumbi, **J.M. Finch**, R. Kinyanjui, C. Courtney-Mustaphi and R. Marchant: Late Quaternary pollen-based biome reconstructions across East African mountains
15:15 - 15:30	**A.H.I. Razafimanantsoa**, L. Gillson and W.J. Bond: Holocene environmental change in the Central Highlands of Madagascar shows evidence of ancient open and mosaic ecosystems
15:30 - 16:00	Coffee break
16:00 - 17:00	**Discussion about Heritage**

Wednesday 28 September
Field Excursion
Vehicles depart from conference venue at 07:00. Refer to field itinerary for details

Thursday 29 September	
8:30 - 9:00	Registration & Coffee
Session 6	

9:00 - 10:00	**PLENARY: H.C. Cawthra**, I. Esteban, J. Pargeter and E.C. Fisher: Mpondoland provides a glimpse into ancient human use of coasts and seascapes
10:00 - 10:15	**L. Pretorius**, N. Cahill, J.M. Finch, T.R. Hill, R. Barnett, K.L. Strachan and C. Cordier: Comparison of salt marsh microfossil Regional and Site-Specific Bayesian Transfer Functions for Sea-Level Reconstruction along the South African Coastline
10:15 - 10:30	**S.L. Manikam**, A.N. Green, A. Cooper, G. Deacon and B. Flemming: Sediment transport and bedform development on a narrow, starved, geostrophic-current forced shelf: examples from the Wild Coast, South Africa
10:30 - 11:00	Coffee break
Session 7	
11:00 - 11:15	**K. L. Kirsten**, T. Haberzettl, T. R. Edwards, A. F. Blackwood and R. Pickering: The palaeoenvironmental development of the Kalkkop impact crater, South Africa: a unique lacustrine record covering MIS 7 and beyond
11:15 - 11:30	**M.K. Bamford** and A. House: Charcoal and vegetation from the Early Iron Age site of Ndondondwane, KwaZulu Natal, South Africa
11:30 - 11:45	**A.C. Effiom**, F.H. Neumann, J. Gensel, M.K. Bamford, E. Schefuß, M. Zabel and L. Scott: Pollen Analysis of the Mkhuze Swamps, KwaZulu-Natal, South Africa
11:45 -12:00	**E. Loftus** and S. Hammann: Insights into ancient food systems from organic residue analyses of Early Iron Age ceramics, KwaZulu-Natal, South Africa
12:00 - 12:15	**A. House** and M.K. Bamford: Machine learning to identify woody plant species represented in the archaeological charcoal record
12:15 - 12:30	Z. Wang and **M.E. Meadows**: Coastal sediments record mid-Holocene dynamics of climate, extreme events, sea level, and the human societal response in eastern China
12:30 - 14:00	Lunch
Session 8	
14:00 - 14:15	**B.M. Chase**, A. Boom, A.S. Carr and P.J. Reimer: Southern African monsoon region climate at the termination of the African Humid Period
14:15 - 14:30	**P.A. Groenewald**, J.C. Sealy and V.J. Hare: Using bomb 14C to write the biography of bones
14:30 - 14:45	**R. Weij**, J. Woodhead, K. Sniderman, J. Hellstrom, E. Reed, S. Bourne, R. Drysdale and T. Pollard: Speleothem U-Th-Pb, pollen and charcoal reveal cave antiquity and fossil accumulation window: a Naracoorte Caves case study

14:45 - 15:00	I. Ward, A. Bastos, D. Carabias, **H.C. Cawthra**, H. Farr, A.N. Green, F. Sturt: Submerged Palaeolandscapes of the Southern Hemisphere (SPLOSH) network
15:00 - 15:15	**B.B. Laqwela**: People and the Sea in Mpondoland: An analysis of Culture, Provisioning and Accessibility to Ocean and Coastal Services
15:15 - 15:30	**A. Xuba**: Indigenous knowledge systems informing an adaptive estuary management: The socio-cultural dynamics of the Sundays River Estuary
15:30 - 15:45	Coffee break
15:45 - 17:00	**SASQUA BGM**
18:30	**Conference Dinner: St Lucia Ski Boat Club**

ABSTRACTS

Oral Presentations

Plenaries

An updated synthesis of the paleoenvironmental records from Boomplaas Cave, South Africa

J. T. Faith (1,2,3), B.M. Chase (4,5) and J. Pargeter (6,7)

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With a rich sequence of floral and faunal remains spanning the last >65,000 years, Boomplaas Cave features prominently in efforts to understand late Quaternary paleoenvironmental change in the southern Cape of South Africa. A substantial body of research has drawn from the well-preserved floral and faunal assemblages recovered during Hilary Deacon's excavations (1974-1979) to reconstruct past biotic communities, inform on paleoenvironmental change, and evaluate human-environment interactions. This literature has grown considerably since the first attempts to synthesize the paleoenvironmental datasets from Boomplaas in the 1980s, but so too has the divergence of opinions concerning the interpretation of key environmental variables. The outcome is uncertainty surrounding one of the richest paleoenvironmental archives in the region. In light of renewed investigations at Boomplaas Cave and the ongoing development of regional paleoenvironmental archives, we provide an updated synthesis of the empirical evidence from the site. Our goals are to review the paleoenvironmental datasets from Boomplaas Cave, evaluate the main points of agreement and disagreement concerning their interpretation, and draw from new quantitative techniques to reconstruct contested paleoenvironmental variables. Among the key takeaways are: (i) winter rainfall and C3 grass dominated during the LGM; (ii) relatively humid conditions prevailed during the LGM; (iii) units in the BP member dating to ~40-38 ka document an important C4 expansion. Our updated synthesis provides a framework that will be evaluated and refined in the coming years through ongoing analyses of materials from Deacon's excavation as well as new excavations at the site.

Stable Isotopes and Palaeoenvironments in southern Africa

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Some of the earliest stable isotope studies of palaeoenvironments were done in southern Africa, in pioneering work by John Vogel (a past president of SASQUA) and collaborators in the 1970s. Since then, stable isotopes have grown from a niche speciality to a mainstream tool in environmental and ecological studies, and I am fortunate to have been part of this. This growth was enabled partly by innovations in instrumentation, especially the development of continuous flow mass spectrometry in the early 1990s, allowing large numbers of samples to be analysed at reduced cost. This talk will survey the development of the field over the past half-century from a southern African perspective. Several key advances were made here, by a core of active researchers making use of our rich Quaternary (and older) record. Newer approaches such as analysis of rarer isotopes and molecular-level work promise further expansion in the future.

Mpondoland provides a glimpse into ancient human use of coasts and seascapes

H.C. Cawthra (1,2), I. Esteban (3,4,5), J. Pargeter, (6,7) and E.C. Fisher (2,8,9,10)

(1) Geophysics and Remote Sensing Unit, Council for Geoscience, Cape Town, South Africa; (2) African Centre for Coastal Palaeoscience, Nelson Mandela University, Gqeberha, South Africa; (3) ERAAUB. Dept. Història I Arqueologia, Universitat de Barcelona, Barcelona, Spain; (4) Evolutionary Studies Institute and School of Geosciences, University of the Witwatersrand, Johannesburg, South Africa; (5) African Centre for Coastal Palaeoscience, Nelson Mandela University, Port Elizabeth, South Africa; (6) Department of Anthropology, New York University, New York, USA; (7) Palaeo-Research Institute, University of Johannesburg, Johannesburg, South Africa; (8) Institute of Human Origins, School of Human Evolution and Social Change, Arizona State University, Tempe, USA; (9) Evolutionary Studies Institute and School of Geosciences, University of the Witwatersrand, Johannesburg, South Africa; (10) Interdisciplinary Center for Archaeology and Evolution of Human Behaviour (ICArEHB), Universidade do Algarve, Faro, Portugal.

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The South African continental shelf and adjacent coastal plain comprise the submerged and emergent portions of a continuous landscape that has waxed and waned over millennia in sync with changing sea levels and global climates. For 90% of the evolutionary history of the genus Homo, climates have been cooler and sea levels significantly lower than today. These exposed landscapes have provided plant and animal resources key to early hunter-gatherer survival. The Mpondoland Paleoclimate, Paleoenviroment, Paleoecology, and Paleoanthropology (P5) Project is an international and multidisciplinary collaboration of scientists that have worked in Mpondoland for over a decade. P5 research leverages the regions exceptionally narrow continental shelf—maximally 9 km wide—that constrained the outward movement of coastlines during prior glacial periods ensuring that records of coastal foraging are preserved in sites along the modern coastline. Our excavations along Mpondoland's coastline have revealed evidence for human occupation spanning the last 300,000 years in a persistent coastal context. At Waterfall Bluff, P5 has recently documented the first directly dated evidence for coastal foraging during the Last Glacial Maximum anywhere in Africa. Mpondoland's rare archaeological records, therefore, provide important and unique records about how hunter-gatherers adapted to coastlines during and across glacial-interglacial phases. We are

addressing research questions about how early humans used Mpondoland's coastal landscapes by reconstructing specific ancient coastlines and obtaining paleoenvironmental data linked to coastline-environment interactions, and have developed a strong focus on education and outreach with the local community.

Session #1

Investigating the potential of intra-'ring' carbon isotopes in Protea charcoal as a rainfall seasonality proxy

G. Poretti (1), V.J. Hare (1), J. Pargeter (2) and A. House (3)

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The relationship between South Africa's Winter Rainfall Zone (WRZ) and Year-Round Rainfall Zone (YRZ) during the Last Glacial Maximum (LGM) remains poorly resolved and debated. This is because rainfall changes are not easily gleaned from most paleorecords and are often inferred qualitatively, leading to uncertainty and contradictory interpretations. This preliminary study outlines a potential method for quantitatively reconstructing rainfall seasonality using a ubiquitous yet underutilised material: archaeological charcoal. It investigates whether an established seasonal rainfall proxy showing success in modern and fossil evergreen wood can be applied to carbonised evergreen wood in Southern Africa. The proxy was tested on LGM Proteaceae charcoal from Boomplaas Cave — today in the YRZ — using Protea nitida wood and charcoal from the WRZ and YRZ as modern analogues. Successive δ13C measurements across the growth rings of the contemporary wood samples indeed produce seasonal amplitudes consistent with local climate data for 2016 to 2020. Seasonal amplitudes produced from the modern charcoal samples were relatively dulled yet still consistent in the case of the YRZ but inconsistent in the case of the WRZ. This inconsistency was interpreted as a function of subsampling resolution effects and/ or depletion of δ13C values with carbonisation and/ or dry season marine fog. The ratios of summer to winter rainfall calculated for the modern samples demonstrate that the proxy can reliably differentiate between seasonal rainfall regimes in both Proteaceae wood and charcoal. The archaeological charcoal results indicate that Boomplaas Cave at the LGM received predominantly winter rainfall and was more seasonal than the present-day coastal WRZ.

Session #2

Can seasonal environmental signals be obtained from high resolution intra-tooth isotopic analyses of herbivores?

J. Luyt (1), J.T. Faith (2), D. Braun (3) and J. Sealy (1)

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There is growing interest in serial sampling of equid and bovid teeth to investigate seasonal variations in carbon and oxygen isotope values. Equids are especially suitable due to their hypsodont dentition with tooth formation over periods of more than a year, thus capturing one or more seasonal cycles. Recent research has, however, reported some previously unanticipated challenges with this approach. The presentation will review our understanding of these issues to date, and their implications for palaeoenvironmental reconstruction. Recent results for modern

specimens will be presented, together with some analyses from the Pleistocene site of Elandsfontein. At Elandsfontein, we have high resolution intra-tooth analyses of enamel δ13C and δ18O on the same teeth in which δ87Sr has previously been measured. Strontium isotope analyses confirm that these large herbivores were not moving off marine sands surrounding Elandsfontein, indicating that the carbon and oxygen isotope values left in teeth are local signals. δ13C values remain consistent over the period of mineralization (a year or more), but δ18O varies considerably: up to 7.70/00 in *Syncerus antiquus* and 8.60/00 in Equus capensis. This approach holds considerable promise, but it will be important to ensure a fuller understanding of the factors contributing to the patterns documented.

What did Theropithecus oswaldi leakeyi eat at the South African middle Pleistocene site of Elandsfontein?

D.D. Stynder (1)

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Theropithecus oswaldi was a Plio-Pleistocene cercopithecoid lineage with a distribution that encompassed most of Africa and parts of southern Eurasia. During its long existence, the T. oswaldi lineage underwent significant morphological change, hence the recognition of three successive chrono-subspecies: *T. oswaldi darti, T. oswaldi oswaldi*, and finally *T. oswaldi leakeyi*. The morphological changes that occurred in this lineage included a marked increase in body size over time and, intriguingly, the development of morphological adaptations for graminivory. A predominantly graminivorous diet for *T. oswaldi* is supported by most stable isotope studies which further suggest a focus on C4 grasses. Consequently, the evolution of the *T. oswaldi* lineage is thought to have been closely associated with the spread of C4 grasslands. It is thus surprising that a handful of *T. oswaldi* leakeyi fossils were discovered at Elandsfontein, a South African middle Pleistocene site that had a similar C3-dominated ecosystem to what exists there today. Here we present the results of stable isotope and microwear analyses of the Elandsfontein *T. oswaldi* dental sample. Our results suggest that the Elandsfontein *T. oswaldi* had a C3-dominated diet that contained little grass. As such, it mirrors the C3-dominated mixed grass/browse diets of several ungulate grazers at the locality. Our study therefore gives further support to the idea that middle Pleistocene ecosystems on the southwestern Cape coast were less grassy than previously thought. It also suggests that *T. oswaldi* was able to cope with a suboptimal diet, which could explain its limited presence in grass-poor environments.

Palaeoenvironments of the Cape Floristic Region: New research & current developments

L.J. Quick (1), S. Manzano (2), M.S. Humphries (3), B.A. Grobler (1), M. Chevalier (4), M.E. Meadows (5), P.T. Gama (6), BM Chase (7)

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The Cape Floristic Region (CFR) is a key focus area within southern Africa due to its botanical importance in terms of high levels of biodiversity as well as its rich cultural and archaeological heritage. The area is highly sensitive to cycles of regional and global environmental change, and records obtained from the region provide valuable information regarding past climate variability. Prior to the last decade, few high resolution palaeoenvironmental records were recovered

from the region, and its environmental history remain relatively poorly understood. This presentation summarises the research initiatives currently being undertaken by Nelson Mandela University's Palaeoecology Laboratory. This ongoing work aims to provide a comprehensive understanding of climate, biodiversity and human-environment interactions within the CFR, with a particular focus on the understudied eastern subregions. The records presented are derived from unique natural archives found within the CFR including rock hyrax middens and coastal lowland wetland deposits. These archives are being analysed within a multi-proxy, multi-disciplinary framework, using pollen, fungal spores, micro- and macrocharcoal, diatoms and geochemistry to elucidate changes in vegetation, herbivory, fire, hydrology and climate. This work is designed to actively develop regional capacity and engage students and early career scientists from the area to contribute to the development of fundamental knowledge regarding their environment and history.

Changes in rainfall seasonality drive long-term vegetation dynamics in highly biodiverse Mediterranean ecosystems of the Cape Floristic Region (South Africa)

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Mediterranean environments are biodiversity hotspots in which strongly seasonal winter rainfall regimes and fire play major roles in driving ecosystem dynamics. Global predictions forecast unreliability of winter rainfall and increases in summer rainfall that are expected to result in major changes in community structure. Mediterranean systems are difficult to model, and although ecophysiological responses can be studied at observational timescales, a long-term understanding is necessary to address uncertainties and refine predictive models at landscape scales. Here we provide a ~1100 year-long palaeoecological reconstruction of vegetation (palynology), fire (anthracology) and sedimentological change at a site adjacent to a multi-annual rainfall manipulation experiment designed to test plant population and community responses to altered seasonal regimes in the Greater Cape Floristic Region hotspot (southwestern Africa). We use this data to test (i) whether long-term vegetation dynamics are controlled by changes in rainfall seasonality and (ii) whether centennial-scale landscape dynamics can be predicted from ecological responses at observational timescales. We conclude that vegetation dynamics correlate with centennial-scale seasonality fluctuations, with transitions between two ecologically distinct fine-leaved shrub communities. These transitions can be predicted from different responses to experimental manipulations of summer rainfall. Our results demonstrate the potential for ecophysiological research to interpret palaeoecological reconstructions and scale up the results of observational research to answer long-term questions about environmental change.

High-resolution sedimentary charcoal records of fire illustrate linkages between burning, climate and people in the Fynbos Biome, South Africa

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Fire is central to South Africa's highly biodiverse and disturbance-adapted Fynbos Biome. However, prehistoric fire regimes and their ecological consequences remain poorly understood. Here, we use high-resolution sedimentary charcoal records to interrogate links between fire, climate, vegetation, and people in the fynbos. We reconstruct fire activity using charcoal particles from two coastal, ecotone lakes – Eilandvlei, a fynbos-afrotemperate forest site experiencing year-round rainfall, and Verlorenvlei, a fynbos-succulent karoo site experiencing winter rainfall. Both records provide exceptionally high continuous-resolution data from mid-Holocene to present with approximately 2-year time steps at Eilandvlei and 10-year time steps at Verlorenvlei. At Eilandvlei, our preliminary results, spanning the period 4250 to 2370 cal BP, show the highest charcoal influx occurs from 4250 to 3500 cal BP, co-occurring with more frequent, higher magnitude fires and 14-20 years between burns. A significant decline in fire activity occurred around 3400 cal BP, after which fire frequency slowed to 25-50 years between events. At Verlorenvlei, results span 4250 to 3350 cal BP and show charcoal influx, peak magnitudes, and fire frequency are considerably lower and less frequent, with fire activity peaking around 3600 cal BP with 40 years between burns. Our data suggest fynbos fire regimes are more dynamic than indicated by historical observations, and points to the importance of using high-resolution fire histories to understand how climate and human impacts shaped disturbance in the fynbos over centuries. Both reconstructions are ongoing and being generated in tandem with experimental burning of known vegetation to establish a biome-specific charcoal morphotype key.

Heads or tails? Consistency needed when applying data-model frameworks to assess long-term drivers of open ecosystem states

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Strong interactions between consumers and their resources continue to intrigue ecologists because they produce oscillations defined by abrupt or gradual ecosystem state changes. Worldwide, fires and large herbivore consumers are considered key drivers of dynamic herbaceous- compared with tree-dominated vegetation cover in open ecosystems. Still, vegetation transitions associated with openness concern ecologists, climate change scientists, and natural resource managers because they may signal when consumers exceed their resource bases beyond critical thresholds. The crossing of some thresholds is associated with ecological degradation followed by reorganisation of vegetation and consumer biomasses. But if resource bases are resilient or consumers switch bases, negative impacts on consumer and resource biomasses are reduced. Whereas ecologists have broadly explored consumer-resource dynamics of open landscapes from daily to centennial timescales, ancient dynamics are hamstrung by temporal patchiness of data, poor taxonomic resolution, and sampling of herbivore foraging hotspots. This hinders our ability to learn about drivers

of prehistoric open ecosystems thereby limiting the successful integration of palaeoecological, historical, and contemporary datasets. Functionally grouping vegetation states (i.e., short grasses, tall grasses, trees) and levels of consumer pressure (fire, herbivory) is key for determining driver-state relationships between competing state-and-transition (ST) and consumer-resource (CR) models. Here, we compare these competing models for analysing ecological transitions using functional traits in multiple-proxy palaeo-ecological datasets from Ghana, South Africa, and Uganda. We use phytoliths, coprophilous fungal spores, and charcoal to reconstruct the dynamics of vegetation, herbivory, and fire respectively.

Session #3

The role of seals and birds in coastal hunter-gatherer subsistence strategies at Klasies River: Preliminary results from Cave 1A

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Previous analyses of seal and bird remains from the important Middle Stone Age (MSA) site of Klasies River reported profiles that contrast with those seen in most Holocene Later Stone Age sites. An apparent lack of clear patterning in age at death of seals, and scarcity of flying birds have been used to argue that MSA hunter-gathers were less effective coastal foragers than their Later Stone Age (LSA) counterparts. These studies were based on bone assemblages excavated by Singer & Wymer in the 1960s, when excavated material was sieved through half-inch (12.7 mm) mesh, and small fragments of bone would have been lost. Preliminary work on more complete bone assemblages derived from more recent excavations by H.J. Deacon and S. Wurz is yielding a very different picture. Seal remains from Cave 1A (approximately 57-101 ka) reflect a strong preference for juveniles. Flying birds, including gannets, cormorants and albatrosses, dominate throughout the Cave 1A sequence. Non-flying birds (penguins) are also present and increase in frequency when the coast is nearby. Skeletal element profiles suggest that Cave 1A birds were processed on site. The differences between previous findings and those reported here may be due to high faunal fragmentation, especially in the uppermost MSA III (57 ka) and Howiesonspoort (65 ka) layers, in combination with use of large mesh sieves. Fragile bones of flying birds are particularly vulnerable to breakage, and tiny flipper bones of juvenile seals may have been inadvertently discarded during the Singer & Wymer excavations.

What were all those grazers eating? Dental microwear texture analysis of Pleistocene herbivores from the southwestern Cape, South Africa

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Pleistocene large mammal communities from the southwestern Cape are characterised by an exceptional diversity and abundance of species that are presumed to be grazers, including wildebeest (*Connochaetes gnou*), buffaloes (*Syncerus* spp.), and zebras (*Equus* spp.). This is typically thought to signal an expansion of grassy vegetation during glacial phases of the Pleistocene. However, recent publication of a ~300,000-year pollen record from the Greater Cape Floristic Region (IODP U1479) demonstrates that grasses were consistently rare, posing a puzzling contradiction between the environmental conditions suggested by the fauna versus the flora. If grasses were so rare, then what were the grazers eating? Dental mesowear analysis of mid-Pleistocene (~1,000 to 600 ka) herbivores from Elandsfontein suggests that some presumed grazers were mixed feeding, casting doubt on longstanding assumptions about the diets of fossil herbivores, and their paleoenvironmental implications. In this presentation, we further evaluate these assumptions using dental microwear texture analysis (DMTA) to reconstruct herbivore paleodiets from several southwestern Cape faunal assemblages: Elandsfontein Main, Duinefontein 2, Swartklip 1, Hoedjiespunt 1, and Sea Harvest. Drawing from both modern and fossil microwear data, we show that many animals that are dedicated grazers in the present-day (e.g., Connochaetes gnou) have a microwear signature consistent with mixed feeding. Our observations suggest that Pleistocene ecosystems on the southwestern Cape were less grassy than typically envisioned, and may force a reinterpretation (in some cases) of previous analyses that have used the isotopic composition of fossil 'grazers' to make inferences about the availability of C3 versus C4 grasses.

Session #4

The curious case of Horvat Kur (Galilee, Israel): A cistern beneath an ancient synagogue reveals a past landscape from the Roman period

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We present palynological results from a Roman-Byzantine cistern. The deposits produced a multitude of well-preserved pollen, spores, bones, charcoal, fungal, mollusc remains as well as bones. The chronology of the sediment deposits warrants further investigation. One sample, on a mollusc shell, points to 80-240 AD. The second sample on sediments gives an older age, probably due to hardwater effect: 1105-920 BC. The latter date pre-dates the ceramics -so far 38 complete and restored ceramic vessels were excavated- from the same sediments. The pollen content points to a Mediterranean open woodland with e.g. pollen of Malvaceae, Asteraceae, Apiaceae, Cistus, *Scabiosa*, Amaranthaceae /Chenopodiaceae, Liliaceae, *Quercus*, *Pinus*, and *Ceratonia*. Cultivars like olive tree (*Olea*), cereals, rare findings of flax (*Linum*) and weeds indicate agricultural activities. The small vertebrate remains are dominated by frogs, toads and a large assemblage of *Crocidura* ssp. (White toothed shrews) and murids (*Mus* sp., *Apodemus* sp.). The absence of open grassland species such as voles (*Microtus guentheri*) and jirds (*Meriones tristrami*) support the reconstruction of the immediate vicinity of the cistern as a Mediterranean woodland. While amphibia probably estivated in the cistern,

small mammals might have been transported in after the cistern was disused probably until Late Byzantine or early Ummayyad times. The multi-proxy data from Horvat Kur reveal 1. the functional change of the cistern from a cleaned water reservoir to a waste deposit, 2. a whole landscape reflecting agriculture and animal husbandry, local living conditions and vegetation, as well as local fauna and provides information on climatic changes.

Stratigraphy and facies characterization of Lefika la Noka tufa deposit in the Cradle of Humankind, South Africa

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The Lefika la Noka tufa deposit is situated north of the Malapa and Gladysvale fossil sites within the Cradle of Humankind (Cradle). It has a maximum thickness of about 12.5 meters and was deposited on top of the Timeball Hill Formation shales. Due to the rapid accumulation, tufa can present excellent opportunities to study and produce high-resolution palaeoclimatic data, seasonality in Quaternary palaeoclimates and records of short-lived climatic events. Such data is crucial for the Cradle, particularly for the past 350 ka when Homo naledi and Archaic Homo sapiens emerge in the fossil record. This study aims to characterize and describe the stratigraphy and environments of deposition of the tufa deposits based on field observations, core logging, and petrographic analysis. The Lefika la Noka tufa comprises five texturally distinct facies based on field observations and drill cores. They are phytoherm framestone facies, phytoherm boundstone facies, oncoidal tufa facies, pisolitic tufa, and tufa breccia facies. Oncoids were deposited in agitated pools within waterfalls, whereas phytoherm framestones and phytoherm boundstones were deposited in a fluvial waterfall/cascade environment. Fluvial channels contained the tufa breccia facies, which represent erosional surfaces of bedrock. This shows the existence of a waterfall with a high slope fluvial system during the late Quaternary period.

The Time Has Come: Revisiting the South African Plio-Pleistocene Faunal Record

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South Africa's Cradle of Humankind contains some of the most important sites of human evolution, representing hominin fossils attributed to at least five species. However, lack of a detailed chronology for the sites has meant that these significant fossils are yet to be placed within a precise climatic framework, thus we could not hypothesize about how species responded to the dramatically changing environments that characterised the PlioPleistocene. Now, recent research has provided precise ages via uranium-lead dating for eight of the most vital fossil-bearing sites in the Cradle: Bolt's Farm, Cooper's Cave, Drimolen, Haasgat, Hoogland, Malapa, Sterkfontein, and Swartkrans. Therefore, the bovid assemblages – found in abundance and crucial palaeoenvironmental indicators – have established dates and can be interrogated without the hermeneutic constraints accompanying eastern African comparisons, which have previously been the only way to estimate South African chronology. We conduct ecomorphological analysis on bovid metapodials via 3D geometric morphometrics, providing the first direct comparison between eastern and southern African Plio-Pleistocene fauna and associated environments. Our results are two-fold: firstly, we do not see a progression in aridity in the Plio-Pleistocene but rather stasis is observed with

predominantly dry/open environments across all South African sites. This is in accordance with inferences from the cave site formation and uranium-lead analysis. Secondly, differences in landscape and environment are seen between southern and eastern sites of corresponding ages, contrasting historical reports. These findings fundamentally advance understandings of both a pivotal period in hominin evolution, as well as species responses to climate change in the Quaternary.

Simulating death assemblages of herbivore teeth to improve expectations for intra-tooth isotopic analysis of fossil samples

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Knowing how environments changed in the past is key to understanding human adaptation and behavioural change. Isotopic analysis of serially-sampled dental enamel from faunal assemblages provides information about environmental conditions during tooth development, which in turn informs on changes in seasonality and vegetation structure in the past. However, multiple factors contribute to patterning observed in these samples, including growth rate changes over the course of tooth development; growth rate differences between individuals; variation in the amount of dental wear; seasonal variation in birth rates that affect the timing of recorded environmental signals; and intra- and inter-annual variation in the isotopic composition of ingested water and plant foods. Here, we model tooth growth and wear in zebra (Equus spp.) to generate simulated assemblages of teeth in order to improve expectations for the fossil record. In the model, a death assemblage of individual animals is generated using data from known populations. For each animal, the upper third molar (M3) is then grown according to different rates of growth (linear, exponential), and if the animal lives to a certain age, the tooth crown is also reduced based on empirically-observed rates of wear. Simulated teeth are sampled serially at a given unit distance of crown height, reflecting different aggregations of time and averaging of isotopic signals. Sequences of isotope measures are then compared across specimens and in aggregate. By exploring the model, we demonstrate how different sources of variability contribute to signals of environmental change and seasonality in serially-sampled dental assemblages.

Reconstructing Late Holocene Vegetation and Climate of Wonderwerk Cave, South Africa, from Charcoal

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The Wonderwerk Cave represents one of the rare cave sites in the arid interior of southern Africa that preserve multiple palaeoclimate indicators, such as pollen, charcoal, and phytoliths. Despite the large amount of charcoal excavated from the Holocene strata, pollen has been the most used indicator for Holocene environmental conditions. Pollen is less spatially precise compared to charcoal; hence this study is aimed to reconstruct the palaeoclimate of the area around the Wonderwerk Cave during the late Holocene by

studying charcoal from one of the Late Holocene strata, Stratum 2b, which records the time between 2.3- 0.5 ka cal BP. The second aim of this study is to infer the human-plant interactions for that time. A sample of 50 charcoal fragments were studied, the wood they originate from identified, and climate and human-plant interactions inferred from the woody species identified. The sample was dominated by shrubs or small trees that tolerate dry environmental conditions, such as Ozoroa paniculosa, Searsia lancea, Brachylaena huillensis, Commiphora sp., Maytenus undata, Olea europaea subsp. africana and Ziziphus mucronata. This indicates that the environment was mostly dry. However, the presence of taxa that tolerate wetter environments such as Heteropyxis natalensis, Olinia ventosa, and Berchemia discolor suggests that rainfall patterns may have been variable. The presence of taxa that commonly grow near riverbanks suggests that there may have been a water source nearby, similar to Boesmansgat found 15 km from the cave. Overall, the results indicate a semi-arid climate and an open bushveld with a grassy layer, and small woody plants that enabled the humans occupying the Wonderwerk Cave to harvest wood, fruits, and medicine from them.

Dating, hydrological modelling and palaeoecological implications of late Pleistocene palaeolakes in the Nama Karoo of South Africa

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Determining the timing and drivers of Pleistocene hydrological change in the interior of South Africa is critical for testing hypotheses regarding the presence, dynamics and resilience of human populations. Combining a suite of new OSL ages and radiocarbon dates with hydrological modelling, we demonstrate the presence of several late Pleistocene palaeolakes and infer regional-scale invigoration of hydrological networks in the South African interior during Marine Isotope Stage (MIS) 3 – particularly 55-39 ka and 34-31 ka – and during MIS 2. The climatic changes required to sustain these hydrological systems would likely have resulted in the replacement of xeric shrubland by more productive higher grass cover vegetation, capable of supporting increased ungulate diversity and biomass. Some support for the latter is found in the existing fauna records. A well-known feature of many of these interior landscapes is the abundance of Middle and Later Stone Age lithic (surface) assemblages. Together these observations contribute to a growing recognition that that Pleistocene interior of South Africa provides an important counter-point to coastal archaeological and palaeoenvironmental records, and must be considered in wider understandings of climate and human population dynamics through the Pleistocene.

Session #5

Understanding vegetation change and their response to past land use and rainfall variability in southwest Madagascar during the last 2000 years

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Knowledge of landscape history has begun to be recognised globally for better planning and management of ecosystems and their associated services, particularly in the face of current concern about biodiversity loss caused by climate change and human activities. Yet, a more synthetic understanding of changes beyond individual sites is needed and particularly for the African continent. Here, we investigated how past changes in land use and rainfall affected the landscape in southwestern Madagascar through the reanalysis of existing palaeoecological records and reviews of paleoclimate records from the region. Paleoclimate records show evidence of rainfall variability with more recurrent and pronounced drought events in the last millennium in the region. Major drought events recorded across the island around AD 1000 corresponded to an increase in the abundance of xerophytics. Moreover, a continuous increase in fire and herbivory activities associated with agropastoralism were also recorded. The combination of land use and drought coincided with a widespread change in compositional turnover and diversity particularly since AD 1750. In the recent century, an increase in xerophytics was recorded for sites located in the northern part of the region linked to increased drying while this has decreased in southern sites due to intensive land use. These results demonstrate that both climate and land use are affecting the landscape differently in southwestern Madagascar. Planning efficient adaptation and management of such a landscape requires the consideration of both social and ecological systems.

Pleistocene dune-dammed palaeolake and palustrine deposits in the southern Kalahari region

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On the southern edge of the Kalahari region at Wedge Hill, a 20m thick succession of calcified palaeolake and palustrine facies comprises a fining-upward succession. Basal rounded gravel is overlain by calcified diatomaceous beds with interbedded, unconsolidated beds of smectitic clay and aeolian sand. Deposition occurred in a shallow ephemeral lake with extensive palustrine margins in the distal reaches of the Soutloop valley. Beds with desiccation cracks, aeolian sand incursion events and cementation by micritic dolomite precipitation suggest periodic exposure and evaporative concentration of lake water. Cementation was coeval with sediment accretion rather than through diagenesis or pedogenic calcretisation. Initial measurements on quartz showed that the OSL signal is saturated so the thermally transferred (TT) OSL signal was used to obtain the De values. The calculated ages range from 265ka to 469 ka, which should be considered as minimum ages as the range of De values are most likely at the limit of TT-OSL. Palaeomagnetic analyses measured intensity of normal remanent magnetization and showed a general increase in the magnetic susceptibility with depth. Uncemented clay and sand beds exhibit distinctly higher values than the calcified sediments. Although both normal and reversed magnetic fabric were observed, the magnetic signature was too weak to accurately correlate it with the magnetostratigraphic logs of either Wonderwerk cave or the Geomagnetic Polarity Timescale (GTPS).

Reconstruction of vegetation and conservation management plan of the dry forest in north-western Madagascar using palaeoecological approaches

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Madagascar western dry deciduous forests have been identified as priority conservation ecosystem due to high rate of endemism and intense anthropogenic pressure (Rogers et al., 2010; Waeber et al., 2016). Evidence has showed that vegetation cover has changed over the time through anthropogenic and climatic drivers and have been linked to the fire history and herbivory activity (Scales, 2012; Douglas et al., 2019). The fact that anthropogenic deforestation induced the formation of open areas led to Madagascar's government to plan a general tree planting across the island. However, the extent of change, the interactions between climate and humans over time is poorly understood particularly in the northwest part of the island. This raises questions for what conservation management should be planned as reference conditions are lacking. Information about vegetation changes and its relationship with human activity over timescales of decades to millennia will be explored using pollen grains, dung fungal spores and charcoal analysis from two sediment cores. The preliminary results show the dominance of herbaceous pollen, coprophilous spores, and charcoal during the last century. This indicates that the vegetation around the area was a mosaic of dry forest and grassland with sign of anthropogenic activities. We also found a vegetation dynamic and changes that have been affected by human livelihood especially using fire for pasture and for agricultural purposes throughout the last millennia. We will evaluate how the changes in these drivers with a particular focus on fire policy has evolved over time to provide a conservation management plan for the dry forest.

The Palynological Reconstruction of the Late Holocene Lagos Coastal Environment, Southwestern Nigeria

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The vegetation of Lagos coastal environment (LCE) has undergone degradation consequent of which some plant species have become non-existent. This current upsurge of changes in vegetation around the LCE deserves a robust assessment to mitigate the impacts. The goal of this study is to reconstruct the vegetation history of parts of the LCE within the last 1500 YBP using sedimentary and palynological evidence and to employ the data to decipher human-landscape interactions within the same period. Sediment samples were collected using a Universal peat corer and processed using standard methods. Radiocarbon dating was carried out with accelerated mass spectrometry (AMS) at Beta-Analytical to provide an accurate ratio of 14C dates. A total of 42 palynomorph types were recovered the pollen sum ranged from 208 to 1601. The dominant palynomorphs include Symphonia globulifera, Cyclosorus sp, Poaceae, Alchornea sp., Aspilia africana, Nephrolepis bisserata, Polypodium sp. and fungal spores. Lithology ranged from fine-grained to silty sediments suggesting overbank or floodplain settings of a low energy regime. pH test revealed most sections of the core were acidic, which accounts for the preservation of the palynomorphs. Using Tilia CONNISS analysis, eight palaeoecological groups and three pollen zones namely PZI, PZII and PZIII were delineated. The work revealed that around ca. 1400 ± 30 BP, significant vegetation changes occurred across the study location transiting from more mangrove and rainforest vegetation zones to a secondary and open coastal savanna setting. For instance, Rhizophora sp., a major marker in the mangrove or brackish swamp forest was found to have disappeared and later replaced by freshwater swamp Alchornea cordifolia and

Cyperaceae, attributable largely to anthropogenic activities currently taking place in the area.

Late Quaternary pollen-based biome reconstructions across East African mountains

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Understanding environmental change over large spatial and temporal scales requires working at a larger ecological scale to enable cross-site comparisons. Biomes offer a broad ecological level to synthesise multisite pollen data and understand Afromontane ecosystem response to climate change over the last 50,000 years. Quantitatively documenting the timing, character and spatial patterns of ecosystem transitions allows data-based comparison to dynamic vegetation model outputs, with utility for climate and land cover modelling. Here we synthesise late Quaternary pollen records from East African mountains using original geochronological and palynological data from 34 sites. Pollen taxonomies were updated and harmonised using the African Plant Database. Geochronologies were reanalyzed and radiocarbon ages (n=219) were IntCal20 calibrated to develop linearly interpolated age-depth models. 636 pollen taxa were grouped into 22 plant functional types, and combined into seven biomes representing the range of montane ecosystems: from lowland forests, montane forests, to ericaceous and Afroalpine. Results were summarised into 16 time windows at 5000-year intervals from 50,000–20,000 years before present (yr BP) and then in 2000-year intervals from 20,000–2,000 yr BP. Results showed that relatively mesic montane forest biomes were continually present throughout our period of analysis although lower montane biomes expanded around, and after the Last Glacial Maximum (LGM). Montane rainforest expanded from the early Holocene and more open vegetation types expanded in the late Holocene. We see wholescale ecosystem transformations across East African Mountains but with regional responses of vegetation to changing climates.

Holocene environmental change in the Central Highlands of Madagascar shows evidence of ancient open and mosaic ecosystems

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The presence and abundance of open and mosaic ecosystems particularly in the tropic and subtropic lead to confusion and controversies. These ecosystems have been always classified as secondary forests, as is the case in Madagascar, particularly in the central highlands region which is currently dominated by open ecosystems compared to forests. However, there is a misunderstanding about the nature and dynamism of the landscapes in the region and scientific debates are still ongoing. Here we aim to reconstruct the vegetation history, fire frequency and herbivory activities in the Central Highlands of

Madagascar before and after human settlement suggested around 2000 years. Sediment cores were collected in lakes within the region for multiproxy analysis. Pollen and stable carbon isotopes were used to reconstruct vegetation history, while charcoal and coprophilous spores were used for fire frequency and herbivory activities, respectively. Our results demonstrated that the landscapes were characterised by a mosaic ecosystem dominated by a variation of abundance of grasslands, ericoid shrubland and some forest taxa in the last 6000 years. In addition, the record shows the presence of high fire frequency before human settlement in the region. However, an expansion of the grassland ecosystem supported by C4 plant dominance, as shown in the stable carbon isotopes (δ13C) results, was recorded in the last millennium. This change was also associated with high increasing fire frequency and herbivory activities. Consequently, our findings imply consideration of natural open ecosystems that might have been driven by fire for conservation management in the region.

Session #6

Comparison of salt marsh microfossil Regional and Site-Specific Bayesian Transfer Functions for Sea-Level Reconstruction along the South African Coastline

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To predict future sea-level rise, recent trends need to be examined to provide context regarding short and long-term variability. Sea-level records in South Africa have been generated by a range of proxies spanning from ~ 250 000 yr BP, however these records are discontinuous and lack the resolution needed to disentangle natural variability from anthropogenic climate forcing. SA's far-field location eliminates isostatic effects associated with recent deglaciation, reflecting eustatic sea-level behaviour, thus making it an ideal location for Late Holocene reconstruction. The performance if regional and site-specific Bayesian transfer functions based on modern microfossil data from multiple estuaries are compared for sea-level reconstruction along the southern coastline of SA. Sediment cores are chronologically constrained using Bayesian age-depth models based on AMS radiocarbon and Pb-210 dating. The results of the sea-level reconstructions show higher than present sea level occurring between ~1100 and ~500 Cal yr BP, falling to ~0.6 m lower than present sea level at ~ 500 cal yr BP, followed by a rise to present sea level. Model performance shows similar coverage for both the regional and site-specific models, with the site-specific scoring the lowest root mean squared error. The regional transfer function observed vs predicted values display more noise associated with variability between sites when compared with the site-specific approach. We explore state of art methods in high-resolution sea-level reconstruction to shed light on the optimum balance in precision and prediction power.

Sediment transport and bedform development on a narrow, starved, geostrophic-current forced shelf: examples from the Wild Coast, South Africa

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The Wild Coast shelf is characterised by a sandy inner shelf and progressively coarser and sediment starved mid- to outer shelf. High resolution bathymetric and side scan sonar data reveal numerous bedforms including sediment ribbons, subaqueous dunes and comet marks on the mid- to outer shelf These features represent the interplay of geostrophic currents with limited supplies of sediment on the seabed. Extensive, discontinuous dune fields comprising small dunes of fine to medium sand grain sizes occur on the mid-shelf, based on dredge data. Large dunes which are up to 10 x larger, comprising coarse sand and bioclastic gravel grain sizes occur on the outer shelf. The south to south-westward orientations of comet mark tails, the longitudinal axes of sediment ribbons and the lee faces of subaqueous dunes reflects the dominant forcing role of the Agulhas Current. Time-series and morphometric analyses show that the small dunes on the mid-shelf are dynamic and migrate southward along the shelf while the large dunes on the outer shelf are mainly stable or are in varying states of degradation. The dunes reflect a cross-shelf variability in current velocity of the Agulhas Current where finer sediment seems to be more readily transported than coarser sediment. The morphological heterogeneity of the shelf is also considered to influence how sediment is trapped by offsetting the flow path and velocity of the Agulhas Current locally, thereby affecting patterns of sediment accumulation and erosion. This facilitates or impedes bedform stability on the shelf as well.

Coastal sediments record mid-Holocene dynamics of climate, extreme events, sea level, and the human societal response in eastern China

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Muddy coasts downdrift of large river mouths trap fine-grained sediments supplied from these rivers and have provided important settlement sites for prehistoric people, although the evolutionary history of such environments has not been well described. In this overview of a number of well-dated sediment cores from the northern and southern coasts of Hangzhou Bay, we deploy multiproxy evidence, including lithology, particle size, microfossils, organic and alkaline earth metal geochemistry, together with archaeological evidence, to reconstruct climate and sea level changes and their associated societal impacts in the mid-Holocene. Complex interactions between phases of sea level transgression and regression, together with changes in the frequency and intensity of storm events, have prompted significant cultural transitions and adaptations. The integrated record casts light on both environmental dynamics and on the evolution of Neolithic cultures along the coast of eastern China.

Session #7

The palaeoenvironmental development of the Kalkkop impact crater, South Africa: a unique lacustrine record covering MIS 7 and beyond

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The Kalkkop impact crater, located in the contemporary Nama-Karoo desert biome of South Africa, hosted a lake in the past. Surface palaeolake samples have been dated to the beginning of MIS 7 (~250 ka) using U–Th, suggesting the lake deposits may cover glacial termination III. Drill depth reached 89 m, before contact with Breccia occurred, achieving ~80% sediment recoverability. The core is dominated by fine laminations, with some massive deposits. The core was subsampled at an approximately 16 cm resolution and subjected to a host of analyses, including spectrophotometry, magnetic susceptibility, CNS elemental analysis, and grain size analysis. The core can be subdivided in three major and statistically significant sedimentary units, as based on the spectral data, namely Z3: 0 – 1866, Z2: 1881 – 7904, Z1: 7938 – 8735 cm. The I-band index, which isolates the [660, 670 nm] reflectance trough values as produced by Chlorophyll-a and its diagenetic products, revealed low, high, and moderate periods of primary productivity, respectively. Carbonate content is generally highest in Z3 and exhibits a weak correlation with parameter L* (Black/White). Future research will focus on diatom and trace elemental analyses but primarily on a more detailed U-Th chronology, annual layer counting and the generation of a detailed age model. The implications of this new palaeoclimate archive presented here, plus its future age model, are significant given the sites close proximity to the rich archaeological record of early modern human behaviour on the adjacent southern Cape coast.

Charcoal and vegetation from the Early Iron Age site of Ndondondwane, KwaZulu Natal, South Africa

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The Early Iron Age, single occupation site, Ndondondwane in KwaZulu-Natal, South Africa, has charcoal remains from 1 300 to 1 200 years ago. First excavated by Tim Maggs in 1978, then by Jannie Loubser in 1980s, and by Len van Schalkvyk and Haskel Greenfield from the mid-1990s, the charcoal and artefacts represent three Cultural Horizons. The deepest horizon represented by the livestock byre (Dung Area) is dominated by woods of the Leguminosae, identified to six distinguishable species representing the genus previously known as Acacia. These hard, thorny woods were preferentially selected for constructing the byre and providing evidence for the usage of specific woody species for a particular purpose. The second or middle horizon includes a communal area, homestead, charcoal preparation, iron forging, and ivory working areas. Large quantities of charcoal associated with an iron slag pit were found in the upper Cultural Horizon, the abandonment phase. Acacia species remain the preferred wood and further research is in progress to try to distinguish the species. Other woods identified are *Sclerocarya birrea* ssp *caffra*, *Searsia rehmanniana*, *Combretum apiculatum*, *Spirostachys africana* and *Ziziphus mucronata*. These species all occur in the region today.

Pollen Analysis of the Mkhuze Swamps, KwaZulu-Natal, South Africa

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Palynological studies were carried out on Late Holocene core sediments from the Mkhuze Swamp that discharges into the most northern part of Lake St Lucia located in the Indian Ocean Coastal Belt Biome of KwaZulu-Natal, eastern South Africa. The project is part of TRACES (Tracing Human and Climate Impacts in South Africa, coordinated by MARUM, University of Bremen, Germany). The aim is to reconstruct past environmental changes and infer past climate fluctuations during the Late Holocene, as well as human disturbances. The record starts c. 2000yrs BP with the palynological results showing a dominance of Poaceae (grasses, > 80 %) suggesting a predominance of grassland with some woodland and forest elements. The decline in fungal spores, cryptogams, wetland plants as well as *Podocarpus* (yellowwood tree) and other forest elements, with a corresponding increase in the bushveld tree Spirostachys (tambooti) between 1200yrs BP and 450yrs BP indicates a drop in water table and a change from a humid forested environment to a drier open savanna vegetation. The peak of microscopic charcoal around 900 yrs BP suggests an increase in wildfires that may have been caused by the drier climate and/or anthropogenic impact (pre-European human disturbance like shifting cultivation i.e., by Iron Age farmers). The increase in microscopic charcoal, charred cuticles, *Persicaria* pollen, a peak of Amaranthaceae pollen and corresponding decrease in trees and grasses in the last 250 yrs suggest disturbances by the European settlers.

Insights into ancient food systems from organic residue analyses of Early Iron Age ceramics, KwaZulu-Natal, South Africa

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Ancient food systems are often broadly simplified as a dichotomy between foraging and farming, but it is likely that ancient societies followed myriad pathways to full food production. In south-east Africa, the coastal situation of some of the earliest sites associated with first millennium AD farming groups (the “Early Iron Age”, c. 300-1000 A.D.) and the accumulation of shellfish in midden deposits suggests that wild marine resources played an role in the expansion of these groups to new environments. However, poor organic preservation means that we lack detailed information about the subsistence practices of these communities, and how they might have differed from those of subsequent farming groups in the second millennium. Using lipid residue analysis, we investigate the molecular traces of foods preserved in the matrix of ancient cooking pots from five Early Iron Age sites in KwaZulu-Natal, South Africa. We assess evidence for key dietary resource groups (e.g., aquatic, dairy) at sites situated both close to the coast (e.g., Enkwazini, Mzonjani) and in the river valleys leading to the interior (e.g., Kwagandaganda, Inanda Quarry) and across several occupation facies that together span the first millennium AD.

Machine learning to identify woody plant species represented in the archaeological charcoal record

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Current methods for identifying archaeological charcoal are tedious and time consuming, relying heavily on specialist involvement to identify preserved micro-anatomical wood features. Machine learning (ML) could leverage the power of computing to recognise and identify the patterns in charcoal images. Image recognition technology is increasingly used today for facial recognition, medical diagnoses, and even identification of art works. The software required for ML systems is now widely available and some are free for academic purposes. A site specific modern charcoal reference collection will be used alongside ML and image recognition technology to expedite and standardise archaeological charcoal analyses. The expected outcomes will include an online, modern charcoal reference database and methodological improvement in both efficiency and accuracy of archaeological charcoal identification. These benefits surpass just identifying the woody species used by past cultures. By including supplementary information such as GPS co-ordinates and calculated ages of the samples, it will be possible to build up regional palaeovegetation maps and gain insight into environmental and climate shifts over time and potential human adaptation to this as evidenced by the species represented at different stages. Utilising ML technology, it is possible to develop a reference collection of localized species that can then be applied to any assemblage from that area. The system is also inherently scalable as more samples can be added. The open-ended nature of this project also means that the methodology can be developed for research locations anywhere in the world, studying any time period.

Session #8

Southern African monsoon region climate at the termination of the African Humid Period

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Evidence capable of characterising the nature of climate variability in the Southern African monsoon region (SAMR) across the termination of the African Humid Period is limited by a spatially and temporally discontinuous regional dataset. Here, we describe a 6680 year long δ15N record obtained from a rock hyrax midden from southeastern Africa. Reflecting changes in water availability and predominantly resolved to sub-decadal resolution, the results provide a detail reconstruction of regional hydroclimates since the beginning of the mid-Holocene. A long-term – albeit subtle - increase in humidity consistent with precessional forcing is observed, but the record is dominated by a strong ~1750-yr cycle, a signal that is shared with other SAMR records. The existing data and synthesis compiled suggest that changes coincident with the termination of the African Humid Period at ~5500 cal BP do not express the abrupt transition observed in some records from the northern African tropics, but rather indicate gradual changes, as observed at peri-equatorial sites. Notably, however, eastern and western subregions of the SAMR experience a phase shift beginning at ~5500 cal BP, with intially in-phase hydroclimate anomalies transitioning to the establishment of a strong east-west dipole. This likely reflects equatorward displacements of the Congo Air Boundary as a result of factors associated with increasing (decreasing) austral (boreal) summer insolation, highlighting the distinct

nature of southern African responses across this key period of African climate history.

Using bomb 14C to write the biography of bones

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One of the frontiers in isotope-based dietary reconstruction is finding ways to improve the resolution of the signals measured. Bone, as a tissue that continues to form throughout life, has generally been considered to average out diet and behaviour over long periods of the organism's life. Here, we use the "Bomb Curve" (the anthropogenic increase and subsequent decrease in atmospheric radiocarbon from the 1950s to the present day) to determine the turnover rates of bone collagen from multiple locations in the same skeletons, obtained from the University of Cape Town Department of Human Biology. This replacement, or turnover, is not consistent throughout the skeleton, so that different skeletal elements (and parts thereof) record diet at different stages of life. The implications of this are wide-ranging. They include the possibility of reconstructing dietary changes over an individual's lifetime, with possible application in both archaeology and forensics. A recent study by Hyland et al. (2021) claimed that a Euclidean difference greater than 1.5‰ in the δ13C and δ15N of collagen from unidentified bone fragments reliably distinguish different individuals. This is not necessarily true, especially for species with omnivorous diets such as humans. In this study, intra-femoral variation in δ13C and δ15N is 1.2 to 3.1 ‰. The methodology used for this study and some initial results will be presented.

Speleothem U-Th-Pb, pollen and charcoal reveal cave antiquity and fossil accumulation window: a Naracoorte Caves case study

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Caves are important fossil repositories providing records extending back over million-year timescales. While the physical processes of cave formation are well understood, a more important parameter to studies of palaeontology, palaeoanthropology and archaeology — that of the timing of initial cave development and opening — has proved more difficult to constrain. The Naracoorte Cave Complex (NCC) in southern Australia is a World Heritage site with a rich record of Pleistocene vertebrate fossils, including extinct megafauna, and serves as a natural laboratory in which to investigate these fundamental cave processes. Using U-Th-Pb dating of speleothems we show that the NCC is at least 1.32 million years old, extending the current understanding of initial speleothem formation by ~70% and the antiquity of initial cave development at this site by at least ~20%. We use charcoal and pollen trapped in the same speleothems to place robust constraints on the timing and extent of subsequent cave opening.

The findings of this study provide an important means for researchers working on the plethora of fossil-rich sites worldwide to assess the potential upper limit of vertebrate fossil records within caves.

Submerged Palaeolandscapes of the Southern Hemisphere (SPLOSH) network

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The INQUA-supported SPLOSH network (Submerged Palaeolandscapes of the Southern Hemisphere) aims to increase awareness of submerged landscapes in the Southern Hemisphere, and help provide a platform for scientific exchange and interdisciplinary collaboration to strengthen the importance of research in this region. The potential of submerged palaeolandscapes to address questions about global migrations, broad-scale climate and landscape change and human response to this has, to date, been more strongly concentrated in the Northern Hemisphere. The Southern Hemisphere has less land, more water and water barriers, higher floral and faunal endemicity and lower population but with indigenous populations that have maintained a connection with coastal and offshore landscapes for at least 40,000 years in Australasia and almost 170,000 years in South Africa. In this talk, we provide an overview of current knowledge in South America, Southern Africa and Australasia with particular reference to South Africa. We explore how new palaeogeographic and palaeoecological research, alongside related coastal archaeology, is helping to map out future directions for submerged cultural landscape research in these regions. A common theme across is the need to raise awareness of submerged cultural resources and indigenous knowledge of these as well as the multi-disciplinary approach needed to understand the unique landscapes in which they are preserved.

People and the Sea in Mpondoland: An analysis of Culture, Provisioning and Accessibility to Ocean and Coastal Services

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South Africa is positioned at the interface of three oceans, namely the Indian, Atlantic and Southern/Antarctic Ocean with roughly 3000km of coastline running from the Namibian border to the Mozambique border. Along this coastline there are many indigenous/local communities with varying ocean cultures and knowledges. This research will examine the cultural use and value as provided by the ocean by making use of Mpondoland coastal communities as a case study. The research is a multi-sited ethnographic study which seeks to engage with elders, youth, and different government and non-governmental institutions regarding their perceptions of the coast.

Indigenous knowledge systems informing an adaptive estuary management: The socio-cultural

dynamics of the Sundays River Estuary

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Although there have been research conducted on estuary management and the ecological dynamics of estuaries in South Africa, there is less of a focus on the socio-cultural dynamics of estuaries which informs strategies of sustainable adaptive management. That is, only a few, and far between, studies have attempted to highlight how estuary users are (or could be) involved in the management of estuaries. Therefore, this research aims to cover the primary socio-cultural dynamics of the estuaries in terms of its uses and management by making use of the Sunday's River Estuary in the Eastern Cape, South Africa as a case study. This study employs an embedded, qualitative research approach to explore experiences, values and knowledge systems around the Sunday's River Estuary by using semi-structured interviews. The use of this approach allows for both a complex and holistic understanding of the perceptions of estuarine management and governance and how they community plays a role in such. The study illustrates that community involvement in the management of estuaries and an indigenous knowledge systems-based policy are required for the sustainable use and management of these socio-ecological systems.

Poster Presentations

Revisiting the dendroclimatological potential of Afrocarpus falcatus, South Africa

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The long-lived evergreen conifer *Afrocarpus falcatus* has been shown to have dendrochronological potential, however, complex tree-ring structures have hampered further research on the species. Hall (1976) produced a classic South African tree-ring width-based rainfall record using an *Afrocarpus falcatus* museum specimen from the Karkloof Forest in KwaZulu-Natal, South Africa. Despite wide and increasing application of this palaeoclimate rainfall record, the dendroclimatological potential of this species has yet to be fully explored, nor has the associated climate environmental forcing been validated. The aim of this research was to investigate tree-growth climate relationships and to develop a modern analogue for *Afrocarpus falcatus* in the Karkloof Forests. Twenty trees were sampled from the Karkloof Forests, but due to ring-width eccentricity, only a limited number could be used to develop a ring-width and ring stable carbon isotope based mean chronology using classical methods. When tested against instrumental climate records, temperature, not rainfall, was found to be the most important variable driving tree growth. Ring δ13C series were shown to be unaffected by compression and ring-width eccentricity, requiring a much smaller sample size than the ring-width analysis. Where annual rings can be correctly identified, and an adequate number of samples crossdated, ring δ13C series of *Afrocarpus falcatus* can potentially provide a reliable proxy for temperature. Dendroclimatological studies of *Afrocarpus falcatus* therefore have the potential to make an important contribution in a region where reliable palaeoclimate records are limited.

A set of 18 new lithostratigraphic geological maps covering the Maputaland region

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The revised set of 18, 1:50,000 scale lithostratigraphic geological maps to be published by Council for Geoscience delineate littoral marine, aeolian and alluvial sediments on the Maputaland coastal plain. Previous geological mapping in the mid 1970's utilized Cenozoic lithostratigraphic units that were mostly derived from studies around the Durban and Richards Bay areas. Geological mapping since 1997 characterised the Maputaland Group units (Botha, 2018) which also take into account the differential pedogenic weathering effects on the sediment. The Maputaland coastal plain evolved in response to orbitally driven, glacio-eustatic sea-level and climate changes superimposed on the epeirogeneic uplift of the continental margin. A pulsed marine regression spanning the middle Miocene and Pliocene epochs (~12–2.5 ma) deposited strandline sediments across the marine planed Cretaceous bedrock surface. Littoral marine and beach sediments overlain by coastal barrier dune sands (Uloa-/Umkwelane Formations) occur up to 70 km from the present coastline but lie buried by up to 80 m of younger dune sands under most of the coastal plain. Reworking of these sands during the middle to late Pleistocene (~350-75 ka; IRSL dates, Porat and Botha, 2008) created the extensive Kosi Bay Formation dune landscape and the Port Durnford Formation estuarine argillaceous sediments. During the terminal late Pleistocene and Holocene (~60-7 ka) this dune landscape was reworked through mobilization of the KwaMbonambi Formation parabolic dunes. Dune mobilization against the aeolianite core of the coastal barrier dune cordon during the Holocene led to the formation of a series of Sibayi Formation accretion ridges.

Re-interpretation of the Cenozoic lithostratigraphy of the Maputaland coastal plain: Integration of field mapping and high resolution airborne radiometrics

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The lithostratigraphic maps covering the Maputaland region were derived using a combination of relative-age relationships, terrain morphology and differential weathering effects, supported by luminescence dating, to delineate at least ten generations of aeolian sand. The high resolution airborne gamma-ray spectrometer radiometric survey across the Maputaland region covered 35,720 line kilometres with a spacing of 200 m and 80 m sensor ground clearance. The K, U, Th and total count (TC) radiometric data show significant variance from Maputaland Group lithostratigraphic mapping units of Formation status, particularly when these are derived from pedogenically weathered protolith. This is probably due to sand source area variations caused by deflation lag effects and is compounded by pedogenic weathering, expansive seasonal wetlands and possibly even leaf litter organics concentrated in densely wooded areas. Deeply weathered Neogene strandline deposits have a "Very High" U-signature. Calcified Muzi Formation smectitic alluvium ("High" U) contrasts with the surrounding Kosi Bay dune sands ("Medium" K+Th). The Tshongwe parabolic dune plume blown north from the Mkhuze floodplain ("High" Th+K) is readily distinguished from the other KwaMbonambi Formation parabolic dunes ("Low" Th;

"Medium" K+Th) to the east. Inland from the Sibayi Formation coastal barrier an anomalous zone of "High" U signal or "Medium" K+Th values defines a distinct KwaMbonambi Formation dune system that was active during the period from ~14 – 8 ka. In the south, the elevated U values point to a sediment source from the formerly exposed northeastern shallows of lake St Lucia, close to the Mkhuze swamps confluence with the lake.

Drivers of Recent Rates of Gully Expansion, Eastern Cape, South Africa

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Late Quaternary dispersive colluvial soils of the Eastern Cape, are highly susceptible to gully incision. Mapping within three quaternary drainage catchments around Mthatha showed that 2.3% of the area is affected by rill and gully erosion. Additional multi-temporal spatial analysis of 25 gullies over an 82-year period (1938-2020) revealed an average lateral expansion rate of 0.2 m/y-1, an average headcut expansion rate of 1.03 m/y-1 and an annual areal increase of 2.8%. Although erosional features are expanding, they do so at fluctuating rates. Annual percentage growth rates range from 3.9% between 1938-1948 to 0.7% between 2017-2020. Both static topographic conditioning factors and the combined temporal change in the state of dynamic drivers holistically control gully expansion. Rapid expansions are directly linked to large scale flooding events during drier climate cycles. These periods of increased erosion are exacerbated by invasive dryland agricultural practices with poor runoff control, inappropriate land use and haphazard settlement and infrastructure development. Indirectly the susceptibility to gully erosion within the former Transkei homeland was further compounded by the legacy of Apartheid settlement laws. Progressive expansion of gullies, exert a substantial environmental and socio-economic impact on the sustainable development of the region. Understanding the severity, mechanisms and rate of gully expansion in relation to erosion drivers aim to guide stakeholders in making informed decisions on future infrastructure development, land use planning and environmental management of the area.

Algoa Bay seaweed diversity and thermal shock responses

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Global warming and climate change have caused in the increase in intensity and frequency of marine heatwaves experienced along the coastlines of South Africa. The diversity of seaweeds within Algoa Bay is unknown presently. The responses of seaweeds in the bay to thermal shock is also unknown therefore it cannot be said whether some species of seaweed may survive extreme marine events such as marine heatwave.

Research-led community engagement in the palaeosciences: A case study presenting a Science Spaza educational comic and activity worksheet, and supporting short videos

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Research-led community engagement in Science Technology Engineering and Mathematics (STEM) subjects are a priority of the national research agenda in South Africa, with science engagement forming a component of research project proposals funded by the National Research Foundation (NRF). We developed an educational graphic novel and activity worksheet as an outreach component of a postgraduate summerschool funded by the German Academic Exchange Service (DAAD) in 2021. A diverse group of African and European geoscience postgraduate students from ten countries helped to brainstorm ideas and a storyline for the worksheet. The worksheet, on sedimentary archives used for palaeoenvironmental analysis, was developed in collaboration with Jive Media Africa following the Science Spaza 4-page formula of: comic, hands-on activity, professional profile, and reinforcing activity. The worksheet was distributed via the Science Spaza network to >140 science clubs at secondary schools across South Africa in July 2022. The worksheet was translated into isiZulu and isiXhosa to improve language accessibility, and is freely available online via a creative commons license. A competition was used to assess levels of engagement with learning materials and activities. Three short semi-animated videos filmed during the summerschool were professionally produced by Jive Media Africa, and used to reinforce concepts introduced in the activity worksheet. The Science Spaza worksheet proved an effective vehicle for promoting the palaeosciences and associated research methods to a wide audience. Furthermore, by drawing on creative inputs from a diverse group of students and translating to indigenous languages, we were able to improve language accessibility and cross diversity barriers.

Using an 8000-year-old fungal spore record from Whale Rock wetland to assess changes in herbivory along the southern Cape coast of South Africa during the Holocene

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Herbivory and anthropogenic land-use patterns such as agriculture and pastoralism are some of the main drivers of ecological disturbance. Quantifying and understanding these drivers allows for more cognisant conservation management decisions to be made, especially in the Cape Floristic Region, a global biodiversity hotspot. Coprophilous fungi give an independent indication of herbivory and herbivore existence that may be directly connected to the vegetation record in which they are found. Spores from coprophilous fungus are one of the most utilized non-pollen palynomorphs for this reason, as well as the fact that they are easily identifiable and remain well preserved in fossil records, even at the basal age of sediment cores. This study investigates the abundance and presence of coprophilous fungal spore taxa in sediment samples from Whale Rock wetland, Plettenberg Bay, to infer herbivory. The integration of the resulting fungal spore data together with geochemistry data from Whale Rock wetland and archaeological evidence from Nelson Bay Cave serves as a powerful tool to gain a perspective on herbivore presence as well as the impact of herbivory in this area during the Holocene, with a peak in fungal spore concentrations at ~7000 cal yr BP. Further research is needed to strengthen the

results of this study, which can be done by additional proxies (i.e. pollen) being added to the already multi-proxy approach used for this study.

Establishing connections between contemporary vegetation distributions, modern pollen representation and the fossil pollen record in the Cape Floristic Region

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The primary aim for this project is to generate calibration data for the southern Cape coastal region. Many fossil pollen records exist for this region, but no modern pollen studies have been conducted. Therefore no calibration data exists which can be accurately applied to palaeoarchives from the region. The calibration data generated by this study will be applied both to future sediment cores from the region and retrospectively to past sediment cores to improve their interpretations. Passive pollen traps were placed within different vegetation types to record pollen for a full year at two study subregions - one from the southwestern Cape (Pearly Beach) and one from the eastern boundary of the Cape Floristic Region (the Nelson Mandela University Reserve). The data from the NMU Reserve will be combined and contrasted with data from an active pollen trap situated on NMU's Ocean Science Campus, which has been collecting data for over two years as part of the South African Pollen Monitoring Network's ongoing national allergy study. Vegetation surveys conducted in each vegetation type (using an adapted version of the Crackles Project vegetation recording field protocol described in Bunting et al, 2013) will be combined with the passive pollen trap data to determine the taphonomic characteristics of dominant taxa, which will be applied to fossil assemblages to provide improved quantitative reconstructions of past environments. As an additional measure, pollen from soil samples collected around the passive pollen traps will be compared to the data from the traps themselves, to determine which is more representative of fossil pollen assemblages obtained from sediment cores.

Assessing herbivory impacts in the Baviaanskloof during the Holocene using coprophilous fungal spores from hyrax middens

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The Holocene epoch is believed to have conditions that are stable on a geological scale, and can sustain most of the life on earth. However, the recent influence of human activities and climate change on the environment has affected ecosystem functions negatively. A comprehensive understanding of these ecosystem structures and functions is required in order to introduce or implement conservation plans on these ecosystems. Palaeoecological studies can be used as a tool for these management plans, since it provides valuable spatial and temporal information. This study used coprophilous fungal spores (CFSs) from a hyrax midden from the Baviaanskloof (eastern interior subregion of the Cape Floristic Region) in order to identify past herbivore activity over the last 1200 years. The CFS data was compared to the pollen data produced by Quick et al. (in prep) from the same midden. Interesting results were

observed from the data, which shows that these types of analyses could potentially provide a substantial amount of information to aid in land management and conservation plans. Further research needs to be done in order to provide more environmental and archaeological contexts.

Using Salt Marshes to Understand Long-Term Sea-Level Variability on The Berg River Estuary on the western coast of South Africa

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The rate of mean se level rise is increasing and is projected to increase through the 21st century and beyond. For coastal management planning at the local level, accurate prediction of the likely and conceivable future regional patterns of sea level changes are essential. This research aims to reconstruct long-term sea-level variability along the south African western coast using marine microfossils preserved in salt marsh sediments from the Berg estuary. Downcore saltmarsh foraminiferal assemblages will be counted. Developing training sets using modern sediments and environmental samples to obtain the relationship between proxies and elevation. Transfer function approach will be used based on the Vertical Zonation concept relating distribution intertidal modern salt-marshes foraminifera to fossilised assemblages. Accelerated mass spectrometry (AMS) radiocarbon dating will be combined with short-lived radionuclide age-depth models for selected sediment cores. The sea-level reconstruction will be compared with published data to produce a late Holocene seal-level curve for South African western coastline. South Africa as far-field located from the ice masse, it is very important to study sea-level as it is sensitive and vulnerable to ice melt effects. Understanding sea-level changes will help refine future sea-level projection, therefor be able to update coastal managements and reduces vulnerability in coastal regions.

A study of the palynological differences between two dominant Asteraceae species within the southern Cape: *Osteospermum moniliferum* and *Metalasia muricata*

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The Asteraceae family is one of the largest contributing plant families in terms of the number of taxa found within southern Africa. Their presence and role within the South African biomes can give indication to the surrounding vegetation structure and abundance that can be expected within the local biomes. However, when it comes to looking for them in the fossil records, identifying them to a species level is seldom achievable due to the lack of a refined classification method. This project seeks out to create such a classification method that can be used to differentiate between Asteraceae within the pollen records, namely between the *Osteospermum moniliferum* and the *Metalasia muricata*. The results of this project found three pollen morphology types that can be used to differentiate between the two selected species, namely the number of spines found between each colpi, the size of the pollen grains, as well as the length of the spine tips. The aim is that this knowledge will aid in extracting more significant ecological information from existing pollen records and aid in recreating more accurate layouts of the palaeoenvironment.

Reconstructing the fire history and palaeoenvironment at Thyspunt, southern Cape coast, Eastern Cape

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Palaeoenvironments can play a crucial in the management and conservation of biodiversity and landscapes. The Eastern Cape coastal region forms a part of the great Cape Floristic Region (CFR). Its ecology and environmental history are understudied. A better look at the palaeoenvironments of the Eastern Cape as a subregion of the CFR through fire reconstruction and sediment analysis is necessary. The need for fire reconstruction is because the dominant vegetation is fire-dependent, and the general study area's vegetation is shaped by fire. The fire regimes for this study will be reconstructed using sedimentary micro- and macrocharcoal fragments. Sediment analysis based on loss on ignition and particle size analysis will provide a better insight into the geological and geomorphic setting, climate history, and sediment properties of the area. Thus, giving a comprehensive detail of the palaeoenvironment of Thyspunt.

Holocene Reconstruction of vegetation and fire history, Lake Futululu, northern KwaZulu-Natal

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This study investigated a Holocene palaeoenvironmental record from South Lake Futululu, a blocked valley lake in the Mfolozi-Msunduze catchment, northern KwaZulu-Natal. A multi-proxy approach was applied, combining accelerator mass spectrometry (AMS) radiocarbon and optically stimulated luminescence (OSL) dating, with fossil pollen and charcoal analysis to investigate Holocene climate and vegetation change. The record commenced ca. 7600 yr BP with a dominance in pollen from local reed sedge wetland taxa with the presence of prominent grasses and low abundance of tree taxa. This early phase was followed by a pollen preservation hiatus from ca. 6600-5900 yr BP. The Mid Holocene (ca. 5900-4900 yr BP) saw an environmental transition with the appearance of key coastal forest taxa like Podocarpus, Celtis and Trema and swamp forest taxa like Barringtonia, Ficus, Morella and Syzygium, high in abundance, which lasted well into the Mid Holocene inferring wet conditions. This was followed by a coastal forest retreat during the latter part of the Mid Holocene transitioning to the Late Holocene (ca. 1200-300 yr BP). This period inferred an interesting linkage with the charcoal data indicating a clear shift from grassy (W/L: 0.5) fuel type. The Late Holocene presents a clear indication of a retreat in forest taxa and a shift to coastal grassland thicket inferring dry conditions during last ca. 300 yr BP. The South Lake Futululu record falls under the understudied Mfolozi-Msunduze catchment hence extending the existing knowledge of paleoenvironments in the subregion.

Phytolith size as indicator of grass leaf width: a potentially new method for inferring past environmental conditions.

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In the Poaceae, production of morphologically distinctive phytoliths occurs in specialized, silica-accumulating short cells located in the epidermis, and although these morphotypes are not mutually exclusive, it is recognized that overall predominance in production of certain shapes are primarily linked to photosynthetic pathway, growing season temperatures and precipitation, and therefore useful for inferring certain palaeo-environmental conditions. Recent studies on global distribution of grass leaf size and shape show meaningful association between leaf width and climate, where leaf width positively correlates with mean annual temperature (MAT), mean annual precipitation (MAP) and aridity. Increases in leaf width and length in particular, occur in response to greater moisture availability and lower levels of solar irradiance. Thus, significant correlation between increase in leaf width and phytolith size could provide an additional method for inferring conditions associated with moisture and precipitation in grassy environments. To test this prediction, I analysed outer periclinal surface measurements of two different phytolith morphotypes common in both C3 and C4 species (n = 25). Results are discussed, including future directions for research in this field.

Recent landslide mapping in the eThekwini region, KwaZulu-Natal, South Africa.

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The presence of hummocky topography in various hillslopes suggests that mass movement caused by slope failure is a primary geomorphic mechanism driving landscape development in KwaZulu-Natal. In recent times intense and/or prolonged rainfall events have triggered numerous landslides in many hillslope areas, cumulatively these landslides have been responsible for large social and economic losses. A review of previous studies has revealed that up-to-date landslide inventory mapping is imperative for computing landslide susceptibility, hazard and risk. This study aims to produce a comprehensive, up-to-date landslide inventory map of the eThekwini region. The current landslide inventory mapping focuses on slope failures that have transpired during the high rainfall events of April 2022. The employed methodologies for the inventory mapping include visual interpretation of remotely sensed high-resolution post-event MAXAR imagery and field verification investigations. The initial phase of the landslide inventory mapping has highlighted the following: • The spatial distribution of slope failure events is widespread. • Landslides transpired in a range of geological units with an increase of landslide activity in areas associated with arkosic sandstones of Natal Group and Berea 'red' sands. • Landslide activity across the region varies in terms of landslide movement, material types, sizes and depth. • Slope failures are more often associated with steep hillslopes or embankments. Landslide mapping in the region has suggested that landslides are related to an interplay of various factors, these include geological, topographical, environmental and anthropogenic factors. Preliminary observations support the suggestion that landslides are important drivers in landscape development.

Evaluating environmental drivers of late Quaternary mammal extinctions in the Cape Floristic Region, South Africa

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The role of human impacts and climate change in driving late Quaternary megafaunal extinctions across the globe is widely debated. In the context of African extinctions, the rich paleontological, archaeological, and paleoenvironmental records from South Africa's Cape Floristic Region (CFR) provide a rich dataset for evaluating extinction drivers. Faunal assemblages from the CFR document multiple extinctions since the end of the last glacial maximum (LGM), including *Antidorcas australis*, *Megalotragus priscus*, *Syncerus antiquus*, and *Equus capensis*. There is general agreement that environmental changes played at least some role in these losses, but the precise environmental drivers and the degree of paleoenvironmental change needed to drive species to extinction are unclear. Here, we examine the ecological tolerances of present-day species to address these uncertainties. Leveraging ensemble machine learning models, we predict species occurrences of modern African mammals to examine how aridity and woody cover relate to the probability of a species occurrence in present-day southern Africa. This provides a framework for evaluating how paleoenvironmental changes since the LGM are likely to have impacted the suitability of habitats for both extinct and extirpated species. Examining extant species that have become extirpated from the CFR (*Connochaetes gnou* and *Redunca arundinum*) and various analogs for the extinct species, we find little consistency in how species respond to changes in aridity or woody cover. It follows that additional environmental variables or anthropogenic impacts should be considered as causes for extinctions.

The landscapes of Sibudu and Border Caves, South Africa, at the time of the youngest Toba super-eruption and a thousand years later

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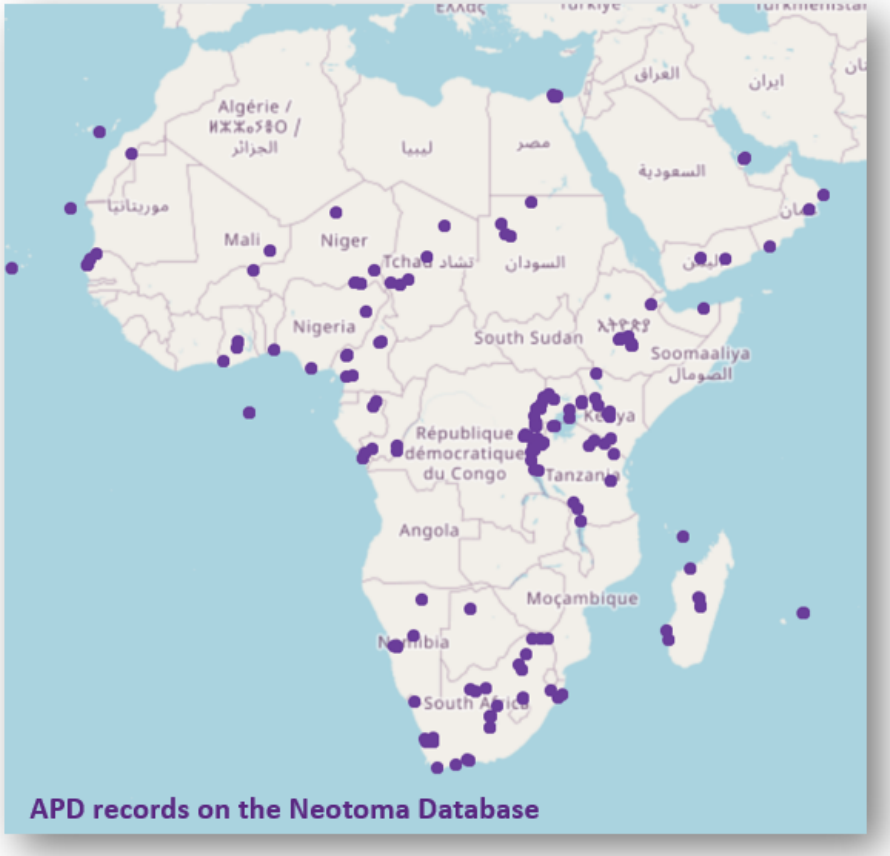
The debate about the impact of the youngest Toba volcano super-eruption on global climate has not received much attention from southern Africa; however, this has changed following the discovery of volcanic ash from this eruption at Pinnacle Point cave 5-6, South Africa. We, therefore, investigated if a 'volcanic winter,' that is commonly associated with this event, was present in south-east Africa between 74 and 72 ka. We assessed if extreme stressful conditions affected the growth of woody vegetation and wood use, based on archaeological wood charcoal. We analysed wood charcoal from Sibudu and Border Caves, two important archaeological sites that have evidence for the continuity of life across the estimated time of the eruption. We identified different types of forests around the two caves, all of which require plenty of moisture to thrive. At Sibudu Cave, there was, predominantly, Afromontane and Scarp Forests with Savanna vegetation, while the Border Cave's landscape had mostly Savanna, Montane Forest and Grassland woody species. Additionally, there were warm and humid conditions at Sibudu, which persisted between 73 and 72 ka, based on a range of active fungi in the wood. Our results suggest no evidence for an extended and catastrophic 'volcanic winter' in KwaZulu Natal. This may be due to a stronger influence of local climate drivers, which prevented the full impact of the Toba super eruption from overwhelming the southern African ecosystem. This ensured the continued supply of woody plant resources for people who inhabited the landscape including at Sibudu and Border Caves.

AFRICAN POLLEN DATABASE

The APD is an international network, which supports the development of scientific research in Africa in the field of past environmental and climate change.

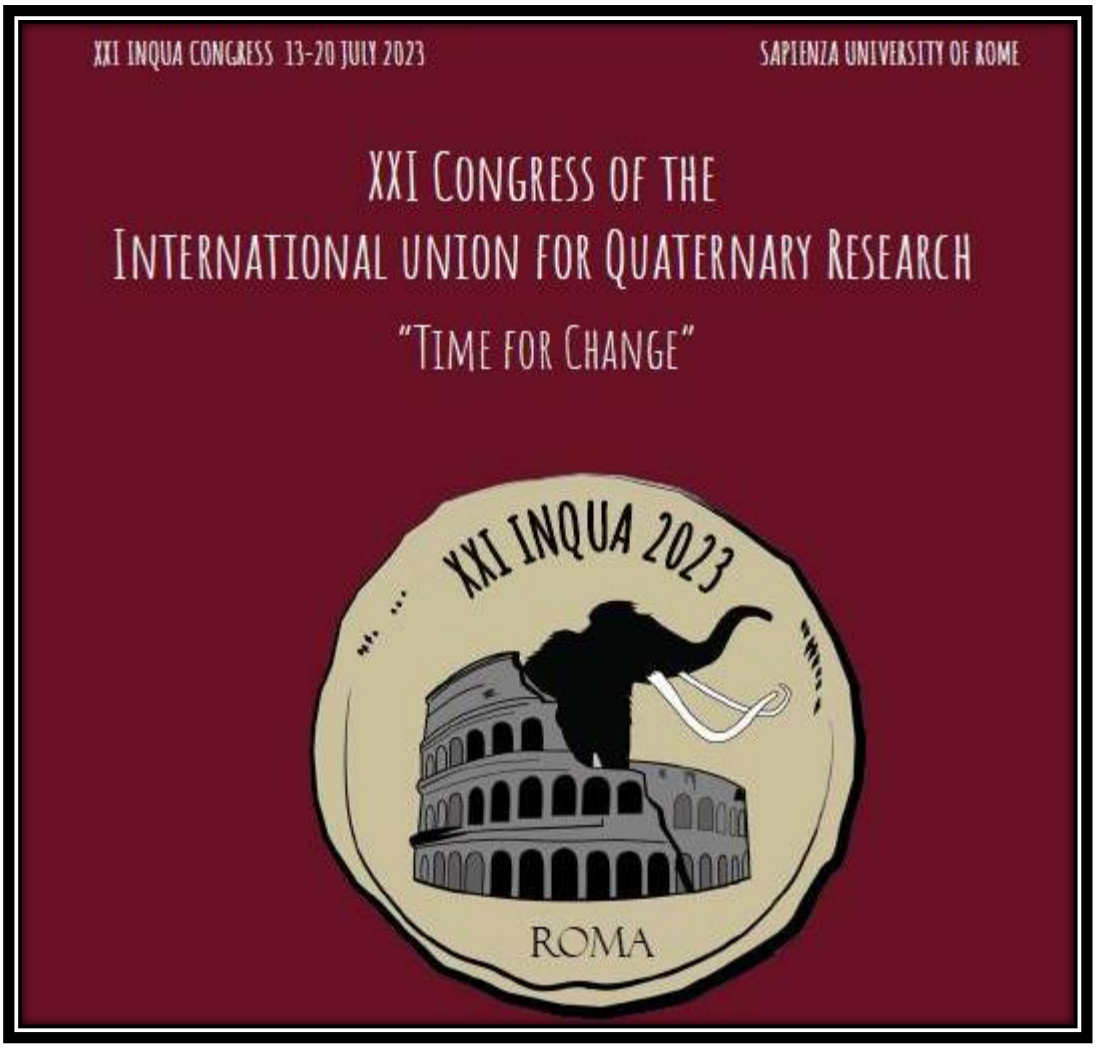
Contribute your pollen data
to this open-source database to ensure archiving, exposure and integration into the wider scientific community.

Contact the southern African APD data stewards:
Jemma Finch [Finchj@ukzn.ac.za]
Lynne Quick [lynne.j.quick@gmail.com]



APD records on the Neotoma Database

https://www.neotomadb.org/ | https://africanpollendatabase.ipsl.fr/#/home



– Session 64: Mapping Ancient Africa: Climate, Vegetation & Humans

Conveners:
William Gosling, University of Amsterdam, Netherlands, w.d.gosling@uva.nl, (lead convener) Stephanie Kaboth-Bahr, University of Potsdam, Germany Rahab Kinyanjui, National Museums of Kenya, Kenya Lynne Quick, Nelson Mandela University, South Africa Sarah Ivory, Penn State University, USA

Scientific theme: 3A: Geological and climate forcing on ancient societies and feedbacks

INQUA commission(s):
PALCOM-Palaeoclimates; HABCOM-Humans & Biosphere

Abstract: Great uncertainty exists surrounding the link between climate change and hominin evolution, cultural development, and dispersal in and out of Africa. Several hypotheses have been proposed about how environmental conditions in Africa might have driven important developments in human origins over the last 4 million years. These findings link important evolutionary events with environmental change including cooling, drying, and wider climate fluctuations over time. However, key questions remain on the type, speed and driver of climate variability in Africa and how it affected evolution and development, e.g., did changing environment affect resources which consequently lead humans to develop new tools, why did so many early hominin species persist, evolve and/or go extinct, why did our species (Homo sapiens) emerge and survive, and how have we shaped our own environment either intentionally or unintentionally? In this session we look to bring together researchers focused on reconstructing past environments in Africa on the basis of empirical data (palaeoclimatic, palaeoecological, archaeological records) with researchers using modelling approaches (climate, vegetation, dispersal and cultural models). We hope to stimulate research and debate on how past change (climate, ecological, behavioral) shaped modern humans and the role of human niche construction on African environments. This session is linked to the INQUA "Mapping Ancient Africa" project, but we welcome all submissions.

https://inquaroma2023.org/

DELEGATES

Linus Ajikah

Marion Bamford

Jean Baverstock

Greg Botha

Hayley Cawthra

Brian Chase

Manuel Chevalier

Debbie Claasen

Selina Clark

Abraham Dabengwa

Larisa DeSantis

Angela Effiom

Talia Enoch

Tyler Faith

Jemma Finch

Marishka Govender

Patricia Groenewald

Vincent Hare

Trevor Hill

Erin Hilmer

Busisiwe Hlophe

Alisoun House

Kelly Kirsten

Tumi Langa

Bayanda Laqwela

Emma Loftus

Julie Luyt

Tim Maggs

Megan Malherbe

Sashan Manikam

Saul Manzano

Nandipha Masemula

Mike Meadows

Stella Mosher

Nozizwe Mtshali

Luke Nel

Frank Neumann

Asithandile Ntsondwa

Tariye Onyeogu

Naomi Porat

Gemma Poretti

Lauren Pretorius

Lynne Quick

Fetraharimalala Randriatsara

Andriantsilavo (Tsilavo)

Razafimanantsoa

Estelle Razanatsoa

Salona Reddy

Leesha Richardson

Lloyd Rossouw

Judy Sealy

Rebekah Singh

Kathryn Sokolowski

Deano Stynder

Sue van Rensburg

Joshua van Schalkwyk

Rieneke Weij

Athabile Xuba

Bongekile Zwane

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