

SASQUA 2024



XXIV Biennial Congress CANGO VALLEY, SOUTH AFRICA

*Exploring the links between humans, climates,
and environments through the Quaternary*



@sasqua



@sasqua1

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Welcome

On behalf of the organising committee, we welcome you to the 24th biennial SASQUA 2024 Congress. We trust you will enjoy this meeting in the Cango Valley, southern Cape.

Venue

Old Mill Country Lodge, Seasonal Working Ostrich Farm & Restaurant

<https://oldmillgardenroute.co.za/>

Presentations

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

Posters: Posters need to be A0 portrait orientation. There will be two poster sessions, where presenters will have 3 minutes to introduce their work, these will be held on Monday and Tuesday afternoon.

Lunches

Lunches are included for registered delegates.

Social Functions

Sunday 19th May from 16h00: Registration and Ice breaker at the Cango Caves Estate

Thursday 24th May 18h30: Conference dinner - Spitbraai (informal dress) at Cango Caves Estate

Field Excursion

Thursday 24th May: Cango Caves and Boomplaas Tours

In the morning we will visit the iconic Cango Caves (<https://www.cango-caves.co.za/>) and spend the afternoon at Boomplaas Cave where an active excavation is taking place, led by Dr Justin Pargeter (New York University). This part of the day provides a rare opportunity to hike up to the site and see the exposed stratigraphy.

Local Organising Chair:

Dr Lynne Quick

Nelson Mandela University



We sincerely thank GENUS for their generous support.



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The Boomplaas Project

The late Prof. H.J. Deacon led excavations at Boomplaas Cave from 1974 to 1979 as part of a broader effort to understand the effects of Quaternary paleoenvironmental change on human behavioural evolution in the southern Cape. The project included excavating Klasies River and several smaller sites between the coast and the Cape Fold Mountains. H.J. Deacon selected the site for investigation because its unique geological setting in a karstic cave held the hope for good organic preservation. The team's efforts uncovered a rich sequence of floral and faunal remains spanning the last >65,000 years. This rich archive enabled pioneering multi-disciplinary palaeoenvironmental research with many of today's more common methods, including anthracology, palynology, micromammalian studies, and sedimentology, all having some of their first southern African outings at the site. Over the last four decades, a substantial body of research has drawn from this evidence to reconstruct ancient plant and animal communities, inform on climate dynamics, and evaluate how human populations responded to environmental changes through time.



In 2015, Justin Pargeter led efforts with the generous support of the PAST and Leakey Foundations to rehabilitate the site's aging and badly damaged excavation infrastructure. The work included rehabilitating the site's scaffolding, hauling thousands of sandbags to the site, and installing a "baboon proof" fence across the cave mouth. All of this work was guided by the great expertise of a local retired engineer, Mr Herman Nortjie, and his team. In 2020, Tyler Faith and Brian Chase joined efforts to revive research at Boomplaas Cave through funding from the US National Science Foundation focused on developing a high-resolution framework to define human-environment interactions. The project tests the hypothesis that changes in climate and environment drove the Middle to Later Stone Age transition. Over the past four years of work, they have built on H.J. Deacon's pioneering research program at Boomplaas to update the site's depositional and chronological context and to integrate a growing archive of increasingly high-resolution hyrax midden records into a new framework for studying human behavioural evolution in the Congo valley and its surrounding areas.

Student training is at the core of the Boomplaas' historical legacy and its future growth as one of Africa's flagship palaeolithic sites. With generous support from the Human Origins, Migration, and Evolution (HOMER) research group, PAST and Leakey Foundations, students train in state-of-the-art Palaeolithic field excavation methods. Most of these students come from African countries, most are women, and many are from disadvantaged backgrounds. Three of these students, Bacara Spruit (South Africa, Wits University), Zarah Abrahams (South Africa, University of Cape Town), and Asithandile Ntsondwa (Nelson Mandela University/New York University), have gone on to use their field training experience at Boomplaas Cave to support postgraduate research projects involving materials from the site. We have also recently created a separate funding pipeline to support two African Masters students to work on projects related to the site's rich ochre assemblage. Participants in the field training gain transferable technical and analytical skills, an understanding of the transdisciplinary nature of science, an appreciation of the need to operate in international and multicultural modes of science, and a life-changing multicultural experience.

PROGRAMME

Sunday 19 May	
16:00 - 18:00	Registration and Ice breaker
	Drinks and snacks at the Congo Caves Estate
Monday 20 May	
8:30 - 9:00	Registration & Coffee
9:00 - 9:20	Welcome by the SASQUA President & Local Organising Committee Chair Announcement for a Special SASQUA Issue of the Transactions of the Royal Society
Session 1	
9:20 – 10:35	<p><u>N.E. Cleghorn</u>, X. Villagran, R.B.K. Saktura, Z. Jacobs, B. Zwane, I. Esteban, S.E. Watson, J. Murray, B. Schoville, H.M. Keller and D. Stratford: Knysna Eastern Heads Cave 1 from MIS 3 through MIS 2: A unique record of intensive site use across Middle to Later Stone Age transitions on the African south coast and Palaeo-Agulhas Plain.</p> <p><u>B.P. Fahey</u>, J. Hodgkins and C.W. Marean: Estimating mammalian body size from unidentifiable long bone midshafts and application to the MIS 5-4 transition levels at Pinnacle Point 5-6N.</p> <p><u>C. Miller</u>, M. Haaland, S. Armitage, S. Mentzer, K. van Niekerk and C.S. Henshilwood: Geoarchaeological Investigations of Klipdrift Shelter, De Hoop Nature Reserve, South Africa.</p> <p><u>T. Lüdecke</u>, S. Brömme, K. O'Brien, J. Sealy, J. Luyt, D.R. Braun, A. Martinez-Garcia and J.T. Faith: Stable isotope-based reconstruction of Pleistocene mammal communities from the southwestern Cape, South Africa.</p> <p><u>K. O'Brien</u>, T. Lüdecke, D. R. Braun and J.T. Faith: Description, phylogeny, and paleoecology of <i>Damaliscus</i> "hipkini," a small alcelaphin bovid species from Elandsfontein, South Africa.</p>
10:35 - 11:00	Coffee break
Session 2	
11:00 – 12:30	<p><u>H.M Keller</u>, N.E. Cleghorn, P. Kaliba, J.C and Thompson: The potential of Ostrich Eggshell taphonomy at Quaternary archaeological sites.</p> <p><u>G. Poretti</u>, V.J. Hare, A. House and J. Pargeter: Exploring high-resolution carbon isotopes in archaeological charcoal as a rainfall seasonality proxy.</p>

	<p>P. Groenewald, J. Sealy, J. Luyt and V.J. Hare: New capability for sulphur isotope ($\delta^{34}\text{S}$) measurements in South Africa.</p> <p>M. Spies, H. Cawthra, P. le Roux, K. Gray and J. Sealy: Developing a strontium ($^{87}\text{Sr}/^{86}\text{Sr}$) isoscape for the Western Cape, South Africa.</p> <p>S.M. Mentzer, T. Beard, C. Berthold, M. Haaland, P. Kloos, C.E. Miller: Diagenetic minerals in South African archaeological caves and rockshelters: An inventory and review.</p> <p>E. Loftus, B.M. Chase, M. Lombard and M. Steyn Challenges for modelling the frequency of dated human burials in South Africa.</p>
12:00 – 14:00	Lunch
Session 3	
14:00 – 15:30	<p>D.D. Stynder and J. Luyt: Developing mesowear profiles for extant grazers in the Cape Floristic Region (CFR) to provide insights into fossil grazer mesowear patterns.</p> <p>A. McGrath, W.A. Barr and J.T. Faith: Examining niche partitioning of extinct hyaenid species in non-analog Pleistocene ecosystems.</p> <p>X.N. Middleton and D.D. Stynder: Using Geometric Morphometrics (GM) to characterise the dentition of southern African Leporidae (Mammalia: Lagomorpha) for species, subspecies, and genera discrimination in archaeological and paleontological contexts.</p> <p>A. Alsgaard, K. van Niekerk, J. Sealy, C. Andersson and M. Lam: Archaeological insights into past and present harvesting pressures of the Cape yellowtail (<i>Seriola lalandi</i>).</p> <p>K. Sokolowski, K. O'Brien, V.J. Hare, D. Yarian, L. Roussouw and J.T. Faith: Paleoecological implications of the Late Glacial hyena den from Besaansklip (southwestern Cape, South Africa)</p> <p>S. Badenhorst, J. Ezeimo, L.T. Lebatla, K.L. van Niekerk and C.S. Henshilwood: Variability in Hunting Behaviour during the Middle Stone Age in the Eastern and Western Cape of South Africa</p>
15:30 - 16:00	Coffee break
Poster session 1	
16:00 - 17:00	<p>A. Wilson, L. Hutten and D. D. Stynder: Seasonal Occupation in the Polihali Dam Basin Area, Lesotho Highlands.</p>

J.J.J. Kraak, W.D. Gosling, J.M. Finch, T.R. Hill and A. Dhevnanan:
Assessing the effect of human induced fire regime changes on
vegetation in the Drakensberg mountains.

L. Hutten, A. Wilson and D.D. Stynder:
Exploring environmental shifts in Lesotho since the Last Glacial
Maximum: Insights from Lowland and Highland faunal records.

S. Manikam, A. Green, A. Cooper; G. Deacon and B. Flemming:
Rocky and sandy palaeoshorelines reflecting palaeolandscape
change: examples from the Wild Coast shelf, South Africa.

R. Singh, G. Botha and J. Kemp:
Wind erosion susceptibility of Cenozoic sediments along the Wild
Coast, Eastern Cape province.

M.P. Nxumalo, F.H. Neumann, J.M. Finch and A. Schoeman:
Late Quaternary Climate Change and Human Impact at St. Lucia,
KwaZulu-Natal.

H.C. Cawthra, F.W van Zyl, A. Williams and S. Manikam:
Quaternary deposits on the Cape's seafloor illuminated by the
Council for Geoscience offshore mapping programme.

S. Manikam, F. W. van Zyl, H.C. Cawthra, A. Williams:
Submerged evidence of erosional and depositional shorelines
offshore False Bay

J. Mohlabeng, M. Abrahams, R. Muir, H.C. Cawthra, C.W. Helm:
Petrographic assessment of substrate conditions in Pleistocene
aeolianites of the Cape south Coast, South Africa.

K. Nilsson-Kerr, M.H. Simon, C. Andersson, E. Pryor and A.N.
Meckler:
Paleoceanography off the Agulhas Bank across the last glacial
period; a high-resolution approach.

R. Prag, M.E. Meadows and E Bergh:
Investigating marine environmental conditions under the influence of
the Agulhas Current, along the South-eastern shelf of Southern
Africa.

D. Claassen, P. Mthembi and D. Black:
Late Pleistocene palaeoshoreline correlation along the southwest
coast of South Africa – A case for a tectonically stable continental
margin.

P. Mthembi, N. Baglow and G.A. Botha:
Cenozoic deposits of the Southern Kalahari geomorphic province,
Northern Cape, South Africa: insights from Council for Geoscience
mapping over the Griqualand West region.

M. van Tonder, H.C. Cawthra and J.C. de Vynck (5)
The Ichnology, Archeology and Geology of Pleistocene sequences in the Woody Cape Nature Reserve, Eastern Cape, South Africa.

S. Davids and L.J Quick:
Validating the dung fungi spectra of herbivores present in the Camdeboo region of southern Africa: A Coprophilous Fungal Spore calibration study

E. M. Carr and E. M. Rudolph:
Quaternary Climate Variation Comparative Literature Review between South Africa and Two Sub-Antarctic Islands

Tuesday 21 May

8:30 - 9:00 Registration & Coffee

Session 4: Boomplaas Session

9:00 – 10:30

J. Pargeter, B.M. Chase, J.T. Faith:
Outlining a new generation of paleoscience and capacity building at Boomplaas Cave.

A. Gregory, J. T. Faith, B.M. Chase and J. Pargeter:
Testing models of technological optimization, intensification, or conservatism during the Late Glacial at Boomplaas Cave.

G. Mauran, J. McGrath, B.M. Chase, J.T. Faith and J. Pargeter:
Shifting Sands and Hues: Investigating Cultural Responses to Environmental Change through the Ochre Assemblage at Boomplaas Cave.

M. Lombard:
Revisiting the current phyto-scape of Boomplaas Cave (South Africa) and its possible implications for past day-range foraging

J.T. Faith, B.M. Chase, G. Wong, D. M. Avery and J. Pargeter:
Thinking beyond the present: mammalian evidence for non-analog Pleistocene ecosystems at Boomplaas Cave.

I. Esteban, N. Laming, J. T. Faith, B.M. Chase and J. Pargeter:
The microscopic imprint of human-plant interactions at Boomplaas Cave, South Africa.

10:30 - 11:00 Coffee break

Session 5

11:00 – 12:30

B.M. Chase, A. Boom, A.S. Carr and P.J. Reimer:
Tropical forcing and ENSO dominate Holocene climates in South Africa's southern Cape.

E Walsh, S. Burrough and D.S.G. Thomas:
Late Quaternary palaeoenvironmental record from fluvial sediments in dryland southwestern Africa.

R. Mey, M. S. Humphries and L. J. Quick:

	<p>Unravelling late Quaternary climate variability along the southern Cape coast: Insights from a 30,000-year geochemical record at Pearly Beach.</p> <p><u>N.P. Mtshali</u>, J.M. Finch and L. Pretorius: Using salt marshes to understand long-term sea level variability on the Berg River estuary, West Coast, South Africa.</p> <p><u>T.N. Enoch</u>, J.M. Finch, L. Pretorius: An assessment of fossil pollen as a sea-level proxy in a southern African mangrove system.</p> <p><u>M.H. Simon</u>, N. Meckler, A. Kvindesland, E. Pryor and E. Jansen: A warm Agulhas Current during glacials off the Southern Cape?</p>
12:30 - 14:00	Lunch
Session 6	
14:00 – 15:30	<p><u>S. Manzano</u>, L.J. Quick, B.M. Chase, M.T. Hoffman, L. Gillson: Patterns and processes of vegetation change in highly biodiverse arid and Mediterranean ecosystems of the Cape Floristic Region (South Africa).</p> <p><u>S.G. Mosher</u>, M.J. Power, L.J. Quick, T. Haberzettl, T. Kasper, K.L. Kirsten, D.R. Braun, J.T. Faith: Fire-climate-pastoralist links in the Cape Floristic Region: High-resolution sedimentary charcoal records from Verlorenvlei and Eilandvlei, South Africa.</p> <p><u>A. Ntsondwa</u>, S. Manzano, M.S. Humphries and L.J. Quick: Reconstructing the fire history and palaeoenvironment at Thyspunt, southern Cape coast, Eastern Cape.</p> <p><u>G. Oden</u>, L. Gillson and T. Hoffman: Ecological Variability in the Eerste River Valley Bottom - Jonkershoek, insights from a multi-proxy Palaeoecological approach.</p> <p>J.M. Finch, T.R. Hill and <u>Z. Omarjee</u>: A multi-proxy palaeo-environmental record of Palmietrivier wetland, southern Cape: Insights into Holocene fire, vegetation and climate dynamics.</p> <p><u>K.D. Wiener</u>, S.M. Manzano and S.E. Grenfell Long-term geomorphological response to disturbance regimes in a peatland of the Cape Floristic Region, South Africa: implications for the resilience of ecosystem services.</p>
15:30 - 16:00	Coffee break
Poster session 2	
16:00 - 17:00	<p><u>K.H. Wogau</u>, M.H. Simon, K.L. Van Niekerk, E. Jansen and C.S. Henshilwood: From Sea to Little Karoo: Tracking the paleo-landscape inhabited by the first modern humans.</p> <p>J.T. Faith, B.M. Chase, <u>G. Wong</u>, D.M. Avery and J. Pargeter: Integrating Micromammal Data from Two Different Excavations at Boomplaas Cave – Challenges and Preliminary Results,</p>

J. Pargeter, A.S. Carr, B.M. Chase and J.T. Faith:
Luminescence dating at Boomplaas Cave: preliminary results from the 2022 excavations.

Z. Abrahams, D.D. Stynder, J. Pargeter and J.T. Faith:
A high resolution analysis of macrofaunal taphonomy at Boomplaas cave during the Last Glacial Maximum.

B. Spruit, J. Pargeter, J.T. Faith, B. Demarchi:
First application of ZooMS to identify fragmented fauna from the Pleistocene Holocene Transition at Boomplaas Cave.

S.M. Mentzer, T. Beard, A. Hristonova and J. Pargeter:
A micromorphological and mineralogical study of Holocene stabling deposits in Boomplaas Cave, South Africa.

S.A. Florin, J.T. Faith, B.M. Chase and J. Pargeter:
Preliminary archaeobotanical results from old and new excavations at Boomplaas Cave, Cango Valley, South Africa.

A. Gregory, J.T. Faith, B.M. Chase, J. Pargeter:
Clarifying the Context for the Middle to Later Stone Age Transition at Boomplaas Cave: High-Resolution Fabric Data and Photogrammetry Approaches.

S. Shafizadeh, B. Marwick, J.T. Faith and B.M. Chase:
Tracing Hominin Footsteps: Deciphering Hominin Life Intensity through Magnetic Susceptibility in Boomplaas Cave.

J.A. Beller, K.L. van Niekerk, P-J Gräbe, S.J. Armitage and C.S. Henshilwood:
Raw material distribution in the southern Cape region and its significance for lithic procurement during the MSA at Blombos Cave, South Africa.

E. Walsh, S. Armitage, C. Miller, M. Haaland, K.L. van Niekerk and C.S. Henshilwood:
Palaeolandscape evolution during the period of Middle Stone Age occupation of Blombos Cave, South Africa.

A. Norwood, J. Rowan and J.T. Faith:
Assessing links between floral and faunal turnover during the late Quaternary in South Africa

Wednesday 22 May

8:30 - 9:00

Registration & Coffee

Session 7

9:00 – 10:30

M. Govender, I. Esteban, B.A. Grobler and L.J. Quick:
Reconstructing past environments: a new phytolith record covering the Holocene from the Baviaanskloof, southern Cape interior, South Africa.

J. van Scalkwyk, T.R. Hill and I. Esteban:
Phytolith analysis of a wetland sediment core to assist in palaeoecological reconstructions along the Eastern Escarpment, Kwa-Zulu Natal South Africa.

A.C. van Aardt, L. Scott, P-L Grundling, A Grundling and S Woodborne:
Late-Holocene paleoenvironmental reconstruction of the Savanna-Grassland ecotone, Gauteng, South Africa.

A.C. Effiom and M.K. Bamford: Pollen Morphology of Southern African Vachellia and Senegalia.

E. Hilmer, A.C.M. Julier, B.A. Grobler and L.J. Quick:
Establishing connections between contemporary vegetation distributions and modern pollen representation in the Nelson Mandela University Reserve.

L.S. Nel, L.J. Quick and S. Manzano:
Extracting more ecologically-significant information from the southern Cape fossil pollen records: A reassessment of the Asteraceae pollen types.

10:30 - 11:00 Coffee break

Session 8

11:00 – 12:30

A. Dabengwa, E. Twala, S. Archibald, C. Lehmann and M.K. Bamford:
Examining savanna charcoal-fire relations using analysing topsoil from long-term ecological experiments in Kruger National Park, South Africa.

G. Hall, C. Kruger, S. Woodborne and A. Antonites:
Evidence for occupation patterns of Middle Iron Age sites in the Greater Mapungubwe Landscape based on stable isotope analyses of modern and archaeological freshwater mussel shells.

C. Cordova and L. Scott:
The phytolith record of Lake Ngami, Botswana, during the past 16 ka and correlation with other paleoclimatic and palaeoecological proxies.

F. Randriatsara, L. Gillson and E. Razanatsoa:
Using multi-proxy to understand the vegetation dynamic in the northwestern Madagascar throughout the mid-Holocene.

S. Musa, B. Linol, A. Tripathi, D. Upadhyay, D. Gebregiorgis and E. Atekwane:
Clumped isotope paleotemperatures from Tsodilo Hills, Northwest Botswana, towards modelling Late Pleistocene climate of the interior Kalahari Plateau.

B. Hlophe, M.K. Bamford and L. van Schalkwyk:
Charcoal Analyses: Reconstructing the Late Quaternary palaeoenvironment of the upper Senqu drainage basin, eastern Lesotho Highlands.

12:30 - 14:00 Lunch

Session 9

14:00 – 15:30

G.A. Botha and N. Porat:
Pediment sedimentation processes on the margin of the Karoo during the middle and late Pleistocene.

R. A. Muir and M. Abrahams and G. Hadebe:
Part 1: Geomorphologic, stratigraphic, and temporal context of Middle Pleistocene termitaria near Calitzdorp, South Africa.

M. Abrahams, R.A. Muir, R. Jacobs and C. Harris:
Part II: The termite's guide to building a long-lasting home.

D. Claassen:
The Role of Quaternary Science in the Growth of the Nuclear Industry
in South Africa

Open Discussion Session

15:30 – 16:00	Coffee break
16:00 - 17:00	SASQUA BGM

Thursday 23 May	
Field Excursion	
To the Cango Caves (two tour options) & Boomplaas Archaeological Site	
18:30	Conference Dinner: Spitbraai at the Cango Caves Estate

Friday 24 May	
Botany For Quaternary Scientists Workshop	
Venue: Old Mill Lodge conference centre	

ABSTRACTS

Oral Presentations

Session #1

KNYSNA EASTERN HEADS CAVE 1 FROM MIS 3 THROUGH MIS 2: A UNIQUE RECORD OF INTENSIVE SITE USE ACROSS MIDDLE TO LATER STONE AGE TRANSITIONS ON THE AFRICAN SOUTH COAST AND PALAEO-AGULHAS PLAIN

N.E Cleghorn (1), X. Villagran (2), R.B.K Saktura (3), Z. Jacobs (3), B. Zwane (4), I. Estaban (5), S.E Watson (6), J. Murray (7), B. Schoville (8), H.M Keller (9), and D. Stratford (10)

(1) University of Texas at Arlington, USA, (2) University of São Paulo, Brazil, (3) University of Wollongong, Australia, (4) University of Johannesburg, South Africa, (5) Universitat de Barcelona, Spain, (6) Field Museum of Natural History, USA, (7) Arizona State University, USA, (8) University of Southern Queensland, Australia, (9) Yale University, USA, (10) University of the Witwatersrand, South Africa

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The shift from the Middle (MSA) to the Later Stone Age (LSA) represents a significant change in the cultural landscape of the Late Pleistocene. This record of transition in southern Africa (as recently surveyed by Bousman and Brink in 2018 and Bader and colleagues in 2022) is complex and still poorly sampled within individual sites. On the southern coast, the MSA to LSA transition coincides with the Marine Isotope Stage 3 (MIS 3) through MIS 2 exposure of the Palaeo-Agulhas Plain (PAP), an extensive and potentially rich foraging habitat for Late Pleistocene hunters. Knysna Eastern Heads

Cave 1 (KEH-1), a south-facing site on the southern coast (115 km southeast of Boomplaas Cave) preserves the first record directly relevant to the lives and environments of people living on the PAP from late MIS 3 through the Last Glacial Maximum. KEH-1 captures an anthropogenically dense and continuous record of multiple technological transitions from the end of the MSA, through the earliest LSA, and into the Robberg, and an even longer record of paleoenvironmental proxies. Here we present our synthesis of the stratigraphy, age model, and find distribution, as well as preliminary paleoenvironmental information. The record at KEH-1 overlaps with the Boomplaas sequence and the later MIS 2 component at Nelson Bay Cave, supporting the future development of a regional framework for these critical technological transitions.

ESTIMATING MAMMALIAN BODY SIZE FROM UNIDENTIFIABLE LONG BONE MIDSHAFTS AND APPLICATION TO THE MIS 5-4 TRANSITION LEVELS AT PINNACLE POINT 5-6N

B.P Fahey (1), J. Hodgkins (2), and C.W Marean (1,3)

(1) Arizona State University, (2) University of Colorado Denver, (3) Nelson Mandela University

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Long bone diaphysis (midshaft) fragments are amongst the most frequently recovered faunal specimens at archaeological sites and provide important taphonomic and zooarchaeological data, but are often unidentifiable to taxon. While teeth are often readily identifiable to

taxon, they can present problems for reconstructing prey size frequencies from archaeofaunal samples due to ethnographic observations suggesting that skulls are subject to extremely different transport decisions by hunter-gatherers, while long bones are less affected. Thus, long bones are an ideal specimen type to include in reconstructions of prey size. Current zooarchaeological methods for assigning fragmented diaphysis specimens to body size classes rely on expert knowledge, but this method may introduce inter-analyst variability and allow subjectivity. This research investigates a quantitative method for assigning diaphysis fragments to body size by defining the allometric relationship between diaphysis cortical thickness and body mass in terrestrial mammals. Cortical thickness measurements were collected from specimens with known species affiliation using museum osteological comparative collections. A linear regression model for body mass as a function of average cortical thickness is statistically significant with an r^2 of 0.95. The transition from Marine Isotope Stage (MIS) 5 to 4 presented humans occupying the Middle Stone Age site Pinnacle Point 5-6N (PP5-6N) with significant environmental change, notably with the expansion of a grassland ecosystem on the adjacent Paleo-Agulhas Plain. Application of the regression model to diaphysis specimens from PP5-6N shows a decrease in mammalian prey size across the MIS 5-4 boundary driven by a decline in larger (> size 3) prey abundance.

GEOARCHAEOLOGICAL INVESTIGATIONS OF KLIPDRIFT SHELTER, DE HOOP NATURE RESERVE, SOUTH AFRICA

C. Miller (1, 2, 5), M. Haaland (2, 3), S. Armitage (2, 4), S. Mentzer (1, 5), K. van Niekerk (2), and C.S Henshilwood (2)

(1) Institute for Archaeological Sciences, University of Tübingen, (2) SFF Centre for Early Sapiens Behaviour (SapienCE), University of Bergen, (3) University of Stavanger, (4) Royal Holloway University, (5) Senckenberg Center for Human Evolution and Paleoenvironment

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The Klipdrift Complex consists of two archaeological sites—Klipdrift Cave and Klipdrift Shelter—situated within Table Mountain Group sandstones, ca. 20m above the rocky coast of the Indian Ocean in De Hoop Nature Reserve. Erosion of the deposits within the complex have exposed deep stratigraphic sections with rich archaeological assemblages. Excavations conducted at the sites since 2011 have uncovered evidence of occupation dating to the late and terminal Pleistocene, including horizons in Klipdrift Shelter corresponding to the Howiesons Poort (ca. 65-60 kya). Here we report on geoarchaeological investigations of the deposits from Klipdrift Shelter, employing archaeological micromorphology combined with additional microcontextual analyses including μ XRF and μ FTIR. The Howiesons Poort deposits at Klipdrift Shelter are almost exclusively anthropogenic in origin and present as laterally extensive, finely laminated concentrations of ash and charred organic material. By employing a microfacies analyses, we were able to document several types of deposits associated with distinct human activities, including middens, hearths, trample and rake out. After ca. 60 kya, the deposits appear markedly different. Organic-rich deposits are largely composed of animal dung, although some ash and charcoal fragments imply the continued presence of humans on site. Additionally, the deposits post-dating the Howiesons Poort occupation are dominated by minerogenic sands. By integrating our results with other analyses, we suggest that the change in depositional regime within the site reflects dramatic changes to the landscape that may have impacted the occupational intensity of the site over time.

STABLE ISOTOPE-BASED RECONSTRUCTION OF PLEISTOCENE MAMMAL COMMUNITIES FROM THE SOUTHWESTERN CAPE, SOUTH AFRICA

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Here, we present the first combined measurements of inter-tooth serially sampled $\delta^{13}\text{C}$ ($n = 380$) and bulk $\delta^{15}\text{N}$ ($n = 98$) in the enamel of Pleistocene herbivores ($n = 60$) and carnivores ($n = 38$) from Elandsfontein, Duinefontein, Hoedjiespunt, Sea Harvest, and Swartklip in the southwestern Cape. We employ two novel methods to generate high-precision stable isotope enamel data: the 'oxidation-denitrification method', for measuring mineral-bound organic nitrogen in tooth enamel, which previously has not been possible due to enamel's low organic content, and the 'cold trap method', significantly reducing sample size requirements for inorganic $\delta^{13}\text{C}$ measurements. Our stable isotope results reveal ecological information about trophic levels, dietary niches, and resource utilization. $\delta^{15}\text{N}$ values clearly differentiate trophic level with carnivore values averaging ca. 4 ‰ higher than those of herbivores. $\delta^{13}\text{C}$ values reflect dominantly C3 plant consumption by ungulates, with only sporadic occurrences of C3/C4 mixed feeders at Hoedjiespunt. This suggests that even grazers had predominantly C3 diets, indicating the absence of C4 grasses. $\delta^{13}\text{C}$ analysis of intra-tooth serial samples, with up to 16 samples taken from a single tooth, reveals some niche partitioning among herbivore taxa, but generally no significant seasonal

fluctuation in plant-type utilization. Furthermore, carnivore $\delta^{13}\text{C}$ data suggest that their prey comprised both browsing and mixed-feeding taxa, completing a deeper understanding of Pleistocene food webs.

DESCRIPTION, PHYLOGENY, AND PALEOECOLOGY OF DAMALISCUS "HIPKINI," A SMALL ALCELAPHIN BOVID SPECIES FROM ELANDSFONTEIN, SOUTH AFRICA

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There is a growing body of evidence indicating higher bovid diversity in the early Quaternary than at present. A key example of this is at the Western Cape Early Pleistocene site of Elandsfontein, with high diversity particularly in the tribe Alcelaphini. Here, we describe the extinct species *Damaliscus* "hipkini," a poorly understood bontebok-like alcelaphin from Elandsfontein Main. This species is represented by three frontlets, 10 horn cores, three mandibular fragments with teeth, and 12 isolated molars from Elandsfontein Main (~1.0-0.6 Ma). Additional specimens derive from the similar aged (~1.0 Ma) deposits at Cornelia in the Free State. This hypodigm represents the smallest known alcelaphin species, characterized by short horns with minimal torsion, no lower second premolars, and simple occlusal morphology. Our phylogenetic analysis places this species in the genus *Damaliscus*, though its morphology differs substantially from known extinct and extant species in the genus. Intra-tooth serial $\delta^{13}\text{C}$ results range from -9.6 to -6.9 ‰, indicating that this species had a seasonally-variable diet, consuming C3 and mixed C3/C4 plants during different parts of the year. As its $\delta^{13}\text{C}$ values are notably higher than presumed browsers and mixed-feeders from Elandsfontein, we

conclude that *Damaliscus* “hipkini” was likely a grazer of both C4 and C3 grasses, with the possibility of some dicot consumption. Furthermore, variation in $\delta^{13}\text{C}$ values across Elandsfontein alcelaphin species indicates dietary niche partitioning within the tribe. This has implications for the high bovid diversity of the site and for the Early-Middle Pleistocene of South Africa more broadly.

Session #2

THE POTENTIAL OF OSTRICH EGG SHELL TAPHONOMY AT QUATERNARY ARCHAEOLOGICAL SITES

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Ostrich eggs offer a unique pathway to examining forager behavior, as they intersect with technology (eggs as flasks), subsistence (eggs as food), and social connectivity (beads and flasks as trade items). Moreover, ostrich eggshell fragments and beads are found in archaeological deposits across Africa and Asia, lending themselves to wide-ranging spatial and temporal discussions. Before inferring human behavior, taphonomic analysis is necessary to distinguish the use-life of the eggs and depositional history. This research holds potential for understanding the effects of site formation processes, including unintentional heating and trampling, as well as anthropogenic activities including flask manufacture and cooking. Recently, research in this area has expanded, however, few ostrich eggshell assemblages have benefitted from a comprehensive taphonomic analysis. Although ostrich eggshell is reported at the majority (83%) of the late Pleistocene sites in

South Africa, only 16% of these published any taphonomic analysis, ranging from descriptive assessments of burning patterns or anthropogenic modifications to robust quantitative datasets. Here we present the data from two Quaternary archaeological sites—KEH-1 in South Africa and Hora-1 in Malawi—as case studies for how taphonomic analysis contributes to understanding hunter-gatherer adaptive strategies during the Last Glacial Maximum in Malawi and South Africa. This analysis complements isotopic and dating methods on ostrich eggshell, informing holistic discussions of human behaviour.

EXPLORING HIGH-RESOLUTION CARBON ISOTOPES IN ARCHAEOLOGICAL CHARCOAL AS A RAINFALL SEASONALITY PROXY

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Precipitation in present-day South Africa is distinctly seasonal, with a summer Rainfall Zone (SRZ) in the east, a Winter Rainfall Zone (WRZ) in the west, and a Year-Round Rainfall Zone (YRZ) occupying the southern coast and interior between them. However, understanding how the boundaries between these zones have shifted over glacial-interglacial cycles remains challenging due to the difficulty of extracting seasonally resolved hydroclimate reconstructions from existing proxies. This study investigates an alternative method to quantify rainfall seasonality from the high-resolution carbon isotope profiles of the pervasive material that is archaeological charcoal. We test whether a proven seasonal precipitation proxy, which has been effectively utilised with evergreen whole and fossil wood in the Northern Hemisphere, can be applied to whole and carbonised *Protea* (angiosperm) and *Podocarpus* (gymnosperm) from all three of South Africa’s rainfall zones. For both genera, successive carbon isotope

measurements across the growth axes of wood and charcoal from the SRZ and YRZ exhibit seasonal amplitudes ($\Delta\delta^{13}\text{C}_{\text{meas}}$), changes in seasonal precipitation (ΔP), and ratios of summer to winter precipitation (P_s/P_w) consistent with local rainfall records, regardless of visible growth increment boundaries. The WRZ results, however, show weak alignment with rainfall records, likely due to subsampling resolution effects and/or a combination of water stress and strong seasonality leading to intermittent growth and incomplete seasonal isotope cycles. With these results as modern analogues, we assess the effectiveness of the proxy when applied to archaeological Proteaceae and Podocarpaceae charcoal from the Last Glacial Maximum and late Pleistocene.

NEW CAPABILITY FOR SULPHUR ISOTOPE ($\Delta^{34}\text{S}$) MEASUREMENTS IN SOUTH AFRICA

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$\Delta^{34}\text{S}$ ($^{34}\text{S}/^{32}\text{S}$) measurements have long been used in geochemical studies and more recently also in archaeology and studies of migration and mobility. There are substantial differences between crustal and oceanic $\delta^{34}\text{S}$ and a number of applications have used it to distinguish successfully between terrestrial and freshwater systems. Previous applications in southern Africa include use as a tracer of moisture sources in the Namib, a tracer of the impact of dam building on pollution and biodiversity in the Kruger National Park Olifants River system, and some preliminary (unpublished) work on archaeological palaeodiets. There is also considerable scope for using $\delta^{34}\text{S}$ as a tracer of atmospheric pollutants. Thanks to BIOGRIP (the Biogeochemistry Research Infrastructure Platform, funded by DSI), the Stable Light Isotope Laboratory at UCT is now equipped to measure $\delta^{34}\text{S}$ in various sample types,

including animal tissues and plants. The 1 σ reproducibility of the international standard 'USGS 43' was 0.29 ‰ (n=6) on the Vienna Cañon Diablo Troilite (VCDT) abundance scale. This presentation is intended to make the SASQUA community aware of this new capability in biogeochemistry in South Africa. Potential users are welcome to contact the staff of the laboratory in order to discuss possible projects.

DEVELOPING A STRONTIUM ($^{87}\text{Sr}/^{86}\text{Sr}$) ISOSCAPE FOR THE WESTERN CAPE, SOUTH AFRICA

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The use of $^{87}\text{Sr}/^{86}\text{Sr}$ to answer questions about the origin of a sample of interest has become widespread across many fields, including archaeology, ecology, biology, forensics, and the food industry. $^{87}\text{Sr}/^{86}\text{Sr}$ is a useful indicator of provenance because it (mostly) tracks with geology, based on the relative concentration of Sr and rubidium (Rb) in the rocky substrate and when in geological time those rocks were formed, as ^{87}Rb decays into ^{87}Sr over time. Importantly, the isotopic ratios are persistent in the soils derived from those substrates and the tissues of plants, animals, and humans from that region. Other Sr influences on the landscape include saltwater aerosol and dust deposition via marine and terrestrial winds, respectively. Building on the pioneering work of Copeland et al. (2016) in the southern Cape, we aim to fill in the gaps in the existing dataset and complete an isoscape for the coastal forelands of the Western Cape Province, South Africa. This talk will outline how plant samples were collected, Sr extracted, and $^{87}\text{Sr}/^{86}\text{Sr}$ measured using mass spectrometry. It will also discuss how isoscapes or isotope maps are

created from the generated data, using both interpolation-based approaches like Kriging and machine-learning approaches like Random Forest, and how these can be used to provenance samples of interest. Some preliminary isoscapes for the Western Cape will be presented, which we hope to use to answer archaeological questions about palaeomobility and migration and expand for use in wildlife and human forensics.

DIAGENETIC MINERALS IN SOUTH AFRICAN ARCHAEOLOGICAL CAVES AND ROCKSHELTERS: AN INVENTORY AND REVIEW

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Secondary minerals that form in archaeological sites can be used to understand post-depositional processes. In open air sites, most secondary minerals form due to pedogenesis and groundwater activity. In caves and rockshelters, a wider variety of secondary minerals can form due to a range of dripwater and groundwater compositions as well as the presence of initial sedimentary components that are unique to these settings (e.g. bat guano). Benchmark studies of mineral diagenesis in archaeological caves in the Levant and Mediterranean have linked the formation of certain minerals or mineral suites to specific chemical micro-environments within the sites. This paper provides an overview of more than 20 secondary minerals that have been identified in South African caves and rockshelters. Many of these minerals were identified during the course of geoarchaeological studies conducted by

researchers and students at the University of Tuebingen using a combination of optical properties, elemental analysis, Fourier transform infrared spectroscopy, and x-ray diffraction, while others are reported in the literature (e.g. Montagu Cave, Waterfall Bluff, the Pinnacle Point sites). The minerals presented in this paper include: anhydrite, apthitalite, ardealite, bassanite, bloedite, brushite, calcite, epsommitte, gypsum, halite, hydroxylapatite, kutnohorite, leucophosphite, niter, nitratite, sveite, sylvite, syngenite, taranakite, whewellite, and whitlockite. Additional compounds identified are amorphous silica/opal and tricalcium phosphate, while other crystalline substances have been documented but not fully identified. In reviewing the occurrences of all of these minerals, several suites corresponding to specific environments, animal occupation, and human activities can be identified.

CHALLENGES FOR MODELLING THE FREQUENCY OF DATED HUMAN BURIALS IN SOUTH AFRICA

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Shifts in human burial behaviours may reflect broad cultural responses to wider archaeological or environmental events. Methods such as summed probability distributions and kernel density estimation allow for an assessment of burial frequency through time, for correlation with archaeological and palaeoenvironmental records. However, datasets of directly dated burials are biased in many parts of the world due to ethical concerns over destructive sampling of human remains. In South Africa,

direct dating of human remains of Holocene foraging people (hunter-gatherers) has been more routine and widespread than the dating of human remains from early farming (or Iron Age) contexts, in part due to the advocacy of descendent communities. Additionally, farming burials can be dated using chronological frameworks from associated finds (e.g., ceramics), further minimising the prevalence of radiocarbon data from such contexts. Thus, we find modelled radiocarbon distributions for directly dated farmer burials do not accurately reflect the distribution of burials through time. Importantly, this bias is unlikely to be resolved through additional direct dating, given the ethical prohibitions. We attempt to redress the bias in the human burial dataset using simulated dates based on associated age ranges, and interpret the modelled distributions in light of regional archaeological and palaeoenvironmental events.

Session #3

DEVELOPING MESOWEAR PROFILES FOR EXTANT GRAZERS IN THE CAPE FLORISTIC REGION (CFR) TO PROVIDE INSIGHTS INTO FOSSIL GRAZER MESOWEAR PATTERNS

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The Cape Floristic Region (CFR) boasts a rich array of plant species, with approximately 80% belonging to the shrub- and heath-dominated fynbos community. Despite this floral richness, grasses are less prominent in the CFR compared to other South African regions. This scarcity of grasses affects the abundance and diversity of ungulate grazers, with only two native taxa, the Bontebok and Cape Mountain zebra, present. In contrast, the Pleistocene era saw a greater variety of grazers in the region. While some researchers suggest that grazer

diversity was higher during the Pleistocene due to greater grass abundance, mesowear and microwear studies suggest that fossil grazers primarily browsed or had mixed feeding habits. This contradicts contemporary observations which indicate that CFR grazers primarily focus on grass over the abundant fynbos. Such a strong grass preference is evident in species like the Bontebok, which modifies its habitat to maintain grazing lawns. Consequently, questions arise regarding the interpretation of fossil grazer dental wear. As a step towards a more informed approach to this interpretation, we generated a spectrum of dental mesowear patterns of contemporary grazers whose dietary habits are directly observable. Here we present the results of our study which included both native and introduced grazers from across the CFR. We also discuss the implications of our findings for interpreting fossil grazer mesowear data sets.

EXAMINING NICHE PARTITIONING OF EXTINCT HYAENID SPECIES IN NON-ANALOG PLEISTOCENE ECOSYSTEMS

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Early Pleistocene ecosystems in eastern Africa are increasingly recognized as functionally non-analog in part due to the exceptionally high richness of large carnivores. One possible explanation for elevated richness is that it is a consequence of niche partitioning, such that greater niche differentiation would manifest as greater morphological divergence in extinct species as compared to extant species. The Pleistocene Koobi Fora Formation in eastern Africa provides an ideal testing ground for this question due to its well-dated record and presence of multiple carnivorous species in each member. Here, we examine niche

partitioning between hyaenid species at Koobi Fora through 3D geometric morphometric analyses. Cranial and postcranial bones of extant and fossil hyaenids were 3D scanned to assess the prey procurement strategy of these extinct species. Our results show that extinct hyaenid species from Koobi Fora are morphologically most similar to their most closely related extant congeners, not morphologically distinct as we would expect if these hyaenids had a greater degree of niche partitioning. Prey preferences based on body mass estimations for the Koobi Fora hyaenid species indicate that there could have been niche overlap unlike that seen in modern African ecosystems. These findings do not support the idea of increased carnivoran niche partitioning in Pleistocene ecosystems, meaning that the high carnivoran richness seen in those ecosystems may be due to other causes. Building on recent paleoecological work, we propose that higher primary productivity facilitated the co-existence of a greater number of hyaenid species relative to the present.

USING GEOMETRIC MORPHOMETRICS (GM) TO CHARACTERISE THE DENTITION OF SOUTHERN AFRICAN LEPORIDAE (MAMMALIA: LAGOMORPHA) FOR SPECIES, SUBSPECIES, AND GENERA DISCRIMINATION IN ARCHAEOLOGICAL AND PALEONTOLOGICAL CONTEXTS

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The Cape hare (*Lepus capensis sensu lato*) is frequently represented in both archaeological and palaeontological assemblages throughout Africa, Europe, and Asia during the Quaternary. Its closest relative, the Scrub hare (*Lepus saxatilis*) is found primarily in southern Africa, alongside several members of the second major genus *Pronolagus*, the “true

rabbits”. This oversight may stem from the challenge of taxonomically identifying their remains due to morphological similarities, as well as their frequent association with carnivore assemblages (Lloveras, Moreno-García and Nadal, 2009). Yet, Leporids are considered indicator species and an essential component of many ecosystems. Therefore, leporids could reveal broader shifts in environmental conditions. This presentation introduces the utilisation of geometric morphometric analysis of molar occlusal morphology for taxonomic identification of Leporidae in faunal assemblages (López-Martínez, 2008; Fostowicz-Frelik and Meng, 2013). Moreover, we showcase its effectiveness in distinguishing extant species and extend its application to a paleontological assemblage from Langebaanweg. Through this approach, we not only hope to enhance our understanding of the evolutionary history and distribution of southern African Leporidae, but also gain insights into broader environmental shifts in the region, while highlighting the crucial role these animals play in ecosystems (worldwide).

ARCHAEOLOGICAL INSIGHTS INTO PAST AND PRESENT HARVESTING PRESSURES OF THE CAPE YELLOWTAIL (*SERIOLA LALANDI*)

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The Cape yellowtail (*Seriola lalandi*) is an important fish in the South African fishery. It is a migratory, predatory, pelagic species that aggregates in Atlantic offshore surface habitats

and feeds on pelagic bait species, such as sardines, anchovies, and mackerel. It is primarily harvested by traditional commercial linefishers, artisanal beach seine netter, and recreational anglers, the yellowtail stock is considered to be optimally exploited. This contrasts with its overfished status during several periods in the recent past: 1989, 1993-1994, 2004, and 2014. We compared data on present day yellowtail body sizes with sizes of from archaeological assemblages dating to between 3310 +/-40 and 3920 +/-40 BP. The site of Hoffman's/Robberg Cave is located on the Robberg Peninsula. Based on the levels excavated thus far, it was utilized for approximately 600 years with a brief 100-year hiatus around 3760 +/-40 BP. Populations on the Robberg Peninsula, including those of nearby Nelson Bay Cave, are known to have consumed high proportions of marine resources including Cape fur seal, shellfish, and fish. While many of the fish species are lower trophic species such as the strepie (*Sarpa salpa*) and dassie (*Diplodus capensis*), the higher trophic yellowtail was also harvested at these sites. Here, we consider the evidence for coastal resource intensification of the yellowtail at Hoffman's/Robberg Cave using body size data reconstructed using 3D geometric morphometrics. We compare these data to present day yellowtail body size data and discuss our findings in the context of present and past fishing pressures.

PALEOECOLOGICAL IMPLICATIONS OF THE LATE GLACIAL HYENA DEN FROM BESAANSKLIP (SOUTHWESTERN CAPE, SOUTH AFRICA)

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While the southwestern Cape of South Africa is dominated by fynbos vegetation, previous research has suggested glacial periods of South Africa were characterized by an expansion of grassy cover. However, the scarcity of reliably dated Pleistocene mammal assemblages, particularly in the southwestern Cape, has made it difficult to link faunal turnover to Pleistocene environmental change. Here, we present a paleoecological analysis of mammalian fauna from a well-dated Late Glacial (~16 ka) hyena den, Besaansklip, located near Saldanha Bay in the southwestern Cape. Besaansklip has high abundance and richness of large grazing herbivores, many of which are extinct (e.g., *Equus capensis* and *Syncerus antiquus*) or no longer found in the area (e.g., *Connochaetes gnou*). We apply previously developed ecometric methods to relate faunal composition to water-deficit. Our results indicate that Besaansklip had a much lower water deficit than today, likely due to increased rainfall or lower evapotranspiration due to cooler temperatures. Additionally, we conducted triple oxygen isotope analysis ($\delta^{17}O$) on 10 ostrich eggshells (OES) from the site to estimate pCO₂ during the Late Glacial period in the region. The $\delta^{17}O$ of OES are consistently higher than $\delta^{17}O$ of modern samples, aligning with the expectations of low pCO₂ during glacial periods. Together, these findings support previous models that propose a connection between low pCO₂, the expansion of grassy vegetation, and increased moisture availability during the glacial Pleistocene in South Africa.

VARIABILITY IN HUNTING BEHAVIOUR DURING THE MIDDLE STONE AGE IN THE EASTERN AND WESTERN CAPE OF SOUTH AFRICA

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Large mammal remains from Middle Stone Age sites in southern Africa, just like in many other parts of Africa, show variability in prey selection. While smaller game are often considered less profitable in terms of meat returns, their abundance and fast reproduction meant that they were often favoured over larger prey species. The Game Index measures the ratio between smaller and larger prey in faunal samples. When applied to MSA faunal assemblages with low probabilities of carnivore activity, it is apparent that at some sites, notably Blombos Cave (M3 phase) and Die Kelders (layers 6, 10, 12 and 14), hominins were focussing on acquiring small prey. At these two sites, the coastal dunes offered plentiful resources to obtain Cape dune molerats, rock hyraxes and steenbok/grysbok. The focus on small game hunting may not necessarily relate to depletion of large game resources, but rather that hominins were exploiting the sandy substrates close to habitation caves.

Session #4

OUTLINING A NEW GENERATION OF PALEOSCIENCE AND CAPACITY BUILDING AT BOOMPLAAS CAVE

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Boomplaas Cave is one of the few sites in Africa with a combination of well-dated, multi-proxy palaeoenvironmental, palaeo-dietary, and archaeological records to test hypotheses about the role of climate and vegetation change in human behavioral evolution. Hilary Deacon's pioneering excavations at Boomplaas Cave (1974-1979) uncovered a well-stratified ~5.5 m sedimentary sequence extending from >65 ka to the protohistoric period. In 2022, a diverse and multinational team of over 16 scientists began a new era of work at the site to test the hypothesis that climate-environment dynamics drove the Middle to Later Stone Age (MSA-LSA) transition. These excavations focus on refining the chronology through in situ 14C and OSL samples, recovering new MSA-LSA transition materials (e.g., lithics, ochre, bone), delivering higher-resolution sediment samples for macrobotanical studies and paleoenvironmental sampling, and providing opportunities for sedimentology and geoarchaeology sampling. High-resolution excavation methods provide detailed 3D spatial information for all recovered materials, allowing us to track site occupation changes and more accurately describe relationships between chronological, cultural, and paleoenvironmental changes. Integrating these data with the team's paleoenvironmental work focused on hyrax midden deposits allows us to reconstruct a local- to regional-scale paleoenvironmental context for Boomplaas Cave's MSA-LSA deposits. In addition to addressing fundamental questions about behavioral shifts in *Homo sapiens*, the excavations grow African and international research capacity by providing a foundation for over 60 undergraduate and graduate students over the past three years. Overall, the ongoing research at Boomplaas Cave underscores its importance as a flagship archaeological site for capacity building and understanding the complexities and contexts of human behavioral evolution in Africa.

TESTING MODELS OF TECHNOLOGICAL OPTIMIZATION, INTENSIFICATION, OR CONSERVATISM DURING THE LATE GLACIAL AT BOOMPLAAS CAVE

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Faced with changing climate and environmental conditions, hunter-gatherers either optimize, intensify, or conserve existing technological strategies, depending on social and ecological contexts. Here, we test three competing models (optimization, intensification, and conservatism) to explain Robberg lithic technological changes between ~17,000-13,000 cal BP, during the last glacial-interglacial transition (LGIT) at Boomplaas Cave. We predict optimal toolkits will show greater cutting edge-to-mass alongside reduced core reduction intensity. Intensification will manifest in similar cutting edge-to-mass return rates in increased core reduction intensity contexts. Conservative strategies will reflect persistent cutting edge-to-mass and core reduction intensity values. Regional and on-site climate, vegetation, and archaeological data show that the LGIT was a climatically variable period. Boomplaas' Robberg deposits in member CL record dramatic increases in occupation intensity, increased artifact deposition densities, and increased symbolic material culture production. These on-site patterns occur alongside wider socioecological shifts across the southern Cape linked to Quaternary climate change. We show that cutting edge-to-mass return rates and core reduction intensity

remain constant across member CL, suggesting that Robberg toolkits were neither optimized nor intensified technological solutions to these shifting social and ecological conditions. A closer look at member CL's raw material proportions and core-to-flake ratios shows increased use of local quartz and reduced emphasis on exotic raw materials (silcrete) across the LGIT. These patterns suggest that, facing increased aridity and reduced resource density, hunter-gatherers retained technological strategies while implementing new raw material and social solutions to cope with rapidly evolving socio-ecological landscapes.

SHIFTING SANDS AND HUES: INVESTIGATING CULTURAL RESPONSES TO ENVIRONMENTAL CHANGE THROUGH THE OCHRE ASSEMBLAGE AT BOOMPLAAS CAVE

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Ochre found in archaeological layers bears witness to the extensive social and symbolic activities of so-called "modern human culture". Cultural abilities are likely a crucial part of the story explaining the success of the hominin lineage. However, it remains unclear

when these cultural capacities came to be and what influence(s) cultural capacities might have had on our survival during periods of marked climate change and resource variability. Here we present, the terminal Pleistocene (~40-10ka) ochre assemblage from Boomplaas Cave (Western Cape, South Africa). It is currently one of the few sites in Africa with the unique combination of well-dated multi-proxy paleoenvironmental, dietary, and sedimentary records to demonstrate significant climate, vegetation, and resources change during the terminal Pleistocene. Tracking the source and use of ochre at Boomplaas Cave allows us to examine how territoriality varies in relation to environmental change. According to the influential economic defensibility model, we expect a decrease of territorial behaviors during increased environmental instability and reduced ecological productivity (<18ka). Relying on a naturalistic approach, the analyses of archaeological and geological raw materials by optical microscopy allow us to provide preliminary results about the evolution of ochre exploitation at Boomplaas Cave. Comparison of these preliminary results with paleoenvironmental records derived from nearby hyrax middens, micromammal assemblages, as well as lithic raw material diversity allows us to address the impact of environment changes on cultural behaviours at Boomplaas Cave.

REVISITING THE CURRENT PHYTO-SCAPE OF BOOMPLAAS CAVE (SOUTH AFRICA) AND ITS POSSIBLE IMPLICATIONS FOR PAST DAY-RANGE FORAGING

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Boomplaas Cave is one of only a few African sites with inland archaeological deposits spanning MIS 4-1. Work conducted half a century ago predicted Boomplaas to be a meagre plant-food location. We reassess this

interpretation by introducing the current vegetation and foodplant inventories growing within roughly a day's foraging distance from the cave. By doing so, we increase the known foodplant species potentially available to Stone Age foragers by 356%, and show that almost all the plant species/families in the Boomplaas archaeo-botanical assemblage still grow within a day's range. We present nutritional values for some of the plant foods, highlighting those richest in moisture, ash, protein, fat, fibre, carbohydrates, and energy, suggesting that such foods may have been important staples in the dietary ecology of the Stone Age foragers who used the site. Lastly, we demonstrate that the Boomplaas Cave foodplant fitness landscape is relatively rich and varied, compared to similar data from other Cape sites such as Klasies River Main Cave, Diepkloof Rock Shelter, and Hollow Rock Shelter.

THINKING BEYOND THE PRESENT: MAMMALIAN EVIDENCE FOR NON-ANALOG PLEISTOCENE ECOSYSTEMS AT BOOMPLAAS CAVE

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Quaternary scientists frequently rely on present-day ecosystems to make sense of those recorded in the fossil record. But to what extent is the present a good analog for the past? Ecological theory and empirical observations support a Gleasonian model (after ecologist H.A. Gleason) of how environmental change shapes biotic communities, whereby each species responds according to its own unique ecological tolerances. The individualistic response gives rise to fossil communities that are compositionally non-analog, including associations of species that are presently allopatric or combinations of taxonomic abundances unknown today. Building on efforts to reconstruct Pleistocene ecosystems in the Cape Floristic Region, we examine how the fossil micromammal assemblages from Boomplaas Cave (~65 ka to recent) relate to >100 present-day assemblages from across southern Africa. Discriminant function analysis shows that modern micromammal assemblages from different biomes (e.g., Fynbos, Succulent Karoo, Savanna) can be distinguished from each other based on their taxonomic composition. At Boomplaas Cave, the Holocene assemblages have good modern analogs, but most Pleistocene assemblages from Boomplaas are compositionally unlike those from any biome. The non-analog assemblages are not a consequence of time-averaging or sampling communities from different adjacent biomes. It follows that late Pleistocene micromammal communities, and the ecosystems they were part of, were distinct from those in any contemporary biome, likely reflecting non-analog climatic conditions. Consistent with the Gleasonian model, biotic communities of the present and past represent geologically short-lived associations of different species, and these communities likely did not respond to climate change as intact units.

THE MICROSCOPIC IMPRINT OF HUMAN-PLANT INTERACTIONS AT BOOMPLAAS CAVE, SOUTH AFRICA

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Boomplaas Cave, located in the Cango Valley at the foothills of the Swartberg mountains, presents a rich sequence of artifacts and faunal and floral remains spanning the past ~65,000 years. Despite constituting one of the most important paleoenvironmental archives of South Africa's southern Cape, biogenic plant, and algae microremains have yet to be explored. These will provide additional evidence on the site's past edaphic and environmental conditions. This study addresses this gap with preliminary phytolith results from deposits dating from 40.9 cal kBP (MIS 3) to 14 cal kBP (MIS 2). This talk explores the implications of our research for understanding past interactions between plants and humans in the Cango Valley, considering factors such as taphonomy, human agency, and past environmental conditions. Most samples contained high phytolith concentrations, and the assemblages displayed considerable diversity, indicating a wide range of represented plant species and parts. Low variance of the PCA (34.1%) indicates the high homogeneity of our dataset. Data distribution was further analysed using non-parametric analysis of variance, revealing that MIS 3 and Last Glacial Maximum (LGM) deposits differ most due to their generally higher abundance of diatoms and

Chrysophyceae cysts suggesting moist edaphic conditions. Our results also show a higher presence of grasses in the MIS 3 and LGM deposits relative to the terminal Pleistocene. Grass phytoliths associated with cooler temperatures/increased winter rainfall are particularly prevalent immediately prior to and during the LGM, consistent with other evidence from Boomplaas, indicating increased humidity and winter rainfall (Faith et al 2024). References: Faith, J.T., Chase, B.M., Pargeter, J., 2024. The Last Glacial Maximum climate at Boomplaas Cave, South Africa. *Quaternary Science Reviews*, 329, p.108557.

Session #5

TROPICAL FORCING AND ENSO DOMINATE HOLOCENE CLIMATES IN SOUTH AFRICA'S SOUTHERN CAPE

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This paper explores the Holocene climatic dynamics of South Africa's southern Cape, a region that supports a large proportion of the Greater Cape Floristic Region and contains an array of important archaeological sites. This region is thought to have been particularly sensitive to past changes in late Quaternary boundary conditions, but evidence of past climate change, however, remains limited. We present a 9000-year record of hydroclimatic variability obtained from rock hyrax midden stable nitrogen records from the Anysberg Mountains. Resolved to an average 6-year

resolution, this is the highest resolution Holocene record from southern Africa and presents a unique opportunity for the detailed study of the primary drivers and spatial gradients of Holocene climate change in the southern Cape. The data indicate a long-term decrease in aridity across the Holocene and a pattern of variability that reveals remarkable similarities with records from the South African tropics and El Niño–Southern Oscillation proxies, highlighting the significance of tropical systems as drivers of Holocene climate change in the region. This substantially expands what has been previously considered to be the zone of tropical influence, extending from a coastal phenomenon associated with heat transport via the Agulhas Current to encompass much, if not all, of the Agulhas Plain south of the Cape Fold Mountains. These findings provide a valuable new climatic framework for contextualizing changes in ecological and archaeological records in the southern Cape, and contribute to a more comprehensive understanding of the spatio-temporal dynamics of climate systems in Southern Africa.

LATE QUATERNARY PALAEOENVIRONMENTAL RECORD FROM FLUVIAL SEDIMENTS IN DRYLAND SOUTHWESTERN AFRICA

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Fluvial sedimentary sequences preserve evidence of past hydroclimatic regimes. These are important, potentially under-utilised, indicators of palaeoenvironmental change in drylands, yet deciphering changes in hydrology from these archives is often complex. Here, we present a new fluvial record from the Huab

River, Skeleton Coast, Namibia. We combine petrographic and heavy mineral assemblages from Raman laser spectroscopy, with lithostratigraphic and particle size changes, and a chronology established using optically stimulated luminescence dating. We reconstruct provenance, changes in river style, and fluvial response to climate. In particular, this record details humid conditions during the early to mid-Holocene, where more sustained river flow in a channelized system occurred from 7 to 5 ka. We interpret this record in the context of a new chronological database of 600 ages from 70 Quaternary fluvial sites in southern Africa's western dryland regions. We collate a scattered literature to detail the current state of the fluvial record from southwestern Africa and highlight opportunities for future research. At the Last Glacial Maximum (24–18 ka), records detail a regionally consistent signal of intermittent to perennial flow under relatively humid conditions. The mid Holocene (8–4 ka) is also characterised by the occurrence of sustained river flow and higher discharge events than present, but with greater spatial variability. Within the last millennium, flash flood regimes within an arid to hyper-arid climate were established with coherence in the timing of flood frequency variations recorded between catchments.

UNRAVELLING LATE QUATERNARY CLIMATE VARIABILITY ALONG THE SOUTHERN CAPE COAST: INSIGHTS FROM A 30,000-YEAR GEOCHEMICAL RECORD AT PEARLY BEACH

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The southern Cape coast of South Africa has undergone complex and dynamic climate

changes due to its position at the boundary of major atmospheric and oceanic systems. However, climate changes that occurred in the region during the Last Glacial Maximum and the subsequent deglaciation period are not fully understood. Using inorganic elemental, grain size and stable carbon isotope ($\delta^{13}C$) analyses, we present a 30,000-year paleoclimate record from Pearly Beach to address this gap. Heavy mineral and grain size analyses reveal heightened storm activity between 18,800 and 14,500 cal yr BP, attributed to intensified Southern Hemisphere westerly winds. Corresponding fossil pollen records indicate increased coastal thicket pollen, aligning with this storm intensification. The heightened moisture availability during this period is linked to a slowdown in the Atlantic Meridional Overturning Circulation (AMOC), fostering stronger low-pressure systems and intensified storms at Pearly Beach. Comparisons with regional records, including Cold Air Cave and Congo Caves, suggest a cooling event ~18,500 to 14,500 cal yr BP, possibly due to intensified westerly winds. The observed lag in South African warming post-deglaciation underscores the persistent influence of westerly winds, transporting cold air masses across the interior. Post-14,500 cal yr BP, reduced westerly wind intensity led to aridification, reflected in increased $\delta^{13}C$ values and a shift to drought-tolerant vegetation. This transition aligns with decreased aeolian flux and warmer conditions observed in other regional records from around 15,000 cal yr BP. This study emphasizes the complex interplay between regional and global climatic drivers, shedding light on past environmental dynamics and implications for future climate scenarios in southern Africa.

USING SALT MARSHES TO UNDERSTAND LONG-TERM SEA LEVEL VARIABILITY ON THE BERG RIVER ESTUARY, WEST COAST, SOUTH AFRICA

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This research aims to reconstruct past sea level changes on South Africa's western coast using marine foraminifera preserved in salt marsh sediments from the Berg River Estuary. Marine foraminifera are precise indicators of sea level because species assemblages vary with tidal position and can therefore be used as a proxy for elevation. 85 modern sediment samples collected along the transect using a pitman corer, measured pH and conductivity. A 2-meter peat core was extracted along with 16 replicated, in 48 cm segments. The Modern foraminifera analysis reveals the high diversity and abundance of foraminifera species found in three distinct salt marsh zonation. The higher salt marsh dominated by typical agglutinated types *Zachamming inflata* and *Jadammind macrescens*. middle marsh characterized by *Techomaing ufiora* and *Haplophagmoides* and mud-flat dominated by calcareous species *amorita bessaci* and *Elonidium* spp. The modern foraminifera data will be used to develop a transfer function based on vertical zonation of modern foraminiferal assemblages. The master sediment core was subsampled for fossil foraminifera at a 1 cm resolution for the upper 50 cm and at a 4 cm along with LOt, Grain size, and bulk density which is assisting in selecting the depth for Accelerator Mass Spectrometry (AMS) radiocarbon dating to produce a Bayesian age-depth model. Downcore foraminiferal analysis revealed low diversity and low abundance of foraminifera, the upper 50 cm core is dominated by the agglutinated species associated with high organic matter and low foraminifera number downcore and mostly calcareous species dominates.

AN ASSESSMENT OF FOSSIL POLLEN AS A SEA-LEVEL PROXY IN A SOUTHERN AFRICAN MANGROVE SYSTEM

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The IPCC has stated that sea-level rise is expected to rise by approximately 1 m by the end of the century. To understand the effects that anthropogenic activities on sea-level rise, a baseline is needed. The mid to late Holocene provides this baseline of pre-industrial levels. Due to South Africa's position in relation to the Greenland and Western Antarctic ice sheets, the impact of isostatic effects is marginal. Instead, eustatic sea-level rise is observed in the region. Southern Africa has a distribution of mangrove forests along the eastern coastline. Foraminifera and diatoms are commonly used as proxies for sea-level change. However, due to poor preservation in mangroves, fossil pollen has been used instead, with varying levels of success. This variability is due to the preservation of mangrove fossil pollen being dependent on the individual mangrove system. Mangroves have yet to be used in sea level research in South Africa. Additional proxies of sedimentology, spectrophotometry, CNS, and XRF scanning were employed to support the fossil pollen analysis. The modern mangrove assemblages reflect that *Rhizophora mucronata* populate the lower elevation of the system, *Bruguiera gymnorhiza* is an intermediate species inhabiting the central intertidal range, while *Avicennia marina* is a high tidal species more abundant at higher elevations in the system. The core data shows that there has been an increase in *R. mucronata*, paired with a steady decrease in *B. gymnorhiza*. This data suggests that there has been an increase in sea level through the record.

A WARM AGULHAS CURRENT DURING GLACIALS OFF THE SOUTHERN CAPE?

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It is well-known that the warm Agulhas Current influences the hydroclimate of the southern Cape of South Africa (SA) by contributing heat and moisture which can lead to localized rainfall (Jury et al., 1993) or to the formation of broader regional convective systems (Tyson and Preston-Whyte, 2000). Extrapolating this modern relationship back in time however remains challenging as ocean surface temperature (SST) records in the main path of the Agulhas Current offshore the southern Cape are missing. Here we fill this knowledge gap by presenting the first high-resolution coupled sea surface temperature (SST) from Mg/Ca and clumped isotopes in the planktic foraminifer *Globigerinoides ruber* and oxygen isotope ($\delta^{18}O$)- and SST-based relative salinity reconstructions over the last glacial cycle based on marine sediment core MD20-3591 (36° 43.707 S; 22° 9.151 E, water depth 2464 m). Our data show that the southwestern Indian Ocean surface salinity and temperature structures were significantly different from modern during glacial stages (Marine isotope Stage (MIS) 2, 4, 6). During the middle and latter phases of glacial MIS2-6 our data indicate a regional increase in sea surface salinity (as well as temperature) during glacial periods. A recent wider regional comparison across the Indian Ocean (Nuber et al., 2023) shows the same patterns of salinification and warming during intensification of glacial conditions suggesting this is an Indian Ocean-wide phenomenon. These findings raise questions about the Agulhas Current's role in shaping glacial SA hydroclimate and the accuracy of climate models.

Session #6

PATTERNS AND PROCESSES OF VEGETATION CHANGE IN HIGHLY BIODIVERSE ARID AND MEDITERRANEAN ECOSYSTEMS OF THE CAPE FLORISTIC REGION (SOUTH AFRICA)

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Mediterranean regions are renowned for their rich biodiversity, influenced significantly by seasonal variations in winter rainfall and the occurrence of fires, both of which play crucial roles in shaping ecosystem dynamics. Projections indicate a potential shift towards unreliable winter rainfall and increased summer rainfall, likely leading to substantial alterations in community composition. Despite their complexity, Mediterranean ecosystems pose challenges for modeling. While short-term studies can provide insights into ecophysiological responses, a comprehensive understanding over longer timescales is imperative to address uncertainties and enhance landscape-scale predictive models. In this study, we present a multi-site

palaeoecological reconstruction spanning the last ~400 years, focusing on vegetation dynamics (using palynology), fire occurrences, and sedimentological changes at a site adjacent to a multi-annual rainfall manipulation experiment. This experiment aims to investigate how plant populations and communities respond to altered seasonal rainfall patterns in the Greater Cape Floristic Region hotspot in southwestern Africa. Through our analysis, we aim to assess whether long-term changes in vegetation are linked to shifts in rainfall seasonality and whether ecological responses observed over centuries can inform predictions of landscape dynamics at different spatial scales. Our findings reveal a correlation between vegetation dynamics and centennial-scale fluctuations in rainfall seasonality, characterized by transitions between two distinct fine-leaved shrub communities. Importantly, these transitions align with different responses observed in experimental manipulations of summer rainfall. This suggests the potential for ecophysiological research to inform interpretations of palaeoecological reconstructions and to extrapolate observational findings to address broader, long-term questions about environmental change.

FIRE-CLIMATE-PASTORALIST LINKS IN THE CAPE FLORISTIC REGION: HIGH-RESOLUTION SEDIMENTARY CHARCOAL RECORDS FROM VERLORENVLEI AND EILANDVLEI, SOUTH AFRICA

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Fire is central to the Cape Floristic Region (CFR)'s biodiverse and disturbance-adapted Fynbos Biome. However, prehistoric fire regimes remain poorly understood. Here, we use high-resolution sedimentary charcoal records from two coastal lakes in South Africa: Verlorenvlei, an arid site in the winter rainfall zone, and Eilandvlei, a dry sub-humid site in the year-round rainfall zone, to interrogate links between fire, climate, vegetation, and pastoralism. Both records span the last 4200 years, with resolutions ranging from 2-10 years per sample. Fire at Verlorenvlei is variable, with low fire until ~2000 cal BP, after which fire activity is variable but higher. The increase in fire likely reflects higher fuel loads due to wetter conditions, as evidenced by a shift in the diatom assemblage from marine towards brackish and freshwater species that has been linked to the strengthening of the southern westerlies. Local evidence for pastoralists lags behind the initial increase in burning by several hundred years. At Eilandvlei, fire activity is high earlier in the record, and declines towards the present, especially after ~1400 cal BP. The lowest fire activity is observed in the past 150 cal BP. The decrease in fire likely reflects the development of a fuel-moisture-limited environment wherein fuel is plentiful but too moist to burn, as indicated by parallel increases in Afrotemperate Forest and declining Fynbos vegetation. This work contextualizes variability in CFR fire activity over millennia and has implications for management and conservation in response to future predictions of a warmer and drier climate in the CFR.

RECONSTRUCTING THE FIRE HISTORY AND PALAEOENVIRONMENT AT THYSPUNT, SOUTHERN CAPE COAST, EASTERN CAPE

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This study aims to comprehensively understand the palaeoenvironments at Thyspunt in the Eastern Cape, a subregion of the Cape Floristic Region, through fire reconstruction and sediment analyses. Given the fire-dependent nature of the dominant vegetation (fynbos) in the area, there is a need for fire reconstructions and an understanding of the broader ecological dynamics within the southern Cape coastal region (SCCR). This research focused on reconstructing the fire regimes using sedimentary micro- and macrocharcoal from a sediment core (TP-1) extracted from the Langefonteinvelei wetland at Thyspunt, covering the last 5000 years. The charcoal fragments were separated into three size classes, with two falling under microcharcoal (size class 1: 10 – 100 μm and size class 2: 100 – 150 μm) and fragments greater than 150 μm representing macrocharcoal. The sedimentary profile of the TP-1 sequence was characterised based on loss on ignition and x-ray fluorescence analyses to provide better insight into the area's geological and geomorphic setting, climate history, and sediment properties. The results from the geochemical data revealed consistently high calcium carbonate composition throughout the sequence with a decrease in concentration at ~2000 cal. yr BP, 1300 cal. yr BP, and from 500 cal. yr BP to recent years. High fire activities occur around 4000 cal. yr. BP and from 1500 cal. yr BP till present, with former fire activities more likely associated with increased wildfires (driven by climate change) and the latter possibly reflecting human influence at that time. This study underpins the importance of a multiproxy study to enrich our understanding of fire histories in Thyspunt and contributes to broader regional insights.

ECOLOGICAL VARIABILITY IN THE ERSTE RIVER VALLEY BOTTOM - JONKERSHOEK, INSIGHTS FROM A MULTI-PROXY PALEOECOLOGICAL APPROACH

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Jonkershoek, a biodiversity hotspot in the Cape Floristic Region has been a hub for ecological monitoring and research for almost 9 decades since the hydrological catchment program of the 20th century. Records of rainfall, stream flow, and effects of introducing non-native tree species on the landscape before and during this period are well captured in the literature. However, until now the longer-term context for these changes was lacking. In this pioneering study, a 700-year pollen and diatom record from the Erste River Valley bottom is presented alongside $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ and fire records, capturing events of the terminal Medieval Climate Anomaly and the Little Ice Age, as well as the footprints from the intensification of human activities in the 20th and 21st century. Over this period, the vegetation evolved to a much wetter fynbos, with intensified fires, fluctuations in humidity, and increased electrolyte content. The water has remained relatively clean with fluctuating nutrient availability. This result gives a good basis for comparing land management practices pre and post-colonial occupation, a context for interpreting decadal scale and present-day assemblages, as well as insights into possible future trajectories of change.

A MULTI-PROXY PALAEO-ENVIRONMENTAL RECORD OF PALMIETRIVIER WETLAND, SOUTHERN CAPE: INSIGHTS INTO

HOLOCENE FIRE, VEGETATION AND CLIMATE DYNAMICS

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Our knowledge of ecosystem climate dynamics in the southern hemisphere has yet to be fully explored in the context of modern climate change using palaeoenvironmental proxies. South Africa's southern Cape is a climatically and ecologically dynamic region with palaeoecological significance. This study aims to reconstruct the vegetation, fire, and wetland formation history of the Palmietrivier wetland. The wetland, near to the town of Herbertsdale, is located in the southern Cape, within the fynbos biome, and is characterised by year-round rainfall and an arid climate, sensitive to environmental change. A 6m sediment core is estimated to be Holocene in age, although dating results remain outstanding. Palynological, charcoal, and grain size analysis was conducted. At 550-600cm, the pollen sequence indicates high Asphodelaceae percentages, and some fynbos elements (*Ericaceae*, *Anthospermum* and *Restionaceae*) in moderate abundances. Very high abundances of Asphodelaceae occur between 400-550cm, associated with the lowest relative percentages of *Asteraceae*, *Ericaceae* and *Cyperaceae*. The highest abundances of Fynbos elements occur at 0-100cm. At 40-60cm, the highest abundance of *Ericaceae* and *Cyperaceae* with *Cyperaceae* remaining relatively high throughout the record. The pollen abundances and change in grain size at 40-60cm, could indicate a depositional event with increased moisture availability, or an anthropogenic signal indicated by the presence of exotic *Pinus*. Peaks in macroscopic charcoal occur at depths of 600, 450, 310 and 180cm. Macroscopic charcoal is abundant in the top 100cm. This study is tied to the regional variability of southern African climate, and provides a unique insight into southern Cape palaeoecology.

LONG-TERM GEOMORPHOLOGICAL RESPONSE TO DISTURBANCE REGIMES IN A PEATLAND OF THE CAPE FLORISTIC REGION, SOUTH AFRICA: IMPLICATIONS FOR THE RESILIENCE OF ECOSYSTEM SERVICES

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Wetlands in dryland regions provide numerous ecosystem services that depend largely on process-landform interactions. Factors such as human pressures, hydroclimate conditions and vegetation dynamics have been proposed to mediate millennial-to-centennial-scale rates of geomorphic processes in wetlands. However, there is a critical need to establish linkages between the temporal dynamics of long-term geomorphic process dynamics and underlying catchment-scale controls in dryland environments. Focusing on a peatland in the South African drylands, this paper uses palaeoecological, sedimentological, and geochronological proxies in a ~2800-year-long sequence to develop insights into the controls of geomorphic processes and associated regulatory ecosystem services. The sequence represented a continuous phase of aggradation, though the depositional regimes vary over time. Sedimentology in the wetland is characterised by cyclic changes in depositional regimes, with alternating sand and silt deposits of variable thickness interrupted by peat lenses. These transitions appear to coincide with marked changes in past fluvial conditions, fire regimes and herbivory intensity, indicating eco-hydro-geomorphic interactions. However, the complex depositional regimes do not extend uniformly across the valley floor as peat deposits are more prolific towards the downstream end. The absence of interbedded clastic deposits is possibly due to spatial variability in wetland-catchment connectivity

patterns. This suggests that the upper part of the system is more sensitive to local disturbance events and may need to be prioritised for management. The alternating depositional regimes can transiently alter the delivery of sediment-linked ecosystem services and pose significant implications for the generalisation of these critical services.

Session #7

RECONSTRUCTING PAST ENVIRONMENTS: A NEW PHYTOLITH RECORD COVERING THE HOLOCENE FROM THE BAVIAANSKLOOF, SOUTHERN CAPE INTERIOR, SOUTH AFRICA

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The Baviaanskloof, forming part of the eastern arm of the Cape Fold Belt, serves as a pivotal research area for understanding the significant climatic contrast between the southern coast and the arid Lower Karoo to the north. Positioned at the eastern boundary of the year-round rainfall zone (YRZ), it offers an ideal setting for studying shifts in the prevalence of winter and summer rainfall contributions. Moreover, it holds profound biodiversity importance, lying at the convergence of two global-significant biodiversity hotspots—the Cape Floristic Region and the Maputaland-Pondoland-Albany Region. Despite its significance, the palaeoclimatic histories of the Baviaanskloof remain largely unexplored. This study aims to address this gap by examining phytoliths in fossil sediment samples from exposed profiles and modern surface soil samples representing six vegetation types in the area. Diagnostic phytolith morphotypes serve as valuable indicators of regional

palaeoclimatic change. Preliminary findings indicate abundant phytoliths throughout the fossil profile, with characteristic grass silica short cell (GSSC) and fynbos (spheroid Restionaceae) phytoliths notably present from the late Holocene to the present. Given the dominance of shrub vegetation in the fynbos biome, the identification of spheroid phytoliths in the fossil profile suggests the presence of fynbos vegetation, regardless of whether woody eudicots or Restionaceae produced them, as both are representative of fynbos vegetation. Thus, the Fy index, which is the phytolith index designed specifically for recognizing fynbos vegetation, may provide a definite signal of the presence of Fynbos vegetation throughout the fossil profile, providing insights into shifts in vegetation composition/distribution and rainfall seasonality over time.

PHYTOLITH ANALYSIS OF A WETLAND SEDIMENT CORE TO ASSIST IN PALAEOECOLOGICAL RECONSTRUCTIONS ALONG THE EASTERN ESCARPMENT, KWA-ZULU NATAL SOUTH AFRICA

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The uKhahlamba-Drakensberg escarpment in KwaZulu-Natal, South Africa, and the Lesotho Highlands are significant areas for investigating palaeoenvironmental conditions during the late Quaternary within the Summer Rainfall Zone (SRZ) of South Africa. Grass community composition stratifies along an altitudinal-temperature gradient resulting in C4 grasses dominating at lower altitudes and C3 grasses dominating at high altitudes however the influence of aspect is an additional environmental variable that plays a strong role in niche development for plant communities in

the Drakensberg (Bentley & O'Connor, 2018, de Deus Vidal Jr et al, 2021, Roberts et. al 2013). The interpretation of proxy evidence is hampered by limitations in temporal, spatial, and taxonomic resolutions. Thus, the extent to which montane grasslands and the phytosociology of the "Afromontane Archipelago" have evolved throughout the late Quaternary period remains inconclusive. This research will attempt, through the analysis of phytoliths from a 3m long sediment core retrieved from a wetland at roughly 1800 m.a.s.l. on the Eastern Escarpment, to elucidate some information on the plant composition of the wetland over time. The base of the core has an estimated maximum age of roughly 15 Kya based on a single carbon date. Analysis showed a high frequency and diversity of GSSP phytoliths associated with the family Poaceae and both a climate and aridity index were calculated where possible throughout the core. Preliminary results suggest that the vegetation composition of the wetland has not changed drastically since after the LGM and throughout the Holocene.

LATE-HOLOCENE PALEOENVIRONMENTAL RECONSTRUCTION OF THE SAVANNA-GRASSLAND ECOTONE, GAUTENG, SOUTH AFRICA

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A high-resolution, radiocarbon dated pollen sequence covering the last 4500 years of a 2.5 m peat core from the Colbyn Valley wetland in the savanna-grassland transition zone in southern Africa, was investigated. The deposits comprise clay and well-preserved peat layers that contain pollen and micro-charcoal, which show vegetation changes, burning and possible human or other disturbances. The environmental reconstruction of the wetland suggests vegetation cover changes in a seasonal climate that can be compared with chronologically parallel records from the nearby Moreleta River in the savanna biome and Rietvlei Dam in the grassland biome. The vegetation shifts and climatic oscillations include, e.g., a drought period between c. 4 ka and 3,5 ka and a shorter drought episode c. 8 ka, both of which are not always obvious in other pollen records from the wider region. Reconstructions can be confirmed in future by more pollen analyses of nearby wetland sources that are available in the region, which can be further strengthened by other proxies like isotopes.

POLLEN MORPHOLOGY OF SOUTHERN AFRICAN VACHELLIA AND SENEGALIA

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Legumes are common components of the African vegetation, with acacias being iconic trees on the landscape. Although not abundant in the pollen records from cores and sediment, because they are usually insect pollinated, some taxa have very restricted environmental distributions. To reconstruct past environment, it would be most useful to distinguish between the pollen grains. A new pollen morphological study is currently being carried out on African species of Acacia (*Vachellia* and *Senegalia*) in order to document the morphological characters that delimits the two African genera and species. Flowers of

eight species consisting of six *Vachellia* and two *Senegalia* species of voucher specimens were collected from the Moss Herbarium, University of the Witwatersrand, Johannesburg. The pollen samples were subjected to the acetolysis method of Erdtman and light and SEM microscopic study is currently ongoing. Preliminary results show that pollen characters of these *Senegalia* species (*S. galpinii* and *S. caffra*) varies from those of the *Vachellia* species (*V. davyi*, *V. abyssinica*, *V. Arenaria*, *V. karoo*, *V. grandicornuta*, *V. hebeclade* and *V. nebrownii*). The latter possesses reticulate to perforate exine sculpture with a conspicuous undulating exine in the peripheral monads forming furrows. In contrast, the *Senegalia* species have psilate to feovulate exine sculpture with no furrows. All the studied species have porate apertures and retain 12 to 24 monads but vary in sizes and exine thickness.

ESTABLISHING CONNECTIONS BETWEEN CONTEMPORARY VEGETATION DISTRIBUTIONS AND MODERN POLLEN REPRESENTATION IN THE NELSON MANDELA UNIVERSITY RESERVE.

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Palaeoecological reconstructions provide an understanding of the past climates of a particular area. This understanding can be used to inform conservation and rehabilitation efforts – however, palaeoecological proxies used for reconstruction (such as fossil pollen) need to be calibrated against a modern equivalent to be interpreted quantitatively. We therefore require an understanding of how pollen is produced and preserved in modern ecosystems, to be able to apply the relevant taphonomic biases to the fossil record. This understanding can be achieved through

comparisons of modern pollen rain with surrounding vegetation composition. Southern Africa is an understudied region and severely lacking in calibration data. This study therefore aims to generate the first modern pollen datasets for the southern Cape coast in South Africa, from the Nelson Mandela University Reserve in Gqeberha. Six modified Oldfield pollen traps were deployed in six different vegetation types throughout the reserve, and paired soil samples were taken from around each trap. Three years of trap data will be compared with the soil samples, and both of these datasets compared with vegetation survey data, to determine which archive better represents the surrounding vegetation. The pollen calibration data from this site will be used to calibrate fossil records from surrounding areas - this produces more ecologically sound inferences to inform climate change mitigation strategies. The southern Cape coast is important in terms of both biodiversity and human history - comprising the Cape Floristic Region, conservation strategies need to be optimized for this unique biome to preserve the vast array of endemic and indigenous species. It is therefore imperative that calibration data is generated for local sites to ensure that climate change mitigation strategies are as accurate as possible.

EXTRACTING MORE ECOLOGICALLY-SIGNIFICANT INFORMATION FROM THE SOUTHERN CAPE FOSSIL POLLEN RECORDS: A REASSESSMENT OF THE ASTERACEAE POLLEN TYPES

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The Cape Floristic Region (CFR) is one of South Africa's most biodiverse hotspots with 70% of the 9000 plant species being endemic. The CFR encompasses large portions of the Western and Eastern Cape Provinces with fynbos being the dominant vegetation. The vegetation along the coastal dune systems within the CFR is dominated by Asteraceae with 198 species, followed by Fabaceae with 103 species and Iridaceae with 76 species. Ongoing research focussing on the systematic study of Asteraceae pollen morphology has resulted in an expanded Asteraceae pollen type key. This key was previously used to re-assess the Asteraceae pollen types within the Eilandvlei fossil pollen sequence from the southern Cape coast. This revealed that the Coastal Thicket ecological group was previously underrepresented due to the lack of a fine scale Asteraceae pollen type classification. Neighbouring studies along the southern Cape coast as well as those across the different South African biomes also lack the classifications needed to differentiate among the Asteraceae more fully, highlighting the need for a re-examination of these records. This current study aims to reassess the Eilandvlei sequence in greater detail (a higher resolution reassessment), as well as the Baviaanskloof and Rietvlei-Still Bay pollen assemblages to provide greater ecological insights into past vegetation dynamics and climate changes within the Cape Floristic Region.

Session #8

EXAMINING SAVANNA CHARCOAL-FIRE RELATIONS USING ANALYSING TOPSOIL FROM LONG-TERM ECOLOGICAL EXPERIMENTS IN KRUGER NATIONAL PARK, SOUTH AFRICA

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Sedimentary charcoal is widely used to reconstruct and compare past fire patterns across ecosystems. Charcoal abundances from sieving and pollen-slide methods are considered to represent fires of local and landscape-scale origin. One problem is that vegetation-type flammability, a key trait influencing fire regimes in space and time, varies from patch to biome level. Furthermore, C4 grass-dominated savanna and grassland biomes with patches experiencing frequent fire or grazing may have fewer charcoal accumulating in sediments. Thus, a missing link may exist between contexts of charcoal production and retention in sediments. This study analyses and compares sieve and pollen-slide methods from topsoil collected from long-term fire and grazing experiments from Kruger National Park, South Africa. We were interested in comparing independently produced charcoal shape metrics with size-class analysis of pollen-slide samples. Our results show flammability contexts and method choice matter when attributing charcoal accumulations to fire regimes, with implications for paleofire reconstruction. Strong interactions between consumers.

EVIDENCE FOR OCCUPATION PATTERNS OF MIDDLE IRON AGE SITES IN THE GREATER MAPUNGUBWE LANDSCAPE BASED ON STABLE ISOTOPE ANALYSES OF MODERN AND ARCHAEOLOGICAL FRESHWATER MUSSEL SHELLS.

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Abstract

Prior to AD 850 archaeological evidence suggests that the Middle Limpopo Valley was almost exclusively occupied by mobile forager groups. Between AD 900-1250, new groups of Iron Age farmers appeared, indicating that climatic and environmental conditions in the Limpopo Valley could sustain permanent agricultural settlements and support trade networks which developed into highly complex society during the Middle Iron Age. The expansion of Mapungubwe gave opportunity for groups to move away from the central Mapungubwe region to specialise in hunting, mining and agricultural activities at smaller hinterland sites. Spatial and temporal environmental fluctuations influence potential grazing and food abundance, affecting the distribution of livestock, agricultural practises and movement patterns of populations over seasonal cycles. We present new environmental evidence for establishing seasonal movement/occupation patterns within the greater Mapungubwe area from several larger central (Schroda, K2, Pontdrift) and smaller hinterland (Maremani and Evelyn) sites from stable carbon and oxygen isotope analyses of archaeological freshwater mussel shells. The validity of the technique was established through the collection, preparation and isotopic analyses of modern freshwater mussel shells collected from the Nzhelele River at three monthly intervals over a year. The carbon and oxygen ratios from modern shells were compared with regional weather data to generate an age and seasonal response model to calibrate the archaeological isotope data. The calibrated archaeological data allowed us to determine the time of the year when mussels were harvested at each site, providing proxy evidence for sites occupation patterns, allowing reconstruction of past human mobility and seasonality behaviour.

THE PHYTOLITH RECORD OF LAKE NGAMI, BOTSWANA, DURING THE PAST 16 KA AND CORRELATION WITH OTHER PALEOCLIMATIC AND PALAEOECOLOGICAL PROXIES

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Lake Ngami occupies the southwestern part of the rift that forms the southern overflow catchment of the Okavango Delta. Past studies on paleo-landforms around the lake and paleoecological proxies from the lake provide a picture of environmental and climatic change since the terminal Pleistocene. The previously published pollen and spore record provided the pattern of regional and local vegetation change in relation to climatic and hydrological fluctuations since about 16 ka. To complement the pollen-based record, the phytoliths from the same core provide a different source of paleovegetation and paleoclimate reconstruction. Phytolith assemblages from modern depositional analogs and vegetation types across climatic gradients provide the basis for interpretation. Thus, the well-defined round saddle, produced by the arid-adapted *Stipagrostis* spp (bushman grass), the typical genus of the deserts of Southern Africa, is a good indicator of aridity. In contrast, the more commonly known short cells produced by the Chloridoideae and Panicoideae indicate a variety of moisture regimes and local environmental conditions. For this reason, the *Stipagrostis* Index (SI) is more suitable as an indicator of dry conditions in this part of Southern Africa than the widely used phytolith aridity index (I_{ph}). Likewise, the Panicoideae Index (PI) provides a more solid indication of moisture. Additionally, the incidence of woody-plant phytoliths correlates with the reduction of lake level and spreading of trees on the lake floor to form a savanna dominated by the Chloridoideae. The study is a contribution to interpreting phytolith assemblages in shallow lakes in the tropics of southern Africa.

USING MULTI-PROXY TO UNDERSTAND THE VEGETATION

DYNAMIC IN THE NORTHWESTERN MADAGASCAR THROUGHOUT THE MID-HOLOCENE

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Madagascar's western dry tropical forest has been identified as the most threatened ecosystem in Madagascar. Deforestation and erosion have been interpreted as results of anthropogenic fire and land-use, leading to vegetation cover loss and degradation. This has led to policies of general tree planting to restore degraded land and combat soil erosion. However, the vegetation dynamics and human-climate interactions are poorly understood. In this research, the Northwestern vegetation cover dynamic before and after human settlement are studied from two sediment cores spanning 5200 years using fossil pollen, stable carbon isotope ($\delta^{13}\text{C}$). And major trace elements (Si, K, T, Fe/K and Sr/Ca ratios) are analyzed to detect the anthropogenic and climatic driver of changes. Our results highlight that shrubland has been dominated the vegetation over the last 5200 years, where the values of $\delta^{13}\text{C}$ varied between -27.29‰ and -22.36‰ . Anthropogenic erosion signal was detected around 2000 years ago with increased Si and K values followed by increases of shrubs. A simultaneous decline of Fe/K, Sr/Ca ratios, and $\delta^{13}\text{C}$ values between ca. 2000 and 1000 cal BP indicates low humidity and increased desiccation. High values of Ti and Si and lower $\delta^{13}\text{C}$ values from 1000 cal BP to the present suggest intensified erosion, with shrublands dominating. Human settlements exacerbated land degradation and erosion, especially during the last five decades. These findings can be used for the conservation of the natural ecosystem and landscape management to the dry ecosystem in the western region of Madagascar and across Africa dry land.

CLUMPED ISOTOPE PALEOTEMPERATURES FROM TSODILO HILLS, NORTHWEST BOTSWANA, TOWARDS MODELLING LATE PLEISTOCENE CLIMATE OF THE INTERIOR KALAHARI PLATEAU

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Paleoclimate reconstructions of south-central Africa are relatively poorly constrained due to limited paleotemperature data across the interior Kalahari Plateau. This study investigates Quaternary carbonate soil concretions, calcretes, marlstones and fossil gastropods at Tsodilo Hills, northwest Botswana, where paleo-lake conditions have been linked to the Last Glacial Maximum (LGM, between 23-19 ka). The laboratory methods include petrographic screening to identify primary micritic carbonates, $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ analysis in order to characterize weathering processes, and ^{14}C ages together with clumped isotope ($\Delta 47$) measurements to interpret paleotemperatures. Modern shells from the Okavango Delta are used to test the method. These shells yield an average $\Delta 47$ temperature of ca. $24 \pm 1.1^\circ\text{C}$ (n=2), consistent with the Okavango River. In contrast, the fossils from Tsodilo Hills with an average ^{14}C age of ~ 29 ka yield an average temperature of ca. $15.6 \pm 2.2^\circ\text{C}$ (n=3); their data range between $13.8 \pm 2.2^\circ\text{C}$ and $18.9 \pm 1.4^\circ\text{C}$. These fossil gastropods reveal stable $\delta^{13}\text{C}$ values between -5.8 and 1.9‰VPDB and $\delta^{18}\text{O}$ values between 9.6 and 2.3‰VPDB , indicative of a good preservation state. It is however likely that weathering has affected these samples. These new results suggest significantly colder conditions just prior to (or during) the LGM

compared to the present day. This result is consistent with Late Pleistocene records of southern Africa: the Tswaing Crater (50-10 ka) and Congo Cave stalagmite (110-20 ka), which will be used to compare our findings using the National Centre for Atmospheric Research regional climate models. In addition, marine fossils and shell middens of the Indian Ocean are investigated to further refine these models.

CHARCOAL ANALYSES: RECONSTRUCTING THE LATE QUATERNARY PALAEOENVIRONMENT OF THE UPPER SENQU DRAINAGE BASIN, EASTERN LESOTHO HIGHLANDS

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Microscopic analysis of charcoal is an important tool in understanding environmental conditions in the past. The Polihali CHMP project was conducted in the basaltic eastern Highlands of Lesotho above 2000 masl. Several archaeological sites, due for inundation by construction of the Polihali Reservoir on the Senqu River, were excavated. The interior montane regions of southern Africa, including Lesotho, have a varied topography, vegetation and climate compared to those below the escarpments. Preliminary evidence from these archaeological sites suggests a pattern of climate change during the Late Quaternary, differing from those at lower altitudes. One of the excavated shelters, site D08, yielded a continuous late Holocene deposit to c. 2000 BP, including substantial charcoal samples. These can provide invaluable information on the vegetation and climate of the interior montane region during the Late Quaternary. Additionally, the charcoal maybe informative on how the people living in the area used the woody plant elements that grew in the vicinity of the shelter. Hence, the

research is also important for cultural heritage and an understanding of the movements and subsistence patterns of past human communities. The preliminary data includes several species, namely *Rhamnus prinoides*, *Salix sp.*, *Cliffortia sp.*, *Leucosidea sericea*, *Scolopia sp.*, *Buddleja salviifolia*, *B. saligna*, *Passerina montana*, *Grewia flava* and *Sideroxylon inerme*. These species suggest a moist climate and a high-altitude woody grassland environment. The identified plants have ethnographically recorded uses as fuel for fires, in artefact manufacture, as well as medicinal and magical uses. These could have also been relevant to people living in the area during the Late Quaternary.

Session #9

PEDIMENT SEDIMENTATION PROCESSES ON THE MARGIN OF THE KAROO DURING THE MIDDLE AND LATE PLEISTOCENE

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The Queenstown Basin geomorphic province comprises broad pediment slopes between saucer-shaped dolerite sills that form rings of high hills on the western edge of the Southeastern Coastal Hinterland. The Great Escarpment separates this landscape from the flatter Upper Karoo towards the northwest. The Golden Valley ring of hills north of Tarkastad is flanked by landsurface facets that reveal the age relationships between relict pediment surfaces and two generations of regolith. The footslopes are mantled with sheetwash colluvial sediments and are correlated with the Masotcheni Formation. The tabular bedrock pediment surfaces at the foot of Toorberg (2145 m) extend from ~1500-1440 m asl. Shallow valleys incised through the relict pediment are infilled with sheetwash

colluvial sediments that probably accumulated during the late Pleistocene (~120-30 ka). To the northwest the pediment surface extends for over 14 km from the Great Escarpment towards the Vlekpoort river. Gully and sheet eroded slope deposits are widespread. A series of borrow pits expose reddish brown, thinly bedded, sandy sediments at an elevation of 1250 m across the broad pediment. The sands contain small pebble gravel beds comprising slightly rounded clasts. Vertical joints are lined with powdery calcrete. A series of TT-OSL age estimates in the 367-500 ka range are probably minimum ages and indicate that these sediments accumulated in alluvial channels discharging across the pediment surface during the Middle Pleistocene. The Late Pleistocene deposits in shallow valleys incised below this relict surface indicate long-term cyclical erosional processes on these footslopes.

PART 1: GEOMORPHOLOGIC, STRATIGRAPHIC, AND TEMPORAL CONTEXT OF MIDDLE PLEISTOCENE TERMITARIA NEAR CALITZDORP, SOUTH AFRICA

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Termites are keystone organisms that influence their environment and ecology. Their soft bodies are not commonly preserved as fossils, but their nests are. In Calitzdorp, Western Cape, eight interconnected fossil termite nests (termitaria) are described, which may represent a new ichnogenus, have unusual taphonomy, and potentially record the presence of a termite species that is now locally extinct. The sediments that host the termitaria have not been previously studied in detail, nor dated, and therefore the termitaria lack age and stratigraphic constraints. In this study we describe the geomorphologic and

sedimentologic context of the fossil termitaria and provide preliminary uranium-series radiometric age constraints on their construction. By constructing a high-resolution digital elevation model (DEM) and undertaking field investigations, we show that the termitaria are situated on an alluvial terrace along the Gamka River within calcified gravel-rich soils. Both the alluvium and the termitaria are strongly affected by secondary pedogenic carbonate precipitation. A geochemical elemental pre-screening of the carbonate was followed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to identify high U/Th ratio regions suitable for uranium-series dating. Subsequently, selected layers were hand-drilled and dated using solution multi-collector inductively coupled mass spectrometry (MC-ICP-MS). Preliminary results indicate that the carbonates probably formed in the Middle Pleistocene (Chibanian), around ~330 ka, which provide a tentative minimum age constraint for the construction of the nests and carbonate precipitation. This on-going research exemplifies the usefulness of multi-disciplinary methods when studying the largely overlooked Quaternary geology and ichnology of the Western Cape.

PART II: THE TERMITE'S GUIDE TO BUILDING A LONG-LASTING HOME.

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Termites are one of the most successful insect groups, inhabiting nearly every continent with over 1000 species in Africa alone. Termite colonies are large-scale geo-engineers, modifying the landscape and substrate through their complex nest building. Unlike their individual bodies, termite biostructures have a higher preservation potential and are often the only features preserved to mark the presence of the insects through geological time. Recently, numerous well-preserved, subterranean fossil termite nests from

Calitzorp (Western Cape) have been reported on and are the focus of an ongoing ichnological investigation. The Quaternary nests, which comprise boxwork galleries that form hollow-centred, metre-tall cylinders, are preserved as distinct carbonate features in powdery and nodular sands. To better understand the preservation of these nests, we consider the localised carbonate features at varying scales:

1. The nest-bearing outcrop consists of carbonates (exclusively calcite) at different morphological stages – gravels, overlain by powdery sands which grade into nodular sands that amalgamate to form honeycomb carbonates capped by a hardpan. Notably, an outcrop from ~3m away, preserves the same succession without the honeycomb and hardpan carbonates.
2. Considering a cross-section of the nest wall, laminated carbonate features (dolomite and calcite) are prevalent at the inner wall, where shelved galleries are clearly defined, whereas detrital sediment dominates the outer wall.
3. Organic rich linings are exclusively associated with the inner wall gallery floors and ceilings. These features are consistent with a pedogenic origin for the carbonates and suggest that sediments directly associated with the termite activity are preferentially overprinted.

THE ROLE OF QUATERNARY SCIENCE IN THE GROWTH OF THE NUCLEAR INDUSTRY IN SOUTH AFRICA

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Nuclear energy forms part of the current and proposed future electricity generation mix in South Africa. The continued operation and siting of new nuclear power plants (NPP) are subject to stringent international regulations set out by the United States Nuclear

Regulatory Commission within the framework of the Senior Seismic Hazard Analysis Committee (SSHAC). The SSHAC process requires that geological, seismological, and engineering characteristics of nuclear sites be investigated in sufficient scope through a rigorous peer-reviewed research methodology termed the Probabilistic Seismic Hazard Analysis (PSHA). This process ensures that the highest standard of technically defensible interpretations is reached in both the seismic and ground motion models developed for nuclear facilities. Eskom identified several proposed sites for the construction of new NNPs. The Thyspunt and Duynefontyn sites have undergone the most extensive PSHA studies. Quaternary research played a vital role in providing valuable geoscientific information in support of the long-term seismic hazard assessments at these sites. Numerous integrated studies included the evaluation of neotectonic activity and/or slip rate of capable fault sources by investigating the presence or absence of tectonic deformation and displacement of Quaternary deposits across capable seismic sources such as the Ceres-Kango-Baviaanskloof-Coega, Colenso and hypothesised Milnerton fault zones. The tectonic displacement of geomorphic landforms, coastal warping and regional tectonic uplift rates were also accessed through detailed investigation of the altimetry and geochronology of marine terraces and marine-related deposits. The detailed study of Cenozoic deposits at these sites also provides pivotal information on the defined NPP footprint location and construction.

Poster Presentations

Session #1

SEASONAL OCCUPATION IN THE POLIHALI DAM BASIN AREA, LESOTHO HIGHLANDS

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The eastern Lesotho Highlands are characterised by their high elevation and drastic variation in topography with temperatures in mid-winter averaging below zero degrees Celsius. In contrast, the summer months (October to March) are considerably warmer and wetter. The harsh conditions experienced during the winter months would make summer occupation more habitable. To explore seasonal occupation of the eastern Lesotho Highlands, a faunal analysis was conducted on the macromammal remains from Site C21 in the Polihali Dam Area. The excavation of this site was conducted by the heritage consultancy firm PGS Heritage – Lesotho, contracted by the Lesotho Highlands Development Authority prior to the construction of the Polihali dams for Lesotho Highlands Water Project. The site was occupied by hunter-gatherers in the last 2500 years with four main occupation periods evident: ~2.5ka, ~1ka, ~0.7-0.8 ka, and < ~ 0.7 ka. Our analysis documented a significant faunal assemblage, encompassing a diverse array of species ranging from hunted game to carnivores. Hunted game formed the majority of the faunal assemblage (75.53%). Bov. II post cranial remains and grey rhebok teeth were the most abundant in the hunted game category constituting 56.21% and 28.71% respectively. Of all identified grey rhebok teeth, 76.82% were deciduous premolars and 12.18% were permanent. These findings imply that hunting occurred during the summer months, coinciding with the vulnerable period when calves are born. Hence, it is likely that the site was occupied during summer.

ASSESSING THE EFFECT OF HUMAN INDUCED FIRE REGIME CHANGES ON VEGETATION IN THE DRAKENSBERG MOUNTAINS

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Through the ignition of fires, humans have been interacting with the environment for millennia. The ignition of fires by humans may change fire regimes (fire frequency, severity and/or intensity), which in turn can cause changes in vegetation composition and structure. By combining phytolith (local vegetation) and charcoal (fire) data from two sediment cores obtained from wetland environments in the Drakensberg mountains, this study aims to assess the effect of fire regime changes on vegetation over the last 6000 years. Phytoliths and charcoal will be analysed from two study sites: Elandsvelei and Baboon swamp. The sites are surrounded by Podocarpus latifolius forests and Protea savannas today and the sediment cores recovered from these sites cover the last 2200 and 5700 years respectively. Phytoliths (biogenic silica microfossils) allow the reconstruction of the past vegetation. Charcoal fragments characterize all aspects of past fire regimes: (i) frequency (time series analysis of charcoal data), (ii) severity (abundance of charcoal in samples reflecting biomass consumed), and (iii) intensity (spectral properties of individual charcoal fragments reflecting combustion temperature). Through parameterizing both the vegetation change and the fire regime we will provide a comprehensive picture of how changing human fire use practices modified the vegetation. We anticipate that: (i) a decrease

in fire intensity resulted in woody encroachment of the surrounding vegetation, which was concomitant with the arrival of agropastoralists c. 600 years ago, and (ii) a shift in the proportion of C3 and C4 grass species in reaction to temperature changes in the Drakensberg mountains.

EXPLORING ENVIRONMENTAL SHIFTS IN LESOTHO SINCE THE LAST GLACIAL MAXIMUM: INSIGHTS FROM LOWLAND AND HIGHLAND FAUNAL RECORDS

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Insufficient focus has been directed towards environmental shifts in the Lesotho Highlands following the Last Glacial Maximum (LGM), with primary attention placed on the Lowlands. Achieving a comprehensive understanding of human adaptation in Lesotho since the LGM, necessitates equal consideration of both Lowland and Highland prehistorical records. This poster draws on published species lists from Lowland sites and unpublished species lists from recently excavated Highland sites to produce a comprehensive picture of environmental change in Lesotho over the last 25k years. In addition to using presence and absence data, we employ Minimum Number of Individuals (MNI) and Number of Identified Specimens (NISIP) to track changes in animal communities as they respond to environmental and ultimately climatic changes. As the climate shifted from colder to warmer conditions, environmental conditions responded differently in Highland and Lowland areas. This influenced the composition of animal communities and ultimately, the food resources that were available to Lesotho's Later Stone Age (LSA) people, resulting in distinct strategies and resource utilisation by Highland and Lowland populations.

ROCKY AND SANDY PALAEOSHORELINES REFLECTING PALAEO LANDSCAPE CHANGE: EXAMPLES FROM THE WILD COAST SHELF, SOUTH AFRICA

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The narrow (~13 km) and flat (0.2o) shelf south of Port St. Johns to Mbashe fronts a mixed rocky and sandy coastline with cliffs and headland-embayments dissected by river mouths. Numerous relict coastal features are revealed along the seafloor by collecting high resolution geophysical data of the shelf that includes multibeam bathymetry, side scan sonar, seismic, magnetic and legacy data. Prominent rocky outcrops, marked by positive magnetic anomalies, crop out across the inner shelf and form palaeoheadlands and embayments. These indicate shoreline occupation at -60 and -40 m under net sediment deficit and erosional conditions. Several stranded river valleys, marked by weaker magnetic anomalies, incise into rocky outcrops, often where palaeoembayments occur and extend to depths of ~ -100 m. Seismic reflection and legacy dredge data reveal these to be filled with unconsolidated sediment. With magnetic data, these reflect the penultimate or last glacial maximum palaeo-drainage patterns that are partly controlled by the regional structural network. The mid- to outer-shelf is dominated by aeolianite ridges and outcrops. Several form prograding cusped and recurved features that represent relicts of ancient dune cordons interposed with segmented lagoon and barrier-inlet complexes. These mark palaeoshoreline positions at depths of -75 m and -85 m respectively, under net sediment surplus and depositional conditions. The shelf profile predisposes large shifts in shoreline position, facilitating the preservation of these features by swift submergence and stranding

along the seafloor during the post-LGM transgression. The exposure of old fluvial courses is related to the strong winnowing effect of the Agulhas Current in the area.

WIND EROSION, AEOLIAN, BEREATYPE RED SANDS, LAND DEGRADATION, WILD COAST

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The Wild Coast study area is situated within the Maputaland-Pondoland-Albany biodiversity hotspot and is underlain by geological formations spanning from the Meso-proterozoic to the Cenozoic Era. This region of high environmental significance faces severe localised land degradation due to accelerated wind erosion. Statistical analyses were conducted to understand the relationship between erosion occurrence and the contributing influence of geological and soil conditions, by assessing the co-occurrence of erosion features across various geological units and land type soil patterns. Results revealed that 52% of wind erosion sites occurred within the Hb land type unit, characterised by deep grey sands associated with coastal aeolian deposits, with numerous wind erosion bedforms located on palaeodune features. There is a particularly strong association with the weathered Berea-type red sands where the surficial soil profile is characterised by a bleached, sandy topsoil horizon. Both the Hb land type and Berea-type sands exhibited significant distribution deviations, indicated by their high Chi-square values (688.04 and 502.47, respectively) and p-values of 0.00. The increased susceptibility of areas associated with this land type and the palaeodunes to wind erosion is attributed to the inherent erodibility of sandy soils that lack cohesion, rendering them vulnerable to the erosive forces of strong winds. Wind erosion development has often initiated in bare croplands, degraded grassland patches, and/or

along segments of trackways traversing the coastal palaeodune features. These findings highlight the crucial role of incorporating geological and soil type factors, among others, when devising land conservation strategies to effectively combat wind erosion.

LATE QUATERNARY CLIMATE CHANGE AND HUMAN IMPACT AT ST. LUCIA, KWAZULU-NATAL

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Studying and differentiating between the patterns of vegetation changes created by climate change vs those caused by anthropogenic impact in the South African archaeological record, in the last 50 000 years is of great importance to our understanding of the cultural development (e.g. technological innovations and use of the landscape). This project aims to identify patterns of vegetation change, characterize this change using qualitative and quantitative analyses, and differentiate between the patterns of vegetation change created by climate change and anthropogenic impact in northern KwaZulu-Natal. The reconstruction of vegetation and climate fluctuations will be done by applying palynological techniques to a sediment core from the Mfabeni Peatland at lake St. Lucia. This includes investigation of fossil pollen and spores, non-pollen palynomorphs like fungal remains and algae as well as measurements of charred fragments to reconstruct past fire regimes. Magnetic susceptibility will be applied to correlate with previously analyzed sediment records from Mfabeni. A chronology will be established using AMS radiocarbon dating and Optically Stimulated Luminescence (OSL), and then using a Bayesian age-depth model on the calibrated ages. Lastly, a survey of modern vegetation on and around the peatland, and investigation of the link between local

vegetation patterns and pollen preserved in surface sediments along a transect will be performed. Final sentence reiterating implications of the study, why it is important etc. Yes, also mention possible use for conservationists plus archaeologists.

QUATERNARY DEPOSITS ON THE CAPE'S SEAFLOOR ILLUMINATED BY THE COUNCIL FOR GEOSCIENCE OFFSHORE MAPPING PROGRAMME

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The South African offshore area is larger than the onshore region, and may be more than doubled if the extended shelf claim is ratified by the United Nations. The Council for Geoscience (CGS)' marine geoscience programme aims to eventually create a complete map of South Africa, which seamlessly spans from the onshore area to the outermost edge of the offshore territory. This programme focuses on hydroacoustic and geophysical methods including multibeam bathymetry, magnetics and shallow- to medium-penetration sub-bottom profiling. The CGS team is undertaking mapping and collation of hydroacoustic datasets on the continental shelf from 10-120 m water depths within map sheet areas on a scale of 1:50 000. We aim to produce a series of onshore-offshore geological maps and have completed six of these in Mossel Bay, Table Bay and False Bay to date. Of relevance to the Quaternary sedimentary record, we have identified several areas of the southwestern and southern Cape that have preserved Pleistocene rocks and these localities are generally associated with rivers and onshore coastal dunefields. The offshore datasets provide baseline information for monitoring global change and anticipated

future projections (e.g., considering sea-level change, coastal erosion). Other ongoing applications of these high-resolution marine geophysical data include earthquake and tsunami hazard assessments, defining areas for prospective current turbines (e.g. in the path of the Agulhas Current), creating a shipwreck catalogue, locating offshore strategic minerals resources and commodities, updating nautical charts, and characterising benthic habitats. This poster presentation provides an update on the South African seafloor mapping programme.

SUBMERGED EVIDENCE OF EROSIONAL AND DEPOSITIONAL SHORELINES OFFSHORE FALSE BAY

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Multibeam bathymetry, backscatter and side scan sonar coverage seaward of the northern shore of False Bay reveal a variety of deposits and geomorphic features. The geomorphic features include parabolic, linear and cusped ridges as well as flat-topped, seaward dipping rocky platforms. These features occur semi-continuously at depths from -10 m to -30 m. The various ridges have platform morphologies that mimic the form of dune fields, barrier-spit systems and intertidal shore platforms present along the present-day coast. The spatial scale of these features suggests that the coastal systems that existed were more extensive than the systems currently observed along the contemporary northern shore of False Bay. Potholes ($n = \sim 450$) are ubiquitous on rocky platforms at depths between -10 to -15 m and -20 to -30 m. Sediment infill and the development of small scale bedforms is observed within some potholes. Coupled with wave base calculations

within False Bay, this supports that contemporary marine abrasion and pothole expansion is not occurring. Potholes are ideal geomorphological indicators of intertidal zone conditions. The depths of occurrence of the shore platforms and relict potholes in this study corresponds with positions of palaeoshoreline occupation identified elsewhere on South Africa's continental shelf. Factors that facilitate the preservation of the observed deposits include rapid cementation of the palaeocoastal sediments, sufficient sediment volume of the palaeocoastal systems to buffer against significant transgressive ravinement and drowning of the palaeolandscape due to rapid rates of sea-level rise associated with a possible meltwater pulse-1c (MWP-1C).

PETROGRAPHIC ASSESSMENT OF SUBSTRATE CONDITIONS IN PLEISTOCENE AEOLIANITES OF THE CAPE SOUTH COAST, SOUTH AFRICA.

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The Southern Cape coast of South Africa preserves a rich abundance of trace fossils in Pleistocene deposits of the Klein Brak Formation (in cemented foreshore deposits) and the Waenhuskrans Formation (in aeolianites). Many of these traces are vertebrate tracks attributed to reptiles, avians, and mammals, including hominins. Track registration and the resultant morphology are influenced by the interaction between the trackmaker's pedal anatomy and the substrate on which it is moving, and the trackmaker's behavior. Of these factors, substrate conditions, specifically those linked to moisture content and grain size, have been shown to have the strongest control on track

morphology. Previous studies have shown that fine-grained substrates with a mud or silt component and low saturation levels provide the optimal conditions for the preservation of high anatomical fidelity in tracks, The Pleistocene aeolianites on South Africa's south coast, however, comprise medium-grained sandstones. Although the impact of substrate conditions on track registration and preservation is well known, a detailed analysis of the micro-sedimentological characteristics of the track-bearing Southern Cape coast aeolianites has not yet been performed. In this study, we aim to quantify the substrate conditions of the track-bearing aeolianites to understand their influence on the registration and preservation of the vertebrate tracks in the area. To achieve this, we will use petrographic techniques combined with field sedimentological observations. Ultimately, this investigation hopes to improve our understanding of how a wealth of traces were registered and preserved in relatively coarse-grained substrates deposited under moderate energy conditions.

PALEOCEANOGRAPHY OFF THE AGULHAS BANK ACROSS THE LAST GLACIAL PERIOD; A HIGH-RESOLUTION APPROACH

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A complex interplay of oceanic and atmospheric circulation, straddling both subtropical and mid-latitude climate regimes, mediates the climate dynamics off the South African coast to the interior. The South African coast is host to a plethora of archaeological rich sites and it is inferred that the climatic variability, in both temperature and

precipitation, throughout the late Quaternary exerted an influence on early hominin technological adaptations and behaviors. However, given the complexity of the climate dynamics of the region understanding precisely how large-scale variations in global and regional climate were manifested in seasonality across the stadial-interstadial periods of the late Quaternary remain to be determined. Here we present high-resolution (centennial-to-sub-millennial scale) planktic foraminiferal assemblage data, designated into relative abundance of Agulhas Leakage Fauna and Transitional-Polar Fauna, spanning the last 140 thousand years from marine sediment core MD20-3591, situated southeast off the Agulhas Bank. This data will serve, alongside a previously generated bulk Mg/Ca-temperature record for the marine sediment core MD20-3591, as a basis for further assessing changes in temperature and salinity extremes in order to infer the sensitivity to both large-scale global and regional changes in climate across the last glacial period. This will be achieved by employing individual foraminifera analysis using detailed analytical techniques as a means to extract higher-resolution geochemical and climate signatures from populations of individually analyzed foraminifera specimens across targeted time-slices. Taken together, these data will provide further understanding of the interaction between changes in the strength of the Agulhas Current, frontal migrations and links to regional temperature and hydrology.

INVESTIGATING MARINE ENVIRONMENTAL CONDITIONS UNDER THE INFLUENCE OF THE AGULHAS CURRENT, ALONG THE SOUTH-EASTERN SHELF OF SOUTHERN AFRICA

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The Earth's Ocean circulation system is connected by various complex networks of bottom, deep-water and surface currents, and plays a large role in regulating the Earth's climate. One of the most important systems in the southern hemisphere is the Greater Agulhas Current. A major objective of modern marine geoscientific research is to unravel the climate history of the Quaternary and its effects on ocean circulation and productivity. During the past decade, many efforts have been undertaken to investigate different sedimentological, geochemical, and paleontological proxies that are known to record past changes of the ocean environment. Foraminifera, an example of a proxy, preserved in biogenic sediments, can be used to provide information and data of past oceanographic settings and environmental conditions. Foraminifera are unicellular marine microorganisms that are also very sensitive to environmental conditions and changes. The aim of this study is to investigate the controls which the Agulhas Current (and other dominant water masses), has on the Holocene oceanographic settings, environmental conditions, and the biogenic sedimentation along the south-eastern margin of southern Africa. A total of 18 sediment samples were collected via a box corer during the R/V METEOR Cruise M123 along the southern Mozambiquan and South-eastern margins of South Africa. Foraminiferal assemblages were then documented, analysed and spatial distribution patterns were produced, to determine the dominant environmental controls on the foraminifera. Thereafter, the variation of taxa in relation to hydrography and bathymetry were examined.

LATE PLEISTOCENE PALAEOSHORELINE CORRELATION ALONG THE SOUTHWEST COAST OF SOUTH AFRICA – A CASE FOR A TECTONICALLY STABLE CONTINENTAL MARGIN

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Authors present contrasting views on neotectonic activity along South Africa's West Cape Coast. This study investigates the altimetry and chronology of marine terraces and associated marine-related sediments to assess the region's tectonic stability. Various geospatial databases were created to facilitate palaeoshoreline indicator correlation across the southwest Cape coast. These included palaeoshoreline, geochronology and borehole databases. Additional methodologies employed included fieldwork, high-resolution survey mapping, LiDAR data interpretation, topographic profiles, interpolated palaeobedrock topography modelling, palaeobedrock profiles, geological cross-sections and new borehole drillings. Results suggest consistency in the correlation in the altimetry and geochronology of shoreline indicators associated with the Middle Holocene highstand ($\sim 3.5 \pm 0.5$ m amsl), Late Pleistocene MIS (marine isotope stage) 5e ($\sim 6 \pm 1$ m amsl) and Middle Pleistocene MIS 11 ($\sim 9/10 \pm 1$ m amsl). Data revealed a lack of vertical tectonic displacement and marginal warping along the coastline and showed agreement with known local eustatic manifestations. Probably seismic fault sources such as the Colenso Fault were found to extend beneath a MIS 11 prominent wave-cut notch cut into palaeodune material and capped by calcrete yet showed no fault scarp or vertical displacement. This suggests fault inactivity since ~ 400 kya. Based on the available geological, geochronology, geomorphological and eustatic history, a lack of neotectonic activity was also inferred for the hypothesised Milnerton Fault source, where overburden Cenozoic marker beds and paleoshoreline indicators remained undisturbed. Ultimately, data affirms the concept of a stable southern African passive continental margin with low regional isostatic rock uplift rates of < 2 m since the Middle Pleistocene.

CENOZOIC DEPOSITS OF THE SOUTHERN KALAHARI GEOMORPHIC PROVINCE, NORTHERN CAPE, SOUTH AFRICA: INSIGHTS FROM COUNCIL FOR GEOSCIENCE MAPPING OVER THE GRIQUALAND WEST REGION

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The Griqualand West project forms part of the Council for Geoscience's multidisciplinary integrated geoscience mapping programme aimed at capturing geological information within the boundaries of South Africa at a 1:50 000-scale. The Southern Kalahari geomorphic province which falls within the confines of the project contains a large variety of Cenozoic deposits from the Kalahari Group, yet these deposits are poorly demarcated, characterised and mapped. As part of this study, geological maps were strategically selected to allow for the detailed delineation and re-evaluation of the region's Cenozoic lithostratigraphy. Comprehensive fieldwork was undertaken in conjunction with targeted remote sensing techniques to aid the unit identification and discern geological boundaries. Mapping efforts enabled the differentiation between stratigraphic units and the identification of new units in the area. It highlighted the widespread occurrence of aeolian sand-forming linear dunes, aeolian sand ramps, climbing dunes, calcrete (dry pans), Witsand 'roaring sands' and sheetwash colluvium. Additional karst controlled geomorphic features such as dolines were delineated from Google Earth imagery in areas South of Kuruman. Other localised formations identified include the Wedge Hill Formation near Volop, a newly described calcareous lacustrine formation.

THE ICHNOLOGY, ARCHEOLOGY AND GEOLOGY OF PLEISTOCENE SEQUENCES IN THE WOODY CAPE NATURE RESERVE, EASTERN CAPE, SOUTH AFRICA

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The presently submerged Palaeo-Agulhas Plain (P.A.P.) borders the shores of the Cape Floristic Region. During the Quaternary, the P.A.P. was exposed for extended periods during glacial phases and sustained entire ecosystems. Palaeoenvironments have been identified and described on the Cape south coast, providing a detailed record of past faunal assemblages. This project focuses on the Quaternary geology, archaeology, and ichnology, of the understudied Woody Cape Nature Reserve (SanParks) located within the northeastern portion of the P.A.P., Eastern Cape. The cliffs were logged geologically, and eight stratigraphic sites were sampled for Optically Stimulated Luminescence dating of which five samples underwent further geological analyses. The geochronology results show that the Woody Cape cliffs range in age from ~126 – ~0.4 ka. The cliffs contained aeolianite units interspersed with palaeosols and rhizolithic horizons. Coastal archeological sites were documented. The Alexandria Dune fields were observed, and shell middens were quantified at eight different locations. The middens consisted of numerous shellfish species, pottery shards and lithics. A total of nineteen ichnological trackways were investigated. Photogrammetry provided increased diagnostic features of images for selected trackways. Previously discovered (2020) trackways were destroyed by the elements and new ones uncovered (2021). Identified trackways include a shod toddler hominin, elephant, buffalo, bird tracks and vertebrate

and invertebrate burrows. This project aims to fill the gaps in knowledge surrounding the palaeoecology of the eastern region of the P.A.P. It also aims to provide educational material as to the Quaternary faunal assemblages within the Addo Elephant National Park.

VALIDATING THE DUNG FUNGI SPECTRA OF HERBIVORES PRESENT IN THE CAMDEBOO REGION OF SOUTHERN AFRICA: A COPROPHILOUS FUNGAL SPORE CALIBRATION STUDY

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At present, there is a lack of calibration studies in Africa that establish a correlation between coprophilous fungal spores (CFS) and the presence of herbivores. The aim of this study was to adopt standardized CFS methodologies from European and American contexts and apply them to a South African setting in order to examine fungal spore spectra and differences in assemblages found in dung collected from large and small herbivores in Eastern Cape private game reserves. Two methods were used to extract the fungal spores: an acid-free technique and the standard palynological technique. While the acid-free technique yielded higher fungal spore counts, there was a notable loss in exotic markers when compared to the standard palynological method. The fungal spectra and assemblages were unique to each herbivore and could be differentiated by size class of animal. The association of *Saccobolus* was highly abundant in African Elephant dung, while obligative coprophilous fungi were relatively high in Wildebeest and Cape Mountain Zebra compared to other herbivore dung. This pilot study confirms that *Sporormiella* is the best CFS to use for identifying the presence of megaherbivores. It also highlights that key factors such as climatic

and environmental conditions need to be considered in conjunction with the coprophilous behaviour of fungal spores.

QUATERNARY CLIMATE VARIATION COMPARATIVE LITERATURE REVIEW BETWEEN SOUTH AFRICA AND TWO SUB-ANTARCTIC ISLANDS

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Understanding climate variations throughout the Quaternary period aids us in understanding current climate change. Studying the climatic variations of the Southern Ocean is especially useful in understanding climatic drivers of the Southern Hemisphere at large and how they influence the South African climate. In this talk I present an initial literature review of the Quaternary climate variability in the South African as compared to the Sub-Antarctic regions most closely related to South Africa, namely Marion Island and Kerguelen Island in the southern Indian Ocean. Due to diverse range of topography, latitudinal extent and oceanic influence on the South African climate, it is hard to conclusively characterise what the Quaternary climate was for the entire area of South Africa. But, by using periods of glacial advance and retreat on the islands, it might be possible to identify patterns of regional climate variability over shorter timescales which could help us to reconstruct some of South Africa's Quaternary climate. Literature suggests that temperatures were approximately 19°C to 24°C cooler than modern temperatures during the early Quaternary period, accompanied by reduced rainfall. During the LGM (~19-26 ka) the temperature were cooler with estimates ranging from 5°C to 10°C cooler than present conditions, and increased aridity. Despite the lowered temperatures, evidence supporting the presence of glaciers during the LGM in South Africa is contentious. In the Southern

Ocean, Kerguelen Island (49°20'49"S 69°24'07"E) experienced a glacier maximum extent around ~41 ka, followed by a period of deglaciation. Although brief periods of glacier advancement and stagnation occurred between ~41 ka and ~15 ka years ago, deglaciation persisted. Similarly, on Marion Island (46°54'02"S 37°43'52"E), glaciers reached their maximum extent before 34 ka. Between ~34 ka and ~17 ka glaciers retreated, with possible periods of stagnation. By approximately ~19 ka years ago, lower altitudes below 850 m a.s.l. were ice-free.

Session #2

FROM SEA TO LITTLE KAROO: TRACKING THE PALEO-LANDSCAPE INHABITED BY THE FIRST MODERN HUMANS

K.H. Wogau (1, 2), Margit H. Simon (2, 3), K.L. Van Niekerk (1, 2), E. Jansen (1, 2), C.S. Henshilwood (1, 2)

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In southern Africa, past climate and landscape features could play a relevant role in the evolution of anatomically modern humans and their dispersal through the continental interior during the Marine Isotope Stage (MIS) 5(-71-130 ka) and MIS 4 (~71-57 ka). The southern Cape of South Africa has a rich Middle Stone Age human occupation record. This region has been shaped by a series of sea level fluctuations resulting in multiple exposures of South Africa's continental shelf named the Agulhas Plain. A coastal and fluvial landscape dominated the Agulhas Plain during the sea regressions. Our work will characterize the continental sediments deposited around Agulhas Bank during regression phases. To

achieve this aim, we will study the MD20-3591 marine record by means of multiproxy sediment characterization. Our project will shed light on the terrestrial landscape that modern humans inhabited during the Middle Stone Age. Additionally, we will explore the landscape possibly inhabited by Middle Stone Age hunter-gatherers in the continental interior. To reach this aim, we will conduct our research in the Little Karoo region to assess the paleo-landscape evolution during diverse climatic events (e.g., MIS 5 and MIS 4). The sedimentary record of diverse natural archives such as pans systems, dune fields, and floodplains will be studied.

INTEGRATING MICROMAMMAL DATA FROM TWO DIFFERENT EXCAVATIONS AT BOOMPLAAS CAVE – CHALLENGES AND PRELIMINARY RESULTS

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Margaret Avery's pioneering study of the micromammal remains from Boomplaas Cave, published in 1982, set the foundation for subsequent micromammal research in southern Africa. This publication and dataset have continued to be used to better understand the ecological conditions humans experienced in the Western Cape over the past ~65,000 years. With the re-opening of excavations at Boomplaas in 2022, we are now analysing new micromammal material, with particular attention to understanding the ecological context of the region's Middle to Later Stone Age transition. This study

integrates Avery's original data with our own, adding a taphonomic analysis of the newly excavated micromammal remains (the methodology for which was not standardized until the 1990s). Our poster describes our analytical strategy and how we believe it will result in optimized paleoecological interpretations, including a discussion of differences between Avery's sampling strategy and our own. We also provide preliminary results from the new micromammal remains at Boomplaas. For example, our initial taphonomic analysis supports Avery's suggestion that the micromammals may have been deposited by barn owls, allowing us to incorporate predator hunting behaviour into our palaeoecological methodology and interpretation.

LUMINESCENCE DATING AT BOOMPLAAS CAVE: PRELIMINARY RESULTS FROM THE 2022 EXCAVATIONS

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The 2022/2023 excavations presented an opportunity to revise and expand the Boomplaas Cave site chronology via a range of geochronological methods. This included the recovery of 20 new luminescence dating samples, which were obtained from members spanning LOH (potentially 80 ka) through to the top of the previously undated member YOL (potentially the last glacial maximum). Here we present preliminary results for several samples analysed using both single aliquot and single grain quartz SAR (single aliquot regeneration), as well as post-IR Infrared stimulated luminescence (pIRIR) analysis of K-feldspars. Given the potential antiquity of the site, and

the measured dose rates in most members (often greater than 2 Gy ka⁻¹), the latter approach is necessary to address quartz signal saturation for older members. Quartz-K-feldspar comparisons were however also used for younger samples as a means to evaluate the occurrence of incomplete bleaching. Although the samples comprise a relatively fine-grained loam, sand-sized quartz and K-feldspar were present in sufficient quantities and both protocols/minerals exhibit good luminescence sensitivity, low signal (zero dose) recuperation and are able to recover known doses administered in the laboratory (dose recovery). As might be expected, the K-feldspars exhibit anomalous fading for the low temperature IRSL signal (3-4% per decade), but this is greatly reduced for the post-IR signal (~1.5% per decade for the 225 °C post-IR signal). Initial results are presented in more detail in this poster, but thus far look promising, with reasonable (MIS 2) age agreement between methods for samples from the YOL member.

A HIGH-RESOLUTION ANALYSIS OF MACROFAUNAL TAPHONOMY AT BOOMPLAAS CAVE DURING THE LAST GLACIAL MAXIMUM

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During the 1970s, Hilary J. Deacon directed excavations of Boomplaas Cave (BPA) situated in the Western Cape of South Africa, with the aim of understanding human-environment interactions during the late Pleistocene and Holocene. His investigation unveiled a rich stratigraphic record, preserving deposits from the Middle Stone Age to the Later Stone Age, encapsulating approximately 65,000 years of prehistory. Renewed excavations at the site provide high-resolution samples to revisit questions about the role of paleoenvironmental changes in human

evolution. This study provides a taphonomic analysis of the Last Glacial Maximum (LGM) macrofauna from the 2022-2023 excavations and compares the results to previous data collected by Faith (2013) from Deacon's excavation. The previous taphonomic analysis characterised the LGM as an interval of low human occupation intensity with a variety of taphonomic agents (e.g., humans, carnivores, raptors) accumulating the faunal remains, though this interpretation was based on time-averaged data aggregated across coarse stratigraphic aggregates. In this study, the primary objective is to examine surface modifications to infer human versus non-human activity and occupational intensity at higher stratigraphic and chronological resolution. Through the analysis of data derived from anthropogenic and non-anthropogenic contexts within LGM members LP (25.4 to 21.7 ka) and LPC (27.3 to 25.8 ka), allowing us to compare taphonomic signatures between these contexts. The results presented will be preliminary as the analysis is currently ongoing. However, I will provide an overview and insight into the findings so far.

FIRST APPLICATION OF ZOOMS TO IDENTIFY FRAGMENTED FAUNA FROM THE PLEISTOCENE HOLOCENE TRANSITION AT BOOMPLAAS CAVE

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Intense fragmentation of faunal remains from archaeological sites is ubiquitous. In many cases, faunal assemblages are dominated by morphologically unidentifiable remains. For example, the vast majority of the large mammal remains from Boomplaas Cave could not be identified beyond the mammal size class using traditional morphological methods (Faith 2013). If they could be identified, these remains could potentially provide additional insight into human-animal relationships, dietary choices, and how they changed through time. Zooarchaeology by Mass Spectrometry (ZooMS) may enable taxonomic identifications when faunal remains cannot be identified using morphology (Buckley et al. 2009). This technique is applied here, and focus is given to sample selection, methodology, and collagen preservation. In total, 115 long bone fragments were selected from the faunal assemblage generated by Deacon's excavation from members CL1-4 (17.8-13.7ka; n=69) and BRL6-7 (14.0-9.1ka; n=46). ZooMS was undertaken at the University of Turin following standard protocol (Buckley et al. 2009). Each sample underwent collagen extraction, trypsin digestion, and peptide extraction. The samples were then spotted in duplicate and analysed using a MALDI MS. Spectra were identified manually. Collagen spectra were produced for 71% (n=165) of the sample with 57% (n=132) producing more than three peptides. A significant difference was found between collagen preservation in members CL and BRL but not between sub members CL1-4 or BRL6-7. Other than sub member CL4, BRL has a larger proportion of 'good' spectra. This could be related to differences in collagen preservation resulting from more extensive burning and increased occupation intensity or the older age of CL deposits.

A MICROMORPHOLOGICAL AND MINERALOGICAL STUDY OF HOLOCENE STABLING DEPOSITS IN BOOMPLAAS CAVE, SOUTH AFRICA

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The uppermost Holocene deposits in Boomplaas Cave (Cango Valley, Klein Karoo) are both the youngest and least-studied from an archaeological perspective. The surface CBM Member, which has been removed the central area of the site, is white in color, and was described by Hillary Deacon as broadly "calcined," having formed as a result of stabling of animals within the cave and periodic burning of the resulting dung. Occupation features such as hearths were also present. The underlying DGL member formed under similar conditions and also contained dung and the remains of both wild and domesticated animals. The deposits are currently exposed in two scarps, one in the northern area of the site and another along the eastern wall. These were sampled for geoarchaeological analysis during the 2022 field season. Six blocks were collected for micromorphological analysis, and more than 50 loose samples of the sediment and visible secondary mineral crusts and nodules were collected for mineralogical analysis. Fourier transform infrared spectroscopy was conducted on site and in the field laboratory. Minerals identified within the CBM and DGL members included calcite, apthitalite and niter, and the deposits are overall enriched in phosphorus, sodium, and potassium. The micromorphological analyses of the deposits revealed fibrous microlaminations containing secondary mineral encrustations. The deposits are significant for the geoarchaeological study of pastoralism in that they provide a southern hemisphere example of fumier, which is a type of burned stabling deposit more frequently associated with Neolithic and younger sites located in caves in the Mediterranean basin.

**PRELIMINARY
ARCHAEOBOTANICAL RESULTS
FROM OLD AND NEW
EXCAVATIONS AT BOOMPLAAS
CAVE, CANGO VALLEY, SOUTH
AFRICA**

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Hilary Deacon's excavations at Boomplaas Cave included the pioneering use of sediment flotation for plant macrofossil recovery. Despite this, Deacon (1979) did not find many non-wood charred plant macrofossils (with the exception of *Pappea cappensis* fruits found in storage pits dating to the last 2000 years), leading him to conclude that the dearth of potential plant foods at Cango Valley would have meant that the cave would not have been able to sustain long term occupation. Since these early excavations, however, the methods required for the analysis of highly fragmented plant macrofossils, and especially underground storage organs have greatly improved (Florin, 2022; Hather, 2000). In this poster we present preliminary analysis of plant macrofossils from Deacon's and new excavations at Boomplaas Cave - the latter including an extensive program of archaeobotanical recovery through flotation. We present the identifications of a number of plant food remains, including fragmented vegetative parenchymatous tissue from underground storage organs, and discuss the potential for analysis of long-term human environment interaction at the site.

**CLARIFYING THE CONTEXT FOR THE
MIDDLE TO LATER STONE AGE
TRANSITION AT BOOMPLAAS**

**CAVE: HIGH-RESOLUTION FABRIC
DATA AND PHOTOGRAMMETRY
APPROACHES**

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The transition from Middle to Later Stone Age (MSA-LSA) technologies is one of the most prominent behavioral shifts observed in *Homo sapiens* evolutionary history. Though many archaeological sites have yielded lithic assemblages described as transitional between the MSA and LSA, there is a need to reevaluate their depositional contexts to determine if they are behaviorally related or mixed. Renewed studies at Mumba in Tanzania show that incremental changes across the MSA-LSA transition may result from stratigraphic admixture due to coarse excavation methods. Elsewhere, artifact refitting shows that some MSA-LSA transitional assemblages reflect artifact mixing through post-depositional processes. This poster uses high-resolution fabric data and photogrammetry to examine the artifact and ecofact patterning in Boomplaas Cave's MSA-LSA transition deposits in Member YOL (30.1-25.9 k cal. BP), previously reported as non-anthropogenic ex-situ materials. However, dense lithics, ochre, and newly excavated combustion features suggest member YOL contains intermittent human occupation signals. We use newly acquired piece-plotted data to quantify artifact orientations (i.e., bearing and plunge) and spatial distributions through YOL. Preliminary results show anthropogenic and geogenic materials have a median plunge of 5.2° (CI [0.09°, 15.6°]) with unpatterned bearings, implying an

undisturbed context. A simple inspection of these materials in 3-dimensions suggests unpatterned distributions. These results suggest that the material in YOL is in situ but without discernible activity areas. We discuss the implication of these results for interpreting MSA-LSA depositional contexts and the broader applications of high-resolution data on archaeologists' ability to evaluate post-depositional processes.

HUMAN OCCUPATION AND ENVIRONMENTAL DYNAMICS THROUGH MAGNETIC SUSCEPTIBILITY ANALYSIS AT BOOMPLAAS CAVE, SOUTH AFRICA

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Boomplaas Cave, located in South Africa's Little Karoo Basin, offers a record of Middle to Late Stone Age human occupation. Its position in a year-round rainfall regime provides unique insights into how environmental changes influenced past populations' mobility and site occupation strategies. Our study at Boomplaas Cave utilizes magnetic susceptibility (MS) analysis to evaluate human occupation intensity and paleoclimatic conditions during the Middle to Late Stone Age transition. We conducted MS measurements on 44 sediment samples from a specific stratigraphic section with a Bartington MS2 meter, aiming to uncover occupation patterns and environmental shifts in this crucial period. Human activities like burning, along with warmer climate conditions, are known to enhance the magnetic susceptibility of soil, leading to higher measurements in warmer climates as opposed to cooler ones. Our findings suggest that enhanced MS correlates with periods of heightened human activity. Layers rich in hearths and burnt organic material (layers LPC and CL), are reflective of intense occupation phases, aligning with robust anthropogenic influences. In contrast,

the layers (LP) with lower MS values, correspond to sedimentation during the Last Glacial Maximum, and a thinner human occupation horizon. The onset of the Holocene (layers BRL), introduces an increase in artifact diversity, signaling a climatic transition that influenced the magnetic properties of the sediment. The data suggest that human occupation at Boomplaas Cave was closely tied to environmental conditions, with strategic use of the cave's resources in response to climatic variability.

RAW MATERIAL DISTRIBUTION IN THE SOUTHERN CAPE REGION AND ITS SIGNIFICANCE FOR LITHIC PROCUREMENT DURING THE MSA AT BLOMBOS CAVE, SOUTH AFRICA

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Archaeological research in the southern Cape region of South Africa continues to demonstrate the importance of this region for understanding the emergence of cultural modernity in anatomically modern humans. Specifically, the excavation of the Middle Stone Age layers (c. 100-70 ka BP) at Blombos Cave by the multi-disciplinary Centre for Early Sapiens Behaviour (SapienCE) has identified extensive evidence for symbolism, such as portable art (engraved ochre) and personal ornaments (perforated shells). However, some recurrent subsistence behaviours, namely the acquisition of lithic raw material, and associated mobility have not been fully explored. A provenance study designed to elucidate the nature of these behaviours has recently been initiated. It involves a comparison of petro-chemical profiles of

artefacts from Blombos Cave and geological sources within the southern Cape. The first step, an identification of potential raw material sources, was accomplished by a geoarchaeological survey during the 2024 field season. This poster presents the results of the survey and outlines the nature of the broader study. It details the distribution of silcrete and quartzite exposures and discusses their diagenesis and condition within the wider evolution of the landscape. The final results of the study will provide further insight into the nature of hunter-gatherer mobility, lithic economies, and occupation at Blombos Cave.

PALAEOLANDSCAPE EVOLUTION DURING THE PERIOD OF MIDDLE STONE AGE OCCUPATION OF BLOMBOS CAVE, SOUTH AFRICA

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Archaeological sites in caves along the southern coast of South Africa are important for understanding the early emergence of complex human behaviour. Research within the multi-disciplinary Centre of Excellence in Early Sapiens Behaviour (SapienCE) has focused on interrogating whether the capabilities of Middle Stone Age Homo sapiens to innovate and develop symbolic behaviour at sites such as Blombos Cave were influenced by

environmental and climate changes. Emerging datasets from marine cores, speleothems, and climate models suggest that within regional shifts in climate, conditions likely varied at the local scale. To reconstruct palaeoenvironmental conditions directly surrounding Blombos Cave, we study sedimentary features across the coastline to establish the timing and nature of palaeolandscapes evolution over time. We have targeted aeolianite and palaeosol sequences for luminescence dating and sedimentological analyses. This work complements detailed geoarchaeological analyses of cave sediments to link the cave sequence with evidence of a changing surrounding landscape.

DELEGATES

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Miengah Abrahams

Asia Alsgaard

Shaw Badenhorst

Jeremy Beller

Greg Botha

Elizabeth Carr

Andrew Carr

Hayley Cawthra

Brian Chase

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Carlos Cordova

Abraham Dabengwa

Shabeer Davids

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Talia Enoch

Irene Esteban

Patrick Fahey

Tyler Faith

Anna Florin

Marishka Govender

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Grant Hall

Vincent Hare

Trevor Hill

Erin Hilmer

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Louisa Hutten

Marilyn Hoole

Hannah Keller

Jelle Kraak

Anna Kudriavtseva

Emma Loftus

Marlize Lombard

Tina Lüedecke

Tim Maggs

Sashan Manikam

Saúl Manzano

Guilhem Mauram

Alyssa McGrath

Michael Meadows

Susan Mentzer

Rachel Mey

Xavier Middleton

Christopher Miller

Joshua Mohlabeng

Stella Mosher

Nozizwe Mtshali

Robert Muir

Sameera Musa

Luke Nel

Katrina Nilsson-Kerr

Alexander Norwood

Asithandile Ntsondwa

Mpilo Nxumalo

Kaedan O'Brien

Glory Oden

Zahra Omarjee

Justin Pargeter

Naomi Porat

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