



SASQUA

**SOUTHERN AFRICAN SOCIETY
FOR QUATERNARY RESEARCH**

SASQUA 2009

6 to 10 September 2009

**Phantom View River Resort and
Conference Venue**

Knysna, Western Cape, South Africa

***Understanding Quaternary Change:
Southern Hemisphere Perspectives***

Welcome

On behalf of the organising committee we welcome you to the biennial SASQUA 2009 Conference. We trust you will enjoy this meeting in the surrounds of the southern Cape coast, with its unique Quaternary environments.

Organising Committee

MIKE MEADOWS, Department of Environmental and Geographical Science, University of Cape Town, Rondebosch, 7701. michael.meadows@uct.ac.za

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Conference venue

Phantom View Resort and Conference Centre, Knysna, South Africa. The venue is situated ~5 km to the west of Knysna, where the N2 road bridge crosses the Salt River at the top of the Knysna Lagoon. For directions, go to: <http://phantomview.co.za/welcome-to-phantom-view-river-resort/how-to-get-to-knysna/>

Transport

No special arrangements have been made for transport between George (~40 km from the venue) airport and the venue. See second circular for airport transfer and car hire details.

Presentations

Oral papers: 15 minutes will be allocated per paper, followed by 5 minutes for discussion.

Poster papers: Posters should be put up for display as soon as possible to be in time for the poster session on Monday 7 September at 15h10.

Lunches

Lunches will be provided for registered delegates.

Social Functions

Sunday 6 September 18h00: Meet and Greet at conference venue.

Wednesday 9 September 19h00: Conference dinner (informal dress).

Public Lecture and Keynote Address

Monday 7 September 17h00: ***Dunes aren't Dumb. The Late Quaternary palaeo-archive from coastal dunes on the southern Cape coast, South Africa.***

Dr Mark Bateman, Reader in Physical Geography, Sheffield Centre for International Drylands Research, University of Sheffield, UK

Excursions and free time

Tuesday 8 September 15h30: Free time to visit town of Knysna.

Wednesday 9 September 10h30: Half-day excursion to Quaternary sites in the vicinity of Knysna, Wilderness, Sedgefield, Karatara and surrounds (returns late afternoon).

Sponsors

SASQUA acknowledges and thanks the following for their generous sponsorship:

Department of Environmental and Geographical Science,
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Department of Geography,
University of the Free State



PROGRAMME

Please refer to the number in **bold** before each paper for cross-referencing to the abstracts. **O** = Oral **P** = Poster

Abstracts are listed **alphabetically** (first author) after the programme

Sunday 6 September

17h00 - 18h00 Registration at conference venue

18h00 - 19h30 Meet and Greet at conference venue

Monday 7 September

08h00 Late registrations

08h45 - 09h10 Announcements and welcome by the President of SASQUA, Prof Michael Meadows

09h10 - 09h30 President's address, Prof Michael Meadows

09h30 - 10h30 **Session 1: South Western Cape**
Chair: AS Carr

O1: Spreeuwal: an Upper Pleistocene Wetland on the Western Cape Coast, South Africa
(G Avery and RG Klein)

O17: Pollen analysis of Holocene sediments from the lake in Princess Vlei, Western Cape, South Africa
(F Neumann, L Scott, M Bamford)

O21: Late Quaternary vegetation history of the Cederberg Mountains, South Africa: pollen evidence from hyrax middens
(LJ Quick, BM Chase, M E Meadows, L Scott, DSG Thomas and PJ Reimer)

10h30 - 11h00 TEA

11h00 - 12h40 **Session 2: East Africa and the Middle East**
Chair: TC Partridge

O2: Vegetation reconstruction based on fossil macroplants from Olduvai Gorge, Tanzania
(MK Bamford)

O12: Savanna dynamics at centennial time scales: long-term encroachment patterns in an East African savanna
(G Gil-Romera, HF Lamb, M Sevilla-Callejo, M Umer and D Turton)

O19: Pleistocene climatic changes and forced variable hominid adaptation in the Central Rift Valley (CRV), Kenya
(IO Onjala)

O23: Late Holocene savanna dynamics in the Amboseli Basin, Kenya
(SM Rucina, VM Muiruri, L Downton and R Marchant)

O16: Geochemical analyses of channel calcretes: a northern hemisphere example
(SJ McLaren and MJ Leng)

12h40 - 13h40

LUNCH

13h40 - 14h40

Session 3: South Africa - 1

Chair: MK Bamford

O7: Quaternary deposits of the Durban Bluff and associated Blood Reef Complex
(HC Cawthra and R Uken)

O10: Late Quaternary dietary shifts of the Cape grysbok (*Raphicerus melanotis*) in southern Africa
(JT Faith)

O13: Current sediment mobility as an analogue for aeolian palaeoenvironments in the Western Free State Panfield
(PJ Holmes and GF Wiggs)

14h40 - 15h10

TEA

15h10 - 16h30

Session 4: Poster Session

Chair: RR Maud and GA Botha

P1: Bivalve-derived records of sea surface temperature from the continental margin of southern Africa: preliminary data from the genus *Donax*
(AS Carr, DL Roberts, A Boom and AG Lombino)

P2: Some observations on the palaeoecology and organic geochemistry of the Knysna lignites as recovered from Makuhlu Quarry
(AS Carr, A Boom, J-C Berrio and PJ Holmes)

P3: Sediment provenance and evolution of the Wilderness barrier dunes, South Africa
(AC Dunajko and MD Bateman)

P4: Experimental approach to Coprolite pollen taphonomy
(Y Fernández-Jalvo, L Scott, JS Carrión, G Gil-Romera, J Brink, F Neumann and L Rossouw)

P5: A palaeomagnetic age of around 1.0 ma for the Cornelia-Uitzoek fossil vertebrate, hominin and Acheulian site, South Africa
(AIR Herries, JS Brink, B Bousman, V Eisenmann, J Gowlett, R Grün, J Hancox, J Moggi-Cecchi and L Rossouw)

P6: Late Holocene environmental change at Groenvlei, South Africa: evidence from diatoms
(KL Kirsten, ME Meadows and B Chase)

P7: Late Quaternary changes in ecosystems and biogeochemical cycling of Lake Rutundu, Mount Kenya, East Africa: review and retrospective
(PV Kloryga)

P8: Climate and modern human behaviour - a study of the link between climatic change and the cultural evolution of Homo sapiens during the Middle Stone Age in the southern Cape, South Africa
(TH Nel)

P9: Wits Online Phytolith Database: a new resource for palaeobotanists
(LM Pereira)

P10: A multi-proxy record of environmental change during the last glacial-interglacial transition from the Cederberg Mountains of South Africa
(L J Quick, B M Chase, M E Meadows, L Scott, D S G Thomas and P J Reimer)

P11: The geomorphology of Florisbad and its aeolian deposits
(M Rabumbulu)

P12: A review of 'Palaeoenvironmental Change in the Mediterranean since the Last Glacial Maximum: a record of Vegetation, Lake-level and Climate Change from Lake Tigalmamine, Atlas Mountains, Morocco'
(ME Scarborough)

P13: Palaeobotany, biogeochemistry and sedimentology of Late Tertiary fluvial deposits, West Coast, South Africa
(L Scisio, H Tsikos, Y van Breugel DL Roberts and L Scott)

17h00 - 18h00

Keynote Address and Public Lecture

Chair: PJ Holmes

Dunes aren't Dumb. The Late Quaternary palaeo-archive from coastal dunes on the southern Cape coast, South Africa.
(Dr MD Bateman, Sheffield Centre for International Drylands Research, University of Sheffield, UK)

Tuesday 8 September

09h00 - 10h40

Session 5: Southern and Western Cape Coasts

Chair: L Scott

O15: The coastal platform in the southern Cape
(ME Marker)

O4: New Middle Pleistocene excavations on the West Coast of South Africa: preliminary results
(DR Braun)

O6: Palaeoecological reconstructions using pyrolysis GC/MS techniques: Rietvlei, Still Bay, South Africa
(AS Carr, A Boom, BM Chase and DL Roberts)

O22: Evolution of the Benguela upwelling system and southern African west coast aridification
(DL Roberts)

O8*: Hyrax middens and what we thought we knew about southwest African climate
(BM Chase, ME Meadows, L Scott, DSG Thomas, L Quick, E Marais, J Sealy, N Ogle and PJ Reimer)

***Paper may have to be accommodated on Wednesday morning before the field excursion**

10h40 - 11h10

TEA

11h10 - 12h30

Session 6: Pinnacle Point

Chair: ME Marker

O3: A high resolution speleothem record of variable climate and environment 90-53,000 years ago from Pinnacle Point (south coast South Africa) and bearing on modern human origins and floral diversity (M Bar-Matthews, CW Marean, Z Jacobs, P Karkanas, EC Fisher, AIR Herries, K Brown, H M Williams, J Bernatchez, A Ayalon, and PJ Nilssen)

O11: Middle and Late Pleistocene paleoscape modeling along the Southern Coast of South Africa (EC Fisher, M Bar-Matthews, A Jerardino, and CW Marean)

O5: An Archaeological Sequence from MIS 3 to 5: The Middle Stone Age deposits at Pinnacle Point site 5-6, Mossel Bay, South Africa (K S Brown, J Bernatchez, CW. Marean, AIR Herries, Z Jacobs, C Tribolo, D Braun, DL Roberts, MC Meyer, HM Williams, M Bar-Matthews)

O14: Pinnacle Point in context: The Cape Floral Kingdom, shellfish, and modern human origins (CW Marean)

12h30 - 12h40

Discussion forum around coastal environments (Keynote address and Sessions 5 and 6)

12h40 - 13h40

LUNCH

13h40 - 15h00

Session 7: South Africa - 2

Chair: DL Roberts

O9: Phytolith morphotypes in Poaceae, Restionaceae, and Cyperaceae: a research protocol for determining rainfall seasonality and growing season temperatures in Southern Africa (CE Cordova and L Scott)

O18: Climate and vegetation changes at Braamhoek wetland, South Africa (E Norström, L Scott, M Finné, J Risberg, T Partridge and K Holmgren)

O20: New evidence on rates of cultural diffusion during the early Acheulian: what was the trigger? (TC Partridge)

O24: Some long pollen sequences from South Africa (L Scott, GA Brook, G Gil-Romera, L Rossouw, E Norström and E Marais)

14h50 - 15h00	Discussion forum around South African and African Quaternary (Sessions 1, 2, 6 and 7).
15h00 - 15h30	TEA
15h30 - 16h30	SASQUA Council Meeting

Wednesday 9 September

09h00 - 10h00	SASQUA Biennial General Meeting
10h00 - 10h30	TEA
10h30	Depart for field excursion
	LUNCH (packed)
17h30	Return from field excursion
19h00	Conference Dinner

Thursday 10 September

09h00	Conference closure and depart for post-conference excursions
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ABSTRACTS

Keynote address and Public Lecture

Dunes aren't Dumb. The Late Quaternary palaeo-archive from coastal dunes on the southern Cape coast, South Africa.

**Dr Mark D. Bateman
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The southern Cape coastline of South Africa is thought to have been generally tectonic stable in the Late Quaternary and its position at the modern interface of the winter and summer rainfall climate zones, near the convergence of the Benguela and Agulhas ocean currents, potentially will have made it sensitive to past terrestrial and marine changes. It is therefore ideally placed to explore long-term coastal geomorphic evolution and sea-level fluctuations provided a suitable Late-Quaternary palaeo-archive can be found.

The southern Cape coastline of South Africa is frequently punctuated with dunes and sediments relating to former aeolian sand transport. These range from the 200 m+ high lithified barrier dunes of the Wilderness area to currently mobile parabolic dunefields such as those near Hermanus to the west. Recent work on these aeolian deposits reveals a history extending from the present to over 250,000 years ago with, in some cases, multiple generations of coastal dune deposits stacked upon one another. This paper reviews what can be learned about when these dunes formed, where the sediment for the dunes came from, and what this can tell us in terms of the history of vegetation, animals, climate and sea-levels on the southern Cape coastline.

O1: Spreeuwal: an Upper Pleistocene Wetland on the Western Cape Coast, South Africa

G Avery¹ and RG Klein²

¹Iziko South African Museum, Natural History Department; Archaeology Department, University of Cape Town, South Africa

²Stanford University, California, USA

Located in the intertidal zone of Saldanha Bay, Spreeuwal includes faunal remains and sparse stone artifacts deposited around a palaeo-wetland during a lowered sea level. The larger mammal component, which includes extinct species and others not recorded historically in the Western Cape, is typical of glacial conditions, which attracted grazers in particular, suggesting an age within the Last Glacial. A U-Series date of ~56 ka, from the capping is consistent with a Last Glacial date for the underlying fauna and artefacts, although the pen-ultimate glacial cannot yet be ruled out. Small mammals, birds, reptiles and amphibians also occur, sometimes in small “clumps”, of several taxa, almost certainly representing scats or pellets from small carnivores or raptors. Hyaena gnawing and coprolites are present. The inferred palaeoenvironment at Spreeuwal is different to those commonly associated with Last Glacial “cold” assemblages. Expected elements, like White Rhinoceros, Greater Kudu, Southern Reedbuck and Springbok are either absent or poorly represented, whereas equids and Black Rhinoceros are more common. Gastropods associated with fresh/brackish vleis and ostracods are common; there are traces of sedge stems and calcified root masses. Rare Middle Stone Age artifacts and a cut rib indicate that some of the bones and artefacts were associated and confirm the existence of an ephemeral human component. Spreeuwal differs from other Last Glacial assemblages and is not a hyaena den – rather, it reflects life on an open landscape with animal (primarily) and human activity focused around a wetland, such as at Middle Pleistocene Elandsfontein and Duinefontein 2.

O2: Vegetation reconstruction based on fossil macroplants from Olduvai Gorge, Tanzania

MK Bamford

Bernard Price Institute for Paleontological Research, University of the Witwatersrand, P Bag 3, WITS 2050, Johannesburg, South Africa

Olduvai Gorge in Tanzania is well known for the Plio-Pleistocene hominin and faunal remains but these occur in association with plant remains in some localities on the eastern paleolake margin from Upper Bed I and Lower Bed II, approximately 1.7 to 1.85 Ma. The plant groups represented are sedges, grasses, and woody and herbaceous dicotyledons. Most of these plants are fragmented but the roots and leaves are *in situ*. The quality of preservation is variable. Silicification is the dominant type of preservation; it ranges from high quality faithful replacement of cells resulting in silicified wood and sedge culms that are identifiable on the basis of their internal anatomy, to poor quality biotubes lacking internal anatomy or external features that prevent assignment to a specific plant or invertebrate origin. In between this range are silicified roots and grass culms identified by their external anatomy, and leaf and stem impressions. The *in situ* root horizons are useful for recognizing paleo-surfaces. The best quality preservation where internal anatomy is preserved occurs at HWKE and MCK, localities that are in the middle of the fault compartments. Some fossil wood of *Guibourtia coleosperma* (Caesalpinaceae) from HWKE is well preserved. *In situ* grass culms from a number of localities are direct evidence of an edaphic grassland in uppermost Bed I. Some sedge culms are illustrated here and identified as possible species of *Cyperus*, *Fuirena* and *Schoenoplectus*. From actualistic studies in modern ecosystems in eastern and southern Africa it is possible to reconstruct the palaeoenvironment in fine detail and to show it has changed over time.

O3: A high resolution speleothem record of variable climate and environment 90-53,000 years ago from Pinnacle Point (south coast South Africa) and bearing on modern human origins and floral diversity

M Bar-Matthews¹, CW Marean², Z Jacobs³, P Karkanas⁴, EC Fisher⁵, AIR Herries⁶, K Brown², H M Williams⁷, J Bernatchez⁷, A Ayalon¹, and PJ Nilssen⁸

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Coastal South Africa draws interdisciplinary interests due to the co-occurrence of a rich record for early human behavioral modernity, hyper-diverse vegetation with very high endemism (the Cape Floral Region), and globally influential oceanic and climate systems. High resolution and continuous climate and environmental records are needed to provide the context for the evolution of behavioral modernity and this diverse flora. Here we present the first such record for climate and environmental change from 90,000 to 53,000 years ago from the southern Cape coast, a time that encompasses expressions of several indicators of human behavioral modernity. Our research location is ideally placed near the location of several critical archaeological sites, near the boundary of the winter and summer rainfall regimes, and close to isotopically distinct floral zones. We used isotopic analysis of precisely dated speleothems to document shifting vegetation and rainfall. The presence of winter rain and C3 grasses waxes and wanes in response to Southern Hemisphere shifts in SSTs and temperature. It is often argued that the Cape Floral Region partially owes its high diversity to relative climatic stability, but our record does not support this explanation for the southern Cape. This record displays abrupt and short-term changes previously undocumented, among them is a dramatic isotopic excursion centered at ~72 ka. This event is associated with one short-lived phase of human technological innovation (the Still Bay). Early modern humans in this region confronted a variable climate and adapted quickly in a manner similar to behaviorally modern humans.

O4: New Middle Pleistocene excavations on the West Coast of South Africa: preliminary results

DR Braun

Department of Archaeology, University of Cape Town, Rondebosch, 7701

The Early-Middle Pleistocene is one of the most intriguing and understudied periods of human evolution. This time period may record the extinction of *Homo erectus* in Africa and appearance of the archaic forms of our species (*Homo sapiens*) as well as the appearance of a subsequently expansive behavioural tradition (Middle Stone Age). Yet the study of Middle Pleistocene hominin behaviour has been largely focused on variation in large bifacial tool morphology. Complementary investigations of landscape scale variation in Middle Pleistocene hominin behaviour are relatively limited. Here we report on preliminary data from new excavations in Middle Pleistocene deposits in the West Coast National Park which may help clarify major features of Middle Pleistocene hominin evolution by linking ecology and subsistence behavior to Acheulian technology. The sediments in the West Coast National Park region and surrounding private nature reserves are stratigraphically complex, yet may preserve one of the largest Middle Pleistocene land surfaces in South Africa. Here we report on evidence of hominin behavior from Acheulean artifacts and associated fossil fauna. Studies of the associated paleoenvironments are described through a variety of proxies of past environments. Initial investigations suggest that variation in landscape use may explain the diversity exhibited in Middle Pleistocene industries. Further, evidence from artifact provenance studies suggests that artifact transport played a significant role in the patterning found in Acheulean localities. This investigation hopes to expand the understanding of the Acheulian beyond simple artefact description to patterns of hominin behavioral ecology.

O5: An archaeological sequence from MIS 3 to 5: The Middle Stone Age deposits at Pinnacle Point Site 5-6, Mossel Bay, South Africa

K S Brown^{1,2}, J Bernatchez² CW Marean², AIR Herries^{3,4}, Z Jacobs⁵, C Tribolo⁶, D Braun¹, DL Roberts⁷, MC Meyer⁵, HM Williams², M Bar-Matthews⁸

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⁸ *Geological Survey of Israel, 30 Malchei Israel Street, Jerusalem 95501, Israel*

Pinnacle Point Site 5-6 (PP5-6) is a rockshelter in the quartzitic cliffs at Pinnacle Point near Mossel Bay, South Africa. Five seasons of excavation at PP5-6 have been conducted as part of the South African Coastal Palaeoclimate Palaeoecology Palaeoenvironment, Palaeoanthropology Project (SACP4) resulting in a 9 meter section of stratified MSA deposit. The base of PP5-6 has several meters of deposit with lenses of shell and anthropogenic burning transitioning to a series of sandy and ashy layers with fine-grained lithics contemporary with the Still Bay. Howieson's Poort deposits occur further up the section with characteristic backed geometric blade segments on fine-grained raw material. OSL dates provide constraints on these sedimentary and technological shifts. The OIS 5-3 archaeological sequence at PP5-6, has a complimentary high resolution speleothem-based oxygen and carbon isotope record from 92-55ka to provide an environmental context for examining technological adaptations by Early Modern Humans at approximately the same time that we see evidence for symbolic behavior. The emerging chronology of PP5-6 when considered in conjunction with a new chrono-stratigraphic synthesis of southern African MSA sites suggests that the "frequency" of the climate curve may be as important as the "amplitude" in examining EMH technological adaptations.

O6: Palaeoecological reconstructions using pyrolysis GC/MS techniques: Rietvlei, Still Bay, South Africa

AS Carr¹, A Boom¹, BM Chase² and DL Roberts³

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²*Institute for Human Evolution, University of the Witwatersrand, South Africa*

³*Council for Geoscience, Belleville, South Africa*

Biomarkers and stable isotopes have become well-established techniques palaeoenvironmental reconstruction. Pyrolysis gas chromatography mass spectrometry (py-GC/MS) is a very powerful method in organic geochemistry, which allows the structural analysis of complex macromolecular organic matter. Although a well known technique in organic geochemistry, it is seldom applied in palaeoenvironmental studies.

In this paper we investigate the potential of py-GC/MS in multi-proxy palaeoenvironmental investigations through the analysis of a near-continuous c. 30 ka lake core from Still Bay (southern Cape). We consider a suite of py-GC/MS data, covering the major sedimentary units in the core, along with standard bulk geochemical data (total organic carbon, $\delta^{13}\text{C}_{\text{TOC}}$ & C/N). We identify the main controls on organic matter composition and outline the potential of this approach for palaeoenvironmental reconstructions in southern Africa.

A total of 110 compounds, comprising all major pyrolysis products were identified and quantified in 22 samples. These data reveal a rapid change in the nature of the organic matter with depth. Principal component analysis suggests that 75 % of the overall variation in these 110 compounds can be explained by four factors. Factor 1, which accounts of 37.6% of the variation is, perhaps unsurprisingly, related to degree of organic matter preservation. More interestingly, factor 2, which accounts for 20.4% of the variation appears to be related to the relative significance of algal vs. higher plant derived organic matter. The remaining factors are associated with nitrogenous compounds and the relative abundance of polyaromatic compounds (9.3 and 7.4 % respectively).

Overall, the data provide an insight into the specific nature and mechanisms of organic matter degradation in this environment, and imply a number of distinct phases of carbon source input within the Late Quaternary history of the lake. The period bracketed by radiocarbon ages of c. 33-12 ka is associated with significantly degraded organic matter and is suggestive of relatively arid conditions. Subsequently, a marked increase in algal-derived organic matter (factor 2) in conjunction with an increase in total organic carbon implies a significant increase in lake primary productivity during the post-glacial to early Holocene period. Late Holocene organic matter is dominated by higher woody plant inputs (including lignin), reflecting both the limited degradation of this relatively young organic matter and current site conditions; with the lake presently characterised by a thick mat of emergent macrophytes (e.g. *Phragmites australis*).

P1: Bivalve-derived records of sea surface temperature from the continental margin of southern Africa: preliminary data from the genus *Donax*

AS Carr¹, DL Roberts², A Boom¹ and AG Lombino¹

¹*Department of Geography, University of Leicester, UK*

²*Council for Geoscience, Belleville, South Africa*

In light of uncertainties in future global climatic projections there is an increased impetus to understand the causes and effects of warm periods in the geological past. In particular, the sensitivity of low-mid latitude SSTs during warm intervals (e.g. mid Pliocene optimum) is poorly constrained, but is critical for interpretations of the causes of global warmth. In this context southern Africa and the surrounding Atlantic and Indian Oceans are important, but understudied regions. The Late Cenozoic emergent marginal marine deposits of the South African coastline record important periods of higher eustatic sea-levels, coeval with Neogene and Quaternary warm intervals. These deposits (particularly on the west coast) contain abundant fauna and represent a significant archive of palaeoceanographic and palaeoenvironmental data.

Here we report ongoing research focusing on the development of seasonal resolution $\delta^{18}\text{O}$, $\delta^{13}\text{C}$ and trace element records using the bivalve genus *Donax* (Bivalvia, Donacidae). Such a dataset would be of special value because: 1) The use of this extant genus will allow greater confidence to be placed in $\delta^{18}\text{O}$ -derived palaeoSST estimates; 2) Rapid and near-continuous shell growth during this organism's lifespan allows the resolution of seasonal-scale variations in past marine conditions; 3) *Donax* typically inhabits high-energy sandy beaches subject to minimal localised salinity and $\delta^{18}\text{O}_{\text{seawater}}$ variation.

Initial work has focussed on testing modern and Holocene *Donax serra* specimens against contemporary marine conditions. Using modern $\delta^{18}\text{O}_{\text{seawater}}$ values $\delta^{18}\text{O}_{\text{aragonite}}$ from modern south coast *Donax serra* (Mossel Bay) produce average SST estimates of $18 \pm 0.6^\circ\text{C}$; with seasonal temperature ranges for individual specimens between 14°C and 22°C . Cooler water conditions are calculated for modern west coast samples ($16 \pm 0.3^\circ\text{C}$), with estimated seasonal temperature ranges of 14°C to 20°C . These temperature estimates are therefore broadly consistent with expectations from the instrumental record. Holocene *Donax serra* from Mossel Bay hint at slightly higher SSTs ($19 \pm 0.5^\circ\text{C}$; range $15\text{--}23^\circ\text{C}$). Preliminary data for last interglacial *Donax serra* and Miocene *Donax rogersi* from the west coast will also be presented.

P2: Some observations on the palaeoecology and organic geochemistry of the Knysna lignites as recovered from Makuhlu Quarry

AS Carr¹, A Boom¹, J-C Berrio¹, and PJ Holmes²

¹*Department of Geography, University of Leicester, UK*

²*Department of Geography, University of the Free State, South Africa*

Palaeoecological information pertaining to the Tertiary of southern Africa is extremely scarce, although fragmentary information has been recovered from some locations (e.g. Noordhoek, Saldanha). A well-known example of a pre-Quaternary organic-rich deposit is the 'Knysna lignites', which have been reported from a number of localities north of the town of Knysna. Their age remains un-resolved, but their palaeoecological significance has long been recognised (e.g. Phillips 1927). Here we report geochemical and palynological analyses of material identified as belonging to the Knysna Formation from Makuhlu Quarry, c. 10 km northeast of Knysna. This was recently proposed as the type site for the southern Cape coversands, which mantle much of the landscape in this area (Holmes et al., 2007). Pollen spectra are dominated by palms. Other pollen types identified include *Podocarpus*, Poaceae, Cyperaceae, *Cliffortia* and Asteraceae (Lynchnophora-type). The data show some commonalities with Coetzee et al.'s analysis (1983; table 1), although the presence of Poaceae and the considerable abundance of palm pollen represent notable differences.

Analysis of the solvent-extractable lipids and macromolecular composition of the lignite facilitates some interesting observations on the likely depositional environment. Solvent-extractable lipids reveal an abundance of plant and bacterial biomarkers. Bacterially-derived hopanoids are abundant, along with their degradation products; although the latter do not indicate significant diagenesis. Pyrolysis GC/MS analysis, which considers a greater proportion of the total organic matter in the sample, supports the lipid data in revealing an abundance of higher (terrestrial) plant inputs; namely cutin monomers (structural units of leaf cuticles) and lignin. Compound-specific stable isotope analysis of leaf wax *n*-alkanes, which are widely dispersed in the landscape via aeolian processes, suggests an environment dominated by C₃ vegetation. The $\delta^{13}\text{C}$ values are more enriched than is typically found in contemporary C₃ closed-canopy tropical forests, suggesting a relatively open vegetation community. $\delta^{13}\text{C}$ values from microbial biomarkers are not indicative of significant methano-genesis or methano-trophism. Overall these data suggest a shallow depositional environment, of limited water depth / expanse; essentially a "boggy hollow", which was surrounded by relative open, palm-dominated tropical vegetation.

References

- Coetzee, J.A., et al., 1983. In Deacon, H.J et al. *Fynbos Palaeoecology: a preliminary synthesis*. CSIR Report 75.
- Holmes, P.J., et al., 2007. *South African Journal of Geology*, 110, 127-138
- Phillips, J.F.V. 1927. *South African Journal of Science* 24, 188-197

O7: Quaternary deposits of the Durban Bluff and associated Blood Reef Complex

HC Cawthra¹ and R Uken²

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The Bluff Ridge is a prominent geographic feature rising 120 m above Mean Sea Level in Durban, KwaZulu-Natal on the eastern seaboard of South Africa. The core of the bluff is believed to reflect a substantial palaeo-dune cordon of the Tertiary Period and Quaternary deposits manifest its seaward margin. Late Pleistocene palaeocoastlines extend semi-continuously from the supratidal zone to -49 m. The continental shelf of the Bluff is particularly narrow (8km wide) compared to the global average (75 km), inducing remarkable oceanographic phenomena and a compact geological history of glacio-eustatic sea-level change.

Evolution of the upper continental shelf has been interpreted by the examination of stratigraphic relationships between units using high-resolution seismic data. Morphology of the reef complex and sediment bedforms are observed on a multibeam echosounder dataset reflecting the contemporary bathymetry.

The intertidal and raised deposits were mapped by standard geological techniques and the offshore component (Blood Reef) extensively SCUBA dived to -50 m. Coverage of all constituent lithologies facilitated the production of a geological map spanning the supratidal zone to the outer continental shelf.

Thirteen units of beachrock incise a basal cordon of mid- to late Pleistocene aeolianite. These palaeocoastlines record sea-level fluctuations from OIS 5C until the Recent. Documented geomorphologic features of the reef indicate sea-level still-stands and eight samples of aeolianite and beachrock are currently being dated by Feldspar Optically Stimulated Luminescence.

Geostrophic subaqueous dunes of quartzose shelf sand dominate the mid-shelf. As no fluvial input is present, a northward flowing gyre of the Agulhas current is postulated to be responsible for the formation of these features. The overlay of two bathymetric datasets collected 2.5 years apart suggests that the bedforms have not migrated or accreted additional sediment during this time. Bioclastic sediment fields underlying migrating sand waves and subaqueous dunes reflect gravel lag deposits, possibly remnant of the Flandrian Transgression.

O8: Hyrax middens and what we thought we knew about southwest African climate

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The scarcity of continuous, well-dated high resolution records of climate change from southern Africa has severely restricted our ability to understand long-term climate variability in the region. Recent work has revealed that stable isotope records from hyrax middens may provide the key to understanding the nature and history of rapid climate change in southwestern Africa. Resolved to decadal timescales and spanning thousands of years, these records are allowing for unprecedented insight into the dynamics of late Pleistocene and Holocene environmental change in the region.

Presented here are results from a selection of middens from southern Africa's western margin. Over the last 29 kyr, strong correlations with marine records, orbitally forced variations in solar insolation, and the importance of Sun-Earth interactions are evident. Also apparent are clear manifestations of events such the Younger Dryas, the Little Ice Age, the Medieval Warm Period and the "2700 BP Event". These data represent one of the few times that these events and cycles have been reliably identified in southern African drylands, allowing not only for the region to contribute to the discussion and debate of the climatic drivers and feedbacks, but also providing important evidence regarding the extent and impact of forcing mechanisms at the global scale.

O9: Phytolith morphotypes in Poaceae, Restionaceae, and Cyperaceae: a research protocol for determining rainfall seasonality and growing season temperatures in Southern Africa

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Graminoids in the winter-rainfall region of South Africa are dominated by Restionaceae, Cyperaceae, and C₃ grasses of the Danthonioideae, Ehrhartoideae and Pooideae subfamilies. The C₄ grasses of the Chloridoideae, Panicoideae, and Aristidoideae subfamilies are more restricted. Graminoids in the summer-rainfall region are dominated by C₄ grasses of the Panicoideae, Chloridoideae and Aristidoideae subfamilies. The Danthonioideae, Ehrhartoideae and Pooideae grasses thrive only at high elevations (usually above 1800 m), where they are found in proportions much lower than the dominant C₄ Panicodiaceae grasses.

Pollen studies suggest that fynbos and rhenosterveld vegetation types had a wider distribution during the cold stages of the Pleistocene, suggesting that grasslands in the Highveld had stronger presence of Restionaceae and C₃ grasses (Scott 2002). The same development during the Pleistocene has been postulated for the highlands of Namibia (Chase and Meadows 2007), where today the Chloridoideae and Aristidoideae grasses predominate. To test these hypotheses this study aims at producing a research protocol to interpret phytolith assemblages in paleosols, sediments, hyrax middens, and dental tartar of herbivores. The basis of this protocol lies on the relationship between modern bioclimatic conditions and phytolith morphotypes of Poaceae and Restionaceae. Although the Cyperaceae have diagnostic phytoliths, they do not seem restricted to a particular bioclimatic region. Although very common in some fynbos types, they seem abundant on wet areas elsewhere. Nonetheless, this study aims at finding any relation with vegetation types and climatic variables. The protocol is based on surface samples collected along two transects connecting the summer and winter rainfall regions, across a variety of vegetation types. The underlying principle of this study is that the expansion of the winter rainfall and the decrease in growing season temperatures during the Pleistocene should be identified by an increase of diagnostic phytoliths of the Restionaceae and the C₃ Poaceae subfamilies.

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P3: Sediment provenance and evolution of the Wilderness barrier dunes, South Africa

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The Wilderness embayment, located on the southern Cape coastline of South Africa, is characterised by a series of geomorphologically impressive, shore-parallel coastal barrier dunes. The relationship between the formation of these dunes and changes in sea-level has received considerable attention (e.g. Illenberger, 1996; Bateman et al, 2004). However, despite the large size of the Wilderness dunes relative to those at other southern Cape coastal sites, and the extensive and regionally-unique coversand deposits which lie inland of the Wilderness embayment and pre-date the dunes (Holmes et al., 2007), the provenance of the sands from which they are formed remains undetermined.

This poster explores the possible source areas and transport pathways of the Wilderness dune sands. Heavy mineral analysis shows that whilst marine sediments from the continental shelf have made a considerable contribution to the dunes, input from the local coversands has been insignificant. Trace element geochemistry indicates that the dune sands have more in common with Table Mountain Group sandstones than the older metamorphic rocks of the Kaaimans Group and/or the granitic inliers also present in the region.

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O10: Late Quaternary dietary shifts of the Cape grysbok (*Raphicerus melanotis*) in southern Africa

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The Cape grysbok is endemic to southern Africa's fynbos biome where it now subsists primarily on browse. Fossil evidence indicates that the grysbok persisted under glacial and interglacial conditions throughout the late Quaternary and inhabited a range of environments. This study employs mesowear analysis to reconstruct the dietary habits of the grysbok over time and in response to changing environments at Nelson Bay Cave, Die Kelders Cave 1, Klasies River Mouth, and Swartklip 1. Results indicate that the amount of browse versus graze included in the diet fluctuated over time and largely in agreement with paleoenvironmental reconstructions. The case for dietary flexibility is particularly clear at Nelson Bay Cave, where there is a significant linear trend from mixed feeding towards increased browsing from the late Pleistocene (~18.5 Ka) through the Holocene. It is suggested that dietary flexibility may explain the numerical dominance of grysbok over its relative the steenbok (*R. campestris*) in many late Quaternary fossil assemblages. Results also suggest that the analysis of grysbok dietary habits may provide a useful tool for reconstructing vegetational changes at fossil localities.

P4: Experimental approach to coprolite pollen taphonomy

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A project is proposed to investigate microscopic inclusions of modern hyena dung for more effective interpretations of hyena coprolites. The main aim of this research is to establish criteria that may allow us to characterize conditions of pollen preservation in relation to predation and local environments.

Hyenas of which representatives are today living only in Africa, have provided important pollen traps in fossil sites both in Europe and Africa. These pollen traps have been used previously by palynologists, because coprolites generally contain richer assemblages of pollen and phytoliths than in the surrounding sediments from which they came.

In order to investigate in which way assemblages are affected during fossilization, pollen composition from a range of different environments and from available coprolites of different areas should be investigated and compared with respective local pollen rain compositions.

Differences between pollen composition in coprolites and the general surroundings where they accumulate have implications for the interpretation of past environments in the study areas. The influence of nutritional preferences of hyenas and degree of preservation under different conditions needs investigation by means of a combination of experiments in the nature and in the laboratory.

O11: Middle and Late Pleistocene paleoscape modeling along the southern coast of South Africa

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Changing climates, environment, and sea levels during the Middle and Late Pleistocene must have had significant impacts on early modern humans and their behavior. Many important sites occur along the coastline of South Africa, where the gradual slope of the offshore Agulhas bank meant that small changes to sea level height potentially caused significant shifts in coastline position. The geographic context of currently coastal sites was transformed by sea level shifts from being coastal to near-coastal to fully terrestrial. To understand human adaptations as reflected in the archaeological deposits of these sites we need to accurately model coastline position through time. Here, we introduce a Paleoscape model as a conceptual tool to ground the records for human behavioral evolution within a dynamic model of paleoenvironmental changes. Using integrated bathymetric datasets, GIS, and a relative sea level curve we estimate the position of the coastline at 1.5 ka increments over the last ~420,000 years. We compare these model predictions to strontium isotope ratios from speleothems as an independent test, and then compare the coastline predictions to evidence for shellfish exploitation through time. Both tests suggest our model is relatively robust. We then widen our paleoscape model to most of the Cape, and compare the predictions of this broadened model to evidence from Blombos cave.

O12: Savanna dynamics at centennial time scales: long-term encroachment patterns in an East African savanna

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Savanna dynamics has concentrated the attention of many landscape ecologists over the last decades. Despite these efforts, some of the pattern and processes shaping the savanna biome are still largely unknown, especially at large time scales where instrumental records are lacking. The bush encroachment phenomenon, by which the woody layer of a savanna takes over the grass cover, is one of these processes. This is however a very essential aspect of savanna ecology since woody plant proliferation in grasslands and savannas has long been a concern of rangeland managers because it adversely affects herbaceous productivity and livestock handling, thus threatening the sustainability of pastoral, subsistence and commercial livestock farming.

Our approach to this topic relies in the analysis of the biome dynamics at centennial time scales, within the context of the social interactions, environmental insecurity and landscape ecology in the Lower Omo valley, in South West Ethiopia. Within this broad aim, our particular objective is to deduce the sequence of environmental changes in the savanna ecosystem over the Late Holocene to recent times, identifying whether the savanna encroachment trend is an unprecedented phenomenon or it is within the normal range of variability in this ecosystem. Given the lack of suitable basins for the collection of palaeoenvironmental records we have obtained a two thousand years pollen record from a hyrax midden. Unlike Southern Africa, the use of hyrax middens as palaeoenvironmental tools is unprecedented in this region.

P5: A palaeomagnetic age of around 1.0 ma for the Cornelia-Uitzoek fossil vertebrate, hominin and Acheulian site, South Africa

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Cornelia-Uitzoek is the type locality of the Early to Middle Pleistocene Cornelian Land Mammal Age of southern Africa. The site has also yielded Acheulian artefacts including hand axes and cleavers made on hornfels and a single upper molar of *Homo*. The site consists of Quaternary alluvial and colluvial gravels and clays accumulated in a small basin of Permian Karoo (Ecca) shale. The fossils and archaeological material at the Cornelia-Uitzoek main section seem to come from two contexts; sparse and fragmented bone occur on a palaeo-landsurface, while a densely packed fossil occurrence, including a hominin molar and occasional Acheulian artefacts, may be the remains of an ancient hyaena burrow. Recent palaeomagnetic analyses indicate that the palaeo-landsurface and matrix of the presumed burrow are of a reversed magnetic polarity, while the white/yellow alluvial clay deposits that underlie the palaeo-landsurface are of a normal magnetic polarity. If it is correct to assume that the burrow had been excavated into the white/yellow clay deposits, then the two fossil bearing contexts may be contemporary. The vertebrate assemblage at Cornelia-Uitzoek records similar taxa as those found in the upper part of the Olduvai sequence, including *Eurygnathohippus cornelianus*, *Hippopotamus gorgops*, *Metridiochoerus compactus*, *Kolpochoerus limnetes* and *Damaliscus niro*. The horns of *D. niro* from Cornelia-Uitzoek are in a slightly more derived state than those from Olduvai, suggesting that the vertebrate assemblage may be marginally younger than those from Olduvai Beds III & IV. At Cornelia-Uitzoek the basal normal is best correlated to the Jaramillo event between 1.07 and 0.99 Ma. Thus, if the rich fossil occurrence is intrusive into the white/yellow basal clays, then the reversed signal from its matrix may be taken to indicate an age just younger than the Jaramillo event of 0.99 ma. If not, it would be somewhat older than 1.07 ma.

O13: Current sediment mobility as an analogue for aeolian palaeoenvironments on the Western Free State Panfield

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The extensive plains of South Africa's centrally situated Free State Province form part of the Highveld region. This summer rainfall area is bisected north-south by the 500 mm isohyet. To the west is situated the Free State Panveld, with the highest density of pans (playas) per unit area in southern Africa. It is particularly vulnerable to wind erosion from August to October when winds, associated with steep pressure gradients linked to the passage of cold fronts, are at their strongest. The situation is exacerbated by gusty conditions associated with the first thunderstorms of the summer. Ploughed fields, prepared for spring planting, are exposed to the wind. We compared aeolian sediment mobility at three sites. The first is a pan (playa) and the others comprise ploughed land and rangeland on a typical Highveld farm.

On both the pan and the ploughed lands, wind, rather than moisture, exercises the predominant control on sediment mobility. Topsoil is quickly desiccated by the wind, negating the influence of recent rain, and encouraging sediment mobility. In spite of greater aerodynamic roughness, and conservative management practices, ploughed fields appear more vulnerable to wind erosion than pan surfaces. Short periods with intense gustiness appear particularly to favour sediment mobility. Evidence for Quaternary environmental change is abundant (e.g. pan-fringing lunettes), and future change is also an important consideration. The region is adjacent to the Kalahari, where recent research has demonstrated that reactivation of dunes is likely to occur within decades. Our initial attempts to quantify sediment yields under different surface conditions may serve as an analogue for sediment mobility under previous environmental regimes (pan-fringing lunettes are currently eroding rather than accreting) and into the future.

P6: Late Holocene environmental change at Groenvlei, South Africa: evidence from diatoms

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Sediment cores extracted from a coastal lake along the south coast of South Africa provide a unique opportunity to assess environmental changes during and since the Little Ice Age (LIA). pH is reconstructed using a diatom inference weighted average model, ($R^2 = 0.7567$, RMSE = 0.50937). Other environmental parameters, including salinity, nutrient availability and water level changes are inferred using ecological indicator species within the diatom fossil assemblage. An age–depth model is developed through the combination of radiocarbon (^{14}C) measurements and chronological markers from two cores in the lake basin. Cluster analysis and principal component analysis identify two significant zones in the core, namely zone *a* (c. 0.6 – c. 0.33 ka) and zone *b* (c. 0.33 ka – present). The results indicate that variations in the diatom assemblage are related to changes in external environmental factors. In summation; changes in zone *a* is associated with temperature fluctuations experienced during the LIA episode. Zone *b* indicates a combination of extreme climates during the LIA and the later impacts of human activities within the catchment. This study demonstrates that diatom analysis of lake sediment can provide very detailed information on short term climate change, hampered only by inconsistent sediment accumulation at Groenvlei.

P7: Late Quaternary changes in ecosystems and biogeochemical cycling of Lake Rutundu, Mount Kenya, East Africa: review and retrospective

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This paper reviews and reflects on the paper by Street-Perrott *et al* (2007) on Lake Rutundu (0°02'S, 37°27'E) which is located at 3078 m a.s.l. on the northeastern flank of Mount Kenya. Woody, subalpine shrubs and grasses currently surround the lake. Using multiple proxies, including pollen and stable carbon isotopes, the late Quaternary vegetation was reconstructed. Pollen data indicate that grasses were a major constituent of the vegetation throughout the late Pleistocene and Holocene. The proportion of grass pollen relative to the pollen from other plants was greatest at the last glacial maximum (LGM). Evidence based on grass cuticles confirms that C₄ grass taxa were present at the LGM. Lake Rutundu had high accumulations of *Pediastrum* and *Scenedesmus* diatoms during the last glacial, due to a greater supply of nutrients (through runoff, periglacial processes, aeolian activity and N₂-fixation). Changes in the Si cycling of the catchment-lake ecosystem were reconstructed over the last ca. 38 ka using a novel combination of lake-sediment fluxes and stable-isotope. Under glacial conditions, high diatom productivity was maintained by substantial losses of dissolved SiO₂ and soil nutrients from the terrestrial ecosystem. Invasion of tall, subalpine shrubs after 9.5 ka led to very low sediment fluxes of both phytoliths and diatoms, due to enhanced stability of the landscape.

Reference

Street-Perrott, F.A., Barker, P.A., Swain, D.L., Ficken, K.J., Wooller, M.J., Olago, D.O. and Huang, Y. (2007) Late Quaternary changes in ecosystems and carbon cycling on Mt. Kenya, East Africa: a landscape-ecological perspective on multi-proxy lake-sediment influxes. *Quaternary Science Reviews* 26: 1838-1860.

O14: Pinnacle Point in context: The Cape Floral Kingdom, shellfish, and modern human origins

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Genetic and anatomical evidence suggests that *Homo sapiens* arose in Africa between 200 and 100 thousand years (ka) ago, and recent evidence suggests symbolic behavior may have appeared between ~135-75 ka. The genetic record shows that this population was bottlenecked to a small effective population of ~600 people during marine isotope stage 6 when the world was in a fluctuating but predominantly glacial stage when much of Africa was cooler and drier, and when dated archaeological sites are rare. These results set as one of the central goals in paleoanthropology the identification of where this population resided in Africa and what were the paleoclimate and paleoenvironmental conditions for this origin point. I hypothesize that this progenitor population was on the south coast of South Africa. The combined richness of the Fynbos Biome, with its high diversity and density of geophyte plants, and the rich coastal ecosystems of the associated Agulhas Current combined to provide a stable set of carbohydrate and protein resources for early modern humans during this environmentally harsh phase in the evolution of modern humans. As sea levels rose and fell, this population targeted the coast-fynbos intersection for their occupation. In a recent paper in *Nature* (Marean et al. 2007) we documented that humans had expanded their diet to include marine resources by ~164 ka (\pm 12 ka) at site PP13B on the south coast of South Africa, perhaps as a response to these harsh environmental conditions, and this archaeological observation may sample that progenitor population. Testing this idea requires a robust, comprehensive, well-integrated paleoanthropological, paleoclimatic, and paleoenvironmental record.

O15: The coastal platform in the southern Cape

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The relatively level Coastal Platform extends from Port Elizabeth to Bot River immediately south of the Langeberg-Outeniquaberg. The platform was eroded subsequent to the break up of Gondwana. As Africa lay central within Gondwana, it stood higher at break up. Faulting created a suite of half grabens trapping Cretaceous conglomerate boulders and marine sediment. Considerable reworking has occurred.

Erosion from the then coast inland exposed pre-existing Cape fold ranges and created the Great Escarpment. The Coastal Platform is therefore 'African' in age. Planation and erosion was facilitated by a hot wet Cretaceous climate. Although of 'African' age inception, the present coastal platform is clearly polycyclic. Evidence, presented as histograms, for 3 areas: Mossel Bay- Albertinia (with laterite and silcrete capped remnants overlying saprolite (Grahamstown Formation), from Sedgefield- Harkerville in the Knysna area and from analysis of the Riversdale Geological sheet which mapped Grahamstown Formation residuals. In that area the older Bredasdorp Group, Wankoe Formation limestone abutted the platform to similar altitudes. The Wankoe Formation is considered of nearshore and dune origin. It is calcretised and in places laterised and supports a complex karst landscape. Today a low plain separates the Grahamstown Formation residuals from the karstic limestone. This plain is interpreted as erosion by acid water draining from the Coastal Platform.

Five episodic sand events are recorded ranging in age from Miocene to Last Interglacial. These sands have created high landscape sensitivity from incoherent rounded sand grains, steep gradients and erratic rainfall patterns. Examples will be demonstrated. The consequence of irresponsible development can be attributed to the ease of machine landscaping and pressure of urbanisation and tourism. Runoff laden with sand is affecting the sustainability of the Knysna estuary.

There is evidence that differential faulting can be identified from the stripped basal surface of weathering. Disruption of the Cretaceous surface was first identified in 1986 in the Cape Peninsula where laterite overlying saprolite lies at -30m in the Noordhoek basin but similar saprolite is mined at +50m 5 km inland. Recent investigation of palaeokarst on Peninsula quartzites has produced further evidence of a fault disruption of the African surface.

O16: Geochemical analyses of channel calcretes: a northern hemisphere example.

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This presentation reports on ongoing research on fluvial calcretes that have been preserved in bedrock channels in the Dana valley in southern Jordan. The study area is on the edge of the tectonically active Dead Sea Transform Fault System. Remnants of a series of fluvial terraces have been preserved within the landscape as planated low gradient straths, incised rock cut channels and fluvial sediments at various heights above the modern wadi system. Deposits preserved within the bedrock channels have commonly become calcretised. Although the fluvial deposits represent periods of river aggradation, when precipitation and river discharge were relatively high, the conditions under which the deposits became calcretised is unknown. To try and better understand the diagenetic environment that these fluvial calcretes formed under, a combination of carbon and oxygen isotope and petrographic analyses have been conducted. The location within the mountain front and position within the channel, relative age, diagenetic processes, climate and source of water appear to influence the $\delta^{18}\text{O}$ values. $\delta^{13}\text{C}$ values are affected by mode of precipitation, climate, vegetation type and geology.

P8: Climate and Modern Human Behaviour - A study of the link between climatic change and the cultural evolution of *Homo sapiens* during the Middle Stone Age in the southern Cape, South Africa

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The objective of my Ph. D. project is to study how behavioural changes of early *Homo sapiens* in southern Africa may have been affected by climate during the Middle Stone Age, especially after c. 130 ka. As a part of my thesis I will perform analyses of micromammals from two Middle Stone Age sites located in the southern and eastern Cape; Klasies River and Blombos Cave. Micromammals are good palaeoecological indicators, as their home range is small, they often have precise ecological requirements and they are primary consumers in the food chain. Species that occupy particular ecological niches can provide detailed information about the vegetation and/or substrate of the area at the time they were living there.

The theory that modern human behaviour may be a direct or indirect result of climatic changes is widely discussed and my thesis aims to contribute to this discussion. A major step forward in understanding the early behavioural evolution of our own species would be by establishing whether there is a link between the material culture indicators of modern human behaviour, for example beads and engravings found at Blombos Cave, and climatic change. The poster will present the sites, the material and the methods of analyses of micromammals which I will employ, as well as the questions I seek to answer with my thesis.

O17: Pollen analysis of Holocene sediments from the lake in Princess Vlei, Western Cape, South Africa

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A three meter Dachnowsky core from Princess Vlei in the Cape Flats, was sealed and stored in Bloemfontein since 1948 by the late E.M. van Zinderen Bakker. High resolution pollen analysis allows reconstruction of vegetation history and the human impact during the last 4000 years in the fynbos biome that may have implications in connection with ground water changes and dune activity. The preliminary chronology is based on two conventional radiocarbon dates. Fynbos pollen includes Restionaceae, Ericaceae, and Proteaceae while tree pollen, i.e., *Podocarpus*, *Myrsine* and *Olea*, suggest a weak influence from patches of Southern Afromontane forest. The lower part of the record may indicate climate changes in the pre-European period. Asteraceae and Aizoaceae are more common at the bottom of the core possibly indicating drier conditions. *Morella* shows a marked peak around 3000 BP followed by an increase of *Carpacoce* and later by fern spores and Cyperaceae suggesting swampier conditions. The top of the core shows vegetation disturbance by human activities. Neophytes like *Pinus*, *Casuarina*, and *Ambrosia* are common while Poaceae increase and Restionaceae decrease. *Morella* and *Carpacoce* are declining, probably as a result of human activities. *Aponogeton* ("Waterblommetjie"), a traditional vegetable, is present throughout the diagram but becomes prominent at its top. Charcoal identification is in progress. Although frequencies of forest fires, represented by microscopic charcoal counts, are not higher in the top, two charcoal peaks (?) probably point to human induced fires. The first fire event, at the beginning of European colonization (coinciding with the spread of *Pinus*) is accompanied by a fungi peak possibly indicating increased decomposition activity. Notes taken during coring indicate water at depths between 75 and 105cm suggesting a floating mat of organic material at the time, which may be related to a changed hydrological system (and eutrophication?) after the European settlement.

O18: Climate and vegetation changes at Braamhoek Wetland, South Africa

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A multi-proxy study on peat from Braamhoek wetland, eastern Free State, infers fluctuations in regional climate and local environment since c. 16 ka (16 000 cal yrs BP). The study includes analysis of fossil pollen, siliceous microfossils and isotopes. The regional pollen taxa, mainly forest trees and fynbos, reflect changes in the moisture situation, particularly in combination with variations in the representation of grass pollen. During the Holocene-Pleistocene transition and onwards, the isotope composition probably reflects the relative abundance of C₃ versus C₄ grasses. Phytoliths give additional information about the grass distribution, while the diatom composition infers shifts in the wetland moisture status.

We interpret depleted isotope values, high PCA-score, high Poaceae/Asteraceae ratio, low phytolith index, as well as presence of planktonic diatoms, as a response to increased wetness, locally and/or regionally. The multi-proxy record suggests three major phases of increased wetness; c. 13.7-12.8 ka, 10.5-9.5 ka, 8.2-7.5 ka and 1.5-0.5 ka. A decline in fynbos pollen after c. 9.5 ka and afro-montane forest elements being prominent between c. 11 and 8 ka, infer a shift from cooler late glacial conditions, to warmer Holocene conditions, at some stage between 11 and 8 ka. The inferred changes suggest a response to millennial scale astronomical forcing and latitudinal shifts in the major weather systems affecting the subcontinent.

O19: Pleistocene climatic changes and forced variable hominid adaptation in the Central Rift Valley (CRV), Kenya

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This paper discusses the complex activities that define hominid adaptive behavior in the face of changing Pleistocene climatic and/or environmental conditions within the Central Rift Valley, Kenya. Global Pleistocene climatic cycles with alternating glacial and interglacial periods affected the area forcing plant and animal species, including hominids, to respond to the changes accordingly. Savannah-forest ecotone may have expanded during the warmer periods of Oxygen Isotope Stage seven (OIS 7), sub-stages of the last interglacial (OIS 5a, 5c, and 5e), and the current Holocene period. Archaeological remains and hominid settlement distribution indicate variable adaptive behavior relating to both climatic and environmental changes. Evidence of such variable adaptive behavior include, but is not limited to, i) selection of suitable environments in the face of changing conditions for effective exploitation of resources, such as, plants and animals; and ii) adapting suitable technology to fit within the alternating climatic regimes. Studies on carbon-nitrogen isotope ratios, soil profiles for carbon isotope ratios, paleosols at sites, and lithic raw material source and use patterns further reveal the nature of microhabitats in which prey animals lived, past forest zones or vegetation patterns, and lastly, social and territorial systems within the region of the CRV. The main argument in this paper is that as climatic and environmental changes occurred, hominids adapted by changing either their technology or pattern of environmental exploitation in order to fit in the prevailing circumstances. This is interpreted as similar to modern behavioral trends in dealing with environmental conditions.

O20: New evidence on rates of cultural diffusion during the early Acheulian: what was the trigger?

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New dates from the artefact-bearing terraces of the lower Vaal River show that handaxe-using hominids inhabited South Africa at the same time as their counterparts in East Africa (Gibbon et.al.2009). Dates for the early Acheulean at hominid sites in Gauteng, and the presence of artefacts of similar typology at Klip-plaatdrift near Vereeniging, show that this technology was firmly established within the upper catchment of the Vaal River by a little after 2Ma. The new dates show that the implements within the Rietputs gravels of the Lower Vaal were entrained within these deposits an average of 1.6Ma. ago.

An hypothesis is advanced linking this rapid technological diffusion to the regular repeated precessional cycles which characterized the more humid early Pleistocene; these maintained the larger fluvial axes as narrow, mesic corridors, within which episodic pressures on local resources drove migrations ever further into the semi-arid west of the subcontinent.

Reference

Gibbon, R.J., Granger, D.E., Kuman, K. and Partridge, T.C. (2009). Early Acheulean technology in the Rietputs Formation, South Africa dated with cosmogenic nuclides. *Journal of Human Evolution* 56, 152-160.

P9: Wits Online Phytolith Database: a new resource for palaeobotanists

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Phytolith research is an asset to palaeoenvironmental reconstruction studies. Critical to these studies is the establishment of locally relevant modern reference collections from a wide range of vegetational environments. This to compare with ancient sediment, and identify recent alien contamination in the ancient samples. While much work has focused on Poaceae subfamilies and genera, less attention has been directed at non-grassy species. The Wits Online Phytolith Database is a new resource which will be updated over time displaying phytoliths from East and southern Africa. The database allows for search options based on phytolith morphology, plant subfamilies, species and genera; and displays images of the most common to least common phytolith shape encountered in the plant parts. In the future, the database will include phytolith examples recovered from modern sediment representing various vegetational communities including dune forest, *Acacia-Commiphora* scrubland, grassy bushland, riparian and grassland environments at various altitudes, mangrove swamp, oases and wetlands.

O21: Late Quaternary vegetation history of the Cederberg Mountains, South Africa: pollen evidence from hyrax middens

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Palaeoenvironmental evidence for the arid and semi-arid regions of southern Africa remains frustratingly incomplete as palaeoclimatic proxy records are scarce and often discontinuous. Within this region, the southwestern Cape is an important focus area as it is recognised as being the heart of the Cape Floristic Region; a World Heritage Site of exceptional floral diversity. Due to its importance in terms of high levels of species richness and endemism and its key location within the winter rainfall zone of southern Africa, the environmental history of this area needs to be further resolved. Stable isotope and pollen data derived from two hyrax middens extracted from De Rif in the central Cederberg Mountains of the southwestern Cape casts new light on the climatic changes that occurred during the last glacial-interglacial transition and the Holocene, and how they influenced the region's vegetation.

Through the analysis of fossil pollen preserved within these middens, it is possible to reconstruct the vegetation history of the study area. As the midden accumulation periods encompass both the late Pleistocene and the Holocene, one would expect the pollen records to reflect significant changes in vegetation community structures in response to different glacial and interglacial climates. However, the overall pollen assemblages indicate that typical mountain fynbos was present throughout this period and that the majority of the pollen taxa exhibited only very subtle changes in frequencies. This conclusion stands in sharp contrast to the great climatic variation indicated by the stable isotope records. Reasons for this apparent disparity as well as an assessment of the overall palynological record for the Cederberg are discussed.

P10: A multi-proxy record of environmental change during the last glacial-interglacial transition from the Cederberg Mountains of South Africa

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The environmental history of southwestern Africa remains incomplete as palaeoenvironmental records are scarce and often discontinuous. Rock hyrax (*Procavia capensis*) middens have been identified as excellent sources of palaeoenvironmental information in arid and semi-arid areas, and have been successfully used in various parts of southern Africa. Hyrax middens from the De Rif site in the Cederberg Mountains of the southwestern Cape have been sampled in terms of their pollen and stable carbon and nitrogen characteristics. Pollen preserved in these deposits was used to reconstruct the vegetation history of the study area to make inferences about past climatic variability. As part of a C₃ ecosystem, the $\delta^{13}\text{C}$ signal is primarily determined by leaf-level changes in plant water-use efficiency, and thus effective precipitation at the sites. Variations in $\delta^{15}\text{N}$ exhibit a strong positive correlation with $\delta^{13}\text{C}$; supporting inferences that $\delta^{15}\text{N}$ in plants is determined to a large extent by variations in precipitation and the 'openness' of the nitrogen cycle.

In aggregate the pollen and stable isotope records from De Rif constitutes a multi-proxy record that provides new evidence for the nature of palaeoenvironmental conditions in the Cederberg, and casts light on the environmental changes that occurred in the region during the last glacial-interglacial transition.

P11: The geomorphology of Florisbad and its aeolian deposits

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Considering the significance of the discovery of the Florisbad hominid, considerable archaeological and paleoanthropological research has been conducted in the Florisbad area. However, no research that specifically looks at the geomorphology and aeolian deposits around Florisbad has been undertaken. Aeolian processes and sand dunes in this area have been widely recognised as being of significance in understanding past environmental conditions in this area. Geologists have also shown an interest in trying to explain the formation of the Florisbad spring and fossil site.

The Florisbad spring site has a complex stratigraphy because the deposits are lithologically variable due to the fact that they are the product of an unusual depositional environment. Many hypotheses have been proposed in trying to understand the complex depositional environment at Florisbad. This research proposes that in order to better understand the complex depositional environment of Florisbad, there is a need to understand the surrounding geomorphological setting in terms of geohydrological and geomorphic processes.

A lunette dune on the south side of the Florisbad salt pan (28°45' 45,5" S 26°03'12,9"E) approximately one hundred meters from the pan perimeter was identified as the primary study site as it appears to define the outer limit of the Florisbad geomorphic setting. Three further sites were selected at a higher elevation. A variety of sedimentological techniques, were applied to sediment samples in order to compare the characteristics of the lunette sediments with those at the spring site itself. The results show that sediments in the lunette have greatly different properties from those at the spring site, and that there is convincing evidence that the lunette sediments are primarily wind-blown in origin. The Aeolian deposits in Florisbad provide the basis for Quaternary correlations, and further research on aeolian deposits that include OSL dating is required so that Florisbad's geomorphic setting can be defined within a tighter temporal context.

O22: Evolution of the Benguela upwelling system and southern African west coast aridification

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Long term global trends in Cenozoic oceanographic/climate evolution are mediated by fundamental processes like the changing configuration of landmasses. The correlation of West Coast oceanographic/climate records with global events is reviewed here.

By the Late Cretaceous the South Atlantic Ocean had greatly expanded, with floral records from Arnot (Bushmanland) illustrating a 'subtropical' open forested setting and with the earliest expression of 'fynbos' elements. Earlier Miocene fluvial deposits at Cape Town, Orange River and southern Namibia witness the dominance of tropical forest taxa, still with only minor fynbos elements and marine cores from this era show high sea temperatures, collectively a setting resembling the late Mesozoic. Although South America had separated from Antarctica in the Oligocene, the Circumpolar Current had yet to advect significant cold water along the southwest African coast.

A sharp fall in sea temperatures evinced by proxies in west coast marine cores corresponds with the global cooling at ~14.5 Ma (Monterey Isotope Excursion) and with the inception of the Namib Desert. Later Miocene fluvial deposits at Cape Town and Langebaanweg display a greater diversity of fynbos taxa. Aeolianites at Saldanha dated palaeontologically to 12-10 Ma contain the winter rainfall dune snail *Trigonephrus* and palaeowind data indicate an early inception of the South Atlantic Anticyclone, which would have enhanced upwelling in the Benguela System.

The Early Pliocene was globally warm and humid, possibly triggered by the opening of the Panama Isthmus and is represented by fluvial and marginal marine sediments at Langebaanweg, Malmesbury and Noordhoek. Nonetheless, these sites document further fynbos expansion, seasonality, and cold upwelling (marine phosphogenesis). Later Pliocene marine molluscan faunas retain a dominant thermophilic signature, but isotopic data suggest significant oceanic cooling. The global early Pleistocene refrigeration is marked on the West Coast by widespread carbonate pedogenesis and thermophobic molluscan faunas, reflecting aridity and modern (cold) ocean temperature respectively. OSL-dated aeolianites in tropical west Africa suggest expansion of the Benguela System as far north as the Equator during Glacials.

O23: Late Holocene savanna dynamics in the Amboseli Basin, Kenya

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Pollen, microscopic charcoal and radiocarbon data are used to document changes in vegetation dynamics during the late Holocene from Namelok Swamp in the Amboseli Basin (Kenya). The data reveal changes in savanna vegetation composition driven by an interaction of climate change, anthropogenic and herbivore activities. The abundance of *Celtis*, *Podocarpus* and *Syzygium* reflects a relatively moist climate from around 3000 to 2400 cal yr BP. Increased abundance of *Acacia*, *Amaranthaceae/Chenopodiaceae* and *Poaceae* suggest a drier climate from 2150 to around 1675 cal yr BP. The expansion of *Syzygium* within the catchment and decrease in *Amaranthaceae/Chenopodiaceae* reflect a relatively wet phase from around 1675 to about 550 cal yr BP – superimposed on this is a large increase in *Poaceae* from 1400 to 800 cal yr BP indicative of a drier environment. The dominance of *Amaranthaceae/Chenopodiaceae* and *Poaceae* with an associated decrease in *Syzygium* from 550 cal yr BP is thought to correspond to a drier climate. The uppermost samples dating to the last 150 years, record a large increase in *Acacia*, *Amaranthaceae/Chenopodiaceae* and *Poaceae* with decrease in *Syzygium* are attributed to recent land-use changes associated with increased sedentary settlement. The increased presence of *Cannabis sativa*, *Cereal* and *Ricinus communis* pollen, combined with charcoal in the sediment record, particularly from 2500 but more constantly from 1600 cal yr BP, indicate a long history of human-ecosystem interaction.

P12: A review of 'Palaeoenvironmental Change in the Mediterranean since the Last Glacial Maximum: a record of Vegetation, Lake-level and Climate Change from Lake Tigalmamine, Atlas Mountains, Morocco'

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This poster represents a review and reflections on a 21 m-long sediment core from Lake Tigalmamine, Middle Atlas, Morocco (Lamb *et al.*, 1989) that preserves a continuous record of environmental change since the Last Glacial Maximum for the Maghreb region of North Africa. Using pollen, stable isotope and sedimentological analysis, the evidence for palaeoenvironmental change is interpreted in the broader context of previous interglacials and the Mediterranean at large. Of enormous significance to our ability to better reconstruct the causes and timing of climate change in the area is an understanding of the complex set of factors influencing vegetation change. This requires the ability to distinguish factors linked to the direct influences of climate change from inter-specific competition and community structure. Vegetational change indicates an increase in available moisture in the area since the Last Glacial Maximum, with several episodes of abrupt, climate induced change. From 14,000-12,000 B.P. scattered oaks are present in the area, oak forest replacing the grassland 8500 years ago and *Cedrus atlantica* arriving in the area 4000 years ago.

Reference

Lamb, H.F., Eicher, U. and Switsur, R. (1989) Record of Vegetation, Lake-Level and Climatic Change from Tigalmamine, Middle Atlas, Morocco. *Journal of Biogeography* 16: 65-74.

P13: Palaeobotany, biogeochemistry and sedimentology of Late Tertiary fluvial deposits, West Coast, South Africa

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Extensive fluviolacustrine clay deposits (Rondeberg clays) situated ~60 km north of Cape Town have been exposed by mining activity. The deposits are about 14 m thick, well stratified and occur at an elevation of some 100 m above sea level, with thin organic rich horizons. *In situ* tree stumps are burnt, suggesting wetland fire activity. Periods of drought/seasonality are further indicated by relatively pronounced growth rings and sequences of upward decreasing organic content grading into pedogenically influenced (ferruginised) horizons. A sparse pollen flora includes gymnosperms (podocarpus), angiosperms of 'fynbos' affinity (including Ericaceae and Restionaceae) along with monocots (palms). This assemblage suggests a Neogene age for the deposits, which may represent palaeo-Diep River fluviolacustrine sedimentation. This interpretation is underpinned by the proximity of this river (2 km to the east) and by the presence of channels filled with fine grained sediments at the top of the succession. The Rondeberg clays are included in the Elandsfontyn Formation of the Cenozoic Sandveld Group and tentatively correlated temporally with the Varswater Formation fluvio-estuarine sediments at Langebaanweg on grounds of botanical affinities/elevation/palaeomagnetism (both have normal polarity).

Biogeochemical analyses were also carried out in two organic-rich horizons of core from the Late Miocene fluviolacustrine deposits of the Elandsfontyn Formation from Langebaanweg. The samples were analyzed via HPLC-MS for glycerol dialkyl glycerol tetraethers (GDGTs). These tetraether membrane lipids, originating from hitherto unknown bacteria abundant in peat but also widespread in soils, were found to be empirically correlative to the mean annual temperature (MAT) and pH of the peat/soil; they therefore enjoy increasing use in palaeoenvironmental and palaeoclimatic re-constructions. Preliminary results from the Langebaanweg site show a MAT of 21°C and a pH of 5.4 for the stratigraphically lower peat sample of the Elandsfontyn Formation, whereas the upper sample revealed a MAT of 15°C and a pH of 6.3.

O24: Some long pollen sequences from South Africa

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Provided that their chronologies are reliable, terrestrial pollen records from a variety of deposit types that reach back into the Pleistocene helps to give a regional reconstruction. The new sequences from Wonderwerk Cave (Kalahari thornveld savanna) and Mirabib in the Namib Desert (dung sequence), are compared with previous ones from the Namib, the Cape fynbos region, the highveld grassland and the savanna. When the patterns from the studied sites are compared with temperature indications from other global records, e.g., the Vostok Ice Core, there seems to be broad agreement but the timing of apparent temperature maxima and minima in the Late Pleistocene is usually up to three thousand years out, forwards or backwards. Therefore suggested temperature minima at different sites during Younger Dryas times, do not seem not to be coeval. This may be an indication that the chronologies of the different sites are not always accurate, which is a problem to consider when modeling vegetation patterns of the South African Quaternary.

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