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Preliminary results of excavations at Spitzkloof Rockshelter, Richtersveld, South Africa

Genevieve Dewar^{a,*}, Brian Stewart^b^a Department of Anthropology, University of Toronto, Scarborough, 1265 Military Trail, Toronto, Ontario, Canada M1C 1A4^b McDonald Institute for Archaeological Research, University of Cambridge, Downing St., Cambridge CB2 3ER, United Kingdom

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ABSTRACT

The recent excavation of Spitzkloof Rockshelter in Namaqualand, South Africa is part of a larger project called AMEMSA: Adaptations to Marginal Environments in the Middle Stone Age. This project is aimed at answering the questions: How, when and under what environmental conditions were so marginal environments permanently colonized during the Middle Stone Age? With over 1500 Later Stone Age, 90 Middle Stone Age and 50 Early Stone Age sites in Namaqualand, evidence of occupation from this southern extension of the Namib Desert has potential to inform on how people used economic, technological and social strategies to adapt to the stress of this environment. In order to address these questions, the shelter was recently excavated in order to establish a chronological, palaeoenvironmental, and archaeological record for the region. Following a biogeographic model to interpret the faunal remains from the bottommost layers Brian and Genevieve, the results reflect evidence for an arid to semi-arid and therefore hard environment: the subsistence strategy is broad for the region and consists of arid adapted species found on the landscape today. Non-local yellow silcrete suggests the potential for higher levels of mobility than found in later layers. The presence of gypsum and *Trigonephrus* sp. land snails suggests an arid environment that may have been slightly more humid than today. Future research will include increasing the sample size through continued excavation, while a rigorous radiometric dating program and geomorphology study will hopefully more precisely identify the time frame of this occupation.

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1. Introduction

Recent discoveries of new fossils, genetics, and evidence for behavioural innovations in Africa make it imperative to develop testable hypotheses of human evolution, paleodemography, behaviour and dispersals within varying ecological habitats. Ongoing research has been hampered by the patchy distribution of continuous, multi-disciplinary, high-resolution records for behavioural and environmental changes over the past two million years. While South African sites have produced evidence for symbolically mediated and therefore modern behaviour, including the engraved ochre and seashell beads from Blombos Cave (d'Errico et al., 2005; Henshilwood et al., 2001, 2002, 2004), engraved ochre from Klein Kliphuis (Mackay and Welz, 2008) and engraved ostrich eggshell at Diepkloof (Texier et al., 2010) the majority of this research has been geographically focussed on regions with rich and predictable

resources, such as the Fynbos biome. While this is valuable, it only adds to the patchiness of the overall data set, as most interpretations of early modern behaviour will be based on a limited range of socio-economic strategies. A project was initiated to explore diversity in early modern human adaptations by studying archaeological and palaeoenvironmental data from a low productivity environment in order to answer the questions: How and under what environmental conditions were Pleistocene foragers first able to colonize marginal environments? What were the different subsistence, settlement, technological and social strategies employed in order to cope with marginal environments and what triggered colonization of these environments in the first place? Were the innovations required to survive in these difficult regions developed elsewhere or were they creative solutions established *in situ*? This project will test the theory proposed by Clive Gamble (1994) that only behaviourally modern humans were able to permanently colonize the world's most marginal ecozones: highland plateaux, tropical rainforests and deserts. Gamble suggests that pre-*sapiens* exhibit an ebb and flow pattern of occupation linked to climatic fluctuations and only the development of modern *Homo sapiens* resulted in the colonization of the Arctic, rainforests and the deserts of Australia.

* Corresponding author. Fax: +1 416 287 7283.

E-mail addresses: gdewar@utsc.utoronto.ca (G. Dewar), bas29@cam.ac.uk (B. Stewart).

In order to address these questions and test Gamble's theory, two very different marginal regions in southern Africa were chosen: the highlands of Lesotho and the coastal semi-desert of Namaqualand. Both regions have unpredictable resources, spatially and/or temporally. This paper presents preliminary results from the Middle Stone Age (MSA) layers of the excavation at Spitzkloof A Rockshelter in Namaqualand, South Africa (Fig. 1).

1.1. Why study Namaqualand?

The semi-desert of Namaqualand is the southern extension of the Namib Desert. Since the formation of the Namib seven to ten million years ago, this coastal region has consistently maintained its desert-like characteristics, fluctuating between hyper-arid to semi-arid (Eitel, 2005). Survey of the region conducted through contract archaeology has identified more than 1500 Later Stone Age (LSA), 90 Middle Stone Age (MSA) and 50 Early Stone Age (ESA) sites (Webley et al., 1993; Halkett and Hart, 1997, 1998; Halkett, 2002, 2006; Halkett and Orton, 2005; Orton and Halkett, 2005; Dewar and Jerardino, 2007; Halkett and Dewar, 2007; Dewar, 2008). On the Namibian side of the Orange River, Kinahan (1991) and Kinahan and Kinahan (2006, 2003) have been studying the LSA while Vogelsang (1998) and Wendt (1972) have focussed on the MSA, particularly at the rockshelter "Apollo 11". Apollo 11 has produced some of the earliest evidence for representative art in Africa with painted slabs dating to 27,500 ^{14}C BP based on

associated charcoal remains (Wendt, 1972). As Apollo 11 is the nearest excavated shelter (100 km) to Spitzkloof A, it provides a data set with which the results from this study can be compared. Other than contract archaeology, relatively little archaeological research has been conducted in Namaqualand south of the Orange River with only two academic projects focussing on the LSA (Webley, 1992; Dewar, 2008). However, the survey data shows that this marginal environment was occupied in the deep past, and evidence of continuous occupation could suggest colonization rather than visitation.

1.2. Hypothesis and theoretical approach

Following Smith (2005), Veth (2005), and Yellen (1977), the results of this study are interpreted based on the hypothesis proposed by the biogeographic model. This hypothesis states that past marginal *versus* rich environments can be identified based on specific patterns in the archaeological record. As marginal environments are regions where by definition nutrients and water are patchy and unpredictable in time and space, the number and diversity of faunal and floral species will be low. Foragers should thus be highly mobile and practice a generalist subsistence strategy requiring flexible social and technological organization. Territoriality should be loose if non-existent while social networking will be an important mechanism for risk reduction. If the environment were to ameliorate and produce a resource base of that is rich and

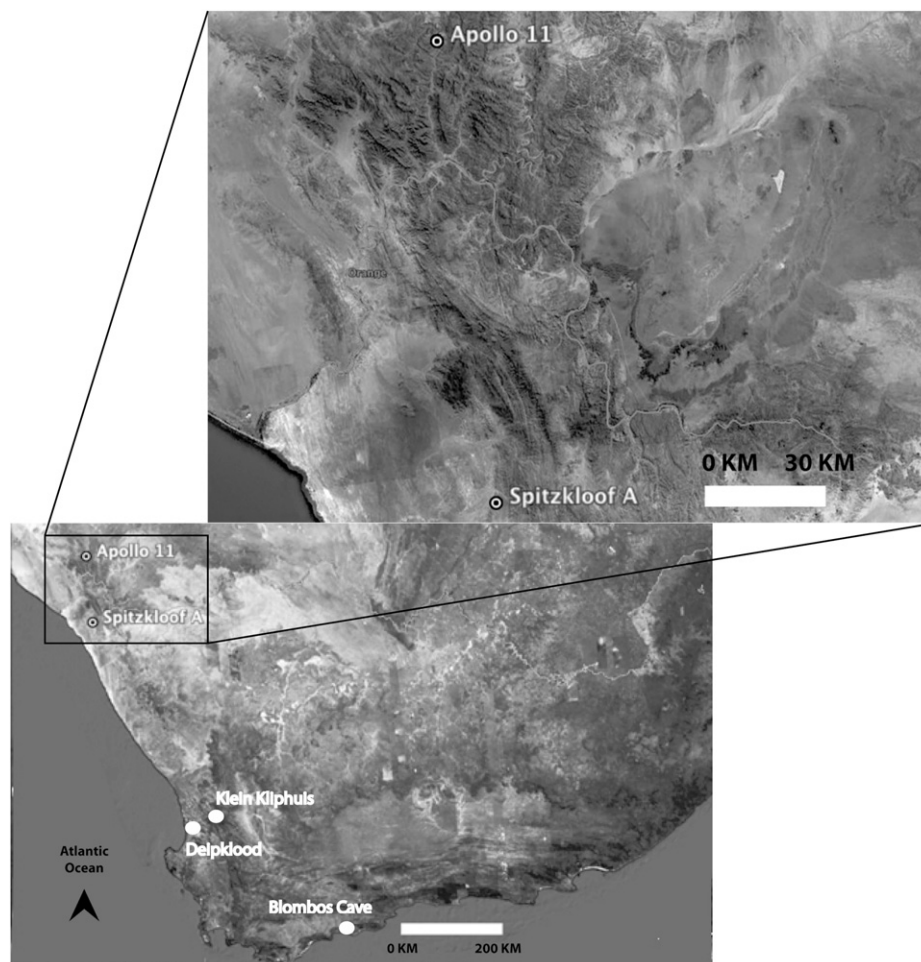


Fig. 1. Satellite photo of South Africa showing the location of Spitzkloof and Apollo 11 as well as other sites mentioned in the text, within southern Africa.

predictable, then species diversity should be high and foragers could practice a focussed economic strategy requiring specialized technology. Evidence for lower levels of mobility, increased territoriality and less flexible social organization are expected.

2. Regional setting

Spitzkloof A Rockshelter (28°51.79'S 17°04.6527'E) (Fig. 1) is located in the northern hinterland of Namaqualand, otherwise known as the Richtersveld. The rockshelter is one of three consecutive dome-shaped hollows (labelled A–C) eroded from a folded outcrop of quartzite from the Stinkfontein subgroup (Frimmel, 2003) (Fig. 2), overlooking quartzitic gravel plains. Immediately in front of the shelters is a dry tributary of the Holgat River. The site is 30 km inland from the Atlantic Ocean and 30 km south of the Orange River. The landscape is desolate with the coastal strip consisting of Holocene white sand dunes and older Pleistocene red drift sands in the interior (Le Roux and Schelpe, 1981; Acocks, 1988). Drainage is westward into the Atlantic *via* rivers that flow infrequently, today these flow once a decade at most, unless there has been an uncharacteristic amount of rain. The factor that defines this arid environment is precipitation. Rainfall is variable and arrives primarily (>66%) in the austral winter months influenced by the westerly winds or the South Atlantic cyclone. The average annual rainfall ranges from 150 mm in southern Namaqualand to less than 50 mm near the Orange River (Cowling and Pierce, 1999). The paucity of precipitation is due to the cold Benguela Current and upwelling of cold water from the Atlantic Ocean floor, producing sea surface temperatures of 11 °C–17 °C (Eitel, 2005). The cold water prevents moisture in the air from precipitating out until it reaches mountainous terrain further inland. The mean annual temperature measured for the entire Succulent Karoo Biome is 16.8 °C (Mucina et al., 2006). While in the immediate vicinity of the site maximum temperatures exceed 30 °C during the summer while winter minimums are below freezing. Very hot and dry Foehn or *Berg* winds can drive the daytime temperatures up to 40 °C. The diversity of mammal and bird species is very low and flora and fauna are arid adapted, typically obtaining hydration through 'Malmokkies' or coastal fogs that extend to the edge of the escarpment, up to 90 km inland. Dwarf succulent shrubs dominate the vegetation (Acocks, 1988) while larger species such as *Acacia karroo* are only found along the dry riverbeds including the tributary of the Holgat River.



Fig. 2. Picture of the front of Spitzkloof Rockshelter showing the three hollow domes and the tributary. The shelters are labelled upwards from A through C. The bakkie is parked in the dry tributary.

2.1. Palaeoenvironmental data

To date there is very little direct palaeoenvironmental data for Namaqualand. Most palaeoecological models are based on data from offshore cores near southern Namibia (cf. Shi et al., 2001; Stuut et al., 2002) or from archaeological sites further south along the west coast of South Africa (Meadows and Baxter, 1999; Parkington et al., 2000; Chase and Meadows, 2007). For the Late Pleistocene, studies of pollen, grain size variation in terrigenous sediments (fluvial activity), sea surface temperature, and trade wind proxies suggest that during glacial periods the winter rainfall zone experienced fairly wet conditions (Chase and Meadows, 2007). Interglacial periods respond by being arid relative to the last glacial. During the Holocene, the diversity and richness of micro-fauna at Spoeg River Cave in Namaqualand suggest a transition from a wet and cool Neoglacial to a warm and arid Medieval Warm Epoch (Avery, 1992). Archaeological evidence from LSA occupations of Namaqualand supports this data as there is little evidence for human occupation during the warm mid-Holocene altithermal or the Medieval Warm Epoch (Dewar, 2008), whereas the region was well populated during the cool Neoglacial and Little Ice Age. Water availability seems to be the primary constraint to settlement in Namaqualand (Dewar, 2008).

3. Excavation of Spitzkloof A

The mouth of the shelter is 25 m long and 7 m deep from the drip line, facing east on the west bank of the tributary (Fig. 3). Excavation began in April 2010 by establishing a two-by-two m² grid near the top of the deposit trying to avoid the remains of modern-day camping fires. Three square meters were excavated (Fig. 3) in a step-like fashion, using standard archaeological methods. The sediment was sieved through both 1 mm and 3 mm mesh in order to collect the smallest artefacts. The artefactual material was sorted and bagged on site. The deepest unit G3 was excavated to 1.7 m (Fig. 4) without reaching bedrock. The sediment was homogenous in colour with a break at 85 cm depth where it transitioned from grey sandy silt in the upper levels to Pleistocene red sands in the lower units (Table 1). Context changes were identified on the basis of texture and inclusions. The site was excavated stratigraphically and 3 cm spits were used in thicker contexts. Bucket counts were recorded to measure density. Standard 10 L buckets were used and measured to the nearest 10th of a bucket. There were numerous rockfall events and gypsum was so abundant that the sediment from many contexts was cemented. To date, excavation has encountered nine layers consisting of twenty contexts and features. Artefacts were consistently present throughout the deposit, although there is variability in the density. Five micromorphology samples were collected throughout the east profile of G3. The preliminary impression based on artefact morphology and levels of fossilization is that the grey layers represent the LSA while the red and orange layers are from the MSA.

The preliminary results discussed in this report will focus on the analysis of the faunal remains from the two bottommost layers Brian and Genevieve in order to evaluate the data against the biogeographic model to determine if the region was a marginal or rich environment. The upper layers, which consist primarily of LSA deposits, will be discussed in a subsequent report.

3.1. Stratigraphy

The sequence of the bottommost layers consists of layer Brian overlying layer Genevieve (Fig. 4). Layer Brian consists of coarse sandy silt with gritty pebbles and a Munsell chart colour of 7.5 YR 4/4 brown. This layer included nine spits as it encompassed a large

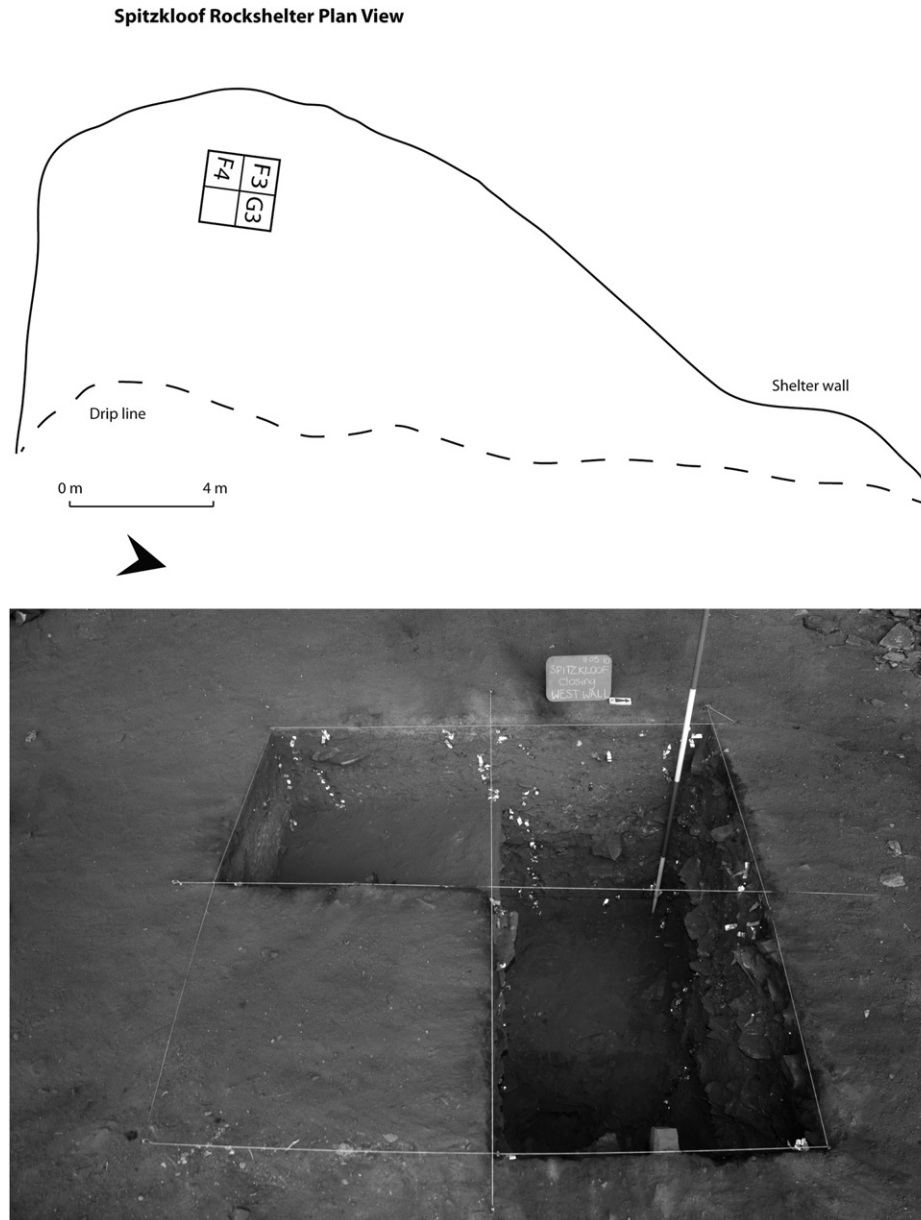


Fig. 3. Drawing and image of the plan post-excavation of Spitzkloof Rockshelter facing west.

rockfall (Fig. 4), for a total of 0.365 m^3 of deposit. Most spits were rich in artefacts. Layer Genevieve is differentiated from Brian by consisting of a much finer sandy silt with gritty pebbles and thin flat inclusions. The Munsell colour is 7.5 YR 5/6 strong brown and includes another rockfall event (Fig. 4). A total of eight spits or 0.134 m^3 of deposit was excavated. This layer has a lower density of artefacts. In both these layers the charcoal has degraded to charcoal flecks but the bone is preserved and present down to layer Genevieve spit three. Plotting the density of bone and ostrich eggshell fragments as grams per bucket (BKT) for each spit (Fig. 5), identifies the fluctuating frequency of artefacts. In layer Brian the density of bone and ostrich eggshell in the upper spits is relatively stable (Table 1) ranging from 15.8 to 19.5 g/BKT for bone with ostrich eggshell following a similar pattern. In the lower portion of layer Brian there is a dip and corresponding oscillation in the density of artefacts with bone ranging widely from 6.9 to 27.2 g/BKT. This pattern is associated with the rockfall where the volume

of sediment changes (Table 2). There is a similar pattern in artefact density in layer Genevieve with ostrich eggshell and bone present, though in smaller frequencies at the top of this layer, thereafter reducing in density through to the bottom of the layer. This shift in frequency is also associated with a rockfall event with varying volumes of sediment (Table 2).

3.2. Dating

Two bone samples from Spitzkloof layers Mark and Genevieve were sent to Beta Analytics Laboratories, but the collagen component of each was too degraded to obtain radiocarbon dates. Re-evaluation of the samples showed no evidence for leaching or burning, thus the most parsimonious explanation for the protein diagenesis is that the samples are greater than 20 ka (Beta Laboratories pers. communication). Future excavation plans include collecting *in situ* OSL samples, while various teeth and ostrich

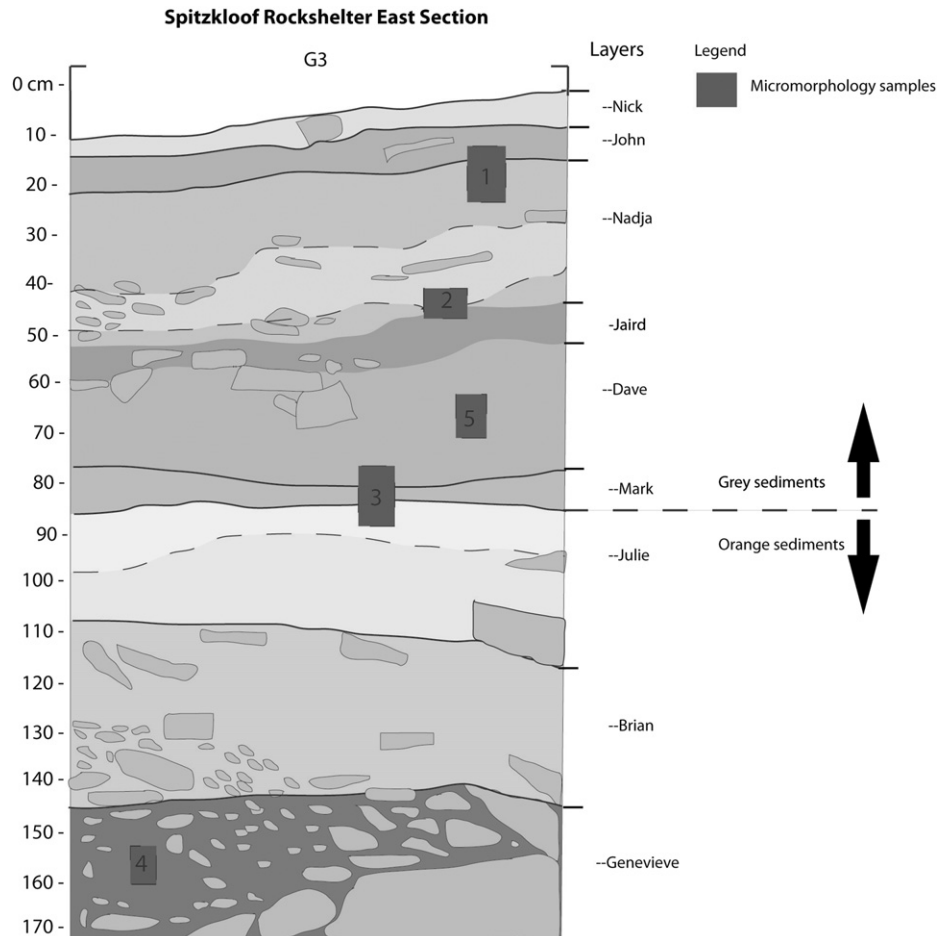


Fig. 4. Profile of the east wall of unit G3 from Spitzkloof Rockshelter. The location of the micromorphology samples are also indicated.

eggshell fragments are currently being identified for ESR and AMS dating respectively.

4. Results and discussion of layers Brian and Genevieve

4.1. Lithics

While the lithics are still being analysed it is of interest to mention an important field observation. Local quartz is well represented throughout the sequence at Spitzkloof A, but an additional raw material is present only in layer Genevieve: non-local yellow silcrete. While they have not been analysed yet, very large flakes and blades made on this non-local yellow silcrete were identified during

excavation. Based on the limited selection of lithics currently at the lab, the large yellow silcrete blades and flakes were compared to images of the assemblage from Apollo 11 and are most similar to the 'early MSA/Komplex 4' from layer 1 (Vogelsang, 1998). Recent re-dating of the sediments at Apollo 11 did not produce an age for this complex (Vogelsang et al., 2010), but it must be older than MIS 4 as this complex is found below the Still Bay layer dated to 71 ± 3 ka (Jacobs et al., 2008; Vogelsang et al., 2010). Yellow silcrete quarry sites and artefact scatters reflecting both ESA and MSA components have been identified over 30 km away near the mouth of the Orange River. These localities range from Port Nolloth in South Africa (Dewar, 2008) through to the northern side of the mouth of the Orange River in Namibia (Corvinus, 1983). This may suggest

Table 1

Description of layers at Spitzkloof A Rockshelter, South Africa. Layers are named after individuals who participated in the project.

Layer	Contexts/features	Munsell colour	Description
Nick	1–4	2.5 YR 3/2 very dark greyish brown	Sandy silt with angular pebbles and degraded quartzite
John	5, 5a & 5b	10 YR 3/2 very dark greyish brown	Silty sand and degrading sandstone patches
Nadja	6, 7, 8, 9, 9a, 9b, 9c & 10	10 YR 4/2 dark greyish brown	Sandy silt with sub angular pebbles and degraded quartzite
Jaird	11 & 12	10 YR 5/4 yellowish brown & 2.5 YR 4/2 dark greyish brown	Fine sandy silt with degraded sandstone and quartzite
Dave	13 & 14	10 YR 4/2 dark greyish brown	Fine sandy silt with pebbles and gypsum crystals
Mark	15	10 YR 3/2 very dark greyish brown & 10 YR 6/6 brownish yellow	Coarse silt with small thin flat inclusions
Julie	16 & 17a	10 YR 4/4 dark yellowish brown	Fine sand with angular pebbles
Brian	18 & 19a	7.5 YR 4/4 brown	Course sandy silt with gritty pebbles
Genevieve	20	7.5 YR 5/6 strong brown	Fine sandy silt with gritty pebbles and thin flat inclusions

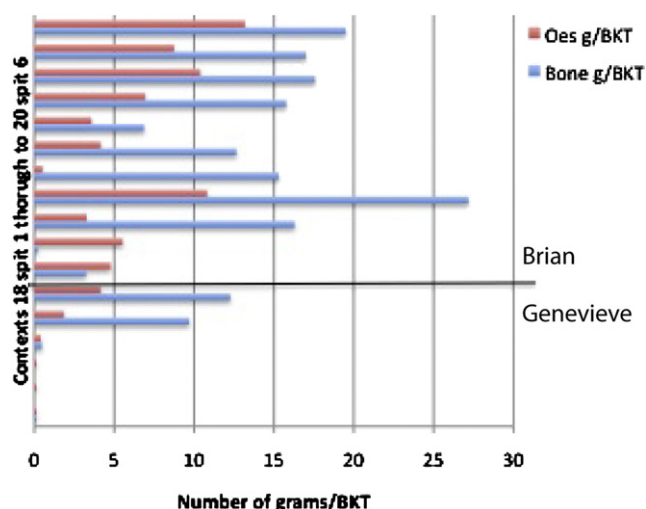


Fig. 5. Chart showing the density of ostrich eggshell and bone in grams per bucket (BKT) of excavated material. 1 BKT is 10L.

a higher level of mobility than the overlaying layers that consist of local quartz and local cryptocrystalline silicates (CCS) found on the gravel plains and riverbeds in the immediate vicinity.

4.2. Bone and ostrich eggshell artefacts

There is only one bone artefact, a complete bone bead from layer Genevieve (Fig. 6). It has a diameter of 4.2 mm with an aperture of 2.1 mm and a thickness of 1.5 mm. There are two burnt ostrich eggshell bead preforms/rough outs from layer Brian (Fig. 6). Following the classification scheme of Kandel and Conard (2005) they are both stage 2 while following Orton (2008) they are at pathway 2 stage 3a, modified but not yet drilled. One has a diameter of 5.9 mm and a thickness of 2.0 mm, while the other is 7.3 mm in diameter with a thickness of 1.6 mm. Of interest is one piece of ostrich eggshell from layer Brian that has two holes that were drilled from the internal side of the fragment. The apertures are 2.8 mm and 3.0 mm respectively. It is unclear whether they represent practice attempts at making flask mouths, pendants or even bead apertures. The uniform drill hole makes it clear that these are not the result of carnivore activity (Kandel, 2004). Ten fragments from Brian exhibit scratches on the external surface, most likely due to post sedimentary processes (cf. Apollo 11,

Table 2

Density in grams per Bucket (BKT) of bone and ostrich eggshell (OES) by spit and unit for layers Brian and Genevieve at Spitzkloof A Rockshelter. One BKT is 10 L.

Layer	Squares	Context	Spit	BKT	OES (g)	Bone (g)	OES (g/BKT)	Bone (g/BKT)
Brian	F3 & G3	18	1	3.2	42.2	62.4	13.19	19.50
Brian	F3 & G3	18	2	3.2	28.0	54.4	8.75	17.00
Brian	F3 & G3	18	3	4.7	48.8	82.6	10.38	17.57
Brian	F3 & G3	19a	1	6.1	42.4	96.2	6.95	15.77
Brian	F3 & G3	19a	2	4.6	16.4	31.6	3.57	6.87
Brian	G3	19a	3	2.6	10.8	32.9	4.15	12.65
Brian	G3	19a	4	1.6	0.8	24.5	0.5	15.31
Brian	G3	19a	5	2.2	23.8	59.8	10.82	27.18
Brian	G3	19a	6	3.0	9.8	48.9	3.27	16.30
Brian	G3	19a	7	2.7	14.9	0.6	5.52	0.22
Brian	G3	19a	8	2.6	12.4	8.4	4.77	3.23
Genevieve	G3	20	1	2.6	10.8	31.9	4.15	12.27
Genevieve	G3	20	2	2.0	3.7	19.4	1.85	9.70
Genevieve	G3	20	3	2.4	0.1	1.1	0.04	0.46
Genevieve	G3	20	4	2.3	0.1	0.0	0.04	0.00
Genevieve	G3	20	5	2.5	0.1	0.0	0.04	0.00
Genevieve	G3	20	6	1.6	0.1	0.1	0.06	0.06

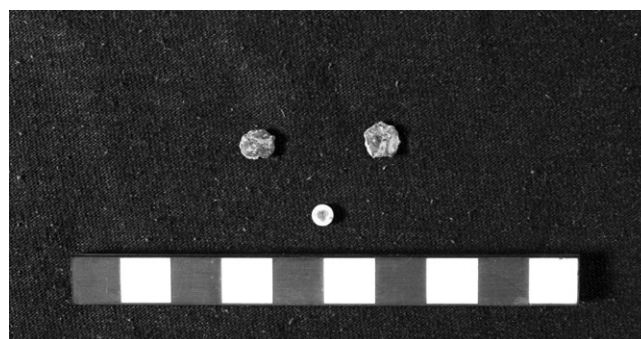


Fig. 6. Burnt ostrich eggshell bead preforms from layer Brian and one bone bead from layer Genevieve. The adhering material is gypsum cement.

Vogelsang, 1998: Fig. 52). Minimally, these artefacts suggest that people were capable of making ornamentation but the small sample size makes it unclear if these items were strictly personal or were also used for social networking purposes.

4.3. Faunal assemblage

The faunal remains were identified to lowest possible taxon by comparison with the African Mammal collection at the Royal Ontario Museum. The bones are highly fragmented (Table 3) and the majority consist of pieces of trabecular bone or shaft fragments with no evidence of a medullary cavity or diagnostic muscle markings. The sample that was identified was minimally classified by size class following Brain (1981) and in some cases, they were identified based on cortical thickness. The element, side, end, and proportion was recorded following Klein and Cruz-Urbe (1984) to maximize comparability with previously published MSA faunal assemblages. Data was also collected following Marean et al. (2001) using the long bone zones published by Abe et al. (2002). All evidence of taphonomic activity was recorded. Heat alteration was identified on the basis of colour changes such as yellow-red to purple-red for scorched bone that has been exposed to fires ranging from 300 to 550 °C; blue-black for charred bone exposed to 600–900 °C; and white for calcined bone exposed to temperatures >1000 °C (Shipman et al., 1984; Johnson, 1989). Recording of carnivore activity, percussion marks and cut marks followed Blumenshine et al. (1996) while weathering followed Behrensmeyer (1978). Root etching, acid etching, long bone fragmentation angle and shape were recorded (Abe et al., 2002). By NISP small mammals (size class 1 and 2) and tortoises including the angulate tortoise (*Chersina angulata*) and the Namaqua tent tortoise (*Psammobates tentorius trimeni*) represents the bulk of the sample at 58% and 38% respectively. Larger mammals (size class 3 and 4) make up the remaining 4%.

4.3.1. Taxonomic abundance

In layer Brian 720 of 1911 bones were identified to size class or better, representing 38% of the assemblage. There is a low diversity of species (Table 4) but the list is actually a fair representation of the ungulates that are present on the landscape today. The assemblage is dominated by small species and includes *Bathyergus janetta*,

Table 3

The fragmentation of the bone sample from layers Brian and Genevieve at Spitzkloof A Rockshelter.

Layer	Total bone	Bone weight (g)	Fragmentation index (bones/g)	Range of length of fragments (mm)
Brian	1911	502.3	3.8	2 to 35
Genevieve	164	52.4	3.1	7 to 20

Table 4

Species list, Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) for the faunal remains from layers Brian and Genevieve at Spitzkloof A Rockshelter.

Species	Brian		Genevieve	
	NISP	MNI	NISP	MNI
Black backed Jackal <i>Canis mesomelas</i>	2	1		
Steenbok <i>Raphicerus campestris</i>	2	1		
Klipspringer <i>Oreotragus oreotragus</i>	1	1		
Bovoid size class 1	3	/	3	1
Duiker <i>Sylvicapra grimmia</i>	3	1		
Springbok <i>Antidorcas marsupialis</i>	1	1		
Bovoid size class 2	14	/		
Gemsbok <i>Oryx gazella</i>	1	1	1	1
Bovoid size class 3			1	/
Namaqua Mole rat <i>Bathyergus janetta</i>	2	1		
Mammal size class 1	240	/	41	1
Mammal size class 2	125	/	4	1
Mammal size class 3	27	/	1	/
Mammal size class 4	1	1		
Micromammal	33	2	11	2
Mammal unidentified size class	19	/	23	/
Namaqua Tent Tortoise <i>Psammobates tentorius trimeni</i>	14	3	1	1
Angulate Tortoise <i>Chersina angulata</i>	26	3		
Tortoise	217	2	27	1
Large Snake	1	1		
Small Snake	5	1		
Land snails	2	2		
Unidentifiable fragments	1172	/	52	/
Total	1,911	23	165	8

Raphicerus campestris, *Oreotragus oreotragus*, *Antidorcas marsupialis*, *Sylvicapra grimmia* and two tortoises, *C. angulata* and *P. tentorius trimeni*. Larger animals (size class 3 through 5) consist of *Oryx gazella* and a single fragment of vertebra from a size class 4 mammal, but it is too degraded to positively identify. There are no size class 5 individuals. Microfauna elements are present in the sample as are the remains of a small and large snake and the land snails *Trigonephrus* sp. However, as these species may have been intrusive into the deposit they are not included in the subsistence analysis. The proportion of small mammals, tortoises and large mammals by NISP is 58%, 38% and 4% respectively.

In layer Genevieve, 90 of the 165 specimens were identified, representing 54.2% of the assemblage. Based on the small sample and lack of complete teeth, the majority of the fauna are identified to size class (Table 4). The diversity of species is low and similar to layer Brian. There are no carnivores and small animals dominate: size class 1 bovid, size class 1 mammal, size class 2 mammal, two micromammals, *P. tentorius trimeni* and unidentified tortoise. An *O. gazella* represents the large animal assemblage. There are no size class 4 or 5 individuals. The proportion of small mammals to tortoises to large mammals by NISP is 61%, 35% and 4% respectively.

As there is no change in the proportion of large mammals between layers Brian and Genevieve, a Chi-square test was used on a two-way table to assess if the proportion of small mammals and tortoises varied. The samples are statistically the same at the 95% confidence level ($\chi^2 = 0.207$, $df = 1$, $p < 0.05$). This suggests that the overall subsistence strategy was similar during the occupation of both layers.

4.3.2. Small species

In layer Brian, a lumbar vertebra and a metapodial belonging to a black backed jackal were identified, but these elements most likely did not arrive at the site through the actions of hominins. This is because the vertebra has evidence of carnivore gnawing. There is a range of small ungulate species representing both the nearby plains environment and the immediate rocky terrain.

The plains-loving steenbok, duiker, springbok and tortoises would have been available a few hundred meters from the shelter while the rock-loving Namaqua mole rat and klipspringer could have been captured in the immediate vicinity of the shelter. The sample size is small but when the plains-loving tortoises are included there is a higher frequency of plains animals over rocky species. Currently the sample size is too small to comment on evidence for past processing or transport decisions that might have affected the assemblage.

4.3.3. Tortoises

The tortoise sample is highly fragmented so that only 14% were identified to species. By NISP angulate tortoise make up 63% of the identified tortoise while the Namaqua tent tortoise represents the remaining 27%. The third species of tortoise living in the region today, the Namaqua speckled padloper (*Homopus signatus signatus*), is clearly missing from the assemblage, as it is easy to identify because it is the world's smallest tortoise at six to ten cm in length (Branch, 1998). As they like to forage on succulents in rocky outcrops, perhaps the focus on plains hunting rather than on rocky outcrops explains their absence. The tiny size of these animals could also explain their absence. All tortoise bone was identified to element and included in the determination of MNI. While the plastron and carapace elements are identifiable between the three species, the MNI happened to be based on long bones. There are three Namaqua tent tortoises (based on left femora), three angulate tortoises (based on right humeri) and two unidentified tortoises (based on fragmented right humeri) in layer Brian and one Namaqua tent tortoise in layer Genevieve.

4.3.4. Large species

There is one identified large ungulate species in both layers, the plains-loving gemsbok, while a vertebra from layer Brian indicates the ephemeral presence of a size class 4 mammal. Gemsbok is a desert-adapted species living in the region today. The sample size is too small to evaluate transport or butchery patterns associated with the large species.

4.3.5. Accumulator

The assemblage is extensively fragmented with 3.8 fragments per gram of bone in layer Brian and 3.1 in layer Genevieve (Table 3). The sample of identified bone is dominated by long bone shaft fragments while the elements that are identified to species are primarily teeth and foot bones, easily identifiable elements that typically survive density mediated destruction. Their presence thus reflects their ability to withstand taphonomic processes rather than purposeful selection by hominins (Marean and Frey, 1997; Marean et al., 2004).

Before the accumulator of the assemblage can be determined the effects of density mediated attrition need to be accounted for. Using the long bone zones presented by Abe et al. (2002) and following Thompson (2010) the proportion of dense mid shafts to less dense epiphyseal ends of long bones is identified. Mid shafts consist entirely of cortical bone and represent 76% of the long bone shaft fragments with the near shaft ends (both proximal and distal ends with some trabecular bone) accounting for 12%. The epiphyses account for the other 12%. This pattern suggests that less dense trabecular bone was preferentially destroyed, while cortical bone survives.

One possible source of the destruction of epiphyses over mid shaft fragments is carnivore activity, so all bone was observed for evidence of carnivore modification. Only three elements in the assemblage bear evidence of carnivore gnawing or puncture marks including one juvenile black backed jackal caudal bone. While this suggests there was at least minimal contribution to the deposit by

carnivores during the occupation of layer Brian, they are not a primary accumulator of bone in the assemblage. There is also no evidence for rodent gnawing on the surface of bone, nor acid etching from travelling through the digestive tract of either bird's or prey or carnivores (Andrews, 1990; Lyman, 1994).

Evidence for human modification includes cut marks and percussion notches on 0.6% of the identified bone and heat alteration on 26% of the assemblage. The low incidence of visible modifications may be due to post-depositional breakage, which can depress the original values (Marean et al., 2000). Additionally, some elements are covered with a cement slip or exhibit exfoliation or pocking on the surface, potentially masking evidence of modifications. If elements exhibiting evidence for post-depositional breakage (Abe et al., 2002) and obscured surfaces are removed from the sample then the frequency of modified elements greatly increases (Thompson, 2010). One measure of post-depositional breakage evaluates long bone fracture patterns with dry bone breaks identified by transverse or irregular, right-angled breaks and fresh bone breaks with a curved or V-shaped oblique angle (Villa and Mahieu, 1991). Of 473 long bone fragments, 222 had at least one right angle break and a further 35 elements had obscured surfaces. Removing these bones shifts the frequency of human modified bones to a modest 2.3%. The problem with identifying cut marks is that if individual butchers are skilled they will not leave any evidence on bone as they attempt to prevent damaging sharp tools.

There is a difference in the frequency of post-depositional breakage between layers Brian and Genevieve with 53% of the long bone sample exhibiting right-angled dry breaks in layer Brian and 73% in layer Genevieve. This is not expected as any activity occurring during the deposition of layer Brian such as trampling, occurred directly on top of layer Genevieve.

In every spit with bone, there is evidence for heat alteration due to fire. In natural fires temperatures can reach high enough values to carbonize bone but not calcine them (David, 1990), making it possible to identify the taphonomic agent responsible for the burning. According to Lyman (1994), bone placed in a hearth for 25 min will produce a pattern of 75.5% of the sample becoming carbonized and 24.5% calcined. If the bone is left in the hearth for up to 6 h, only 5% of the bone will be carbonized and the remaining 95% will be calcined. In layer Brian a total of 12 elements were scorched (yellow-red to purple-red), while 465 bones were carbonized and 24 were extensively calcined. This pattern fits most readily with Lyman's (1994) 25 min fire. As all elements are thoroughly burnt this suggests the bone was placed in the fire to clean up refuse as opposed to the effects of cooking. Even roasting meat will produce regions of bone that are not carbonized as they are protected by flesh. In layer Genevieve 27 bones are carbonized and the lack of calcined bone suggests the possibility that these remains were not burnt through human behaviour but naturally, for example through a brush fire.

Other taphonomic factors affecting the sample were limited and found only in layer Brian with 0.5% of the total assemblage producing evidence for stage 2 weathering with minor exposure to solar radiation, atmospheric humidity or temperature causing the surface of the bone to start flaking (Behrensmeier, 1978). Root etching was identified on 0.3% of the identified assemblage and thus indicates limited vegetation growth.

4.3.6. Ostrich eggshell

If the ostrich eggshell in the assemblage was brought to the site for consumption, there is only one egg represented in each layer by weight. The average weight of three complete and empty eggshells from Namaqualand is 259 g (Dewar, 2008). In layer Brian there is a total of 132.5 g of shell and in Genevieve there is 14.9 g of shell. The eggshell sample also shows evidence for heat alteration

throughout the spits, with a similar pattern of heat exposure as seen in the bone for both layers. In layer Brian 53% of shell fragments are burnt with 32 scorched, 136 carbonized and 15 calcined while 57% of the shell in Genevieve is simply carbonized. Gathering ostrich eggshell was practiced but not at the same frequency or level of importance as has been suggested for other MSA sites along the west coast (cf. Klein et al., 2004).

4.3.7. Comparison with Apollo 11

The sample size is small but a chi-squared test identified a similar economic strategy was used in both layers Brian and Genevieve. In both data sets, there is no evidence for a focussed economy and the majority of ungulate and tortoise species that are locally available today are present in the assemblage. When the sample size increases to over 100 elements per species, Shannon's Evenness/diversity index can be utilized to mathematically determine the relative evenness of species diversity at Spitzkloof A and compare that value with Apollo 11 and sites from rich biomes. The MSA faunal assemblage at Apollo 11 (Thackeray, 1979; Vogelsang et al., 2010) is also representative of the ungulate species that are available on the landscape today. Thackeray (1979: 31) concluded that "low ungulate species diversity, including fauna adapted to withstand arid conditions, reflects an environment with a relatively low carrying capacity". This suggests that the economic strategies utilised were similar between sites and were more likely broad rather than focussed.

There are also a few differences between the faunal assemblages at Apollo 11 and Spitzkloof A. The first difference is taxonomic abundance with a range of birds, a warthog (*Phacochoerus* sp.) and equids present only at Apollo 11 (Thackeray, 1979). Although the sample size at Apollo 11 is much larger (~20,000 in Thackeray, 1979 and 4500 in Vogelsang et al., 2010) and these species may appear once the sample size at Spitzkloof A is increased. The second difference is the ratio of rock-loving species to plains-loving species of ungulates at the two sites. The ratio of ungulates at Spitzkloof A is 2:4 in favour of plains-loving species and at Apollo 11 it is 3:2 in favour of rock-loving species (Thackeray, 1979: Table 5b). Vogelsang et al. (2010) and Thackeray (1979) concluded that the hunting strategy at Apollo 11 centred on the rocky hills, while the species present at Spitzkloof A suggest the plains were favoured. Thirdly, there is a difference in the relative frequency of small mammals, tortoises and large mammals (Table 5). For this evaluation only the data from the recent re-excavation of Apollo 11 (Vogelsang et al., 2010) was included. The original faunal analysis of the Apollo 11 excavations reported by Thackeray (1979) did not include NISP values only estimated MNI values and thus the data could not be compared. While small mammals and tortoises dominate the assemblage at Spitzkloof A, the faunal assemblage at Apollo 11 has more large mammals at the expense of tortoises. A Chi-squared test confirms the samples are significantly different at the 95% confidence level ($\chi^2 = 211.4$, $df = 2$, $p < 0.05$). The difference between the abundance of tortoises and large mammals is most likely based on the previously identified hunting zones. In rocky regions, there is a low incidence of finding larger tortoises but the larger mammals such as equids are available. In plains regions, the ungulates are smaller but there is a high incidence of opportunistically discovering larger tortoises.

Table 5

Comparison of the distribution of small mammals, tortoises and large mammals by NISP at Spitzkloof Rockshelter A and Apollo 11.

	Spitzkloof A	Apollo 11 ^a
Small mammals	441 (58%)	107 (61%)
Tortoises	285 (38%)	8 (5%)
Large mammals	32 (4%)	60 (34%)

^a Vogelsang et al., 2010.

4.4. Environmental evidence

The presence of gypsum throughout the entire deposit indicates that the occupation of Spitzkloof A occurred during arid to semi-arid climatic conditions (Dregne, 1976; Middleton, 2003). However, there is a relative reduction in the presence of gypsum crystals or cementation in the layers Brian and Genevieve. Two *Trigonephrus* sp. land snail shells were identified from layer Brian. *Trigonephrus* sp. dune snails live in relatively dry Mediterranean climates (Roberts and Brink, 2002) but are less xeric than other similar taxa (Dallas et al., 1991) requiring at least minimal moisture for survival. *Trigonephrus* sp. are known to bury themselves during very dry periods, laying dormant until rainfall or lower surface temperatures allow them to resurface (Dallas et al., 1991).

The species list consists of arid-adapted species that are found on the landscape today. The lack of riverine species might indicate an inability of the hunters to catch them or it may indicate that the tributary was not flowing. Root etching is visible on very few elements indicating poor growing conditions for vegetation. Together these environmental proxies suggest that layers Brian and Genevieve were deposited in an arid to semi-arid environment, which may have been slightly more humid than overlying deposits experienced.

5. Conclusion

Using the biogeographical model to interpret the archaeological signature at Spitzkloof A suggests that during the occupations of layers Brian and Genevieve, the region was a marginal arid to semi-arid environment, not unlike the environment today. This interpretation of the paleoenvironment is based on numerous lines of evidence including the presence of arid adapted species, gypsum and *Trigonephrus* sp. shells. The economic strategy is seemingly a general opportunistic use of the available ungulates with small mammals and tortoises especially abundant. Hunting is focused on the plains rather than the immediate vicinity of the shelter, which in conjunction with the potentially non-local yellow silcrete suggests high levels of mobility. While the lithic analysis is underway, if this model holds, the lithics should reflect a pattern of a flexible and informal technology. The bone bead indicates that people were making ornamentation but the small sample size makes it unclear if they are *in situ* or if there has been vertical movement from upper layers. Hopefully the geomorphological study of the micromorphology samples will clarify this issue. While these layers were deposited when the region was a marginal environment, it remains to be seen if these people were modern or what time period this represents. Future excavations of the shelter will provide much needed larger samples sizes, and the dating program under way will hopefully be fruitful.

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