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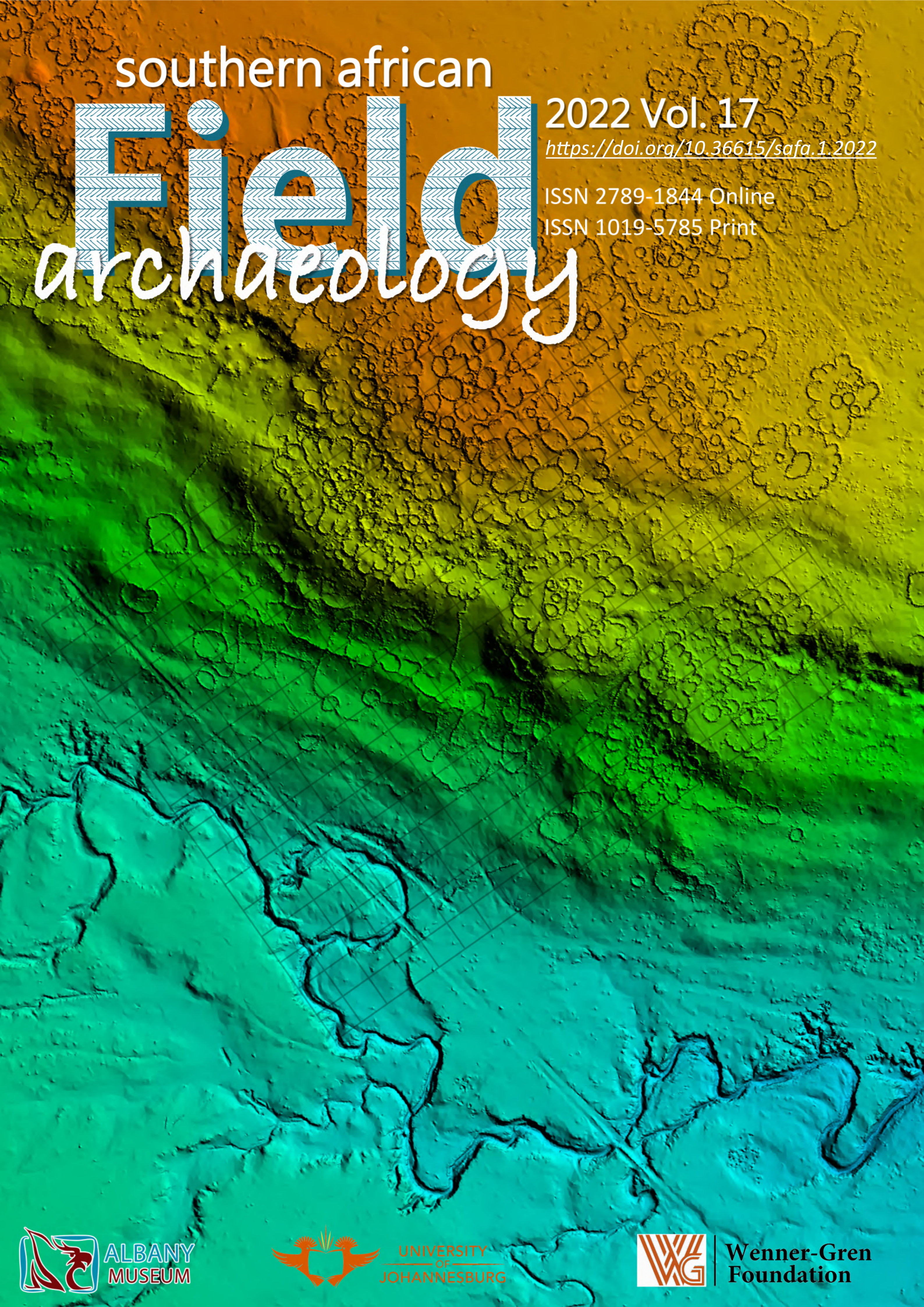

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REVISITING MIDDLE STONE AGE HUNTING AT ≠GI, BOTSWANA: A TIP CROSS-SECTIONAL AREA STUDY

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ABSTRACT
≠Gi was excavated almost half-a-century ago. Despite no formally published analyses of its lithic and faunal assemblages, the site has been important to discussions about technological development during the Middle Stone Age (MSA). Dating to ~77 ka, ≠Gi has been argued to represent one of the earliest contexts in southern Africa where the spearthrower-and-dart may have been used as a mechanically projected weapon system. Here we provide a brief history of lithic-point research pertaining to the site, and report on a tip cross-sectional area (TCSA) analysis conducted on 359 MSA points excavated from ≠Gi. Based on the TCSA approach, we hypothesise that the use of stabbing spears in ambush hunting, perhaps in tandem with lightweight javelin hunting, was the most likely scenario for the MSA hunters who used the site.

Keywords: Middle Stone Age hunting, spearthrower-and-dart, bow-and-arrow, lightweight javelin, thrusting/stabbing spears

1. Introduction

≠Gi Pan (we use '≠Gi' for the archaeological excavation, and '≠Gi Pan' to refer to the broader, but immediately related, pan-scape) with its associated archaeological site is in the Dobe Valley of the northern Kalahari Basin, Botswana, one kilometre east of the Namibian border (Fig. 1). The climate here is semi-arid, with sporadic summer rains between October and March and moderate to cool winters with little to no rain (Thomas & Shaw 2010). Southern African pan-scapes are wide, shallow depressions that create localised drainage basins where run-off water accumulates after good rains. The pans often dry out by the end of the winter or during cyclic periods of drought. A /Xam hunter-gatherer from South Africa described pan-scapes as places where there is water which is "level with the ground" (Digital Bleek and Lloyd n.d.: L.II.12: 629). When other open water and grazing become scarce, large animal herds congregate in these spaces, not only to drink when the pans still hold some water, but also to benefit from the minerals and vegetation.

To the Ju/'hoansi hunter-gatherers of the Kalahari Dobe region these areas represent land-use hubs (Lee 2013), wherein the pan-scapes form part of their 'resource territories' that are handed down from one generation to the next (Hitchcock et al. 2019). Similar, inheritable landscape custodianship around water sources is known from the Northern Cape in South Africa that used to be inhabited by /Xam hunter-gatherers (Deacon 1986). Many of the pans, including the one at ≠Gi, are known hotspots for ambush hunting where hunters would build small stone blinds within ~100 m of the water's edge (Hitchcock et al. 2019), or large hunting-funnel systems on higher ground up to 1 km away (Lombard et al. 2021a). In both cases, the structures are strategically constructed along animal trails.

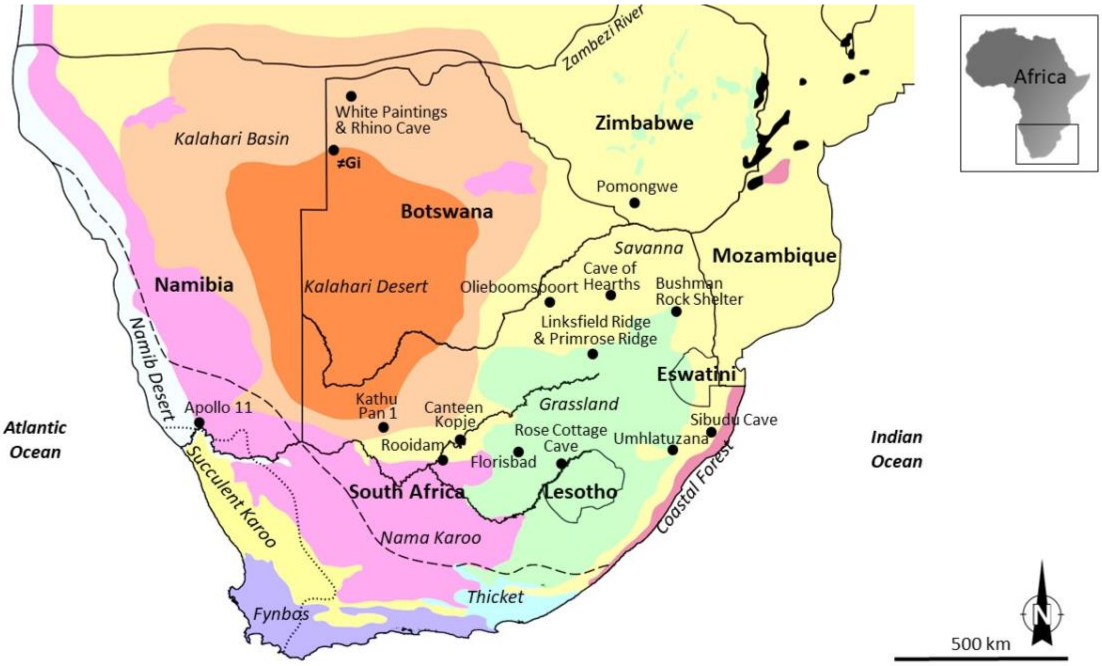

Figure 1. Map of southern Africa with the location of ≠Gi and other sites mentioned in the text. The area left of the stippled line = winter-rainfall zone, the area between stippled and dashed lines = year-round rainfall zone, and the area right of the dashed line = summer-rainfall zone (base map by Matt Caruana, University of Johannesburg, with details and annotations by ML).

Hitchcock et al. (2019) report that in the greater Dobe/Nyae Nyae region hunters preferred to ambush animals such as duiker, eland, gemsbok, hartebeest, impala, kudu, springbok, steenbok, warthog, and wildebeest. Such ambush hunting is often done from the hunting blinds (either shallow-dug hollows or low stone circles) scattered around the pans. Hunting from behind the blinds is mostly done with bows and arrows, probably because they provide stealth. Animals wounded with poisoned arrows or javelins are then pursued and killed elsewhere. Sometimes, ambush hunters also kill prey immediately with their spears and clubs (Hitchcock et al. 2019). These records provide valuable insight into hunting strategies and the different weapon types used simultaneously by the same groups of hunters, indicating that reconstructions of past hunting arsenals focussing on a single weapon type may be out of touch with African hunter-gatherer reality.

≠Gi is situated on an ancient pan-scape (for geo-archaeological discussion see Helgren & Brooks 1983), and as such was also used by humans during the Stone Age. As an archaeological site, it was first observed by Alison Brooks and John Yellen in the 1960s, and excavated by them during the 1970s (Brooks & Yellen 1979). Some of the hunting blinds or pits at ≠Gi are from Later Stone Age contexts, which date from ~24 ka to the last two hundred years or so (Helgren & Brooks 1983). It is therefore reasonable to suggest that the site was used for ambush hunting during the Holocene, and perhaps the final Pleistocene (Brooks 1978; Kuman 1989).

Beneath the Later Stone Age levels at ≠Gi, sealed by a non-pedogenic lacustrine limestone layer, is a Middle Stone Age (MSA) deposit dated to 77±11 ka (Brooks et al. 1990). Brooks et al. (2006) have suggested that stone points from this context were likely used to tip spearthrower darts, which would be the first and only indication of such weapon use in southern Africa to date. The purpose of this contribution is to make available the morphometric data for 359 MSA points excavated from ≠Gi, report on a tip cross-sectional area (TCSA) analysis based on these data, and discuss what the results may reveal in terms of current research and theorising about MSA weapon use and hunting strategies in southern Africa.

2. Background to the MSA point assemblage from ≠Gi

Despite the 244 m² excavated to an average depth of two metres (Brooks & Yellen 1977), and the recovery of approximately 1500 retouched lithic pieces (Brooks et al. 2006), the only formal stone tool analysis for ≠Gi, of which we are aware, is Kathleen Kuman's (1989) unpublished PhD thesis. She reported that the MSA assemblage is most similar to the Bambatan industries of Zimbabwe (previously known as the Rhodesian Still Bay [e.g., Bond & Clark 1945]), sharing traits such as a common richness and variety of retouched tool types, a variety of unifacial and bifacial points, an emphasis on the radial working of cores and the rarity of blades.

Retouched points and scrapers are dominant in the ≠Gi MSA formal-tool assemblage – here we focus on the points (Fig. 2). Kuman (1989) recorded 597 points, and a further 78 broken point tips. Her point categories included unifacial points (n=218), unifacial points with basal ventral retouch (n=93), points with inverse-obverse/dorsal-ventral retouch (n=17), partly bifacial points (n=124), bifacial points (n=131), and an incomplete/uncertain sub-type (n=14). The summarised descriptive statistics for the four most frequent point categories studied by Kuman are presented in Table 1. The number of points for each category measured by Kuman differs from the number of points reported for each category in the text (Kuman 1989: 189), probably reflecting broken points for which maximum dimensions could not be measured.

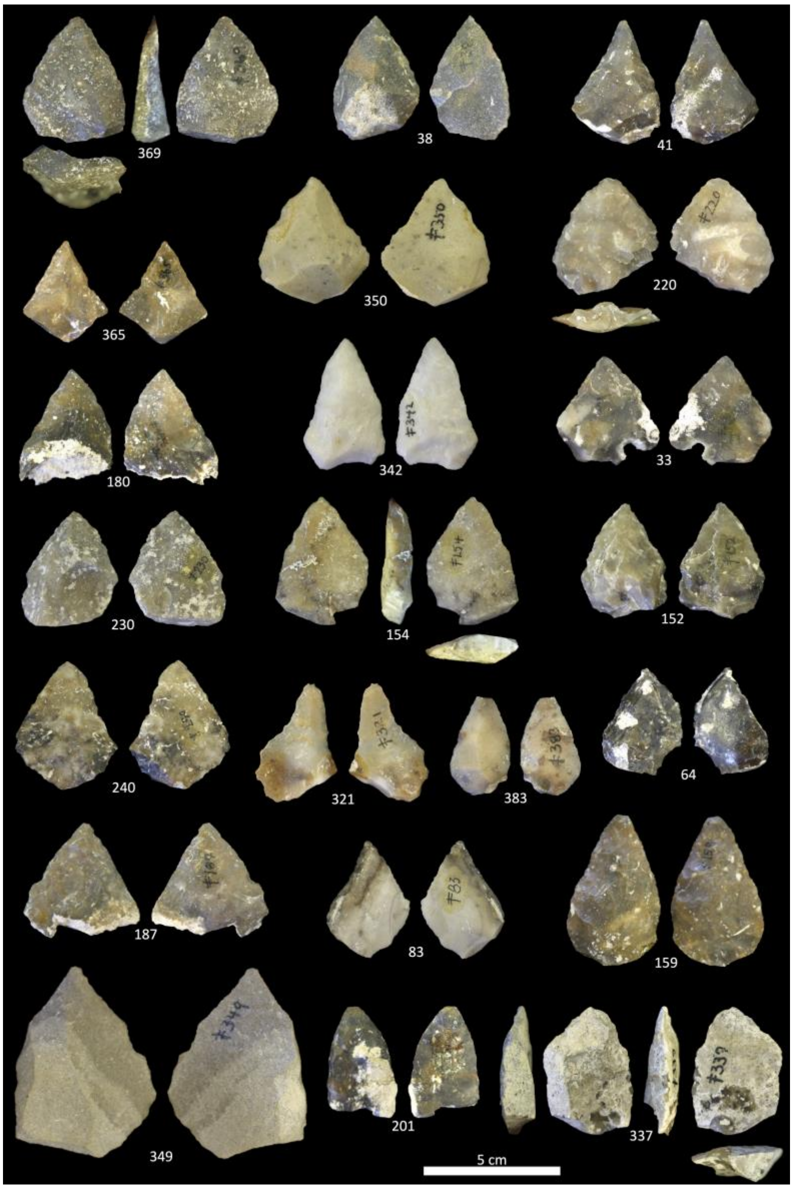

Figure 2. Selected examples of what were interpreted as MSA points from ≠Gi (photographs and individual numbers by Julie Daniel, plate preparation by Matt Lotter).

Table 1. Mean dimensions and standard deviations for points from ≠Gi from Kuman (1989: 242), Brooks et al. (2006), and dimensions of stone arrow and dart tips published by Thomas (1978).

Point category	Length mm mean±SD	Width mm mean±SD	Thickness mm mean±SD	Mass g mean±SD
≠Gi Pan Kuman dimensions				
Bifacial	43.4±7.9 (n=47)	35.5±18.8 (n=57)	11±3.3 (n=55)	-
Partly bifacial	41.6±8.7 (n=69)	34.4±15.3 (n=70)	10±2.7 (n=69)	-
Unifacial	49.7±9.5 (n=138)	32.8±14.3 (n=149)	10±3 (n=148)	-
Unifacial basal/ventral ret.	40.7±7.1 (n=43)	30.1±4.7 (n=48)	10± 2.4 (n=48)	-
Kuman sample total	**~43.9 (n=297)**	**~33.2 (n=324)**	**~10.3 (n=320)**	**-**
Dimensions provided by Brooks et al. (2006)				
≠Gi Table 2	74±24.9 (n=16)	46.8±14.7 (n=16)	14.1±10.8 (n=16)	50.1±43.9 (n=16)
≠Gi Figures (same as Aduma 5 in Table 2)	40.2±8.2 (n=299)	30.1±6.1 (n=299)	10.2±2.7 (n=299)	11.8±7.2 (n=299)
Thomas' (1978) ethnographic standards				
Stone arrow tips	31.1±2.8 (n=132)	14.7±1.3 (n=132)	4.0±0.4 (n=132)	2.1±0.3 (n=132)
Stone dart tips	46.2±10.5 (n=10)	22.9±4.77 (n=10)	4.9±1.37 (n=10)	4.4±2.1 (n=10)

Based on point variability and informal wear observations (hand lens 5-10x magnification), Kuman's (1989: 240) working hypothesis was that the points were a dependable tool form, "perhaps akin to a pocket-knife, that was used in more than one manner", but mostly for cutting. She also suggested that some of the points may have been handheld, but that many were probably curated (re-sharpened), some perhaps in their shafts or hafts. Kuman (1989) interpreted the site as 'purposely specialised', but was cautious to ascribe a hunting function for the MSA because, at the time, there were no published records of MSA points in direct association with carcasses or hunting contexts, and no points have been associated with shafts to demonstrate their function as hunting weapons. There is, however, a reasonable faunal assemblage from the MSA context at ≠Gi. The preliminary list provided by Kuman (1989) includes: zebra (*Equus burchelli*), warthog (*Phacochoerus aethiopicus*), white rhinoceros (*Ceratotherium simum*), blue wildebeest (*Connochaetes taurinus*), giraffe (*Giraffa camelopardalis*), and Antelopini sp. (a tribe of medium-sized gazelles that may be springbok), as well as three extinct taxa in the form of giant zebra (*Equus capensis*), giant buffalo (*Pelorovis antiquus*), and a giant alcelaphine (?*Megalotragus priscus*).

Based on the 'abundant mammalian fauna' accompanying the lithic assemblage, apparently including >1000 teeth, Helgren and Brooks (1983) considered the use of ≠Gi Pan during the MSA as a hunting location for specialised techniques such as game drives or ambush hunting. According to them the dominant fauna are zebra and warthog (extinct and extant). Because these animals are difficult to hunt without dogs and/or from horseback today, the authors hypothesise hunting them during the MSA may have been best achieved through an ambush strategy – and that ≠Gi Pan provided such an ambush landscape.

In a review of trends in point assemblages, Brooks et al. (2006: 233) argued that the comparatively small size of many African MSA points – as opposed to Middle Palaeolithic (MP) points from Europe – denotes the use of "a complex projectile technology" rather than simple spears. They provide a discussion of the ≠Gi points listing the following traits:

- Predominantly small, triangular, and bifacial.
- Bases are heavily thinned and modified, presumably for hafting.
- Although some points are entirely unifacial, most have some degree of bifacial working, either just at the base, over part of the edge, or over the entire ventral surface.
- Maximum width, usually at the base, was tightly controlled, despite the range of raw materials including chert, jasper, chalcedony and quartzite (mostly locally available).
- Made on discoidal cores, with flake bulbs and striking platforms frequently on the corner rather than in the centre of the base.
- Markedly smaller than typical MP points from outside Africa.
- Multiple examples of projectile impact damage, including hinge fractures, broken tips, and burination spalls, micro-striations possibly due to hafting wear (but no formal use-trace method or results are presented).

Although she has not been cited, these traits are in general agreement with Kuman's (1989) analysis, so that it is uncertain whether Brooks et al. (2006) drew from her work or conducted their own analysis. The mean dimensions for 16 points from ≠Gi are, however, given as 74±24.9 x 46.8±14.7 x 14.1±10.8 mm (Brooks et al. 2006: table 2; our Table 1), which is different from the data for ≠Gi points in the subsequent figures (n=299). It seems that the row that says '≠Gi' contains the data for Aduma 1 and the 'Aduma 5' row that of ≠Gi, the row for 'Aduma 1' contains data for Aduma 8, the 'Aduma 8' row the data for Aduma 4, and the 'Aduma 4' row that of Aduma 5 (Benjamin Schoville pers. comm. March 2022). The authors nonetheless suggest that the size of the points from ≠Gi "places them at the lower limits of ethnographically known spear armatures and within the range of ethnographically known spear thrower darts and larger arrowheads" (Brooks et al. 2006: 240). They do not provide a baseline for spear tips, but conclude that the relatively small dimensions and mass of MSA points from Africa indicate the development of a projectile system – spearthrowers-and-darts more likely than bows-and-arrows (Brooks et al. 2006). Their inferences are based on Thomas' (1978) examination of 142 stone-tipped projectiles (10 darts and 132 arrows) from ethnographic contexts housed at the American Museum of Natural History. At the bottom of Table 1 we show how the Brooks et al. (2006) data for points from ≠Gi compare to that of Thomas (1978) for stone-tipped arrows and spearthrower darts, and return to this topic in our concluding discussion.

One of us (Lombard 2021) used the TCSA method (Table 2), with new ranges for poisoned arrow tips (Lombard 2020a, b) and lightweight javelins as used in sub-Saharan Africa to hypothetically assess variation in hunting weaponry during the MSA of southern Africa. Raw data for the points from ≠Gi were not available for that study (John Yellen pers. comm. January 2021). However, mean data from Kuman (1989) were used to calculate their approximate average TCSA value, following Villa and Lenoir (2006) for the use of processed data in TCSA studies. Compared to the standardised TCSA ranges for five Stone Age weapon-delivery systems (Table 2), the derived TCSA value of ~168 for the points from ≠Gi indicates that they would have been most effective for use as thrusting/stabbing-spear tips, and that their cumulative TCSA value is considerably greater than the ranges for American dart tips or arrowheads.

Table 2. Standardised TCSA ranges for five Stone Age weapon-delivery systems.

Weapon type	N of artefacts	Mean TCSA	TCSA range
Poisoned arrow tips (Lombard 2020a, 2021)	434	11±7	4-18
Arrowheads (Shea 2006)	118	33±20	13-53
Dart tips (Shea 2006)	40	58±18	40-76
Javelin tips (Rios-Garaizar 2016; Lombard 2021)	137	71±27	44-98
Thrusting/stabbing spear tips (Shea 2006; Lombard 2021)	75	159±71	88-230

To re-assess the inferences about MSA weapon use at ≠Gi Pan we report here on the TCSA analysis of 318 points curated at the National Museum of Natural History in Gaborone (Botswana), and 41 points currently held at the Smithsonian Institution in Washington (USA) (Fig. 2). Morphometric data for the artefacts identified as points were generated by Julie Daniel in 2005 as part of an unpublished student project supervised by SC, and we share some of these data in the Supplementary Online Material [SOM File 1]).

3. Tip cross-sectional analysis of MSA points from ≠Gi

TCSA analysis is based on a simple formula (0.5 x maximum width x maximum thickness) that provides directly comparable data for the part of a weapon tip that cuts the hole through the hide for the shaft to enter the prey animal (Hughes 1998; Shea 2006). Sitton et al. (2020) also demonstrated that TCSA geometry can be used to predict the penetration depth of stone-tipped weapons. The approach has been published often, and ML has recently provided methodological improvements (Lombard 2020a, b, 2021). We therefore do not rehash such discussion here. Instead, we start by presenting the TCSA values for each individual point from ≠Gi (Fig. 3), and interpret what these results may indicate about the use of weapon tips against the background of the standardised TCSA ranges in Table 2.

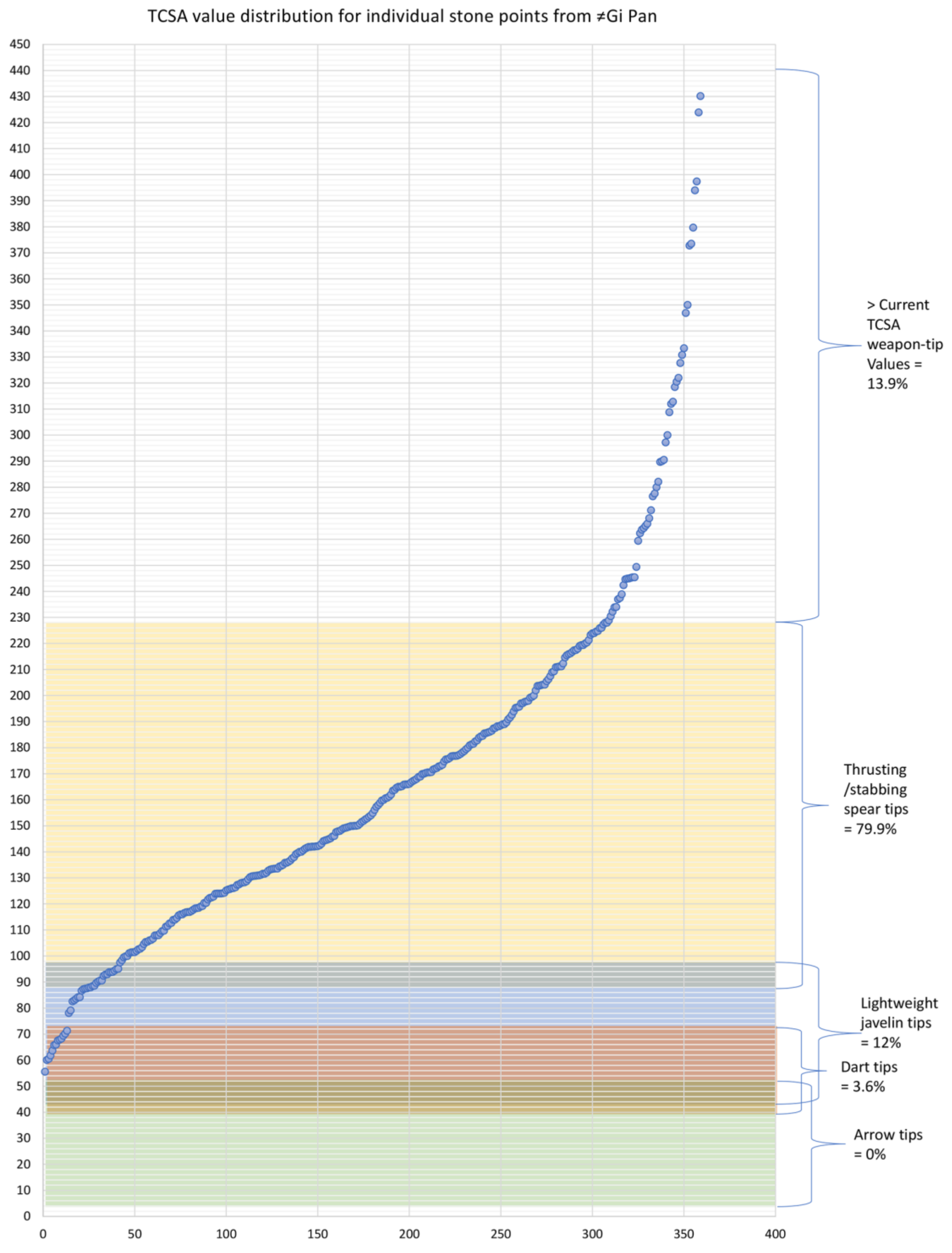

Figure 3. TCSA values for each of the MSA points from ≠Gi Pan plotted against the standardised TCSA ranges of the different weapon-delivery systems.

Our analysis shows that, hypothetically, 287 (79.9%) of the points from ≠Gi would have been most effective when used to tip thrusting or stabbing spears. By contrast, only 43 (12%) would be most suited for tipping lightweight javelins, and 13 (3.6%) conform to northern American spearthrower-dart tips. None of the ≠Gi points fall in the TCSA category for arrow tips, either poisoned or un-poisoned (in Fig. 3 we combined the range for both arrow-tip types).

Whereas TCSA results provide objective comparable data, without the support of contextualised use-related evidence the outcomes remain hypothetical, and is most suitable for building heuristic frameworks that can be assessed and fine-tuned with ongoing research. In the southern African context, we have reached a critical mass in multi-stranded work on the interpretation of Stone Age weapon use (see references listed in table 1 of Lombard & Shea 2021; also see Donahue et al. 2004; Lombard 2004; Lombard et al. 2004; Lombard 2005a, b; Wilkins et al. 2012; Wilkins et al. 2014; Schoville et al. 2016, 2017; Rots et al. 2017; Hitchcock et al. 2019). The interpretations of TCSA results for the region are thus anchored in a diverse range of ethno-historical, experimental, use-trace and archaeological records.

This allows us to hypothesise that, if some of the MSA points from ≠Gi were hafted and used as hunting weapons, they were most likely made to tip thrusting or stabbing spears, while a small percentage could also have served well as tips for lightweight javelins. Based on their TCSA values, the likelihood that these artefacts were made to tip darts (akin to those used in northern America) or arrows is unlikely in the sub-Saharan context. Also, their potential to serve as weapon tips do not distract from the probability that pointed tool forms were used as hafted knives (e.g., Clark JD 1988, Kuman 1989). Only detailed use-trace and residue analyses can demonstrate which tools were last used as either a weapon tip or a knife blade (e.g., Lombard 2004, 2005a).

The lightweight javelin category is, however, strict (Lombard 2021), and there is a reasonable expectation that many of the points with lower TCSA values in the thrusting/stabbing spear category could have been thrown effectively over shorter distances, compared to lightweight javelins that can be thrown forcefully and accurately for up to 30 m (Lombard submitted). Either thrown, stabbed or thrusted, it seems that the specialisation at ≠Gi Pan during the MSA was hunting with hand-held weapons. To further assess the points from ≠Gi in terms of variability in MSA hunting behaviour, we compare our results with those of other inland sites (Nama Karoo, Grassland Biome, Savanna Biome and the Kalahari Desert/Basin) dating roughly between MIS 4 and MIS 12 (Table 3; Figs 1 & 4).

Table 3. TCSA results and distribution across the potential weapon-delivery systems. Data for assemblages may vary from Lombard (2021), because we now include pieces with TCSA values >230. Also included are the Howiesons Poort backed microliths and corrected data for the Umhlatuzana Howiesons Poort where the tools now measured n=232. We also collated some assemblages from the same sites such as the Apollo 11 MSA 1.1 and 1.2 assemblages of MIS 5.

Assemblage	**TCSA**			**% Potential weapon-delivery system**					
Total number of artefacts n=2101	Mean	SD	Median	Spear	Javelin	Dart	Arrow	P-arrow	>230
~MIS 4 assemblages (n=712)									
Umhlatuzana HP ~56.5-63.5 ka (n=232)	24	21	17	3	7.3	7.3	62.9	45.3	0
Apollo 11 HP ~63.2 ka (n=57)	56	44	41	19.3	33.3	29.8	61.4	7	0
Pomongwe Magoisian MIS 4 (n=65)	87	55	77	26.9	59.7	38.8	23.9	0	3
Rose Cottage HP ~62-69 ka (n=84)	39	32	47	7.1	35.7	32.1	56	20.2	0
Sibudu HP ~60-67 ka (n=219)	51	44	36	14.6	32.4	28.3	58	18.3	0.5
Rhino Cave MSA ≥66 ka? (n=26)	89	43	72	42.4	61.5	50	23.1	0	0
White Paintings MSA ≥66 ka (n=29)	94	31	88	58.6	58.6	34.5	10.3	0	0
~MIS 5 Assemblages (n=840)									
Apollo 11 SB ~68-73 ka (n=15)	107	42	104	73.3	40	27.7	6.7	0	0
Sibudu SB ~68.5-72.5 ka (n=38)	116	51	102	71.1	34.2	26.3	7.9	0	0
Umhlatuzana SB ≥70 ka (n=39)	89	31	92	58	53.8	25.6	15.4	0	0
Sibudu pre-SB >77 ka (n=46)	100	54	84	45.7	54.30	43.8	15.2	0	2.2
≠Gi Pan, Botswana, ~77 ka (n=359)	168	76	155	79.9	12	3.6	0	0	13.9
Apollo 11 MSA MIS 5 (n=45)	176	108	152	55.6	17.8	11.1	6.7	0	24.4
Bushman Rock MIS 5 (n=165)	146	81	130	56	25.9	13.9	9.6	0	16.9
Cave of Hearths MIS 5 (n=63)	126	51	116	69.8	33.3	11.1	4.8	0	4.8
Florisbad expedient MSA 121±60 ka (n=70)	208	85	198	60	8.6	5.7	2.9	0	34.3
~MIS 6-8 assemblages (n=398)									
Olieboomspoort ~134-164 ka (n=79)	158	75	139	75.9	16.5	7.6	0	0	13.9
Florisbad early MSA ~175 ka (n=76)	190	71	187	68.4	5.3	1.3	0	0	28.9
Rooidam 2 MSA/Fauresmith >174 ka (n=130)	170	101	150	53.1	29.2	15.4	5.4	0	23.8
Linksfield Ridge Sangoan MIS 6-8? (n=46)	200	73	194	65.2	0	0	2.2	0	32.6
Primrose Ridge Sangoan MIS 6-8? (n=54)	210	64	195	68.5	0	0	0	0	31.5
Canteen Kopje Fauresmith >300 ka (n=13)	189	94	190	76.9	7.7	0	0	0	15.4
~MIS 11-12 assemblage (n=151)									
Kathu Pan Fauresmith >464 ka (n=151)	223	85	215	56.3	6	2	0	0	40.4

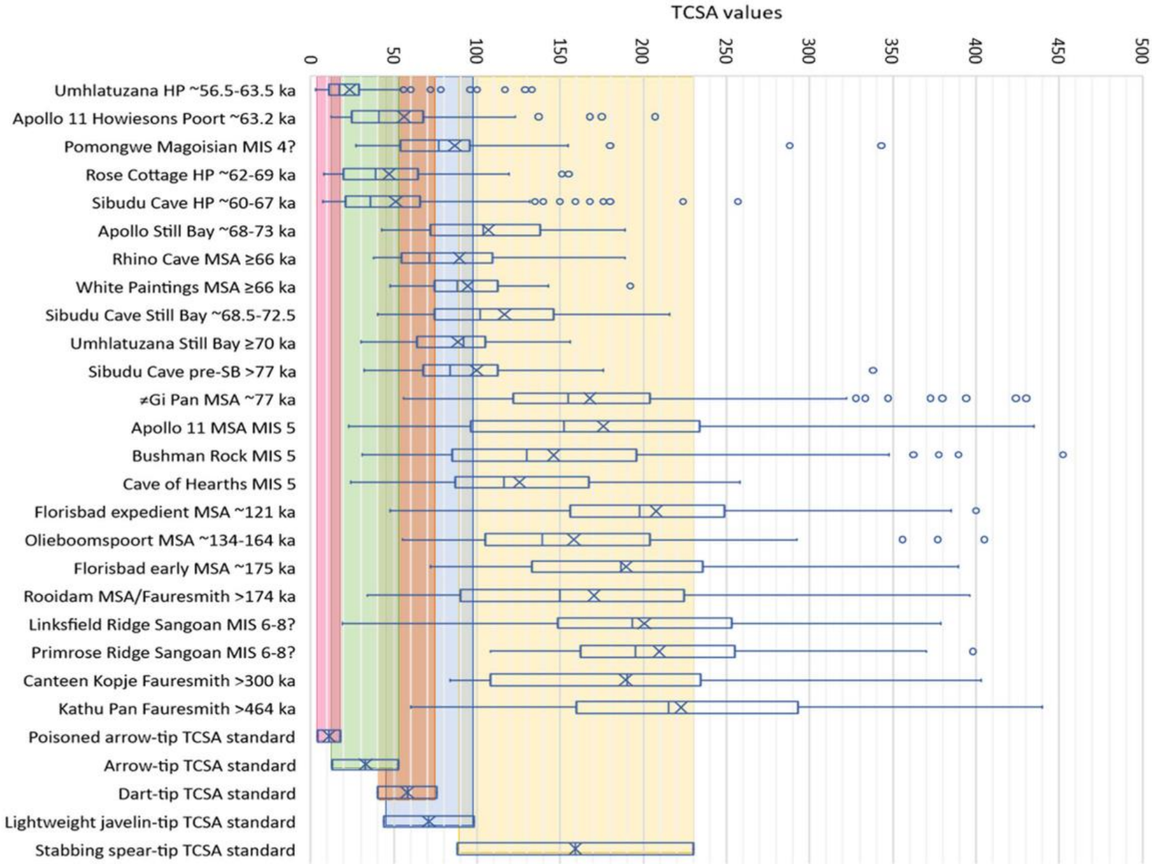

Figure 4. Bar and whisker plots of the TCSA values for points from inland (Nama Karoo, Grassland Biome, Savanna Biome and the Kalahari Desert/Basin) sites in southern Africa, with assemblages dating from roughly 60 ka to almost 500 ka.

The median TCSA value (indicating the main weapon-tip trend) for the points from ≠Gi groups with other MIS 5 point assemblages falling in the thrusting/stabbing spear-tip range such as those from Apollo 11, Bushman Rock Shelter and Cave of Hearths (Table 3, Fig. 4). These assemblages are different from the Still Bay/pre-Still Bay group of MIS 5 assemblages wherein two (Umhlatuzana Rock Shelter [Still Bay] and Sibudu Cave [pre-Still Bay]) have medians in the lightweight javelin-tip range and the other all have relatively large proportions (34.2-54.3%) of their points suitable for tipping lightweight javelins. The possible use of spearthrower-dart tips is also highest in the Still Bay/pre-Still Bay assemblages (25.6-43.8%), but never reach levels to indicate that it was the preferred weapon-tip type. The ≠Gi point assemblage has the lowest proportion (3.6%) of possible dart-tip use (according to the northern American standard) amongst all the MIS 5 assemblages.

In contrast to the MIS 5 assemblages, none of the younger MIS 4 assemblages have median TCSA values that are consistent with the preferred use of thrusting/stabbing spears, instead, there is a clear trend towards hunting with stone-tipped arrows, especially in the Howiesons Poort assemblages (56-62.9%) that also indicate the use of poisoned arrow tips at Umhlatuzana Rock Shelter (45.3%), Rose Cottage Cave (20.2%) and Sibudu Cave (18.3%). Lightweight javelin-tips dominate the Rhino Cave (61.5%) and Pomongwe Rock Shelter (59.7%) assemblages. At White Paintings Shelter the production of points falling into either the lightweight javelin or thrusting/stabbing spear categories were equally practiced (58.6% for both). The possibility of hunting with spearthrowers-and-darts during MIS 4 ranges from 7.3% at Umhlatuzana Rock Shelter to 50% at Rhino Cave, but is never the dominant category (Table 3, Fig. 4). Collectively, the MIS 4 assemblages demonstrate a clear shift away from hunting with thrusting/stabbing spears to using long-range weapons.

The ≠Gi points also group well with the older assemblages where thrusting/stabbing spear tips were the preferred category (Fig. 4). Three of the seven older assemblages (Florisbad, Rooidam 2 and Kathu Pan) were excavated from open pan-scape sites. It is reasonable to suggest that these localities were similarly attractive to deep-time Stone Age hunters as land-use hubs and for ambush hunting as ≠Gi Pan is still today – what we do not know is whether deep-time hunters ambushed from hunting blinds as they did during the Later Stone Age. Although the MIS 5 sites of Apollo 11, Bushman Rock Shelter and Cave of Hearths, as well as the ≥MIS 6 sites of Olieboomspoort, Linksfield Ridge, Primrose Ridge, and Canteen Kopje are not pan-scape sites, they are all positioned in locations conducive of ambush hunting (Lombard et al. 2021b), with some or all of the following traits:

- Topographic barriers such as river gorges and fault scarps with safe, high-lying lookout points for surveying animal herd movements.
- Predictable drinking points with water-logged soils that limit herd response time and mobility.
- The presence of suitable knapping material for artefact production.
- Diverse mountainous biotopes with rugged topography juxtaposed between extensive grazing plateaus that facilitate the congregation of large animal herds.

And it may be noteworthy that all their point assemblages have TCSA ranges consistent with a preference for hunting with thrusting/stabbing spears.

4. Discussion

Harvesting ambush-trapped animals probably represents the oldest context in which hominins started to actively kill their prey with weapons (Bunn & Gurtov 2014). Direct evidence for lake-edge horse ambush hunting with wooden spears was excavated at Schöningen, Germany, dated to ~300 ka (Thieme 1997). In southern Africa, ambush hunting or harvesting during the Acheulean is suggested for the spring wetland at Elandsfontein (Bunn 2019), and the natural ambush funnel at Wonderboompoort (Lombard et al. 2021b). These sites may date to ~0.5-1 Ma, and neither has yet been associated with hunting weapons, so that it is uncertain whether people actively hunted or simply harvested animals from the ambush scenarios (Lombard et al. 2021b). The large lithic assemblage from Kathu Pan possibly dating to ≥464 ka, however, contains pointed artefacts with impact fractures that are consistent with some of them having been hafted and used for hunting (Wilkins et al. 2012). Similar evidence was observed on point assemblages from Blombos Cave dating to 73-99 ka (Lombard 2007), Sibudu Cave dating to ~52-72 ka (Lombard 2005a, 2006), and White Paintings Shelter dating to ≥66 ka (Donahue et al. 2004), so that it is now widely accepted that pointed stone tools and/or convergent flakes were used for hunting in southern Africa – amongst other things.

At the time that Kuman (1989) conducted her study, there was no such evidence and researchers such as Klein (e.g., 1979) still thought that 'active hunting' only occurred after a sudden genetic mutation by ~40 ka. When Shea (1988, 1990) identified impact wear on points from the Levantine Mousterian dating back to ~60 ka, it was seen as controversial because similar evidence was thought to be lacking in European assemblages (e.g., see discussion in Shea et al. 2002). Some Euro-centric researchers remain sceptical (e.g., Rots & Plisson 2014), despite the now prodigious evidence for stone-tipped weapon use during the MSA in southern Africa, and despite themselves using similar approaches to argue for the use of stone-tipped hunting weapons during the European Upper Palaeolithic (e.g., Tomasso & Rots 2021). As things stand, the onus is on those who still doubt that MSA hunters used stone-tipped weapons to explain the hunting strategies responsible for the often-sizeable faunal assemblages associated with these artefacts (e.g., Steele & Klein 2013; Reynard & Henshilwood 2017; Hutson 2018; Clark JL 2019).

Whilst Kuman attempted a rudimentary approach to use-wear, she did not follow a protocol designed to recognise hunting use specifically, and several of the approaches for doing so were only refined after her study of the ≠Gi assemblage. Her working hypothesis that the retouched points were dependable multi-purpose tools may be accurate. For example, Lombard (2006) found that Still Bay points from South Africa dating to a similar timeframe may have been hafted and used as both knives and spear tips. Use-trace evidence for variable functionality does not distract from discussing MSA weapon-assisted hunting strategies.

Almost 20 years after Kuman's analysis, the Brooks et al. (2006) study had much more research to draw from in terms of MSA hunting. Yet, different from other groups working on an assortment of hunting-weapon questions at the time (e,g., Hutchings & Bruchert 1997; Shea et al. 2001, 2002; Schmitt et al. 2003; Lombard 2004, 2005a, b; Shea 2006; Whittaker & Kamp 2006), they never conducted experiments or systematic use-trace work. Instead, although their inference about spearthrower-and-dart hunting at ≠Gi was based on Thomas's (1978) ethnographic data for northern American stone-tipped arrows and spearthrower darts, they did not present his data in direct relation to their results.

At the bottom of Table 1 we present a summary of these data, demonstrating how the Brooks et al. (2006) data for the points from ≠Gi compare to that of Thomas (1978). This direct comparison reveals that both data sets presented by Brooks et al. (2006) for the points from ≠Gi (Table 1) is markedly different from Thomas' arrows or darts in terms of width, thickness and mass, so that the basis for their interpretation is unclear. For example, although they claim that weight may be the most important attribute in the development of a projectile technology, the mean mass they report for the ≠Gi points is either 50.1±43.9 g or 11.8±7.2 g, whereas Thomas' (1978) are 2.1±0.3 g for arrows and 4.4±2.1 g for darts. Thus, even if the smaller weight range for ≠Gi is the correct one (our weight for 359 points = 12.1±7.4 g [SOM File 1]), they are still considerably heavier than the ethnographic dart tips from northern America. Thomas (1978) also warned about low confidence levels for his spearthrower-dart standard because the data come from only 10 artefacts.

The perception that the points from ≠Gi are relatively small compared to Middle Palaeolithic points from Europe (Brooks et al. 2006), may come from the fact that they are fairly short. For example, Still Bay points from four sites (Apollo 11, Hollow Rock Shelter, Sibudu Cave and Umhlatuzana Rock Shelter) in southern Africa have mean lengths of ~47-65 mm whereas the mean length of our sample from ≠Gi is ~41 mm. The ≠Gi points are, however, relatively wide (~31 mm) and thick (~11 mm) compared to the four Still Bay assemblages ranging from 20-29 mm in width and 8-11 mm in thickness. This could reflect Kuman's (1989) observation that many of the ≠Gi points may have been re-sharpened in their shafts or hafts, so that their original length and mass is perhaps obscured.

Returning to their possible use as dart tips, Lombard (2021) highlighted some issues regarding the current TCSA standard for dart tips, and the TCSA value of 132 hafted Leilira points analysed by Newman and Moore (2013) from the South Australian Museum is ~290, so that they fall outside the conventional TCSA values for the different weapon-delivery systems (Table 2). According to Newman and Moore (2013), it demonstrates that indigenous Australians did not optimise the ballistically-relevant attributes of their darts (also see Clarkson 2016). It is therefore likely that the TCSA method (in its current format) is ineffective for distinguishing darts tips from other weapon-delivery systems, whilst being robust for hypothesising about arrows, lightweight javelins, and stabbing/thrusting spears in the sub-Saharan African context. In our results section (Table 3) we included a >230 TCSA category. In the Australian context, this may relate to dart tips for specific prey types such as emus and kangaroos (e.g., Trigger 1987). Leilira points were, however, mostly used as resin-hafted ceremonial knives or fighting picks (Akerman 2007), so that expectations of them conforming to a ballistically relevant TCSA standard in a generalised sense may be skewed.

As indicated above, morphometric studies do not have the power to determine use 'blindly', instead, interpretations must be anchored contextually to be robust (Lombard & Shea 2021). This also applies to morphometric studies that suggest the use of spearthrowers in sub-Saharan Africa during the MSA (e.g., Brooks et al. 2006; Sisk & Shea 2011; Sahle & Brooks 2019). Thus far, there is no ethno-historical, experimental, or convincing use-trace backup for the use of spearthrower-propelled darts – neither in their small northern American form, nor in their large Australian shape. It is our stance that much more experimental and use-trace work is needed to resolve the dart-tip TCSA category.

The use of javelins and spears is, however, habitual amongst hunter-gatherers from sub-Saharan Africa – and their TCSA categories for the African context relatively robust (Lombard 2021). It is therefore necessary to have controls for these weapon types when hypothesising about Stone Age weapon-assisted hunting strategies. Our TCSA results suggest that, similar to other Middle and Earlier Stone Age ambush sites, the MSA hunters at ≠Gi preferred to kill their prey animals with relatively sturdy thrusting/stabbing spears, which could perhaps be thrown over short distances – not much different from what hunters still sometimes do at the site. Some (12%) of the points would have been most suitable for tipping lightweight javelins. The proportions of artefacts that can be ballistically associated with long-range, mechanically projected weaponry such as northern American spearthrowers with darts or bows with arrows (3.6% and 0% respectively) are too small to indicate their habitual use at the site during the MSA. At other sites with point assemblages that are roughly contemporaneous with the MSA occupation at ≠Gi, hunters seem to have used lightweight javelins together with thrusting/stabbing spears. Such a variable strategy would have brought adaptive advantages such as a broader range of prey animals, killing prey with less risk of injury, and increased potential for opportunistic hunting on a more diverse hunting landscape.

The trend at ≠Gi, however, seems to have been a general preference for using the tried-and-trusted thrusting/stabbing spears (sometimes perhaps flung from a short distance), appropriate for hunting herd animals congregated at the water's edge, as demonstrated by the horses hunted at Schöningen. The zebras and blue wildebeest in the faunal assemblage of ≠Gi would support such a hypothesis, as does the presence of warthog, giraffe and extinct giant buffalo remains. Based on the TCSA results we presented in this study, those looking for the possible use of spearthrower darts (similar to their northern American counterparts) during the southern African MSA may fare better by looking at Still Bay and Howiesons Poort assemblages. Yet, also in those assemblages, points conforming to the current TCSA range associated with either small northern American or large Australian dart tips never dominate. Until experimental, use-trace and faunal evidence can corroborate the use of spearthrowers for the southern African context it remains an unsubstantiated hypothesis (Lombard & Shea 2021).

5. In conclusion

To further assess MSA hunting hypotheses for the ≠Gi pan-scape, we need to return to the assemblage. First, we need to identify all the points and point fragments in the assemblage of both retouched and Levallois-type points that may not be included in this study. For example, Daniel measured 359 points, and Kuman 324, yet Kuman (1989) indicated that 597 points and a further 78 broken point tips were present in the assemblage, and she did not consider the presence of unretouched Levallois points (Kuman pers. comm. March 2021). Secondly, a formal macro-fracture analysis should be able to confirm whether some of the points from ≠Gi were indeed used for hunting. However, if the excavators did not use fine-meshed sieves to curate all the small tips of broken points, such an analysis cannot be thorough or directly comparable with the results of other studies that included all the fragments and tips in an assemblage (e.g., Lombard 2005b, 2007). Robust hunting interpretations – or the lack of hunting – cannot be based on casual fracture observations made on assemblages of unbroken points (as done by Douze et al. [2020], self-citing a paper [Douze et al. 2015] that does not include any reference to a formal micro-fracture study). The depositional and curational history of the MSA artefacts from ≠Gi may also prevent micro-wear and micro-residue studies from being fruitful, for example, several of the points have depositional concretions (Fig. 2), but possibilities for such studies will be evaluated when/if access to the assemblage is granted.

To explore possible variability in hunting strategies practiced at ≠Gi Pan during the MSA, we also need to better understand the proportion of points with TCSA values >230. In the current ≠Gi assemblage this constitutes almost 14% of all the points represented in this study and 40.4% of the Kathu Pan points. If these large points were used to tip hunting weapons, they are currently not covered by TCSA weapon-tip ranges – apart from perhaps representing large Australian Leilira-tipped darts. Although not impossible, we are not about to suggest that southern African *Homo erectus* hunters used spearthrowers at Kathu Pan by ~500 ka. On the other hand, the thick wooden spears from Schöningen seem to have been most comfortable and effective to use in bimanual thrusting (underarm and overarm) as opposed to one-handed stabbing (Milks 2018). Bimanual thrusting-spear use was suggested by Schmitt et al. (2003) as consistent with anatomical features observed in the Neandertal anatomy – as opposed to the 'throwing' arms and shoulders of later *Homo sapiens* (e.g., Roach et al. 2013). It could, however, also indicate different weapons used for different purposes, or during different phases in an ambush hunt.

Future experimental research needs to explore variation in dart-tip categories, and the parameters of bimanual thrusting *vs* single-handed stabbing spears in more detail. The current TCSA standard for thrusting/stabbing spears was derived from experiments using a calibrated crossbow (Shea 2006) and one-handed stabbing spears as used by some African warriors (Lombard 2021). Continued experimentation and locating ethno-historical weapons that were used mainly for bimanual thrusting may, however, provide a new TCSA baseline to distinguish between tips suited better for one-handed stabbing spears *vs* those best suited for bimanual thrusting. Similarly, continued work on dart-tip variation may confirm two distinct categories as was proposed by Cattelain (1997), namely large terrestrial spearthrowers most effective for Bov II (sheep size) and larger animals, and small Arctic spearthrowers to hunt marine mammals and birds. Whether either of these were ever used in a southern African context such as on the ≠Gi pan-scape remains to be established.

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Supplementary online material
Lombard & Churchill Supplementary Online Material File 1

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A BIOARCHAEOLOGICAL ANALYSIS OF SKELETAL REMAINS FROM VAN ZYL'S FARM, CLARENS, FREE STATE, SOUTH AFRICA

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ABSTRACT
In 1933, several skeletons were recovered from Van Zyl's farm near Clarens in the Free State Province of South Africa. Apart from the general location from which these remains were recovered, very little was known about these individuals' temporal and cultural contexts. This study aimed to analyse and describe these skeletons and any possible associated historical and archaeological records to reconstruct aspects of their archaeological context and lifestyle. Most of the remains were commingled, and from these, a minimum number of individuals (MNI) of 11 was established. There was one complete and intact individual, which raised the sample size to 12 individuals. The assemblage comprised three juveniles (<5 years) and nine adults (between the ages of 20 and 45, and 50+ years), of which six were estimated to be males and three females. The complete individual, an older adult male, was radiocarbon dated to 844±35 BP (Ua-61831). Several individuals had osteoarthritis and signs of non-specific and dental disease. One of the younger adult female individuals had culturally modified upper central incisors. Stable $\delta^{13}C$ and $\delta^{15}N$ values indicated a predominantly C4 terrestrial plant-based diet, with little reliance on animal-derived protein. The only complete male individual was of interest due to his unique biological characteristics, being very tall and morphologically robust and clearly not of Khoe-San ancestry. The date obtained for the complete individual is unusual as it is generally thought that Bantu-speaking farmers only reached the interior Drakensberg and Maluti regions much later.

Keywords: bioarchaeology, Late Iron Age, farming communities, skeletal analysis, collections-based research

1. Introduction

One of the goals of bioarchaeology is to interpret remains within their associated archaeological context, taking into consideration the influences of culture and the ability of societies to adapt to their environments (Zuckerman & Armelagos 2011; Larsen 2018). Unfortunately, the way in which many sites and skeletons were excavated in the past has led to the irretrievable loss of much information with very limited means to place them into a proper context. These past practices resulted in there now being many skeletal assemblages housed in various collections in South Africa of which little is known. This is also the case with remains recovered from the Clarens region in 1933, which are now housed in the Raymond A. Dart Archaeological Human Remains Collection (School of Anatomical Sciences, University of the Witwatersrand).

The only information available on the origins of the remains found near Clarens were a few entries in old, archived catalogues, which indicated that the remains were discovered on Van Zyl's farm by a Mrs E.M. Wells in 1933. According to the catalogues, the remains were thought to have been associated with the Stone Age. Unfortunately, there is no other information pertaining to these skeletons and their archaeological context is largely unknown.

All human remains are valuable as much information can be gained from them, even if they are incomplete and not well-documented. On an ethical level, the reconstruction of lost contexts is a necessary step towards rehumanising remains and is essential to the effective long-term management of such remains in collections. This is true for multiple excavations that occurred during the early 20th century from the Drakensberg region of South Africa (e.g., Steyn et al. 2019; Meyer et al. 2021) and other areas (e.g., Meyer et al. 2013; Meyer & Steyn 2016; Steyn & Meyer 2020). These excavations had little to no documentation of the graves or their context; however, information gained from skeletal analysis, radiocarbon dating and ancient DNA (aDNA) analysis provided insight to past lifestyles and population movements, subsequently proving useful in reconstructing aspects of the southern African Iron Age archaeological sequence. While highly specialised analyses such as aDNA assessment provide immensely valuable insights into southern Africa's past, these studies cannot stand on their own or be interpreted without knowledge of the individuals themselves and the landscapes they were occupying (Morris 2017). Assessment of the remains themselves, within their context, remains the mainstay of bioarchaeology.

This study aimed to analyse and describe the skeletons from the Clarens region of South Africa, currently housed in the Raymond A. Dart Archaeological Human Remains Collection, including any available associated artefacts. Using standard bioarchaeological methods, we attempted to gain a better understanding of the context of the remains and the lifestyles of the communities they represent. Following several avenues, attempts were also made to establish the remains' original location.

2. Materials and methods

Other than for the one intact and complete individual, the remains were in a commingled state and therefore required sorting and the establishment of a minimum number of individuals (MNI). The techniques set out by Adams and Byrd (2006) and L'Abbé (2005a) were used to determine the MNI, with some adaptations related specifically to this sample given the extreme extent of commingling. These methods require a stepwise, methodological assessment of commingled remains using visual pair matching, articulation, and a process of elimination.

Before these techniques could be applied each skeletal element was grouped, sided, counted and where possible the bones were measured (Buikstra & Ubelaker 1994). Standard osteological measurements (Langley et al. 2016) were used as an additional means of attempting to match paired bones. A code was given to each bone, which represents the left (L) and right (R) sides, as well as a number.

Once this was completed, visual pair matching was performed. This entailed the matching of the left and right sides of the same skeletal element using morphological (size and shape) similarities. For the sake of consistency and standardisation it was decided that skeletal elements with similar measurements, within 2 mm, were assigned as possibly belonging to the same individual. Visual pair matching also included the analysis of the bones for age and sex. Elements could be excluded in cases where the age ranges or sex did not correspond.

Articulation was used to match different skeletal elements of the major joints, but it could not be used to match the vertebrae and ribs, for example. The procedure involved the articulation of two bony elements to create the best fit of a joint. If the bones articulated poorly with each other they were excluded from being part of the same individual (L'Abbé 2005a). If there were bones that remained, a process of elimination was used that designated any repeated skeletal elements on either side to a separate individual. Other factors such as pathology and taphonomy of the remains were also considered in the sorting process.

Age in juvenile remains was assessed using the epiphyseal and sutural fusion of the cranial and postcranial skeleton (Schaefer et al. 2009) as no teeth were recovered. The maximum lengths of the long bones were also measured (in mm) (Schaefer et al. 2009) and compared to the ages provided by Scheuer and Black (2000) and Stull et al. (2014). Age estimation of adults was based on the assessment of degenerative changes following complete epiphyseal union. Techniques used include morphological changes observable on the sternal ends of ribs (Oettlé & Steyn 2000), the pubic symphyseal face (Brooks & Suchey 1990), and a general assessment of degenerative changes such as osteophytic lipping on the major joints and osteophyte formation on the vertebral bodies.

Both metric and morphological characteristics of the skull and pelvis were used to estimate sex in adult individuals (Phenice 1969; Buikstra & Ubelaker 1994; Walker 2008; Klales et al. 2012; İşcan & Steyn 2013; Krüger et al. 2015). As some of the commingled remains could not be assigned to a particular pelvis or skull with certainty, other methods were used. In these cases, the sex was estimated using single long bone dimensions such as the humeral and/or femoral head diameter, femoral distal breadth and humeral epicondylar breadth (Steyn & İşcan 1997, 1999).

To gain more information on the possible origin of the individuals, measurements from the crania were used to conduct a FORDISC 3.2 analysis (Ousley & Jantz 2012). Only measurements that could be recorded with standard spreading and sliding callipers were included. This, of course, can only be a broad estimate as there are limited comparative samples available in the FORDISC database. Howells (1973) measurements of historic African populations were used from the database and included the Teita (representing East African groups), Dogon (representing West African groups), Bushman (Khoe-San) and a modern Zulu group (representing South African groups), following his terminology. Stature could only be estimated for the one complete individual. This was done using the Lundy and Feldesman (1987) formulae with soft tissue correction factors developed by Raxter et al. (2006).

All skeletons were observed for signs of disease and trauma (Aufderheide & Rodríguez-Martin 1998; Ortner 2003). Remains were assessed for non-specific signs of disease, infectious diseases, degenerative lesions, and trauma. The analysis of dentition included documenting the presence of occlusal surface wear, scoring dental caries, abscesses, periodontal disease, antemortem tooth loss, and dental calculus (Lukacs 1989; Goodman & Rose 1990; Langsjoen 1998; Ortner 2003). Teeth were also observed for enamel defects such as hypoplasia and possible dental modifications. Caries frequency in the Van Zyl's remains was compared to those of Oakhurst (Patrick 1989), K2/Mapungubwe (Steyn 1994), Riet Rivier (Morris 1992) and Soutpansberg (L'Abbé 2005b) remains, using Fisher's exact tests. The Oakhurst sample represents a Stone Age hunter-gatherer society and the K2/Mapungubwe sample an Iron Age agriculturalist society, whereas the other two are from historic and more recent communities.

A tooth sample from one of the individuals, A4237, was radiocarbon dated using accelerator mass spectrometry (AMS) at the Tandem Laboratory, Department of Physics and Astronomy, Uppsala University, Sweden (SAHRA Permit ID: 2789). Isotopic data were also obtained from this laboratory.

Several avenues were followed to find more information about the Van Zyl site, which included a detailed internet search of the archaeological history of Clarens and the potential sites in the area, as well as an archival search of documents housed within the School of Anatomical Sciences.

3. Results

The results from sorting the commingled remains yielded an MNI of 11 individuals (Table 1), based on the most common element – in this case, right femora. The assemblage also included 10 crania. This brings the total sample to 12 when the one complete individual (A4237/A4231) is added. The complete individual has two catalogue/box numbers as the one was assigned to the skull (A4231), and the other to the post-cranial remains (A4327). The commingled remains and complete individual were all accessioned into the collection together and there is no reason to suspect that they may be from different assemblages. No taphonomic differences, such as differences in colour or preservation, were noted.

The assemblage included a minimum of three juveniles below the age of five years (Table 2). The remaining nine individuals (including the complete individual) were adults (Tables 2 and 3) based on complete epiphyseal fusion. A4237 (the complete individual) was estimated to be older than 50 years based on the morphological features visible on the sternal rib ends (presenting as phase 7; 52 to 69 years) and pubic symphyses (phase 5; 27 to 66 years). His age estimate was supported by the presence of osteophytes on almost all the vertebrae and extensive osteophytic lipping of all the major joints.

Table 1. Skeletal elements present, excluding the complete individual, with the total number of bones indicated for the vertebrae. Minimum number of individuals (MNI) represented are indicated in brackets.

Skeletal elements	Left	Right	MNI
Skull	10		10
Vertebra	36		3
Sacrum	3		3
Sternum	3		3
Ribs	36 (2)	32 (4)	4
Clavicle	5	4	5
Scapula	5	4	5
Humerus	9	7	9
Ulna	4	4	4
Radius	7	5	7
Pelvis	6	4	6
Femur	7	11	11
Tibia	7	7	7
Fibula	6	5	6
Patella	0	2	2
Calcaneus	4	2	2
Talus	4	4	4
Carpals	0	0	0
Tarsals	2	4	4
Metacarpals	13	8	N/A
Metatarsals	11	4	N/A
Phalanges	10	8	N/A

Table 2. Age and sex estimations of commingled post-cranial remains. The skeletal regions on which the estimations were based are also shown.

Age	**Juveniles**	**Adult**
Total individuals (years)	3 (<5 years)	8 (>20 years)
Sex	**Male**	**Female**
Pelves	5	2
Humeri	4	0
Femora	2	3
Total	**5**	**3**

Sex estimation was only attempted for the adult remains, the results of which indicated that six individuals were male (including A4237) and three were females. Sex could not be estimated for the remaining adult individuals due to the incomplete nature of their remains. A summary of the age and sex of all individuals is shown in Tables 2 and 3. Cranial measurements that were possible are shown in Table 4.

Table 3. Summary of individual age, sex, and stature for the crania and complete individual.

Catalogue no.	Age (years)	Sex
A4326	2-5	-
A4238	25-45	Male
A4239	50+	-
A4240	20-45	Female
A4241	50+	Male
A4242	-	Female
A4243	50+	Female
A4244	50+	-
A4245	<5	-
A4246	50+	-
A4237	50+	Male

Relatively few signs of disease were observed in the commingled remains and none of the individuals had evidence of cribra orbitalia, porotic hyperostosis or enamel hypoplasia. The most common change was bony lipping on a variety of elements such as the calcanei, femoral and humeral heads, the glenoid cavity, an olecranon process, the femoral condyles and a proximal tibia. The commingled vertebrae had evidence of osteophytic lipping. These are all changes that could be expected in older individuals. A femur and two tibiae had evidence of non-specific subperiosteal bone deposition. One of the tibiae presented with myositis ossificans, which is a bony outgrowth commonly associated with overlying soft tissue trauma.

Table 4. Cranial measurements in mm (Howells 1973).

Measurement	Abbreviation	A4237 (male)	A4240 (female)	A4238 (male)	A4241 (male)
Glabello-Occipital Length	GOL	200	186	182	188
Nasio-Occipital Length	NOL	197	184	178	187
Basion-Nasion Length	BNL	112	103	104	106
Basion-Bregma Height	BBH	145	138	136	145
Maximum Cranial Breadth	XCB	133	127	132	-
Maximum Frontal Breadth	XFB	117	110	115	123
Bistephanic Breadth	STB	114	103	100	120
Bizygomatic Breadth	ZYB	144	-	128	146
Biauricular Breadth	AUB	126	115	118	127
Minimum Cranial Breadth	WCB	73	66	69	77
Biasterionic Breadth	ASB	114	110	105	117
Basion-Prosthion Length	BPL	109	96	103	101
Nasion-Prosthion Height	NPH	69	71	75	74
Nasal Height	NLH	52	47	55	54
Orbit Height	OBH	33	34	36	38
Orbit Breadth	OBB	41	38	40	41
Nasal Breadth	NLB	31	27	29	31
Palate Breadth	MAB	67	62	63	65
Mastoid Height	MDH	31	28	29	31
Mastoid Width	MDB	19	14	18	23
Bimaxillary Breadth	ZMB	101	82	91	94
Bifrontal Breadth	FMB	111	95	102	107
Biorbital Breadth	EKB	110	95	101	107
Interorbital Breadth	DKB	36	24	26	28
Simotic Chord	WNB	19	8	9	11
Malar Length Inferior	IML	41	-	41	41
Cheek Height	WMH	26	21	24	27
Foramen Magnum Length	FOL	38	36	40	40
Nasion-Bregma Chord	FRC	115	113	114	119
Bregma-Lambda Chord	PAC	126	117	104	125
Lambda-Opisthion Chord	OCC	101	94	93	98

Individual A4237 (Figs 1 & 2) was of particular interest, as this was the only complete/non-commingled skeleton. This individual was an older male who was quite robust with prominent muscle attachments. He was estimated to have been 181.7±2.371 cm tall. Non-specific subperiosteal bone deposition, possibly indicative of chronic disease and/or malnutrition, was observed on both femora and tibiae. The individual suffered from osteoarthritis, as evidenced by prominent osteophytic lipping in several skeletal regions as well as eburnation on both tibiae and the right femur. This individual had a healed fracture on the right ulna (Fig. 3), which is also referred to as a parry fracture as it is often observed in cases of interpersonal violence when an arm is raised in self-defence (Ortner 2003); it can also be associated with a fall. An anatomical anomaly or variation was observed in the form of a right first rib which had fused to the manubrium of the sternum.

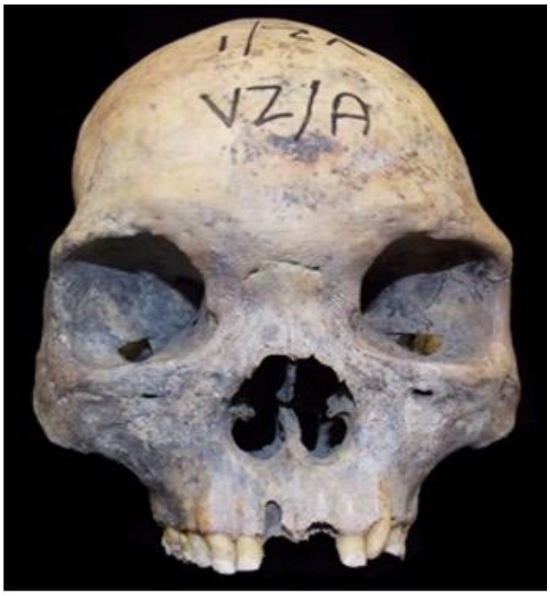

Figure 1. Anterior view of cranium A4237.

Figure 2. Left lateral view of cranium A4237.

Figure 3. Healed fracture of the right ulna of A4231/A4237.

A summary of the dental pathology in adult individuals (permanent teeth only) is shown in Table 5. Four individuals had evidence of antemortem tooth loss. Dental calculus was observed in three individuals, as were periapical abscesses. Most of the abscesses were not associated with dental caries except for one on a tooth of A4237. A4237 was the only individual with carious lesions but only one abscess was associated with a carious lesion (maxillary M1) (Fig. 4). This individual had particularly extensive dental wear of all the teeth that were present, and the carious lesions observed most probably followed after the dentine or pulp was exposed. The exposure of dentine leaves the tooth susceptible to further infection which could account for the carious lesions (Hillson 2008; Molnar 2011). The wear was at an angle and large patches of dentin had been exposed especially on the posterior teeth.

Table 5. Summary of dental pathology in adult individuals, indicating the number of teeth affected per individual.

Catalogue no.	Periodontitis	Caries	Calculus	Antemortem tooth loss	Enamel hypoplasia	Periapical abscesses
A4238	Present	-	-	4	-	3
A4239	Present	-	-	-	-	-
A4240	Present	-	Present	2	-	-
A4241	Present	-	Present	-	-	-
A4244	Present	-	-	-	-	-
A4246	Present	-	-	6	-	1
A4237	Present	3	Present	2	-	5

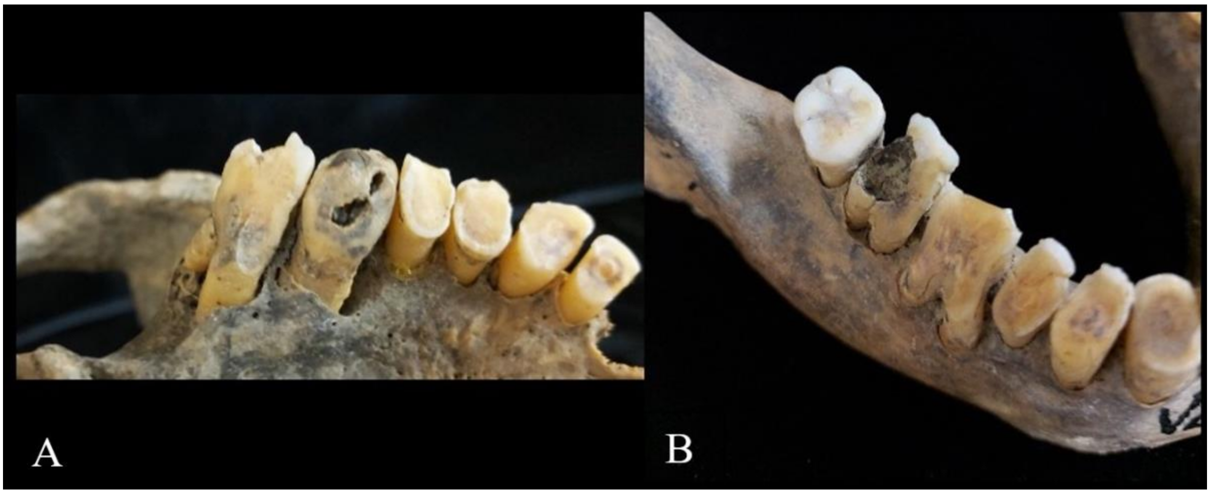

Figure 4. Extensive dental wear and carious lesions were observed on A4237 on the the right maxillary dentition M1 (a) and right mandibular dentition M2 (b).

The sample size from Clarens is quite limited, but nevertheless, an attempt was made to compare the occurrence of caries with those from four other sites (Table 6). Of the five sites, the Van Zyl's farm sample had the lowest caries frequency and intensity. There was only one statistically significant result when comparing the caries frequency, which was that the Clarens sample had a lower caries frequency than the Soutpansberg sample, but this is probably related to sample size. The caries intensity of the Van Zyl's sample is significantly lower than all other samples except for the Riet Rivier sample. This indicates a non-cariogenic diet.

Table 6. Carious lesion comparisons using Fishers Exact tests, with individuals unaffected by caries (n^{un}) and individuals affected by caries (n^{a}) indicated. Caries frequency (Freq.[a]) = total number of individuals (Ind.) affected with caries/total number of individuals in the sample; Caries intensity (Inten.[b]) = total number of teeth affected with caries/total number of teeth in the sample. References and key sites include Oakhurst (Patrick 1989), K2/Mapungubwe (Steyn 1994), Riet Rivier (Morris 1992) and Soutpansberg (L'Abbé 2005b).

Site	n^{un}	n^{a}	Total	No. Unaffected teeth	No. Affected teeth	Total	Freq.[a]	Inten.[b]	X^2 Freq.	X^2 Inten.
Van Zyl	6	1	7	114	2	116	14.3	1.7	-	-
Oakhurst	12	9	21	243	32	275	42.9	17.7	0.3642	0.0007
K2/Mapungubwe	24	23	47	231	68	299	54.5	18.3	0.1167	<0.00001
Riet Rivier	-	-	46.5	1015	46	1061	41.7	4.3	-	0.2216
Soutpansberg	38	59	97	1859	157	2016	60.8	7.8	0.0399	0.0101

One of the females, A4240, presented with dental modification. The two upper central incisors were modified through mesial filing to form a V-shaped gap between the two teeth (Fig. 5).

Figure 5. Dental modification of the upper central incisors of A4240.

Four individuals could be analysed using FORDISC, with measurements as shown in Table 4. Individual A4237, the robust male, aligned to the Teita group with a posterior probability of 79.5%. The graphical output is shown in Figure 6a, which shows that the individual placed far from any centroid and is thus not typical for any of the groups. Individual A4240, the only female analysed, closely corresponded to the modern Zulu group (Fig. 6b) but was not close to any centroid. When the modern Zulu data were taken out of the analysis (Fig. 7), FORDISC could not align this individual with the other population groups. A4238, another male, aligned most closely with the modern Zulu data (Fig. 6c). When the modern Zulu group was taken out and the analysis was run against the other three groups, he then aligned more closely to the Teita data. A4241, another robust male, could not be classified by FORDISC as he was too atypical. Many of the measurements for this individual fell above two standard deviations of the mean. The analyses thus clearly exclude the individuals as being of Khoe-San ancestry and suggest that they are probably unrelated to those groups represented in the FORDISC database.

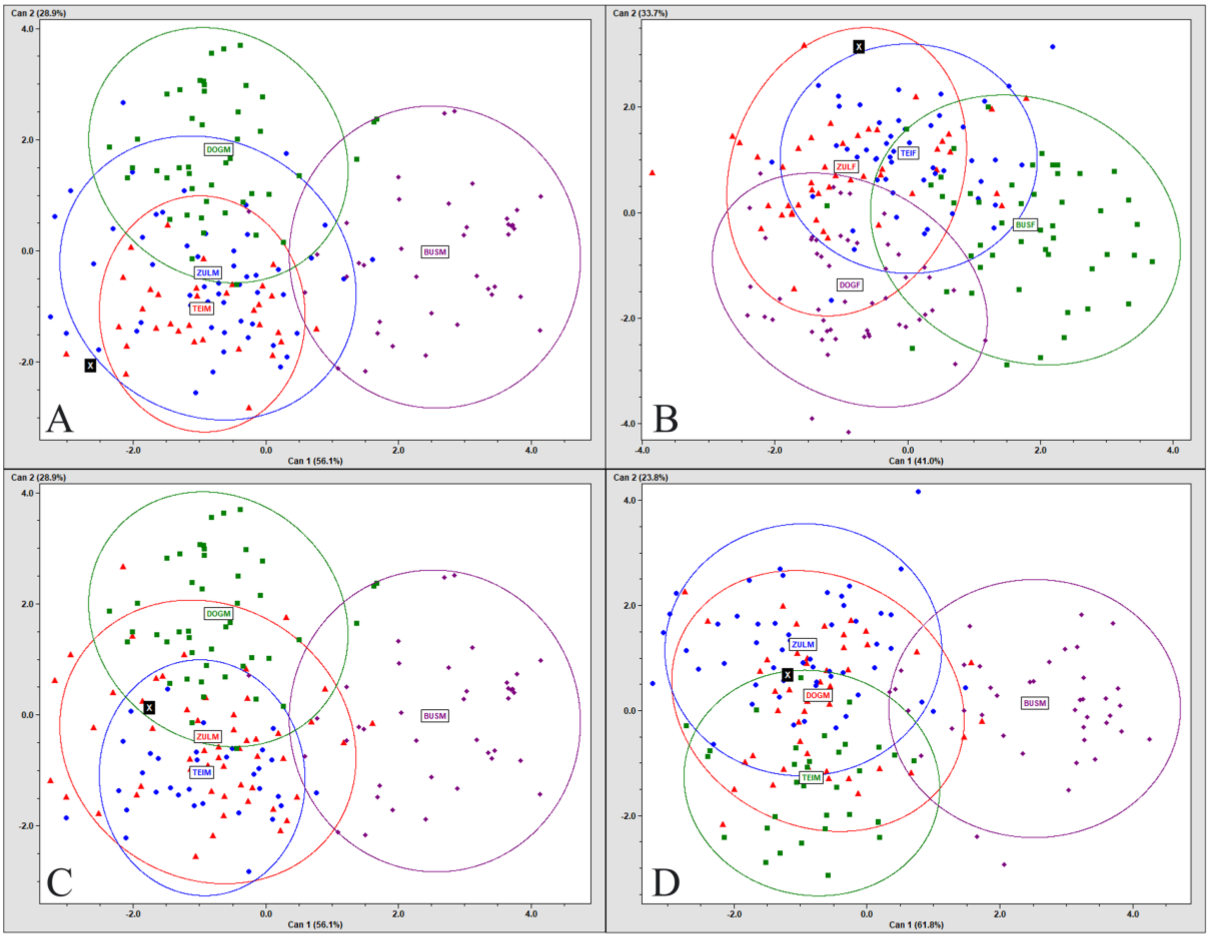

Figure 6. FORDISC output: (a) A4237, (b) A4240, (c) A4238, (d) A4241. The X indicates the individual analysed.

Very few cultural artefacts were associated with the remains, but those that were present included iron and copper spiral-wire bangles (Figs 8 & 9), as well as eight beads (seven red glass and one ostrich eggshell; Fig. 10). Unfortunately, it is not known with which individual these artefacts were recovered and the only information was a note that stated it was collectively found “near grave 2” (it is not stated which remains are referred to as grave 2). There were also four undecorated red burnished ceramic sherds. These sherds are described as being discovered on the surface by Mrs E.M. Wells.

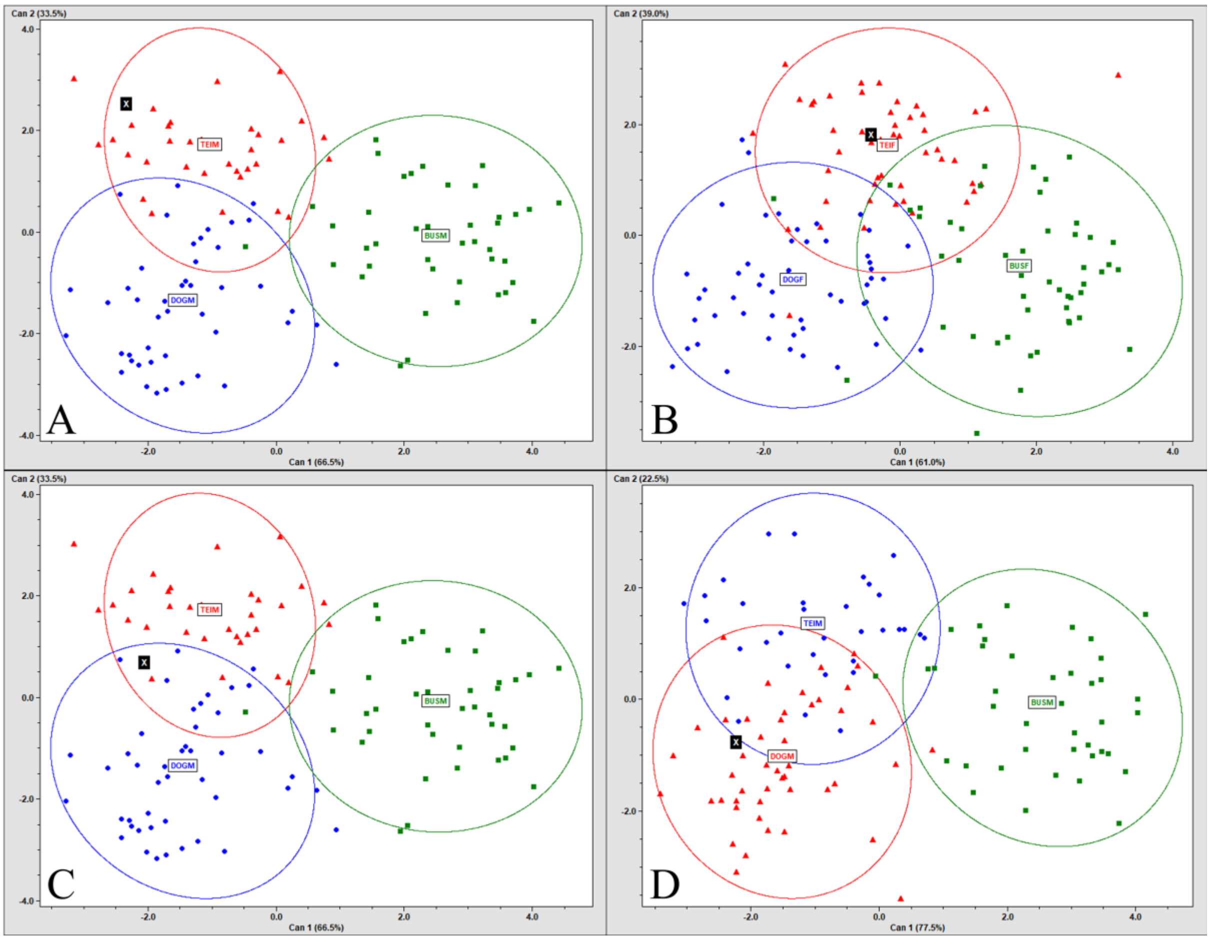

Figure 7. FORDISC output with Zulu data removed: (a) A4237, (b) A4240, (c) A4238, (d) A4241. The X indicates the individual analysed.

Figure 8. Copper spiral-wire bangle found with the assemblage.

Figure 9. Iron bangle fragments found with the assemblage.

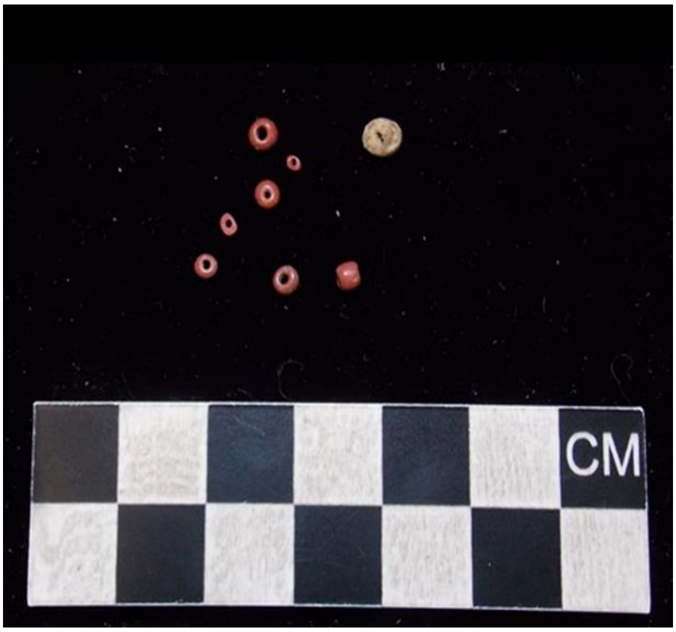

Figure 10. Eight beads, of which seven are red glass and one is ostrich eggshell.

Radiocarbon dating was performed on a bone sample from individual A4237 and provided an estimated date range of AD 1150-1270 (844±35 BP; Ua-61831)[1]. The radiocarbon date places these skeletons into the early part of the Late Iron Age. Additionally, carbon and nitrogen isotopes were also analysed for individual A4237 (Ua-61831). Results indicated a $\delta^{13}C$ value of -8.8‰ Vienna Pee Dee Belemnite (VPDB) and a $\delta^{15}N$ value of 8.3‰ atmospheric nitrogen (AIR), indicating a diet predominantly made up of C4 terrestrial plants, such as sorghum and millet (Ribot et al. 2010; Lightfoot et al. 2015; Meyer et al. 2021).

[1] The radiocarbon measurement presented here was calibrated with OxCal 4.4 (Bronk Ramsey 2009) using the atmospheric curve SHCal20 (Hogg et al. 2020).

Based on archival and published work it seems the Clarens area presented a rich archaeological history that included various sites attributed to the Stone and Iron Ages. Looking specifically at information related to the Van Zyl's farm, the following information could be obtained.

The Van Zyl's were one of the pioneering families of the area and owned large properties, including the Schaapplaats farm which is well-known for its rock art (Woodhouse 1996; Wadley & Laue 2000). Entries in an old handwritten artefact catalogue housed in the School of Anatomical Sciences, University of the Witwatersrand, indicated several small collections of stone implements recovered from sites in the Clarens region. The entries indicated that the stone tools were collected by a Mrs E.M. Wells during the 1930s. Two entries specifically mentioned surface collections of stone implements from Van Zyl's farm and Schaapplaats in 1933. According to Malan (1941), Mrs Wells and Dr L.H. Wells collected stone artefacts from various sites in the Upper Caledon Valley (including Clarens). The Stone Age designation originally assigned to the Van Zyl's skeletal remains is therefore likely related to the stone implement surface collection also recovered from the same farm. However, given that the stone implements were recovered from the surface, a direct association with the skeletal remains cannot be confirmed.

Harper (1997) studied two sites on the Schaapplaats farm, known as the Twin Caves. These caves are situated on a hilltop facing west and overlooking a perennial stream. Harper's excavations only focused on the cave towards the north of the hilltop, which he attributed to a Middle Stone Age assemblage possibly predating Rose Cottage Cave. Even though Harper did not excavate the southern cave, he does mention the presence of Iron Age walling and ceramics within, the latter of which he regarded as originating from the "large Iron Age site in the adjoining cave." (Harper 1997: 96) Additionally, there is another site, near to the Schaapplaats farm, called Adullam that also had Later Stone Age tools as well as evidence of Late Iron Age inhabitants (Wadley & Laue 2000). The University of the Witwatersrand's School of Geography, Archaeology and Environmental Studies were contacted to retrace the artefacts mentioned in the old catalogues housed in the School of Anatomical Sciences. Several entries associated with material recovered from the Clarens region, including specifically Van Zyl's farm and Schaapplaats 1785, were recorded in the School of Geography, Archaeology and Environmental Studies' catalogues (Thembiwe Russel pers. comm. October 2021). Entries contained information related to the material culture or artefacts (e.g., flaked stone and ceramics), the donor's information (in this case "Wells 1933"), a map number, and Global Position Systems (GPS) coordinates. Unfortunately, no direct reference to the skeletal remains was noted in the catalogues. GPS coordinates recorded in the catalogues (28º34'30"S and 28º27'08"E, associated with Schaapplaats 1785 I; 28º34'30"S and 28º27'42"E, associated with Schaapplaats 1785 II; and, 28º34'45"S and 28º25'40"E, associated with Clarens) were assessed using satellite imagery from Google Earth Professional Software (2021) (Figs 11 & 12).

Both sets of coordinates associated with the Schaapplaats farm are situated at the base or foothill (Schaapplaats II) of the surrounding hills. It may be that Schaapplaats I is associated with the Twin Caves site seeing as though it also faces west, but this can only be confirmed with a foot survey. An aerial survey of the immediate surroundings showed no evidence of settlement structures or features associated with historic farming. The area is, however, affected by modern-day farming that may have obscured historic features. The third GPS coordinate associated with a 'Clarens' site is about 2 km west-south-west of Schaapplaats I. This site is not situated on the Schaapplaats 1785 farm, but on Letsoana Stad 347. The site is also situated at the base of a hilltop next to a perennial river. An aerial survey of the immediate area indicated the presence of several features that may represent archaeological cattle enclosures and other settlement features. Much of the area has been affected by modern-day farming, which may have resulted in the destruction of additional features associated with a settlement, such as stonewalling and hut floors.

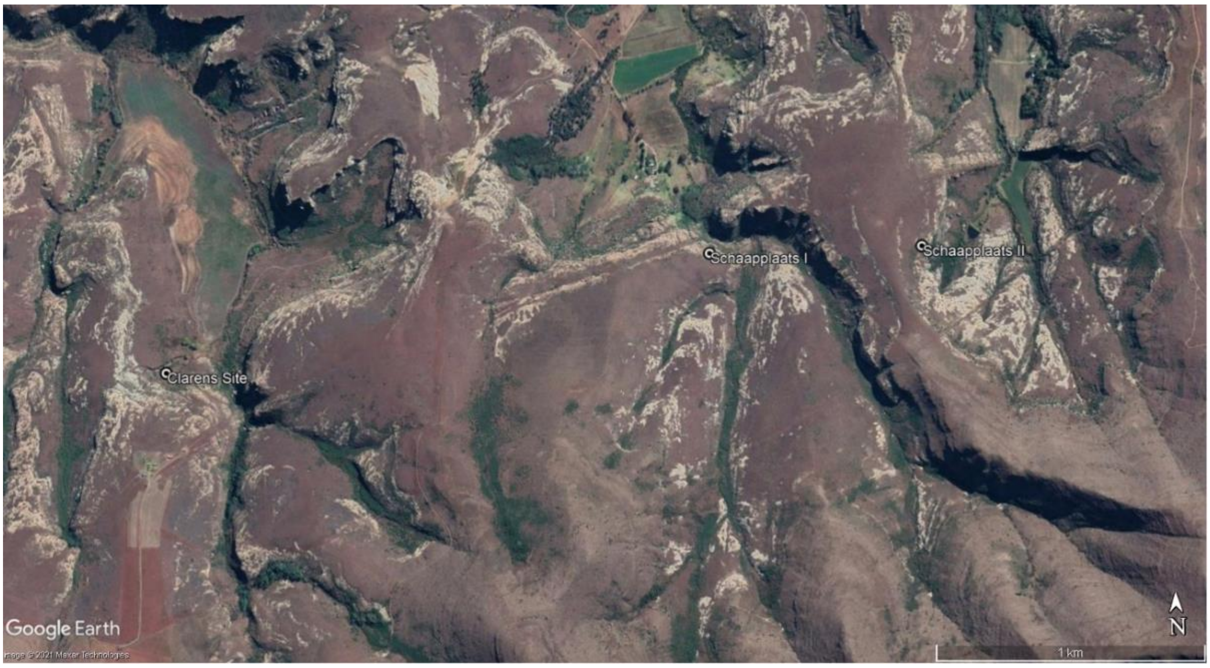

Figure 11. The location of two sites associated with Schaapplaats I and II, as well as a 'Clarens' site to the west. All three sites are located at the base or foothills of the surrounding Maluti mountains (image from Google Earth Professional, date: 2019/6/10, Maxar Technologies satellite).

Figure 12. The Clarens site is situated at the base of the hilltop and next to a perennial river (blue arrow). Several features can be observed (yellow arrows) that may be associated with cattle enclosures and other settlement structures. The area has, however, been affected by modern farming as is evident by the ploughland (red arrow), which may have obscured some of the settlement features (image from Google Earth Professional, date: 2019/6/10, Maxar Technologies satellite).

4. Discussion

The skeletal assemblage represented at least 12 individuals and included children as well as adult males and females. The adults were mostly older individuals, while the three juveniles were all estimated to have been younger than five years of age. In this sense it seems to represent a normal spread of individuals, arguing against selective burial practices. The relatively high number of juveniles (25% of the assemblage) may suggest a high infant mortality rate, but this is difficult to substantiate due to the small sample size.

In the catalogues at the University of the Witwatersrand, these remains are described as dating to the Stone Age, but it is unclear how this was originally established. It may relate to the recovery of stone artefacts throughout the Clarens regions by a Mrs E.M. Wells, amongst which included from the Van Zyl's and Schaapplaats' farms. The results of a radiocarbon date placed them within the range of AD 1150-1240, which suggests they lived in the early part of the Late Iron Age (Maggs 1980; Vogel & Fuls 1999).

The Bantu-speaking farmer expansions during the Late Iron Age (ca. AD 1025-1820) into southern Africa consisted of two major streams: an Eastern stream and a Western stream (Hammond-Tooke 2004). The western stream consisted of the Sotho-Tswana speaking groups of which some moved into the Free State. Maggs (1976) noted that Ntsuanatsatsi can be regarded as one of the oldest Sotho settlements south of the Vaal River, dating to AD 1410. From Ntsuanatsatsi, the Koena lineage divided into several groups who moved southwards where some would eventually occupy the Caledon Valley around the mid-17th century (Maggs 1976). The relatively early date for the Van Zyl's farm remains makes this group quite unique and interesting, as there are to our knowledge no other similarly dated Iron Age groups in the western side of the Drakensberg region around this time. However, this region has not been studied as extensively as other parts of the Free State, with most research in this area related to the work done by Maggs (1976). Therefore, this sample is most probably associated with the Eastern stream that represents Nguni-speaking groups (Hammond-Tooke 2004; see also Badenhorst 2010). This assumption is tentatively supported by the FORDISC analyses, which showed a weak link to the Teita (as representing an eastern African group) (Howells 1973). This migration/expansion moved down primarily between the Indian Ocean and the Drakensberg while smaller groups branched off into the highveld (Hammond-Tooke 2004), which includes the Free State province where Clarens is situated. This correlates well with the archaeology as the Zulu group forms part of the Nguni-speaking population that is associated with the eastern stream migrations. However, this assemblage could form part of a group that is not yet within the FORDISC database as evidenced by the low posterior probabilities and typicalities. This should be further investigated by doing more sophisticated analyses using other databases. The alignment of the individuals from Van Zyl's farm with eastern stream migrations (i.e., the Teita data) is somewhat surprising considering that other similar and slightly later dated skeletons from the eastern Drakensberg (Steyn et al. 2019; Meyer et al. 2021) seem to be of West African descent. This interpretation attests to the complex nature of migrations into southern Africa, which probably cannot be oversimplified into two migration streams only.

The Early Iron Age and the early part of the Late Iron Age had much in common (e.g., Mitchell 2002; Mitchell & Whitelaw 2005; Badenhorst 2010). During this time, people practised metalworking, cultivated crops, kept livestock and had distinctive pottery (Maggs 1994/5). Early Iron Age settlements were mostly situated near water sources. The savanna was preferred as this environment provided abundant grazing grasses as well as wood for building and fires. The Free State, however, is a grassland biome that only became heavily populated during the Late Iron Age (Maggs 1994/5; Vogel & Fuls 1999), making this group of individuals in this study, in this region and at this particular period, quite unusual. The expansion into the grasslands was suggested to be caused by the increasing importance of cattle in the Late Iron Age economy (Mitchell 1992). The individuals from Van Zyl's farm can probably be placed within the transition period from the Early to Late Iron Age and could possibly represent some of the expansion from the east of South Africa to the grassland interior.

The health and diet of this group of individuals were difficult to infer due to the commingled state of the remains and the small sample size. Most of the pathological lesions observed were osteoarthritic changes mainly observable on the major joint surfaces and the vertebrae in the form of osteophytes. This should be expected as there were many older individuals in the assemblage. These changes are highly dependent on increasing age, but activity patterns also have an impact (Jurmain & Kilgore 1995). Advancing age primarily influences the vertebral column while activity patterns have more of an effect on the appendicular joints; however, other factors need to be taken into account, such as genetics and individual variation in anatomy (Weiss & Jurmain 2007).

There was no evidence of specific infectious diseases such as osteomyelitis, tuberculosis or treponematosis, nor were there non-specific indicators of stress such as cribra orbitalia, porotic hyperostosis or enamel hypoplasia. This is similar to remains from other nearby regions, such as in KwaZulu-Natal at sites dated to the Early Iron Age and the early part of the Late Iron Age, including Nanda (6th and 7th century AD) and KwaGandaganda (AD 620-1050) (Morris 1993; Whitelaw 1993), and at Elands Cave, Champagne Castle, Mfongosi and those at Newcastle (AD 1300-1700) (Steyn et al. 2019).

Non-specific subperiosteal bone deposition, however, was seen on the complete individual's (A4237) tibiae and femora as well as on one femur and three of the tibiae from the commingled remains. This is associated with the inflammation of the periosteum. It is a non-specific indicator of stress as it can be caused by localised trauma, infectious diseases as well as malnutrition. It is a relatively common skeletal finding in archaeological assemblages (Aufderheide & Rodríguez-Martin 1998; Ortner 2003) and may suggest some nutritional or other stress. In an assessment of remains from the Cathkin Peak region in the eastern Drakensberg (Meyer et al. 2021), several individuals with subperiosteal deposition and other non-specific signs of disease were noted, attesting to the hardships of living in this region.

Only one individual (the adult male, A4237) had signs of trauma. He had a healed fracture of the right ulna, commonly referred to as a parry fracture (Lovell 1997). This type of fracture can result from a fall or from defensive movements when raising the arm to protect against a blow. The presence of this fracture may indicate an episode of interpersonal violence.

Dental wear in many of the individuals was considerable, and many had periodontal disease. A4237 had five periapical abscesses of which only one was associated with dental caries. A4237 was also the only individual with dental caries. Two other individuals (A4239 and A4244) also had periapical abscessing. These lesions are most likely associated with severe dental wear, which exposed the pulpal space in some individuals. This would probably suggest an abrasive diet that, as expected, was low in refined carbohydrates (Lukacs 1989; Forshaw 2014). This is supported by the low levels of caries in this group. The observed advanced dental wear was mostly observed on the posterior teeth, arguing against the use of teeth for purposes other than mastication (Smith 1984; Deter 2009). It has been shown that the angle of the occlusal wear plane may differ between hunter-gatherers and agriculturalists due to the differences in masticatory loads brought on by dietary differences. In agricultural communities, occlusal wear facets are often at an angle, with the wear plane showing attrition towards the buccal surfaces, whereas in hunter-gatherer communities occlusal wear results in a more uniform horizontal flattening of the crowns (Larsen 2015). The dental wear observed in A4237 could therefore serve as further confirmation that this individual consumed an agriculture-based diet.

The stable isotope values for A4237 indicated a diet rich in C4 terrestrial plants. The relatively low nitrogen value suggests a low consumption of proteins derived from animal sources, probably only on an occasional basis. The $\delta^{15}N$ value observed in A4237 (8.3‰) is similar to that observed for the Cathkin peak individuals, who had an average of 8.4‰ (Meyer et al. 2021). This suggests that the Van Zyl's farm individual, like the Cathkin Peak individuals, were more dependent on the consumption of grains like sorghum and millet as opposed to cattle and caprines.

Individual A4240, a young adult female, had dental modification of the maxillary central incisors. In Africa, a variety of modification styles have been observed, which include chipping, filing, avulsion of predominantly the anterior teeth, notching and ablation (Finucune et al. 2008). In this case, the mesial edge of the incisors had been filed away to create an inverted V-shaped gap between the teeth. Dental modification was a common practice in many regions of the world such as Australia, East Asia, the Americas, and Africa (Morris 1998; Finucane et al. 2008), especially during the Early Iron Age (Morris 1998; Badenhorst 2010). Dental modifications have been associated with group identity or may form part of a rite of passage ceremony when the individual reaches puberty (Shaw 1931; Pindborg 1969; Van Reenen 1986; Morris 1998). The modification seen on A4240 is fairly common and was also observed during 10th to 13th century AD K2 and Mapungubwe sites in the Limpopo Valley (Steyn 1994); however, these sites are far removed from the Van Zyl farm site. Nanda in KwaZulu-Natal also had two individuals with dental modifications (Morris 1993). This site is closer to Clarens and the western side of the Drakensberg mountains, but the modification style was very different. Here the modification included the removal of all the lower incisors and the upper central incisors as well as the chipping of upper lateral incisors and canines to form a point (Morris 1993). The modification was observed on both a male and a female individual. A4240 was the only individual for whom dental modification could be observed as the upper central incisors of the remaining crania were unfortunately not recovered.

The beads that were recovered from the site were red glass beads and one ostrich eggshell or bone bead. The glass beads are consistent with those associated with East Coast Indo-Pacific beads, manufactured, and traded in the early 13th century AD (Wood 2011; Wilmsen 2017). East Coast Indo-Pacific beads were discovered at the Cathkin peak site and were associated with the pelvis of a skeleton (Wells 1933), as well as at Sibudu Cave in KwaZulu-Natal (Wood et al. 2009).

Unfortunately, the Van Zyl's farm remains cannot be directly linked to any of the documented sites mentioned in this paper and these locations should be seen as speculative. The Late Iron Age date, population affinity results and associated artefacts seem to suggest that these people represent one of the farming communities that either moved in from the east (KwaZulu-Natal), or that they represent an earlier unknown lineage from West Africa. Both the Twin Caves site, situated on the Schaapplaats farm, and the Clarens site, situated on the Letsoana Stad farm, indicate the presence of settlement features associated with farming communities in the region, and these could potentially be linked to the skeletal remains. Foot surveys and dating of these sites may shed more light on their possible association with the skeletal remains discussed here.

5. Conclusion

Through the current research the possible origin, as well as the temporal context, of the Van Zyl's farm skeletons were established. Unfortunately, not much is known about the archaeology of the site itself, but the analyses of these previously unstudied remains provide valuable information on settlement patterns and population movements, and they could prove useful in future research.

One of the skeletons from Van Zyl's farm was dated to between AD 1150 and AD 1240. This date is associated with the early part of the Late Iron Age. This is an early date for this particular region, predating all the known local Sotho-Tswana sites. Based on the FORDISC results it seems that the Van Zyl's farm individuals are most closely aligned with eastern and southern African reference samples. This, along with the early date, seems to suggest that these people were part of the eastern stream of Bantu-speaking farmers who moved into South Africa. They may represent one of the proto-Nguni-speaking populations that moved into the interior. Most of the Early Iron Age populations occupied the savanna biomes but during the Late Iron Age, there was expansion into the grasslands. Thus, this sample could be an early representation of these expansions. There has been very little archaeological research in this area and thus this sample represents the earliest date, as yet, for this particular region associated with the Nguni-speakers' expansion. This is further supported by the isotope values as the $\delta^{13}C$ value indicated a diet primarily of C4 plants such as sorghum and millet. Assessment of health was difficult due to the small sample size and poor preservation, but the presence of subperiosteal bone deposition in four individuals may indicate some nutritional or other stress.

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COMPARING MORPHOLOGICAL VARIABILITY IN HANDAXES FROM PENHILL FARM AND AMANZI SPRINGS, EASTERN CAPE, SOUTH AFRICA

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ABSTRACT
Recent excavations at Penhill Farm and Amanzi Springs have reinvigorated interest in the Acheulean archaeological record of the Eastern Cape Province, South Africa. While this research now provides valuable detail on hominin adaptations in environments that differ from the interior, few Acheulean assemblages in this region have been recorded or thoroughly analysed. Here we compare Acheulean handaxes from Penhill Farm and the Amanzi Springs Area 1 locality to help characterise the expression of this technocomplex in the Eastern Cape. We employ a multivariate analysis of allometry to highlight the relationship between shape variance in relation to the size of handaxes, which further provide perspective on shaping processes. Results demonstrate high levels of techno-morphological variability that may distinguish Acheulean handaxes in the Eastern Cape region from sites elsewhere. We further argue that morphological variation in handaxes from Penhill Farm and Amanzi Springs may have also been influenced by site function, discard behaviours and group mobility patterns. These data refute the notion that the Acheulean technocomplex represents a single, homogenous technological entity, but rather was a flexible tradition that was influenced by region-specific factors.

Keywords: handaxes, allometry, Acheulean, Penhill Farm, Amanzi Springs

1. Introduction

Acheulean sites in the Sundays River Valley (SRV, namely Penhill – PHF, Atmar and Bernol Farms) and at Amanzi Springs (AMS; located in the neighbouring Coega River Valley) have increased resolution both on the timing and nature of technological trends within the Earlier Stone Age sequence of the Eastern Cape Province (Fig. 1) (Lotter & Kuman 2018a, b; Caruana & Herries 2020, 2021; Lotter 2020a, b, in press a; Lotter & Caruana 2021; Mesfin et al. 2021; Herries et al. in press; Lotter et al. submitted). The SRV and AMS are within 25 km of each other, and their raw materials are both predominated by similar quartzite lithologies (Deacon 1970; Lotter & Kuman 2018a, b; Lotter 2020a, b; Lotter & Caruana 2021; Mesfin et al. 2021; Herries et al. in press). While the Sundays River sites are older (ca. <1.4 to >0.5 Ma) than AMS (ca. 0.4 Ma), this paper explores whether there are consistencies in the morphological features of handaxes, given that these sites have similar proximities to usable toolstone sources.

Comparisons between Acheulean sites in the Eastern Cape have never been conducted, and the degree of technological variability observed within this region remains unknown. While numerous Acheulean localities have been documented in the Eastern Cape (see Davies 1971, 1972; Sampson 1974), only a few have been described, and with varying levels of detail (e.g., Geelhoutboom – Laidler 1947; AMS – Deacon 1970). Characterising Acheulean technology from the Eastern Cape is important for investigating regional trends in tool production and mobility patterns. The Acheulean technocomplex has been described as a conservative cultural entity due to the ubiquity of large cutting tools (LCTs; e.g., handaxes and cleavers) and their common forms (Clark 1994; Corbey et al. 2016). However, some studies have noted regional differences in handaxe forms that suggest either adaptations to local raw materials, differences in motor-cognitive capacities or the possibility of population-level cultural traditions in Acheulean technology (Wynn & Tierson 1990; Lycett & Gowlett 2008; Shipton & Petraglia 2011; White et al. 2019). We focus on handaxes because they have been used to characterise differences in both morphologies and production strategies across the Acheulean technocomplex.

We use a multivariate analysis of allometry to investigate the relationship between the size and shape of these tools (Crompton & Gowlett 1993; Gowlett & Crompton 1994). This method provides insight into how knappers balanced the morphological (i.e., size + shape) proportions throughout reduction processes. Given the elongated nature of these tools, Acheulean toolmakers manage width and thickness proportions to maintain intended shapes, edge angles and the centre of mass (Gowlett 2006, 2011, 2013, 2021). Thus, understanding how specific proportions of handaxes scale with size provides insight into the shaping strategies of ancient knappers. We assess allometric differences between Penhill Farm and Amanzi Springs to highlight levels of techno-morphological variability, which are then compared to other Acheulean sites beyond the Eastern Cape Province. In contrast to the notion of cultural conservatism defining the Acheulean technocomplex, our study highlights differences in both the allometric patterns and shaping processes that structured handaxe forms across the analysed assemblages. We argue that differences in handaxe morphologies at PHF and AMS were influenced by site function, raw material constraints and group mobility, which in turn define patterns of regional variation.

Here we present the first preliminary comparison between PHF and AMS to explore regional variability.

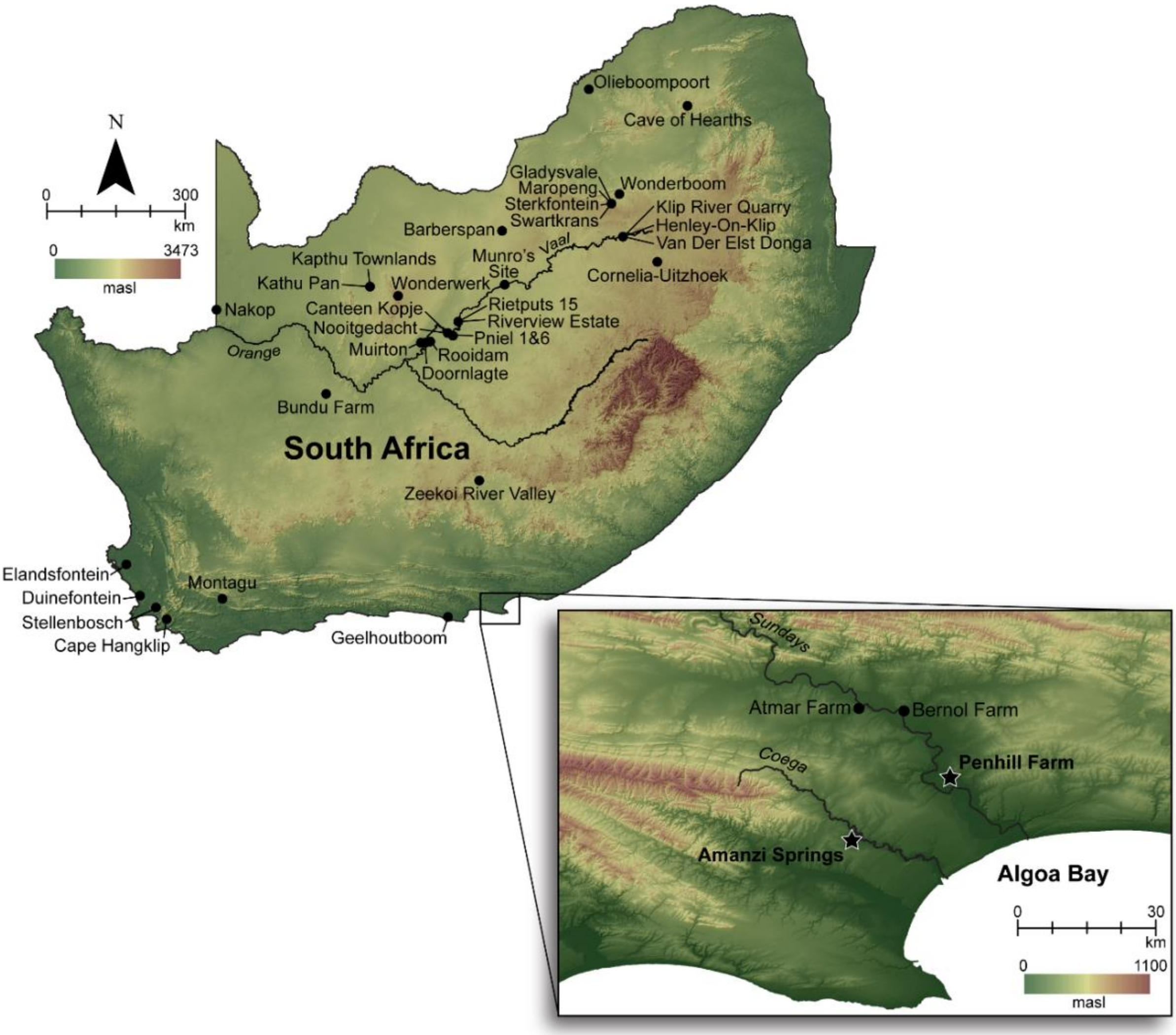

Figure 1. Map of South Africa (upper left) showing the geographic distribution of Acheulean sites. Inlay (bottom right) shows the location of Penhill Farm (Sundays River Valley) and Amanzi Springs (Coega River Valley).

2. Background

Regional trends or one homogenous entity?

Since its definition, the Acheulean technocomplex has been conceptualised as a wide-spread, homogenous cultural entity, largely based on the ubiquity of LCTs. Upon initial observations, handaxes are relatively consistent in their morphology across both spatial and temporal scales, which have led some researchers to suggest that Acheulean culture was 'static' in nature (Clark 1994; Corbey et al. 2016). However, focused studies on the size and shape of these tools have consistently noted high levels of variability, which now defines modern research agendas in Acheulean archaeology (see Lycett et al. 2016).

In South Africa, research on handaxe morphologies have identified trends in variability that challenge past notions of 'refinement through time' (Hodgson 2015). Comparisons between early and later Acheulean assemblages have revealed that the later period is typified by a high degree of variation in both size and shape, and that planview symmetry is not correlated with chronology (Li et al. 2018; Caruana 2020, 2021; Caruana & Herries 2021). However, differences in shaping strategies are noted between early and later Acheulean handaxes, where the latter examples show an increase in thinning of tip regions (Caruana 2020, 2021).

While variability through time has been explored in the South African Acheulean, the question of regional trends remains open to interpretation. Past research has noted potential inter-regional differences in handaxe forms. Comparing later Acheulean assemblages from eastern Africa, India, West Asia and Europe, Wynn and Tierson (1990) noted that handaxes from Israel were distinct in planview shape, which were consistently wider in form. Given the chronological affiliation to the Middle Pleistocene of sites compared, they hypothesised that shape differences were either due to raw materials or potentially local cultural traditions. Lycett and Gowlett (2008) used multivariate statistics to compare handaxes from eastern Africa, Korea and India to assess variation across the 'Movius line'. They found subtle differences in linear proportions that may reflect regional differences, supported by within-group variation in knapping techniques and cultural transmission. Shipton and Petraglia (2011) compared handaxes from the Arabian Peninsula, India, Korea, China, and eastern Africa to test if the eastern Asian Acheulean assemblages were similar to those from Africa. Their results suggested that handaxes from Korea and the Baise (Bose) Basin in China were morphometrically distinct in terms of refinement (width/thickness – w/th) and weight, respectively.

Thus, inter-regional comparisons have the potential to refine our understanding of Acheulean variability. While the reasons for variation in handaxe forms are debateable, regional trends in how handaxes were reduced and their resulting shapes may distinguish Acheulean assemblages. For example, Li et al. (2021) used geometric morphometric methods to assess variability in handaxe morphologies from the Baise Basin in China and found that 'tongue-like' handaxe tips were characteristic of this area, which may represent a regional adaptation to wood working (also see Lei et al. 2021; Li & Lotter submitted). This corroborates some of Shipton and Petraglia's (2011) earlier conclusions that the Baise Basin handaxes are regionally distinct, which may have implications for functionality and mobility patterns (Li et al. 2021, 2022).

Therefore, it is increasingly important to examine variability on regional scales, although such studies are largely lacking in the southern African context. Given the general dearth of information on the Eastern Cape Acheulean, we attempt to characterise handaxe production and morphologies through comparing samples from PHF and AMS Area 1. Below we test the hypothesis that handaxe technology is ubiquitous within this region and compare resulting trends with other early and later Acheulean assemblages to contextualise our results. A brief summary of the sites is presented below to characterise the handaxe samples.

Penhill Farm

PHF occurs in Terrace 9 of the lower Sundays River Valley, in one of thirteen terraces that occur within the lower valley that collectively span the Miocene to the Holocene (Erlanger et al. 2012). Their sedimentological composition is predominantly gravel and fine silts and sands, the former of which are extremely rich in quartzite and sandstone and account for >95% of all clasts downstream (Ruddock 1948; Hattingh 1994; Hattingh & Rust 1999). Their geological composition reflects that of the upstream Klein Winterhoek Mountains, which comprise the easternmost limit of the Cape Fold Mountains (Witteberg Group, Cape Supergroup) (Ruddock 1948; Hattingh 1994; Hattingh & Rust 1999). In addition, a limited number of clasts from the Zuurberg basalt and Enon, Kirkwood, and Sundays River Formations are also present in the terrace gravels (Hattingh 1994).

During a recent cosmogenic isochron burial dating study of the terraces, Erlanger and colleagues (2012) observed *in situ* Acheulean handaxes at PHF and their dating results provided an age of 1.36±0.36 Ma (later revised to 1.37±0.16 Ma) for the local deposition of the Terrace 9 alluvium, within which they suspected the artefacts were preserved (Granger et al. 2013). Subsequently, Lotter (2016) conducted an excavation to target the artefact-bearing deposits and later established that the artefacts are instead preserved within a secondary context debris flow, which infilled the base of an erosional channel (gully or donga) that cut its way into the surrounding sterile Terrace 9 alluvium. As a result, the PHF burial age does not pertain directly to the artefacts but rather, it serves as a maximum chronological constraint (for discussion on new dating currently underway, see Lotter et al. submitted).

Basic techno-typological descriptions and regional inter-site comparisons of the PHF assemblage have been provided in several recent papers (Lotter & Kuman 2018a, Lotter 2020a, b; Lotter & Caruana 2021; Mesfin et al. 2021; Lotter in press a, b). It is comprised of 9904 artefacts in total, a limited number of LCTs (n=49, with n=16 handaxes), and over 85% of all artefacts have been produced on quartzite and less frequently on siltstone (n=363, 7.5%) and hornfels (n=255, 5.2%). Lotter (2020a) explores the techno-morphological characteristics of the PHF handaxes through several analyses, documenting trends in the mean technological measurements and size ratios where there are clear differences between those made on quartzite (n=11, 68.8%) and those on siltstone (n=5, 31.2%), the only two raw materials represented. The latter are consistently larger and heavier, more elongated and less refined, and this is the result of the larger blank properties of siltstone as opposed to underlying differential trends in shaping by raw material (Lotter 2020a; Lotter & Caruana 2021). In terms of production, large flake blanks were favoured and flaked bifacially across the majority of tool portions while retaining some cortex. Given the abundance of suitably large cobbles in the local landscape, this illustrates a clear preference by hominins to procure large flakes for tool blanks, versus using what was immediately available in exposed terraces and from the nearby river. Given the on-site abundance of flaking debris and debitage, it is clear that production accounts for the majority of activities, but the over-representation of flakes on raw material types that are not reflected in the core sample talks to the possibility of some off-site flaking. This is further supported by the consistent over-representation of large flakes (60 mm up to those >120 mm) on-site when compared with the negative flake scar dimensions on core surfaces, along with a series of flake, core and scar ratios (see Lotter & Caruana 2021). Collectively, this supports the idea that hominins were acquiring large flake blanks possibly from large boulder cores off-site (as documented at other SRV sites, see Lotter & Kuman 2018b), subsequently transporting them on-site specifically for handaxe production. Overall, this talks to variable procurement strategies and mobility throughout the valley for tool production purposes, which is further supported by Mesfin et al. (2021) in their recent investigation of local raw material exposures and their comparison of local cobble blank properties to those in the PHF assemblage (Mesfin et al. 2021).

Amanzi Springs

AMS was first systematically excavated by Inskeep (1965) followed by Deacon (1970), who excavated two spring eyes, referred to as Areas 1 and 2. Deacon (1970) originally described three sedimentary Members (Enqurha, Rietheuvel, and Balmoral; ordered oldest to youngest), although Herries et al. (in press) recently reassessed the stratigraphy of Area 1 and dated its artefact-bearing layers using a combination of single-grain, thermally transferred optically stimulated luminescence, multi-grain post-infrared stimulated luminescence and palaeomagnetic techniques to ~400 ka.

In terms of the lithic assemblages from AMS, quartzite lithologies represent the vast majority of raw materials used to produce artefacts at Areas 1 and 2 (Deacon 1970; Herries et al. in press). In fact, 98.8% of the Area 1 assemblage is comprised of quartzites derived from the Enon Formation (Uitenhage Group) (Herries et al. in press). These quartzites were initially formed within the Peninsula Formation Sandstones (Table Mountain Group), located in the eastern Cape Fold Belt, and incorporated into the Enon conglomerates during pre-Cretaceous times (Booth & Shone 2002; Muir et al. 2017). As the Enon conglomerates were eroded during or after the Cretaceous period, quartzite nodules were deflated onto the landscape around Amanzi Springs and incorporated into the bedload of the nearby Coega River (~2 km north of the spring sites) (Deacon 1970; Herries et al. in press).

Deacon (1970: 11) initially described the AMS lithic collections as “large and unstandardised,” noting variation in their morphologies across all tool types. Later, Sharon (2007) compared linear measurements of handaxes from Amanzi Springs to 21 other Acheulean sites across Africa, West Asia and India, and found that they were significantly larger in both thickness and mass proportions. He suggested that AMS may in fact represent a ‘workshop’ site where handaxes and cleavers were discarded before being thinned, similar to STIC (Morocco) and Isimila K19 (Tanzania). Caruana and Herries (2020, 2021; Herries et al. in press) have recently supported the workshop hypothesis for the Area 1 spring eye. They used linear measurements and three-dimensional scans of Area 1 handaxes to compare morphologies with other Acheulean sites in South Africa, including the Cave of Hearths (<780 ka; Latham & Herries 2009) and Rietputs 15 (~1.31 Ma; Leader et al. 2018). In an initial study, Caruana and Herries (2020) used Gowlett’s (Crompton & Gowlett 1993; Gowlett & Crompton 1994) methods for analysing multivariate allometry to compare handaxes from AMS Area 1, the Cave of Hearths and Rietputs 15, which found that the Area 1 specimens were larger in width, thickness and mass proportions. While they characterised allometric trends across all three sites, Caruana and Herries (2020) found that the Area 1 handaxes were more morphologically similar to the Rietputs 15 rather than to the Cave of Hearths, despite the Middle Pleistocene chronology of the Area 1 assemblage.

Later, Caruana and Herries (2021) examined the potential causes of the ‘large and unstandardised’ morphologies of Area 1 handaxes and compared their variability to the size of step and hinge fractures (surface flaws). They hypothesised that a significant correlation between these features might indicate that the development of surface flaws during handaxe reduction impeded shaping processes and led to early discard. They further analysed handaxe cross-sectional shapes in the tip region to assess the intensity of bifacial thinning that took place (see Caruana 2022). A significant relationship was found between morphological variability and the size of surface flaws, and tip cross sections were found to be amorphous and triangular in shape, which indicated a lack of thinning. Caruana and Herries (2021) concluded that the majority of Area 1 handaxes were likely abandoned after primary shaping, which skewed morphological variability in this assemblage and corroborated the workshop hypothesis (see Barkai et al. 2002; Sharon 2007).

More recently, Herries et al. (in press) found more of evidence of on-site LCT manufacturing at Area 1 including giant cores, large flake blanks and bifacial shaping flakes. They suggest that Middle Pleistocene hominins periodically occupied AMS to take advantage of the unique floral and faunal resources, as well as access useable toolstone. Occupational sequences may not have been long as Acheulean groups were likely highly mobile, but the number of stone tools recovered from Area 1 implies that groups repeatedly returned to the spring sites over the Middle Pleistocene period. In terms of handaxes, Herries et al. (in press) found that they were larger and more variable in linear proportions when compared to cleavers, picks and knives. They further noted that the surfaces of these tools lacked signs of extensive thinning despite the affiliation of this assemblage to the later Acheulean period. Cortical surfaces ranged from 0-30% in handaxes, which was mostly concentrated on mid and basal tool portions, and an average of 15.5 flake scars were recorded. Herries et al. (in press) also found that 57.3% of handaxes were made on cobbles, while 30.5% were produced on large flake blanks.

3. Materials and methods

All the handaxes from PHF (n=16) and 75 from AMS Area 1 (hereafter AMS1) were examined (Fig. 2). We note that the unequal sample sizes may skew perspectives on degrees of morphological variation. However, multivariate allometry is largely based on the independent assessment of assemblages to identify size-shape relationships, which limits any potential issues of statistical ‘overpowering’ by the

AMS1 sample. We further compared these Eastern Cape assemblages with 85 handaxes from Rietputs 15 (~1.31 Ma; Leader et al. 2018), and 50 handaxes from the Cave of Hearths (<0.78 Ma; Latham & Herries 2009), which are used here as representative samples of early and later Acheulean, and to compare morphological variability in southern Africa handaxes (Li et al. 2018; Caruana 2020).

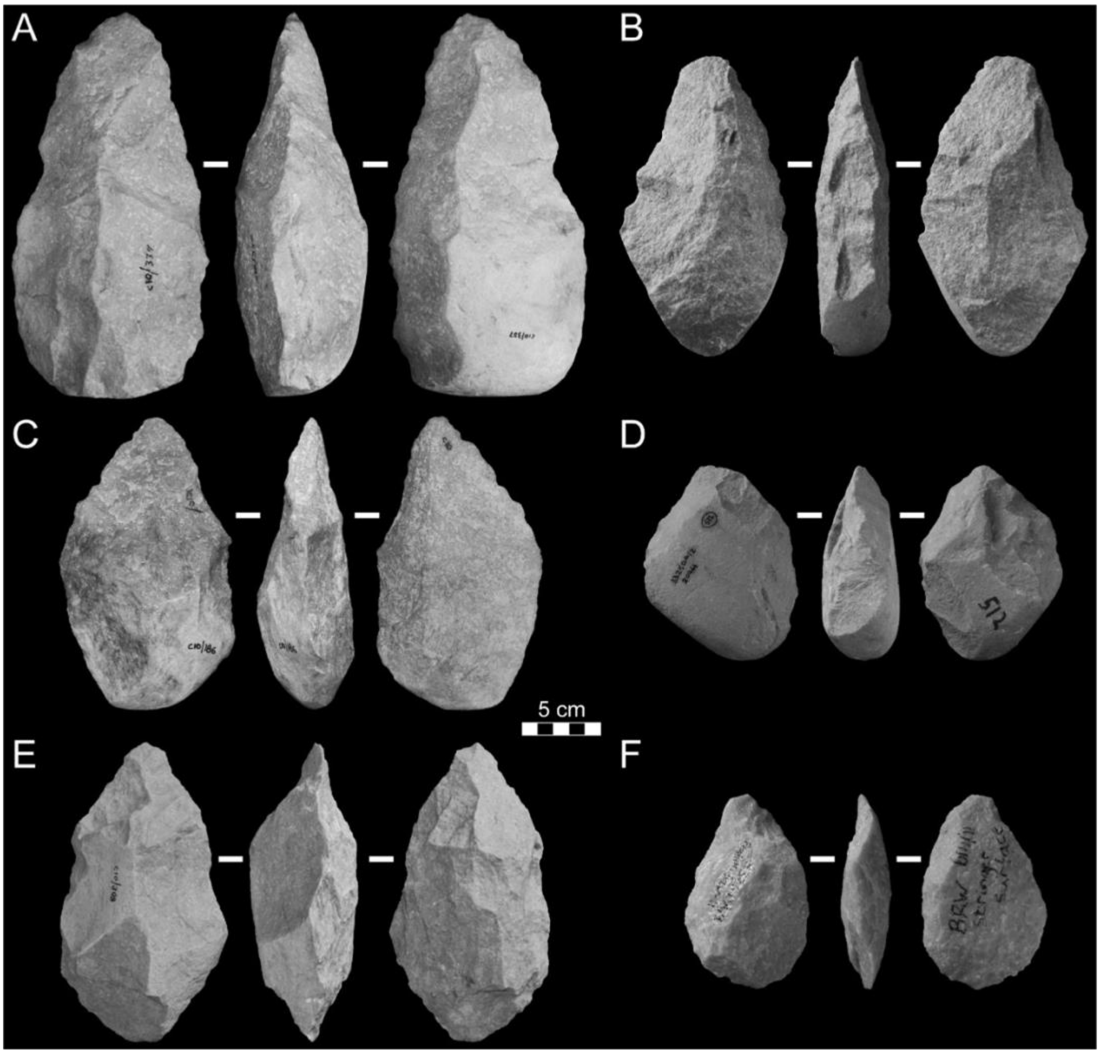

Figure 2. Handaxes from Amanzi Springs Area 1 (a, c, e) and Penhill Farm (b, d, f).

To compare handaxe morphologies we draw upon Crompton and Gowlett's (1993; Gowlett & Crompton 1994) multivariate allometry (MVA) methods, which calculates allometric components (AC) for linear measurements. This is operationalised through principal component analysis (PCA) using a covariance matrix on log-transformed variables. The first principal component (PC1) subsequently captures size variation. Rescaling PC1 coefficients to a mean of one can then be used as ACs that measure size-shape relationships, where values of one represent isometry (variables remain constant with increases in size), while values under one represent negative allometry (variables that decrease with increases in size) and values over one represent positive allometry (variables that increase with increases in size) (Crompton & Gowlett 1993). Comparing allometric trends (i.e., ACs) with degrees of variation in linear measurements, calculated through coefficient of variation (CV) scores, further provides insights into the balance of size-shape proportions in handaxes, which Crompton and Gowlett (1993; Gowlett & Crompton 1994; Gowlett 2006) used to define reduction 'rule-sets'. Consistency in handaxe proportions through allometric scaling suggests that Acheulean toolmakers managed the proportions of handaxes through the knapping process relative to their size, which had potential functional implications (Gowlett 2006; Key et al. 2016; Key & Lycett 2017, 2020). We utilise these MVA methods while appreciating their potential shortfalls when being used to infer reduction intensity (see recent work by Mika et al. in press) – something that is not explored in this paper.

We present the following set of analyses to explore morphological variability in handaxes from PHF and AMS1:

1. We compared linear measurements (mm), including maximum length, width, thickness; width and thickness for tip, midsection and base regions (defined as 1/5, 1/2 and 3/5 of the tool length); the position of the widest point measured from the base end. We also compare mass (g), surface area (mm^2), total scar count and the Scar Density Index (SDI – scar count/surface area; see Shipton & Clarkson 2015); and elongation (l/w) and refinement (w/th) ratios defined by Roe (1969). We use Mann-Whitney U tests to compare these variables in terms of significant differences ($\alpha=0.05$), and boxplots to graphically represent techno-morphological trends.
2. We conducted a PCA of PHF and AMS1 based on ten linear measurements (maximum length, width, thickness; width and thickness for tip, midsection and base regions; the position of the widest point measured from the base end), which were log-transformed to minimise the effects of non-normality. We exclude mass due to its overlap with geometric size as noted by Crompton and Gowlett (1993). A covariance matrix was used to conduct the PCA to highlight size-shape relationships in multivariate space.
3. Inter-site MVA: we first plotted CV values for PHF, AMS1, Rietputs 15 and the Cave of Hearths based on the ten linear measurements used on the MVA. A second series of PCAs were conducted using a covariance matrix to highlight size-shape relationships. PC1 coefficients were extracted and scaled to a mean of one, which are used as AC scores. A line graph was used to compare allometric trends between the four assemblages, which highlight trends in size-shape relationships.
4. A third PCA was conducted that combined PHF and AMS1 samples into a single 'Eastern Cape sample' to calculate AC scores, which were then compared to Rietputs 15 and the Cave of Hearths to test the notion of regional trends.

4. Results

Techno-morphological traits

Table 1 compares techno-morphological traits of handaxes between PHF and AMS1, the Cave of Hearths and Rietputs 15. Mean and median values for all linear measurements are larger in the AMS1 sample when compared to PHF. Mann-Whitney U tests comparing linear measurements and mass are significant, aside from position of maximum width (PMW) and midsection width (SOM Table 1). Figure 3 displays boxplots for mass, SDI, elongation and refinement variables, which provide some perspective on general techno-morphological patterns. Mass is higher in the AMS1 sample when compared to PHF, although SDI values are not significantly different, suggesting that neither assemblage was intensely reduced. Elongation values are significantly higher in AMS1 when compared to PHF, although the opposite trend is observed in refinement. AMS1 handaxes are also significantly larger than Rietputs 15 and the Cave of Hearths in terms of mass, while the Cave of Hearths is significantly higher in SDI values when compared to all other assemblages. PHF is slightly smaller in elongation when compared to Cave of Hearths, although Mann-Whitney U results are near the alpha level, while AMS1 shows significant differences with the Cave of Hearths. For refinement, PHF is higher in proportion when compared to Rietputs 15, and AMS1 shows the opposite trend with the Cave of Hearths.

Principal component analysis – Penhill Farm and Amanzi Springs Area 1

In the PCA comparing PHF and AMS1, ten principal components were extracted. The first principal component (PC1) accounted for overall size, and all variables loaded strongly onto this axis, aside from PMW (SOM Tables 1-3). The second principal component (PC2) is more complex, where maximum thickness, along with tip, midsection and base thicknesses load strongest onto the positive axis, and PMW defines the negative end, along with length and tip width to a lesser extent (SOM Tables 2 & 3). The principal component scatterplot displays differences in group clustering patterns for PHF and AMS1, where PHF is skewed towards the negative end of PC1, and slightly towards negative PC2, while AMS1 is centred with an even dispersion of points on both PC axes (Fig. 4). These scatter patterns suggest that PHF geometric shape-size variables are consistently smaller when compared to AMS1 (Table 1).

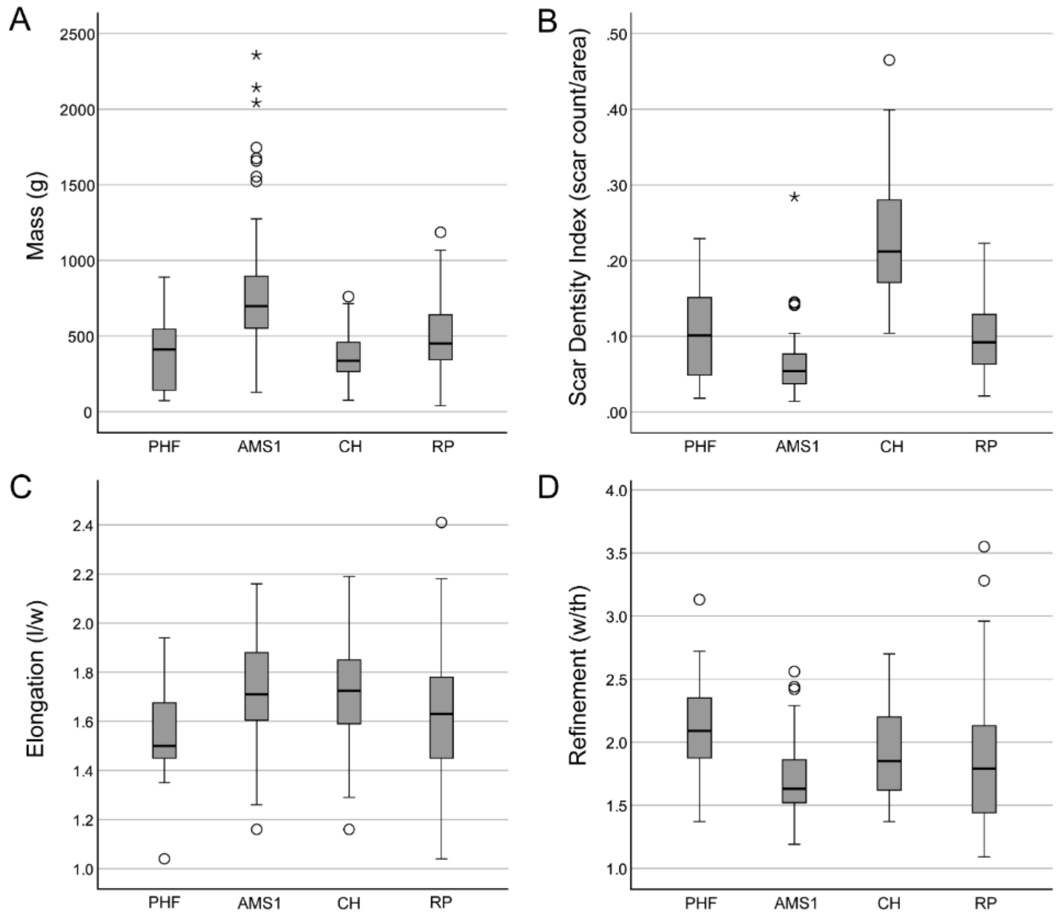

Figure 3. Boxplot graphs displaying techno-morphological traits for Penhill Farm (PHF), Amanzi Springs (AMS1), the Cave of Hearths (CH) and Rietputs 15 (RP).

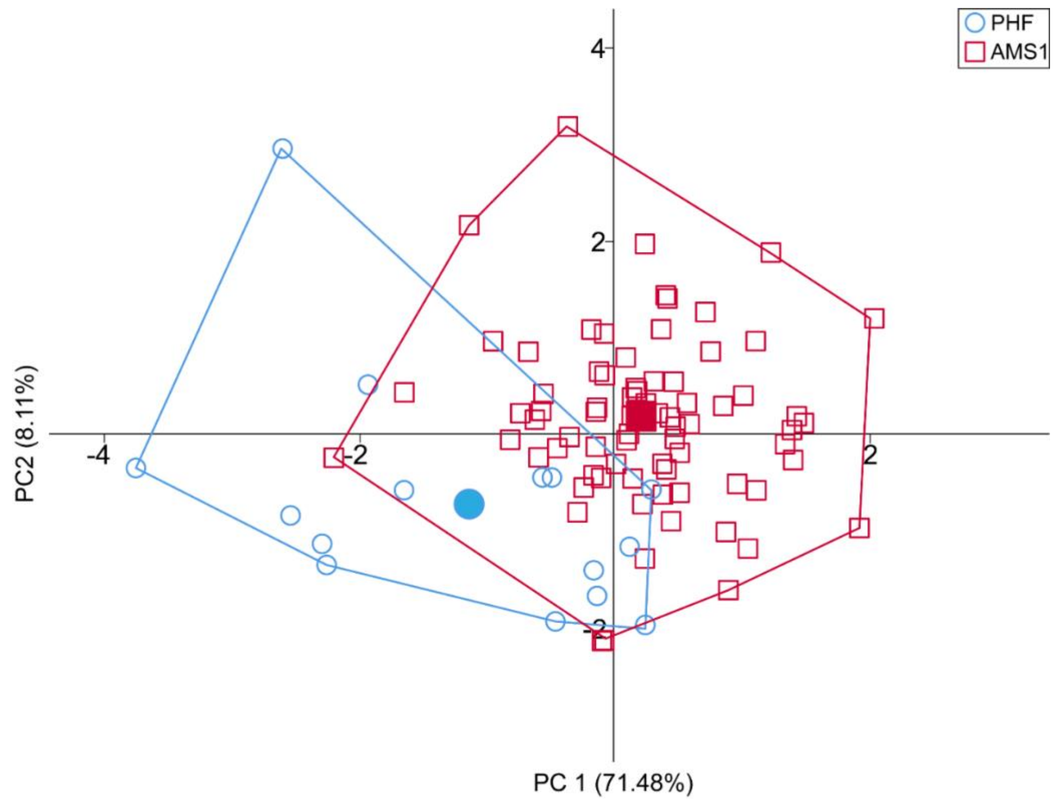

Figure 4. A principal component scatterplot graph comparing Penhill Farm (PHF) and Amanzi Springs (AMS1).

Table 1. Descriptive statistics of handaxe measurements from Penhill Farm (PHF), Amanzi Springs Area 1 (ASA1), Cave of Hearths (CoH) and Rietputs 15 (RP15) (L=length; W=width; Th=thickness; PMW=point of maximum width; TW=tip width; TTh=tip thickness; MW=midsection width; BW=base width; M=mass; A=area; S#=scar number; SDI=scar density index; EL=elongation; RF=refinement).

	L	W	Th	PMW	TW	TTh	MW	MTh	BW	BTh	M	A	S#	SDI	EL	RF
PHF																
Mean	116.6	73.8	36.2	52.0	47.3	21.7	70.6	34.6	61.5	32.7	369.5	17285.2	13.9	0.1	1.6	2.1
Median	112.0	78.0	36.0	50.0	46.0	20.2	66.4	32.7	61.6	34.0	411.8	17906.7	15.0	0.1	1.5	2.1
Min	73.0	50.0	16.0	11.0	27.3	10.6	46.5	16.0	46.0	13.4	72.4	6983.8	4.0	0.0	1.0	1.4
Max	185.0	102.0	57.0	99.0	65.1	33.6	93.4	56.8	81.7	49.9	889.9	34338.7	24.0	0.2	1.9	3.1
SD	37.8	16.4	11.2	24.8	11.8	7.0	15.8	11.6	11.4	10.5	258.0	8878.9	6.0	0.1	0.2	0.5
CV	32.4	22.2	31.0	47.7	24.9	32.1	22.4	33.5	18.6	32.2	69.8	51.4	43.3	64.5	14.9	21.1
ASA1																
Mean	160.1	93.3	55.7	54.8	67.3	33.0	81.4	48.7	84.3	47.8	807.7	29442.7	15.8	0.1	1.7	1.7
Median	159.7	92.3	55.2	52.4	65.4	31.1	82.2	48.0	83.1	46.0	697.2	28070.3	16.0	0.1	1.7	1.6
Min	90.5	45.3	35.0	16.1	33.6	19.3	39.7	30.8	40.8	24.5	127.7	8450.3	5.0	0.0	1.2	1.2
Max	240.5	129.8	89.8	111.1	107.1	62.6	123.1	77.5	119.6	99.2	2358.0	61160.9	35.0	0.3	2.2	2.6
SD	30.9	16.7	10.8	18.7	13.6	8.4	15.0	9.8	15.5	12.6	443.5	10285.4	5.8	0.0	0.2	0.3
CV	19.3	17.9	19.3	34.2	20.2	25.4	18.5	20.1	18.4	26.4	54.9	34.9	36.9	62.6	12.2	17.9
CoH																
Mean	137.3	79.8	43.0	91.5	39.6	23.4	74.9	32.8	66.0	41.8	368.3	183.8	39.9	0.2	1.7	1.9
Median	134.8	81.2	43.0	86.7	40.2	22.4	76.6	32.2	64.9	36.3	336.0	174.5	38.0	0.2	1.7	1.9
Min	77.4	47.7	22.6	46.1	14.8	11.1	42.6	16.5	29.2	18.1	76.0	67.7	12.0	0.1	1.2	1.4
Max	209.3	110.5	68.3	151.9	70.3	44.4	110.5	47.1	95.5	82.9	761.0	330.4	106.0	0.5	2.2	2.7
SD	31.8	12.8	9.1	23.4	13.1	7.0	15.8	7.6	15.7	16.3	156.8	56.8	13.9	0.1	0.2	0.3
CV	23.1	16.1	21.2	25.5	33.1	30.1	21.1	23.1	23.8	39.0	42.6	30.9	34.9	34.7	12.9	18.0
PR15																
Mean	135.7	83.3	47.9	45.4	51.9	29.0	72.1	40.8	73.4	40.3	486.8	21971.7	20.2	0.1	1.6	1.8
Median	134.4	82.2	46.5	44.0	51.0	28.9	72.8	39.7	73.3	38.3	450.3	20450.5	18.0	0.1	1.6	1.8
Min	84.3	52.6	20.5	18.7	34.1	16.1	5.2	20.2	43.8	13.5	41.0	9255.9	7.0	0.0	1.0	1.1
Max	192.6	120.7	73.6	91.0	73.7	44.7	101.6	66.9	102.9	68.5	1185.6	37964.8	50.0	0.2	2.4	3.6
SD	25.3	12.9	12.2	13.8	9.6	6.4	14.4	9.6	11.3	11.3	231.8	6545.8	8.7	0.1	0.3	0.5
CV	18.7	15.5	25.5	30.4	18.4	22.1	19.9	23.6	15.4	28.2	47.6	29.8	42.9	47.1	15.5	27.2

Multivariate allometry – Penhill Farm and Amanzi Springs Area 1

Figure 5 displays CV scores for the geometric variables used in the multivariate analysis of allometry, which shows that the PHF sample is highest in scores for seven of the ten linear measurements. Although, this may be an effect of sample size, where the low number of handaxes in the PHF sample somewhat inflates variation. The highest peaks of CV scores (observed left to right) for the PHF sample occur for length, PMW, tip thickness, mid thickness, and base thickness. In the AMS sample, peaks are found in PMW, and tip and base thicknesses, while the Rietputs 15 sample mimics the trends for PHF, and the Cave of Hearths shows peaks in PMW, tip width, tip thickness, along with base width and base thickness. While each assemblage shows differences in variance levels, PMW and base thickness are highest across Figure 5.

The analysis of MVA reveals variation in the allometric scaling of handaxe proportions between the four handaxe assemblages (Table 2; Fig. 6). AC scores for tip thickness show a consistent pattern of isometry relative to size growth across the handaxe assemblages. For PHF, maximum width, as well as tip, midsection and base width variables consistently show negative allometric patterns, suggesting that these variables decrease as overall size increases. The point of maximum width in PHF handaxes shows the highest increase in allometric scaling when compared to all other assemblages. Interestingly, the length, width and thickness proportions of the AMS1 handaxes show near isometric scaling patterns, with width and thickness variables showing some trend towards negative allometry. The Rietputs 15 sample is highly variable when compared to all other assemblages, which shows negative allometric trends for length, tip and base width variables, while maximum thickness, tip, midsection and base thicknesses increase relative to size scaling. The Cave of Hearths sample shows a high propensity for negative allometry, aside from tip thickness (isometric) and PMW and base thickness (positive allometry).

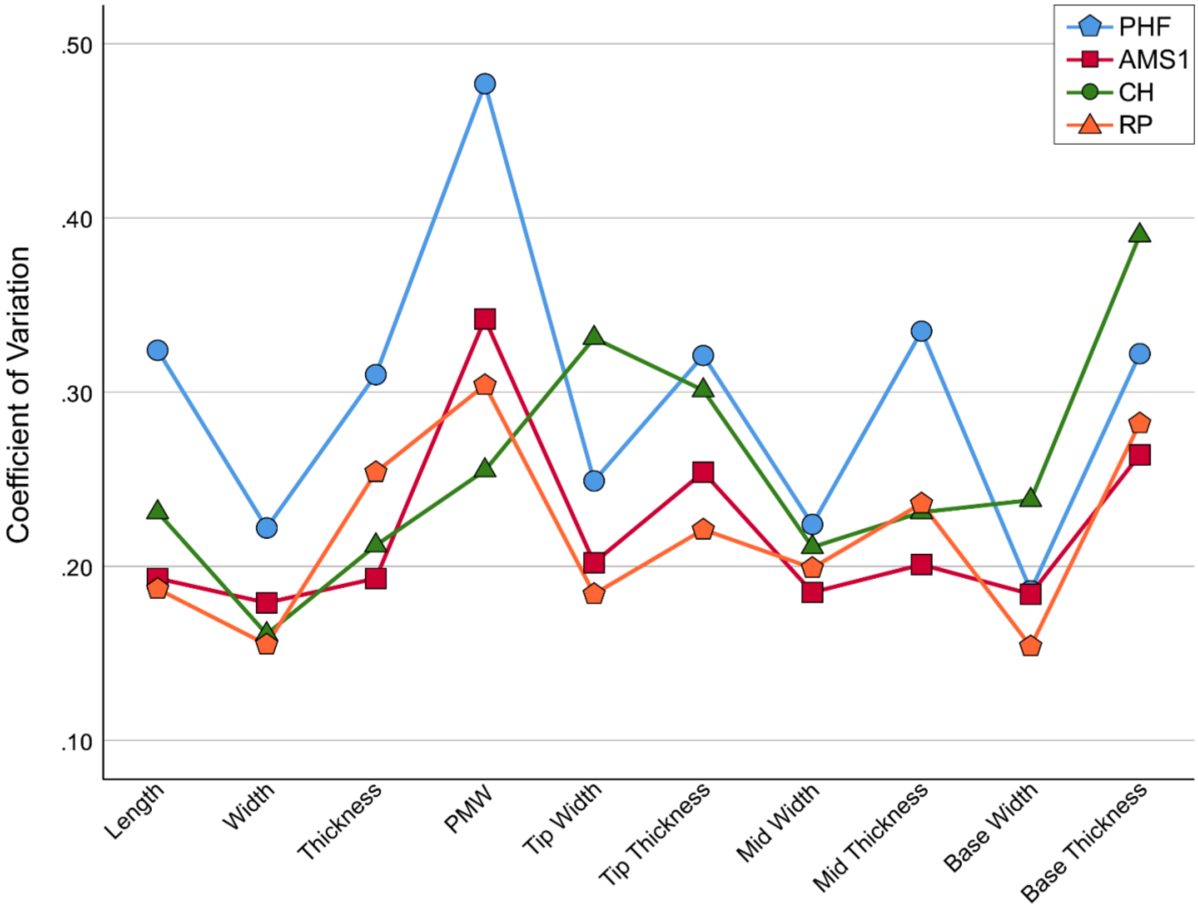

Figure 5. Line graph displaying coefficient of variation scores for Penhill Farm (PHF), Amanzi Springs (AMS1), the Cave of Hearths (CH) and Rietputs 15 (RP).

Table 2. Principal component 1 (PC1), allometric component (AC) and coefficient of variation (CV) scores for assemblages analysed in this study.

Site name	Penhill Farm			Amanzi Springs			Cave of Hearths			Rietputs 15			Eastern Cape Sample		
Measurements	**PC1**	**AC**	**CV**	**PC1**	**AC**	**CV**	**PC1**	**AC**	**CV**	**PC1**	**AC**	**CV**	**PC1**	**AC**	**CV**
Length	0.10	0.87	0.32	0.12	0.91	0.19	0.15	0.96	0.23	0.08	0.58	0.19	0.11	0.94	0.25
Width	0.06	0.48	0.22	0.10	0.79	0.18	0.07	0.45	0.16	0.06	0.42	0.16	0.08	0.64	0.20
Thickness	0.12	1.04	0.31	0.10	0.74	0.19	0.12	0.78	0.21	0.22	1.55	0.25	0.14	1.12	0.26
PMW	0.35	3.06	0.48	0.26	2.00	0.34	0.43	2.82	0.26	0.16	1.11	0.30	0.20	1.63	0.37
Tip width	0.07	0.65	0.25	0.12	0.90	0.20	0.07	0.48	0.33	0.07	0.45	0.18	0.11	0.91	0.25
Tip thickness	0.10	0.84	0.32	0.14	1.08	0.25	0.16	1.07	0.30	0.14	0.96	0.22	0.15	1.21	0.30
Mid width	0.06	0.50	0.22	0.11	0.80	0.19	0.10	0.65	0.21	0.19	1.32	0.20	0.07	0.56	0.19
Mid thickness	0.13	1.12	0.34	0.10	0.79	0.20	0.10	0.65	0.23	0.19	1.30	0.24	0.12	1.02	0.24
Base width	0.03	0.24	0.19	0.11	0.85	0.18	0.08	0.52	0.24	0.06	0.39	0.15	0.08	0.69	0.22
Base thickness	0.13	1.19	0.32	0.15	1.16	0.26	0.24	1.60	0.39	0.28	1.91	0.28	0.16	1.28	0.29

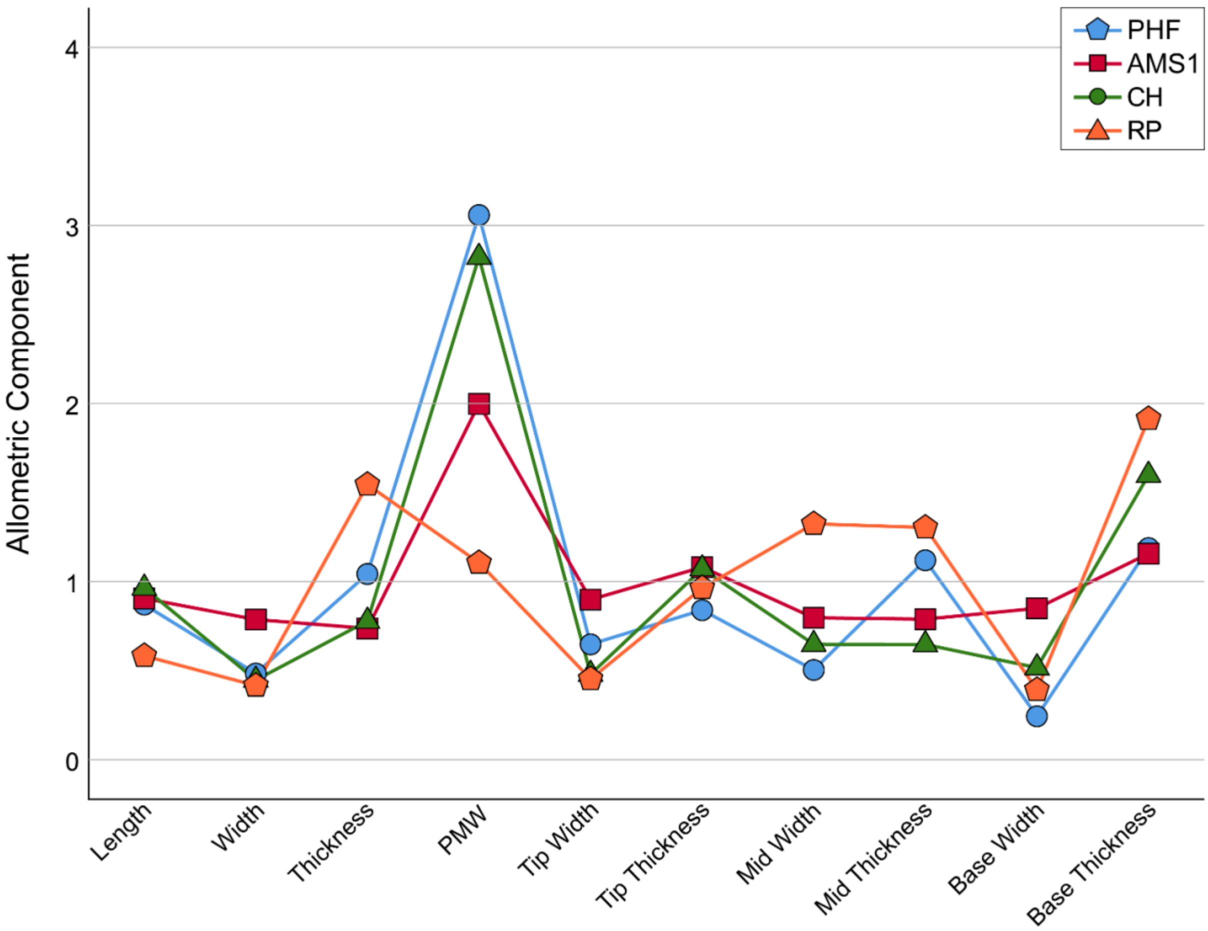

Figure 6. Line graph displaying allometric component scores for Penhill Farm (PHF), Amanzi Springs (AMS1), the Cave of Hearths (CH) and Rietputs 15 (RP).

Figure 7 displays AC plotted against CV scores for PHF and AMS1, which provides insight into variable groups that share similar relationships between allometry and variability. For instance, the PHF sample shows two loose variable groupings, the first comprised of width dimensions (maximum, tip, midsection and base), which are low in variance and decrease relative to allometric scaling; and a second group comprised of length and thickness variables (maximum, tip, midsection and base), which are higher in variance yet nearly isometric. On the other hand, the AMS1 sample shows two tightly grouped variable sets, one comprised of length, width (maximum, tip and midsection) and thickness (maximum and midsection), which are low in variance and decrease slightly with allometric scaling; and a second group of tip and base thickness variables that are higher in variance and increase slightly with allometric scaling. For both samples, PMW represents their own single group of extreme positive allometry.

Multivariate allometry – regional comparisons

To understand regional patterns of variability, we combined the PHF and AMS1 datasets into a single 'Eastern Cape Acheulean' sample. We note limitations in using two sites to represent variation for an entire region of South Africa, where much of the Acheulean archaeology remains understudied or undocumented. We consider this analysis a preliminary set of results from which methods can be used for further characterising the Eastern Cape Acheulean expression. Figure 8 compares CV values of linear measurements relative to Rietputs 15 and the Cave of Hearths, where the Eastern Cape sample is more variable in length, width and midsection thickness. Lastly, AC values for the Eastern Cape sample were determined thorough the MVA methods described above, which showed positive allometric trends for maximum, tip, and base thicknesses, as well as PMW, while maximum, midsection and base width dimensions display negative allometric trends (Fig. 9). Length and tip width show slight negative allometric patterns, while midsection thickness is isometric.

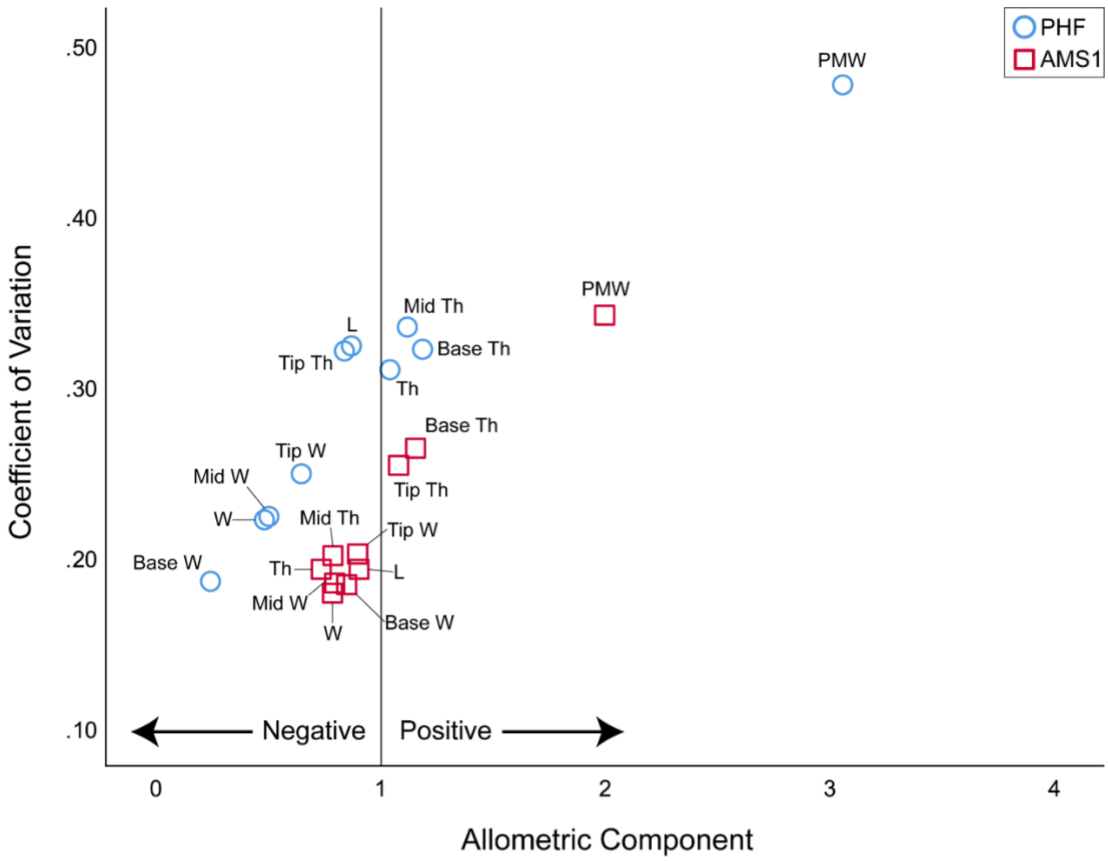

Figure 7. Scatterplot graph regressing coefficient of variation against allometric component scores for Penhill Farm (PHF) and Amanzi Springs (AMS1), where negative values show less allometric variation and positive values show greater variation.

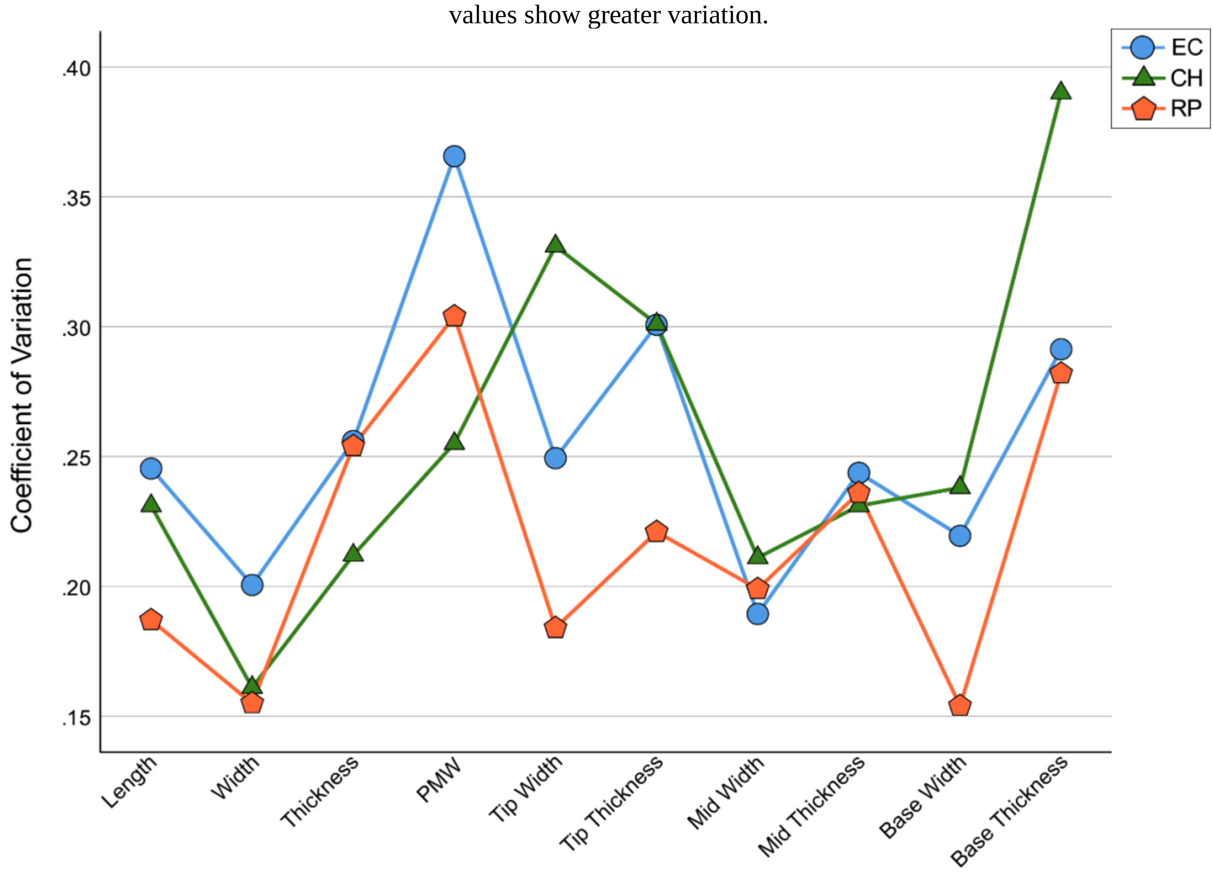

Figure 8. Line graph displaying coefficient of variation scores for the Eastern Cape sample (Penhill Farm + Amanzi Springs) with the Cave of Hearths (CH) and Rietputs 15 (RP).

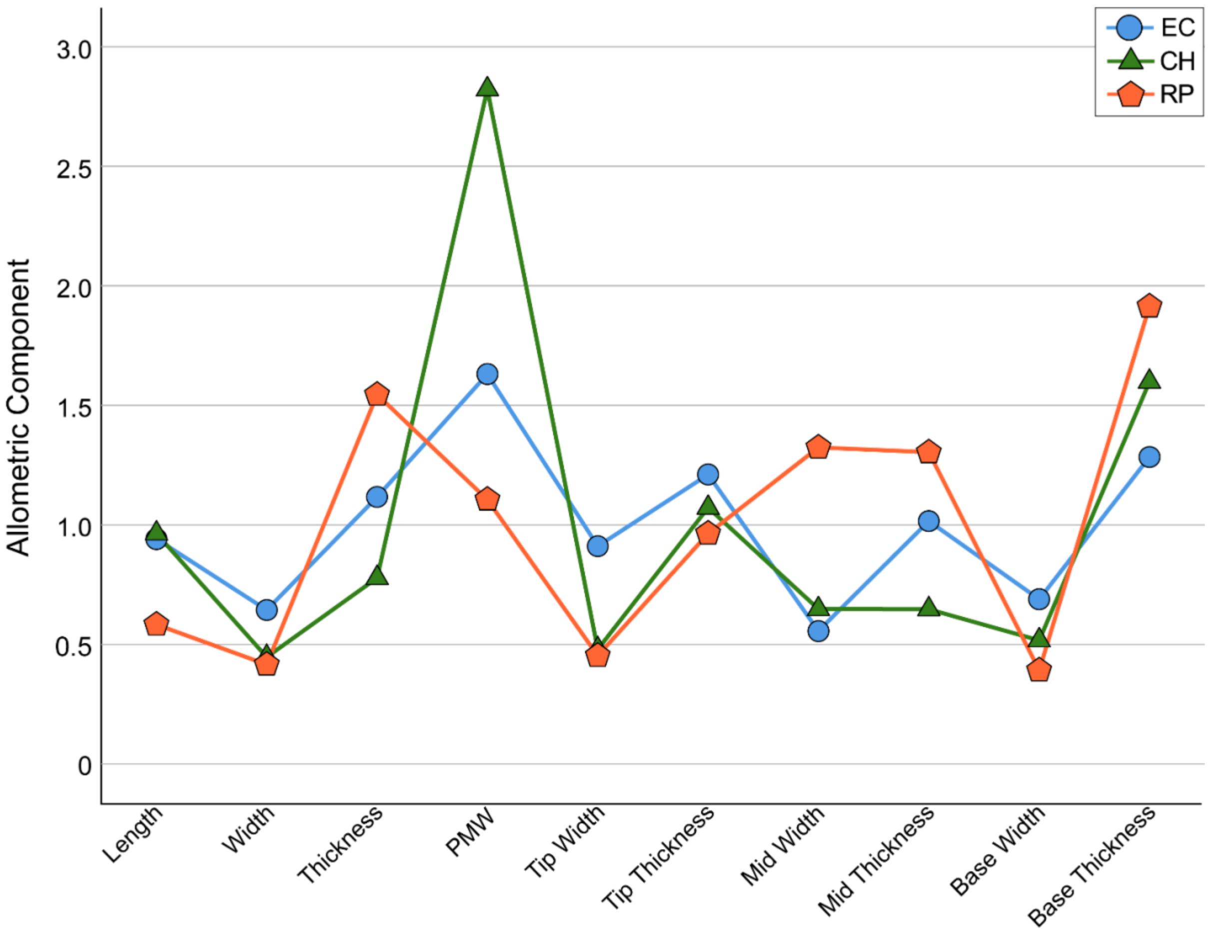

Figure 9. Line graph displaying allometric component scores for the Eastern Cape sample (Penhill Farm + Amanzi Springs) with the Cave of Hearths (CH) and Rietputs 15 (RP).

5. Interpreting 'rule-sets' from allometric relationships

Inter-assemblage comparisons

Looking at differences between PHF and AMS1 highlighted in techno-morphological variables shows that the AMS1 assemblage is larger in overall geometric size (Figs 3 & 4). While there are no differences in reduction intensity (SDI), the refinement ratio distinguishes PHF as thinner relative to width proportions, which may potentially relate to a higher frequency of flake blank use. Comparing general trends in variation, PHF shows higher CV values in maximal length, width and thickness proportions (Fig. 5). The thickness of tip, midsection and base proportions in the PHF handaxes are also substantially higher when compared to AMS1. These CV scores provide insight into what aspects of handaxe morphologies were standardised, in terms of low variance. Overall, the AMS1 sample seems more standardised across length, width, thickness, as well as midsection width, midsection thickness and base width proportions.

Turning attention towards allometric trends, the PHF handaxes show a clustering of near isometric trends in maximal length and thickness, as well as in thickness proportions across the tip, midsection and base proportions (Figs 6 & 7). Width proportions in the PHF handaxe generally showed trends towards negative allometry, with base width showing the most negative allometric pattern. The AMS1 sample shows slightly negative allometric trends for length, and most width and thickness proportions, while tip and base thickness increase slightly with allometric scaling (Figs 6 & 7).

In breaking down comparisons between variance and allometric trends, specific 'rule-sets' can be interpreted (see Crompton & Gowlett 1993). The concept of a rule set is based on the notion that allometric scaling of specific proportions (i.e., length, width, thickness, etc.) correlates to high and low levels of variance. When specific proportions display low variance, they are relatively more standardised and were likely managed by ancient knappers throughout reduction processes. As mentioned above, controlling certain proportions of handaxes in relation to their size likely impacted their utility (Gowlett 2006, 2011, 2013, 2021; Key & Lycett 2017, 2020). However, CV scores are a relative measurement of variance. To define a meaningful point in which to distinguish high versus low variance, CV scores for all linear measurements for PHF and AMS1 were averaged to a value of 2.5. Thus, CV scores above this level might be considered high relative to the PHF and AMS1 assemblages.

Based on this, interpreting patterns in Figure 7, we see that width in the tip, midsection and base width regions of PHF handaxes were standardised, which also show similar trends towards negative allometry. This suggests that PHF knappers were likely focused on reducing width proportions in larger handaxes. Interestingly, Lotter (2020a) showed that secondary shaping on tips and midsections was higher when compared to base regions, which corroborates differential patterns of reduction across handaxe bodies. Conversely, thickness proportions in PHF handaxes were not as standardised, which may have been 'pre-determined' during the production of large flake blanks that were transported to the PHF area (Lotter & Kuman 2018b; Lotter 2020a; Lotter & Caruana 2021). Within the AMS1 handaxes, most variables aside from tip and base thickness proportions were relatively standardised. Caruana and Herries (2020, 2021) have argued that most of these artefacts were likely abandoned after primary shaping, and thus their similarities in length, width and thickness proportions were also likely influenced by the use of raw material packages. Cobble reduction predominates LCT shaping processes in the AMS1 sample, which suggests that knappers were collecting raw material packages based on overall size (Caruana & Herries 2020). Tip and bases thicknesses were seemingly difficult to control for the AMS1 knappers, which corresponds with the fact that evidence of thinning is rare in the LCTs at this locality (Caruana 2021; Caruana & Herries 2020, 2021).

Inter-regional comparisons

When grouping PHF and AMS1 into a single, Eastern Cape (EC) sample, trends in variance (i.e., CV) are generally high when compared to Rietputs 15 and the Cave of Hearths (Fig. 8). Averaging CV scores between the EC, Rietputs 15 and the Cave of Hearths samples provides a value of 2.4, which we use to define high versus low levels of variance. In the EC sample, only mid width and base width show relatively low levels of variance, i.e., standardisation. In the Rietputs 15 handaxes, length and width proportions were generally low in variance, as well as width across the tip, midsection and base regions (Fig. 8). Thickness and base thickness display relatively high levels of variance. When comparing these trends to allometry, thickness and width in the midsection, as well as base thickness proportions increase with size scaling (Fig. 9). This suggests that knappers either had difficulties in managing thickness in larger handaxes, specifically in the base region, or raw material packages were highly variable. Li et al. (2018) demonstrated equal proportions of cobble (33.3%) versus flake blank (36.8%) use, which may account for variability in thickness proportions. They also showed that primary and secondary shaping were higher in tip and midsection regions of these tools when compared to bases. Overall, knapping strategies may have been more focused on managing the length to width relationship rather than thickness proportions.

In the Cave of Hearth sample, maximal proportions in length, width and thickness, as well as midsection width, midsection thickness and base width show low patterns of variance (Fig. 8). On the other hand, proportions of tip width, tip thickness and base thickness vary considerably, which also show patterns of positive allometry (Fig. 9). Thus, the Cave of Hearth knappers seemingly did not focus on reducing the tip proportions, nor base thickness of larger handaxes. Interestingly, Li et al. (2018) showed that primary and secondary shaping were fairly standardised across the entire body of handaxes at this site. Thus, the influence of raw materials on handaxe morphologies was comparatively less at the Cave of Hearths when compared to the rest of the sites analysed in this study. The trends observed in the Cave of Hearths handaxes may instead relate to a more classic pattern of larger handaxes representing those that were less reduced. As handaxes became smaller throughout reduction sequences, their tip width and thickness proportions decreased proportionately.

6. Conclusion

Our study demonstrates a high degree of variability in the techno-morphological traits of handaxes from

PHF and AMS1 (see Table 1). Some of this variability is significantly different when compared to other Acheulean assemblages on an inter-assemblage scale, which may reflect trends that are characteristic of the Eastern Cape. However, both the PHF and AMS1 handaxes show some consistency in linear measurements, and constraints on size-shape relationships, specifically in width to thickness proportions.

From a regional perspective, an emerging pattern of differential reduction in handaxes is beginning to emerge (Li et al. 2018; Caruana & Herries 2020, 2021; Lotter 2020a). This corroborates the notion that handaxes may not have become more 'refined' through time in terms of their proportions overall, nor their symmetrical planview shapes (cf. McNabb & Cole 2015; Li et al. 2018; Caruana 2020). The causes of variation in handaxes are perhaps more complex than initially perceived and cannot be simply explained by 'trends through time'. When we contextualise results for PHF and AMS1, we see different pattern of behaviours at these sites. At PHF, Middle Pleistocene hominins were seemingly visiting the area to exploit raw materials within exposed terraces of the Sundays River. While collecting and reducing cores for small flakes (<10cm) and formal tool production, large flake blanks for shaping handaxes were brought into the area (Lotter & Kuman 2018a; Lotter 2020a; Lotter & Caruana 2021). These archaeological trends speak the fact that hominins visited the PHF area to produce flake tools, while some shaping of LCTs took place at other localities. Handaxe variation at PHF was undoubtedly impacted by mobility patterns where only specific portions of LCT production processes were carried out on site.

On the other hand, hominin populations were likely periodically visiting spring sites at AMS to exploit natural resources and raw materials to specifically shape LCTs (Caruana & Herries 2020, 2021; Herries et al. in press). The higher frequencies of handaxes and cleavers at AMS1 (~10% of the total lithic assemblage; see Herries et al. in press) when compared to PHF (~0.3% of the total lithic assemblage; see Lotter & Kuman 2018a) infers differences in technological behaviours. Thus, the function of AMS1 as a possible 'LCT workshop' also impacts handaxe variability, where the discard of artefacts after primary shaping results in specimens that are larger than numerous other Acheulean assemblages (Sharon 2007; Caruana & Herries 2020, 2021). Thus, we assume that highly reduced LCTs that had gone through thinning and finishing stages at AMS1 were transported off site.

Putting these patterns together, the handaxes from PHF and AMS1 suggest that raw material packages and specifically the use of flake blanks versus cobbles influenced differences in morphological proportions. Similarities in the structure of quartzites corroborate previous findings that the quality of raw material alone does not constrain artefact morphologies (see Eren et al. 2014; Dogandžić et al. 2020). The larger size of AMS1 handaxes reflects the use of large cobbles to shape handaxes, whereas a focus on flake blanks likely constrained the proportions of the PHF specimens. Beyond this, group mobility patterns were also influential to some degree. Transport of blanks into PHF and finished pieces out of AMS1 influenced observed levels of variation. Discard behaviours and tool transport at these sites left handaxes at different stages of reduction. Such factors skew levels of morphological variability at an assemblage level, which are in turn directly related to the movement of Acheulean populations on the wider landscape. Local and inter-regional variability in LCTs is likely the result of raw material use, site-specific reduction behaviours and group mobility patterns. Therefore, preliminary insights into handaxe variability suggest that the Acheulean is not a static technological entity. Rather the Acheulean reflects a flexible system of toolmaking, centred around a tradition of shaping specific forms that were carried out according to access to raw materials and the movement of Acheulean people.

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Supplementary online material
Caruana & Lotter Supplementary Online Material File 1

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THE REMEDIATION OF KRUGER CAVE: A LATER STONE AGE AND LIVING HERITAGE SITE IN THE WESTERN MAGALIESBERG

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ABSTRACT
We report on a programme of work to remediate Kruger Cave, a Later Stone Age painted rock shelter in the western Magaliesberg, South Africa. Kruger Cave, excavated in the 1980s and never backfilled or stabilised, has deteriorated through forty years of erosional and quotidian processes that have significantly reduced the extent of the archaeological deposit. The cave is currently occupied by a lay Christian pastor whose activities at the site place the remaining archaeological deposit at further risk. Remedial work was undertaken on what remains of the archaeology-bearing sediment. We also present the preliminary analysis from two small-scale excavations that aimed to document the site's stratigraphy. We explore the ambivalence of Kruger Cave's living heritage status within the context of current heritage management practices and discuss how our remedial work is designed to be responsive and respectful to both the archaeological and living heritage priorities.

Keywords: Kruger Cave, Oakhurst, Magaliesberg, living heritage, remedial archaeology

1. Introduction

Kruger Cave is a painted rock shelter with Holocene deposits overlooking the Hex River in the western Magaliesberg, South Africa (Fig. 1). Immediately east of the cave is the Olifantsnek Dam, which was completed in 1932 and has been a popular fishing spot ever since. The cave, which is one of only seven recorded rock painting sites in the Magaliesberg, is currently the occasional home of a lay Christian pastor who has been living at the site intermittently since 2013, and since 2018 on a semi-permanent basis (Bradfield & Lotter 2021). Situated on what is now public land, the footpath past the cave entrance is frequently traversed by weekend revellers to the angling club grounds below, and by pedestrians from the R24 road above, both of whom seem to be in search of a secluded rendezvous. Cartons of sorghum beer litter the alcoves behind the dam wall.

Originally excavated in 1956, the site underwent a large-scale excavation in the early 1980s in response to persistent vandalism (Unknown Author 1982; Mason 1988). The rationale for the 1982-1983 campaign, which removed approximately two-thirds of the deposit, was to 1) rescue data before further damage occurred, 2) ascertain the relationship between the rock art and the occupation of the site, and 3) gather more information about the plant material that people were using in the region between 10 000 and 1000 BP (Mason 1988). The deposit was excavated along a NW to SE grid and the sediment removed in 10 cm spits and sieved through an 8 mm mesh (Steele 1987). Approximately 460 kg of sediment, which we estimate to be about 3% of the total excavated material, was floated and sieved through a 2 mm mesh to retrieve small, light-weight botanical remains (Friede 1987). A fence erected to protect the site at the conclusion of the 1983 excavation had proved ineffectual by 1986, having been, by that stage, partly torn down and removed (Alan Retief pers. comm. January 2020).

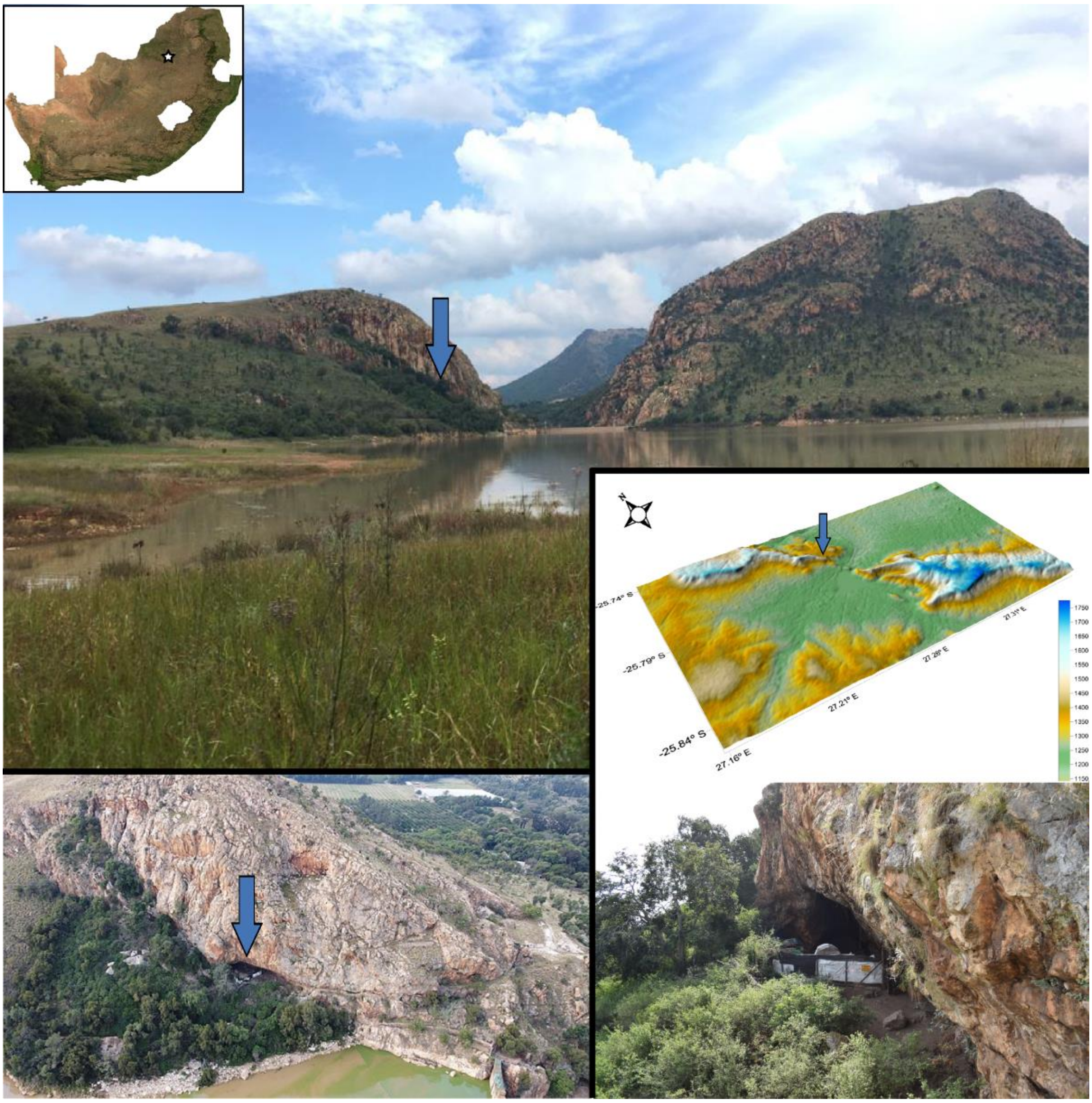

Figure 1. Location of Kruger Cave and its entrance as it appears in 2022. The elevation map (heights in meters) is provided courtesy of Fernando Colino (using data from the NASA EOSDIS Land Processes Distributed Active Archive Centre [LP DAAC]). Aerial photograph provided courtesy of Vincent Carruthers.

Contrary to standard archaeological excavation procedure (e.g., Du Toit & Küsel 2015; Vogelsang 2017), Kruger Cave was never backfilled at the conclusion of the 1983 season. Consequently, the open excavation trench has been subject to 40 years of natural erosion and anthropogenic deterioration. Figure 2 presents a rough timeline of photographs showing the extent of erosional slump and surface deflation as of April 2022. Based on our conservative estimates, a further 22.8 m^3 of archaeological deposit has been lost to erosion. The fact that the site is currently inhabited places an additional risk to the remaining deposit, as normal quotidian activities (e.g., sweeping the floor) can be destructive, however unintended.

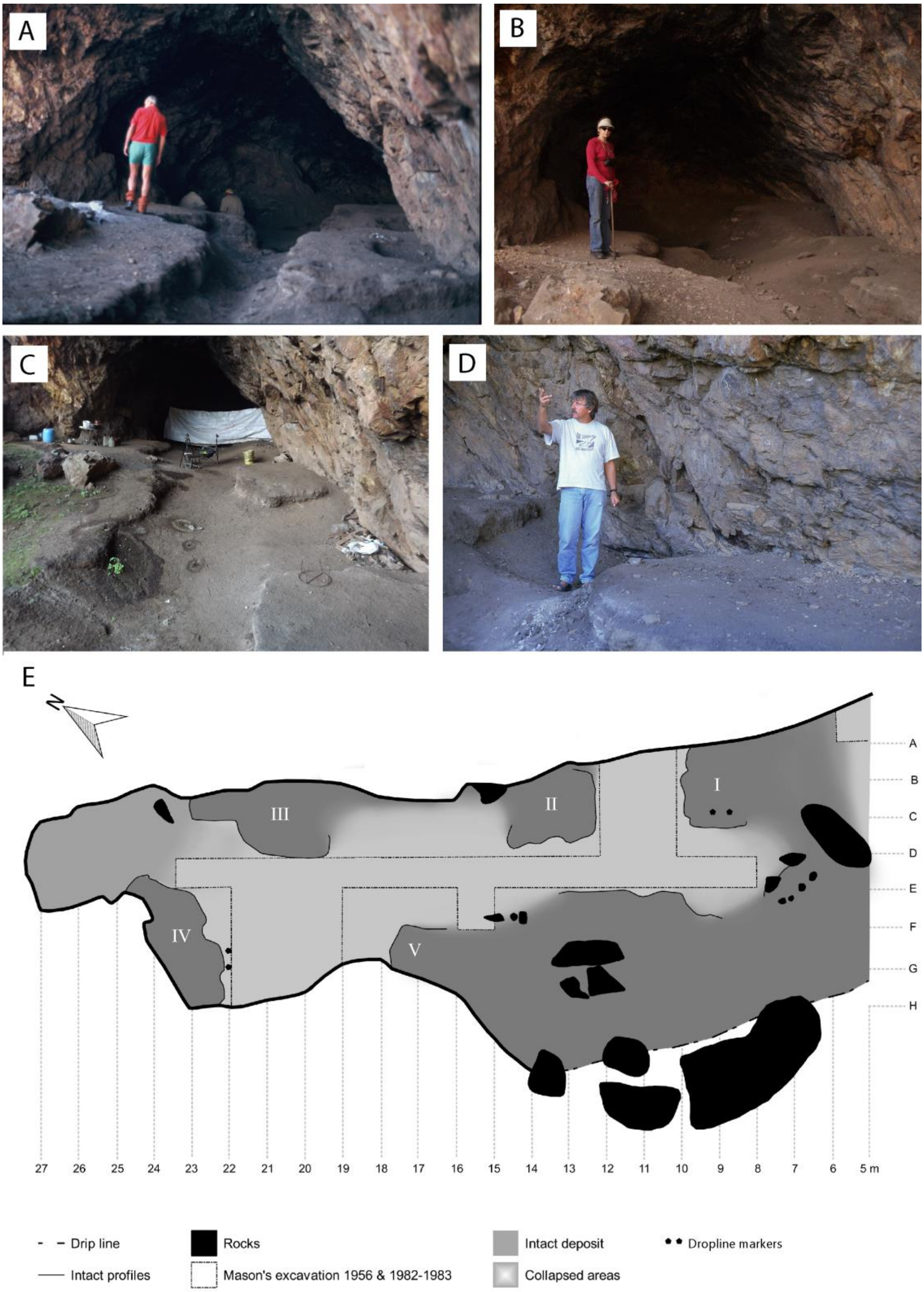

Figure 2. Chronological site photos. a) looking towards the rear of the cave in 1997; b) looking towards the rear of the cave in 2007 with the same boulder in the left foreground; c) the site in 2021 showing the makeshift partition erected by Pastor Voyi for privacy in the rear and Mason's AC 10-12 excavation in the fore; d) Simon Hall standing in the AC 10-12 excavation in 1997. Below is our map showing the intact deposit in dark grey and slump deposit in light grey. The stabilised bulks are labelled I-V. A rectified version of Mason's excavation grid is superimposed for reference (used throughout when referring to locations, i.e., excavations). Twin pentagons indicate our dropline markers, between which are the rear profiles of our two small excavations. Historical photographs supplied courtesy of Vincent Carruthers.

It is not uncommon to revisit a site decades after it was originally excavated. Scientific, technological and methodological advancements present opportunities for higher resolution palaeoenvironmental information, better dating and reassessment of stratigraphic contexts and site formational history. Analytical and digital recording technologies, such as aDNA and DStretch, that were not available 40 years ago can provide new information about a site that contributes to broader archaeological questions. A host of southern African Pleistocene and Holocene sites have been re-excavated in recent years, including Olieboomspoort (van Der Ryst 2006; Val et al. 2021), Elands Bay Cave (Porraz et al. 2016), Grassridge Rockshelter (Collins et al. 2017), Border Cave (Backwell et al. 2018), Mwulu's Cave (de la Peña et al. 2019), and Klipfonteinrand (Mackay et al. 2020), all with encouraging results. Several others are ongoing (e.g., Justin Pargeter's re-excavation of Boomplaas Cave). Kruger Cave, with its exceptional organic preservation and unique finds, similarly has the potential to contribute to our knowledge of Holocene subsistence strategies, human diseases, palaeo-pharmacology, responses to inter-ethnic contact and the material culture repertoire of Holocene hunter-gatherers, but only if it is preserved from further effacement.

Here we present the programme of work carried out in April 2022 to stabilise the remaining intact deposits in order to preserve them for future scientific research, while being responsive to the living heritage status of the site and the needs of its current occupant. Apart from not being backfilled, Kruger Cave was excavated rather crudely in 10 cm spits, instead of following the natural (and clearly visible) stratigraphy. Most of the material was sieved through course 8 mm mesh, which would have missed many small finds. We therefore also present the findings of two small-scale excavations in the fore and rear of the cave undertaken specifically to document the stratigraphy of the site and to attempt to correlate the 1983 radiocarbon dates with stratigraphic layers. Further analyses of the excavated materials are ongoing.

2. The archaeology of Kruger Cave

In this section we summarise the findings from Mason's original excavations of Kruger Cave; results of our new work are described below. Steele and Mason recognised five depositional lenses, interchangeably referred to as carapaces or clusters, of which three are dated and described (Mason 1988). Using the latest radiocarbon calibration curve for the Southern Hemisphere (Hogg et al. 2020) Lens One dates to 10 751-7956 BC, Lens Two to 6222-3901 BC and Lens Four to AD 641-1217. Lens One contains an Oakhurst technocomplex lithic signature, with Lens Two evincing a slightly smaller variant of the same lithic technology. Lens Two represents a late expression of the Oakhurst as it overlaps with the Wilton technocomplex at contemporaneous sites like Boomplaas Cave and Jubilee Shelter (see Deacon 1984; Wadley 1987). Lens Four abuts the NE wall in the fore of the shelter and appears to have been cut into the older underlying deposits by the first millennium AD occupants (Mason 1988). The sediment deposit is largely determined by the natural slope of the shelter floor. Very little sediment is present in the SE section, whereas the depth of deposit in the NW section is approximately 90 cm. Natural sediment stratigraphy is horizontal to a depth of ~40 cm, below which more complicated grass and vegetal layers (5657-5331 BC) occur. In one section in the rear of the cave (DE 23-24) there is evidence that these grass layers were dug into the older underlying Lens One deposit (Mason 1988). The first millennium AD occupation appears to have been restricted to the outer section of the shelter, near the drip line, and it is likely that the paintings date to this period (Mason 1988). The artefacts from this final period of occupation resemble contemporaneous assemblages from other sites in the wider area, such as Munro Cave and Olieboooomspoort, and are consistent with a final Later Stone Age attribution (*sensu* Lombard et al. 2012). Lithic raw material is dominated by quartzite, hornfels, dolerite, chert and andesite.

Hunting provided the bulk of the meat supply throughout the three occupations, although fishing was also practised. The only noticeable change in subsistence activity in the first millennium AD occupation from the preceding Oakhurst occupations is the prevalence of freshwater mussels, particularly *Unio* and *Aspatharia* sp. (Brown 1987). Some of the remarkable organic finds from this site include: a bladder cap with human hair preserved; a bone quiver with bone arrowheads inserted, poisoned bone and wooden arrowheads, one of which has beautifully preserved ochre paint; finely plaited plant-fibre rope, and chewed bark. Eggs from two parasites, *Trichuris* sp. and *Ascaris* sp. were found in a human coprolite (Evans et al. 1996) suggesting the potential for the site to inform on palaeo-parasitology (see Rifkin et al. 2017). Two individuals of the extinct springbok (*Antidorcus bondi*) were also identified in the deposit (Brown & Verhagen 1985).

Kruger Cave is one of only seven recorded rock art sites in the Magaliesberg. Pager (1987) recorded 57 poorly preserved and crudely executed monochrome paintings on the NE wall of the shelter, the overwhelming majority (70%) of which are depictions of humans, with men carrying weapons constituting the dominant theme. Birds and animals are also recorded. Pager noted that the human depictions at Kruger Cave are on average slightly larger than comparable depictions at other sites in the Magaliesberg and Drakensberg. Although the paintings have not been dated, they are thought to be contemporaneous with the Lens Four deposit or first millennium AD occupation (Mason 1988).

Along with other hunter-gatherer sites in the Magaliesberg, Kruger Cave was unoccupied between AD 300 and AD 600 when the first Bantu-speaking farmers infiltrated the landscape. Kruger Cave preserves the earliest record (in the form of pot sherds) of Iron Age occupation of the Magaliesberg (Mason 1962), although there is no evidence for farmer occupation of the cave itself. Between AD 600 and AD 1300 climatic deterioration is thought to have pushed the farmers out of the area. As with other sites in the region, Kruger Cave was re-occupied by hunter-gatherers during this period, after which they permanently abandoned the region when the farmers returned. The remaining archaeology at Kruger Cave is from the early twentieth century when the blacksmith working on the dam wall had his shop in the cave entrance.

3. Approaches to conservation of living heritage sites

The primary objective of cultural conservation is to protect heritage from loss or damage and to mitigate those causes of destruction such as neglect, decay and mismanagement. Conservation measures of archaeological sites range from structural stabilisation to camouflage and barricading, all of which may affect the way a site is experienced and interpreted by the community (Matero 2008; Sullivan & Mackay 2012; Du Toit & Küsel 2015; Vogelsang 2017). For an archaeological site to be relevant to a community they must be able to appreciate it, visit it and interact with it (UNESCO 1972; Miura 2005; Smith 2006; Jones & Yarrow 2013; Williams 2018). Indeed, part of the mandate of any conservation management plan should be to ensure the retention of cultural significance (Sullivan & Mackay 2012).

But what happens at living heritage sites? Broadly defined, living heritage is the aesthetic, spiritual, symbolic and social traditions, including other intangible aspects, such as traditional knowledge, ritual, music and oral traditions that are practised at a site (UNESCO 2003; Deacon 2004). Such practices may not necessarily be related to the site's original purpose, and in fact they seldom are (e.g., English Heritage 2009; Moephuli 2016). While contemporary uses may add to the social and symbolical value of an archaeological site, they may also threaten its integrity, where integrity is understood as relating to the site's original function (Lala 2014). One of the challenges of conserving a living heritage site is what to prioritise. While some would argue that conservation must consider the authenticity of a site (Matero 2008), there has been a steady call to re-evaluate and broaden received notions of authenticity (Ndoro 2003; Bwasiri 2011). It is now widely recognised that archaeology is a constantly evolving process that sometimes leads to conflicting perspectives of what is relevant (Pwiti 1996; Ouzman 2003; Harrison & Schofield 2010; González-Ruibal 2014; Lala 2014). What is relevant to contemporary local communities may not be what was important to the community in the past or what is relevant to the science community. Core to the concept of living heritage conservation is that it must be cognisant of such dichotomies and responsive to the needs of contemporary communities, regardless of whether they are related to the original inhabitants (ICOMOS 1994; Agnew 1997; Jokilehto 2007; Poulios 2011; Ndoro 2015; Williams 2018). The best results are often achieved when living heritage is incorporated into management plans to the financial benefit of local communities (Miura 2005; Bwasiri 2011; Lala 2014). We return to these issues in respect of Kruger Cave below.

4. Programme of work and findings

As part of an ongoing programme to reinvestigate some of the findings from the 1982-1983 excavations, a direct date was obtained from the bladder cap that Mason (1988) had interpreted to be of 19th century

Ndebele origin. This relative date was based on the fact that the bladder cap was found in the upper 20 cm of the deposit and that only Nguni groups are known to have used gall bladders as part of their headdresses. Our direct date on the bladder tissue, however, returned a result of 500±46 bp (IT-C-3305), which calibrates to AD 1398-1504. This clearly indicates that the upper levels of Kruger Cave are much older than previously thought. It is precisely these levels that have been most adversely affected by erosion and deflation, and which are most at risk of further effacement.

The continuing deterioration of the archaeological deposit at Kruger Cave as a result of the Pastor's activities was carefully monitored between 2017 and 2022. Although damage was negligible, it was present. What damage occurred during this time was mostly the incidental result of quotidian activities that paled in comparison to the natural, erosional degradation that had already taken place since 1983. Nevertheless, the potential of Kruger Cave to contribute to our knowledge of Holocene hunter-gatherers is sufficient inducement to protect what remains of the archaeological deposit. It was therefore decided to stabilise the intact deposit in a manner that would both protect the remaining archaeology and be accommodative of the pastor's needs.

Excavations to document stratigraphic profiles

Prior to stabilisation, we selected two areas, in the fore and rear of the cave, near to where Mason had obtained some of his radiocarbon dates and that had clearly visible and intact stratigraphic profiles. Following Mason's grid reference, we chose squares BC8 and FG22 as being representative of all three chronological lenses. To obtain clean stratigraphic profiles we removed the slump material to bedrock and then excavated back a ~30x50 cm area. The rear profile wall of each excavation is shown as a pair of pentagons on the map in Figure 2. When removing the slump material in front of FG22 from the area indicated by Mason to be in his excavation trench, we discovered *in situ* deposit. We therefore proceeded with careful excavation of this deposit back to the edge of the exposed bulk and down to bedrock but were consequently unable to incorporate the exposed bulk into our excavation. The top layer (VDGB) of FG22 therefore lies below the 6452-5331 BC dates obtained from adjacent squares and most likely represents only the oldest dated lens. Figure 3 shows our two small excavations and the 'step' of exposed, intact deposit above our excavation. Figures 4 and 5 present the stratigraphic profiles of each section.

Figure 3. Top row: excavation and profile images of FG22. Note the step of intact bulk above, and set back from, the surface of our excavation. Bottom row: excavation and profile images of BC8.

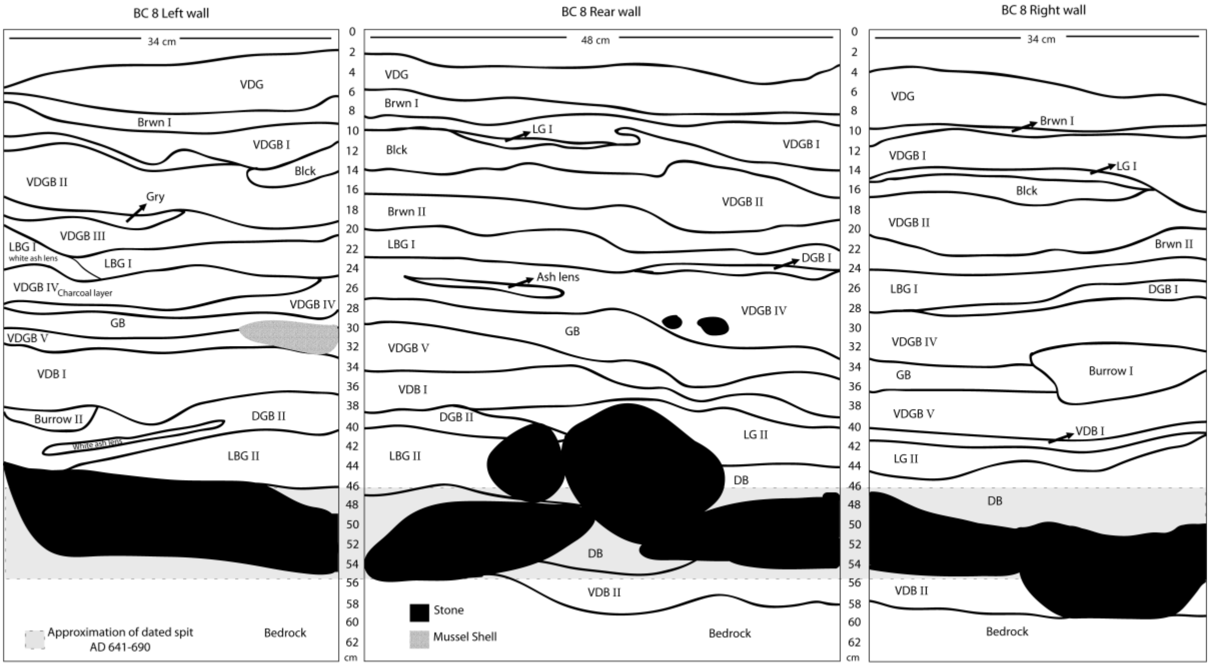

Figure 4. Profile drawings of BC8.

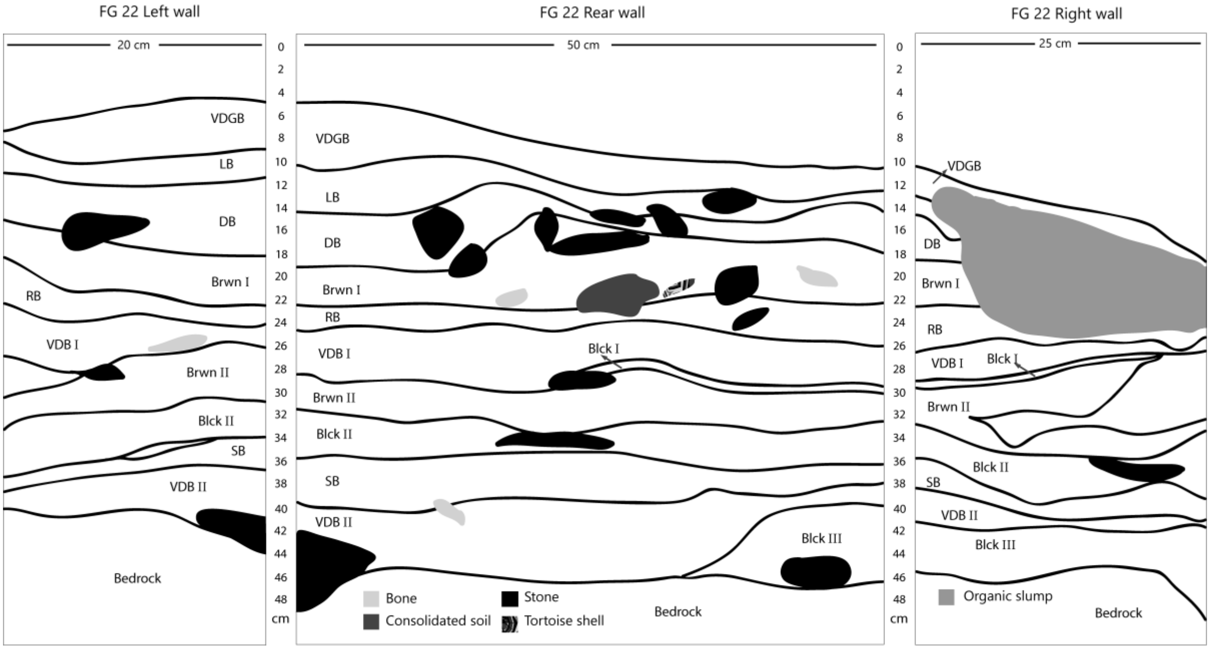

Figure 5. Profile drawings of FG22.

Excavation followed similar protocols to that used at Border Cave (Backwell et al. 2018). Each excavated stratigraphic layer was assigned a Munsell colour code and named accordingly. Duplicates of the same name are distinguished by Roman numerals. It should be noted that even though the same names sometimes repeat in BC8 and FG22, this does not necessarily indicate that the layer is contiguous, merely that there is a colour correspondence. All excavated material was sieved through 2 mm and 1 mm meshes, sorted and weighed. The nett weights of sorted material per category are presented in Table 1. A full analysis of the material is pending. Four soil samples were taken from each of the rear profile walls for future sediment DNA analysis. In both excavations a large quantity of material was recovered from the slump deposits, highlighting the volume of previously *in situ* deposit that has been contextually lost due to erosion. Metal and silica globules are present in the upper layers of BC8 and probably relate to the blacksmith's workshop. The silica globules form when molten metal comes into contact with the sandy floor, causing the silica in the sand to melt and congeal around the molten droplet (Thy et al. 2015). In general, our findings from the two excavations concur with Mason's.

Table 1. Sample weights per stratigraphic layer. All values are in grammes. Note that * indicates that weight is skewed due to the presence of a large hammerstone. Whereas any tortoise bones are included in the 'bone' column, tortoise carapace and plastron has been given its own column in the table.

Square and layer		Bone	Charcoal	Lithics	Metal	OES	Plant	Shell	Silica	Tortoise	Total
BC 8	Slump	432	7	546	115	5	2	609	0	13	**1729**
	VDG	7	25	23	96	-	5	0	24	-	**180**
	Brwn I	5	39	12	-	2	4	0	18	-	**80**
	VDGB I	9	19	75	-	2	4	3	24	-	**136**
	LG I	6	5	12	-	2	3	3	-	-	**31**
	Blck	3	1	34	-	-	0	-	-	-	**38**
	VDGB II	15	15	13	-	3	6	5	-	-	**57**
	Gry	5	7	3	-	-	2	3	-	-	**20**
	Brwn II	11	11	38	-	0	1	0	-	-	**61**
	VDGB III	15	9	18	-	-	7	3	-	-	**52**
	LBG I	11	6	-	-	2	2	5	-	-	**26**
	DGB I	11	9	30	-	2	5	2	-	-	**59**
	VDGB IV	36	35	41	-	3	15	39	-	-	**169**
	GB	31	24	56	-	-	0	58	-	2	**171**
	VDGB V	79	16	38	-	0	1	77	-	1	**212**
	VDB I	50	37	26	-	0	0	240	-	0	**353**
	DGB II	30	13	913*	-	3	1	17	-	4	**981**
	LG II	52	19	61	-	1	0	86	-	-	**219**
	LBG II	66	21	74	-	0	6	34	-	3	**204**
	DB	36	8	23	-	-	3	2	-	3	**75**
	VDB II	45	9	275	-	2	2	-	-	2	**335**
	Total	**955**	**335**	**2311**	**211**	**27**	**69**	**1186**	**66**	**28**	**5188**
FG 22	Slump	852	38	843	-	19	155	24	-	63	**1994**
	VDGB	33	3	20	-	1	3	1	-	1	**62**
	LB	61	4	19	-	5	3	1	-	2	**95**
	DB	51	10	16	-	5	3	-	-	3	**88**
	Brwn I	267	5	301	-	15	4	-	-	38	**630**
	RB	129	5	44	-	9	1	-	-	7	**195**
	VDB I	102	9	13	-	-	2	-	-	15	**141**
	Blck I	18	7	5	-	2	3	-	-	7	**42**
	Brwn II	63	9	103	-	-	-	-	-	5	**180**
	Blck II	18	17	292	-	-	15	0	-	19	**361**
	SB	48	12	2	-	-	3	-	-	7	**72**
	VDB II	170	128	80	-	-	1	2	-	0	**381**
	Blck III	9	-	20	-	-	-	7	-	-	**36**
	Total	**1821**	**247**	**1758**	**0**	**56**	**193**	**35**	**0**	**167**	**4277**

Similar to Mason's excavations we found a low ratio of stone artefacts to excavated deposit. Unmodified flakes dominate the lithic technology category, while cores are relatively scarce (Table 2). Bladelet and split pebble cores are the most common throughout the deposit. The retouched tool category is dominated by scrapers. Along the outskirts of Kruger Cave many hammerstones and Oakhurst-style D-shaped scrapers made from dolerite and hornfels can be found lying on the surface (Fig. 6). These items recur in the FG22 deposit, whereas BC8 contains smaller scrapers on quartz and chalcedony, typical of the final Later Stone Age (Fig. 7). Although we have not performed use-wear on our sample, Johann Binneman (1987), working on a small sample from Mason's excavation, found that wood-working wear was evident on scrapers with hinge and step flaked edges, whereas scrapers with abraded convex edges tended to display wear consistent with hide scraping.

The fauna has not yet been analysed to taxon, but we do not expect it to differ substantively from what was identified by Brown (1987). The bone weight is almost double in FG22 compared to BC8 (Table

1). FG22 also has far more evidence of butchered bone (Fig. 8; Table 3). Butchery marks range from one or two precision cuts (Fig. 8a) to a crude sawing motion (Fig. 8c & e). Fourteen pieces of modified bone were recovered, including bone point fragments, one of which had multiple incised decorations, and a perforated abraded piece that could have been a pendant (Fig. 9; Table 3). These decorations are consistent with those found by Mason. Bone modification is more prevalent in the younger BC deposit. Most of the bone shaft fragments were made by grinding against an abrasive surface (Fig. 9f), whilst others were whittled with a sharp lithic blade (Fig. 9b & e). One piece recovered from the BC slump was ring-snapped and its opposite end ground smooth (Fig. 9a). This technique is common after 4000 BP at several Later Stone Age sites throughout southern Africa, including Kruger Cave (Bradfield 2014, 2015a). Ring snapping is a rejuvenation technique used to shorten a bone point in a controlled manner. Edge grinding was only found in the BC deposit. Patterned horizontal scratching below the flattened end may indicate that a metal arrowhead was affixed over the bone (Bradfield 2015b), but no such metal device has yet been found here or at any other archaeological site where these bone modifications occur.

Table 2. Main lithic categories per layer. Column names are as follows (C=core, HS=hammerstone, RF=rejuvenation flake, F=flake, Bl=bladelet, CP=convergent point, A=adze, BP=backed piece, S=scraper, RP=retouched piece).

Square and layer		C	HS	RF	F	Bl	CP	A	BP	S	RP
BC 8	Slump	3	1	4	1	1	1	-	-	-	1
	VDG	-	-	-	-	-	-	-	-	-	-
	Brwn I	-	-	-	-	-	-	-	-	-	-
	VDGB I	-	-	-	-	-	-	-	-	-	-
	LG I	-	-	-	-	-	-	-	-	-	-
	Blck	1	-	-	-	-	-	-	-	-	-
	VDGB II	1	-	-	-	-	-	-	-	-	-
	Gry	-	-	-	-	-	-	-	-	-	-
	Brwn II	-	-	-	-	-	-	-	-	1	-
	VDGB III	1	-	-	-	-	-	-	-	-	-
	LBG I	-	-	-	-	-	-	-	-	-	-
	DGB I	-	-	-	-	-	-	-	-	1	-
	VDGB IV	1	-	-	-	-	-	-	-	-	-
	GB	1	-	-	-	-	-	-	-	-	--
	VDGB V	-	-	-	-	-	-	-	-	-	-
	VDB I	-	-	-	-	-	-	-	-	-	-
	DGB II	-	1	1	-	-	-	-	-	-	-
	LG II	3	-	-	-	-	-	-	-	-	-
	LBG II	-	-	1	-	-	-	-	-	-	-
	DB	-	-	-	-	-	-	-	-	-	-
	VDB II	-	-	2	-	-	-	-	-	-	-
	Total	**11**	**2**	**8**	**1**	**1**	**1**	**0**	**0**	**2**	**1**
FG 22	Slump	3	-	1	2	2	-	1	-	5	1
	VDGB	-	-	-	-	-	-	-	-	-	-
	LB	-	-	-	-	-	-	1	-	-	-
	DB	-	-	-	-	-	-	-	-	-	-
	Brwn I	-	-	-	1	1	-	-	-	2	-
	RB	-	-	-	-	-	-	-	-	-	1
	VDB I	-	-	-	-	-	-	-	-	-	-
	Blck I	-	-	-	-	-	-	-	-	-	-
	Brwn II	-	-	-	-	-	-	-	1	1	-
	Blck II	-	-	-	-	-	-	-	-	1	-
	SB	-	-	1	-	-	-	-	-	-	-
	VDB II	-	-	1	-	-	-	-	-	-	-
	Blck III	-	-	-	1	1	-	-	-	-	-
	Total	**3**	**0**	**3**	**4**	**4**	**0**	**2**	**1**	**9**	**2**

In addition to bone, four pieces of ivory were found, some of which have been knapped (Fig. 9d). Based on gross morphology and provisional histology at the break facets, three of the four ivory pieces come from warthog (*sensu* Espinoza & Mann 1992; Locke 2008). The most intact warthog tooth has remnants of ochre paint near the tip (Fig. 9g). The ochre paint appears identical to that which was applied to the 6000 BP poisoned arrowhead recovered by Mason (for a colour photograph of this artefact see Bradfield & Choyke 2016: figure 3).

Figure 6. A typical sample of lithic material found lying on the slopes below Kruger Cave.

We recovered 41 ostrich eggshell beads (Fig. 10). Beads are concentrated in the lower half of the BC8 deposit and confined to the upper four levels of FG22 (Table 3). The total average diameter of ostrich eggshell beads is 3.9 mm, but when measured according to excavated square the FG22 bead average diameter is 3.5 mm compared to the slightly larger 4.5 mm for BC8. The median diameter is 3 mm across the board. Most of the beads were drilled from both ends, albeit unevenly.

Tortoise carapace and plastron occurred in large quantities throughout the FG22 deposit, but only in the lower half of BC8, where it occurred less frequently (Table 3). Unlike in the Mason excavation, we did not find any perforated tortoise shell. We did, however, find the articulated carapace of a baby tortoise *in situ* in FG22 Blck II (Fig. 11). This is a black hearth layer, rich in lithics and burnt seeds (Table 1).

All the pieces of carapace that we found are of a similar size, suggesting that people were deliberately targeting baby tortoises. Also in this layer, we found a dermal plate of a species of catfish (Fig. 11; cf. Ebstein et al. 2015). This is the first identification of this taxon at the site, although catfish are known from other riparian sites (e.g., Plug et al. 2010).

Figure 7. Lithics recovered *in situ*. a) a piece of chalcedony from the BC8 slump material retouched into a tear-drop shaped piece, possibly an arrow insert; b) a scraper from BC DGB; c) a dolerite adze recovered from the FG slump; d & e) D-shaped scrapers from FG Brwn I.

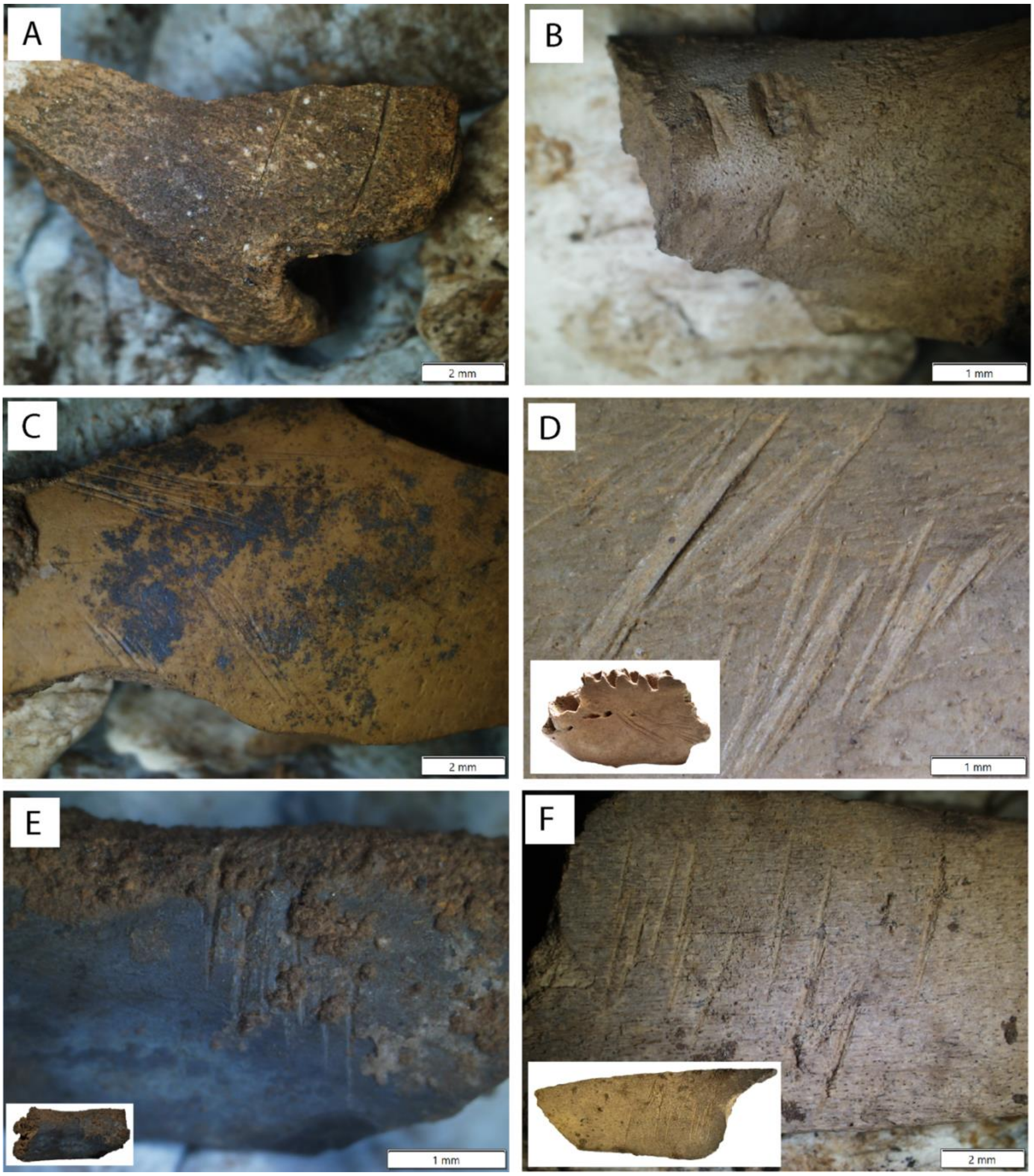

Figure 8. Butchery marks on bones from a) BC VDGB IV; b) FG VDB I; c) FG VDB I; d) FG Brwn I; e) FG Brwn II; f) FG slump.

Freshwater mussel proliferates in the first millennium AD deposit but is virtually absent in the older deposit (Table 1). Like Brown (1987), we found no other species of shellfish. Similarly, our cursory examination of the shell fragments did not identify any edge abraded pieces or other signs of use-wear. We did, however, find two pieces of perforated mussel shell and one piece that had a row of near-perforations (Fig. 12). Perforations appear to have been made using the same drilling technique used for ostrich eggshell beads. Indeed, the piece from BC8 LG II is additionally chipped and its surface abraded, presumably to make it resemble ostrich eggshell. Had it not broken we can suppose that it would have ended up perfectly resembling an ostrich eggshell bead. Although Mason's excavation did not recover any perforated mussel shells, he did remark on their occurrence at the nearby early Iron Age site of Broederstroom (Mason 1988). Coincidentally, the line of near-perforations slightly resembles a motif on a piece of tortoise carapace from 1500 BP levels at Broederstroom (Mason 1988: figure 48).

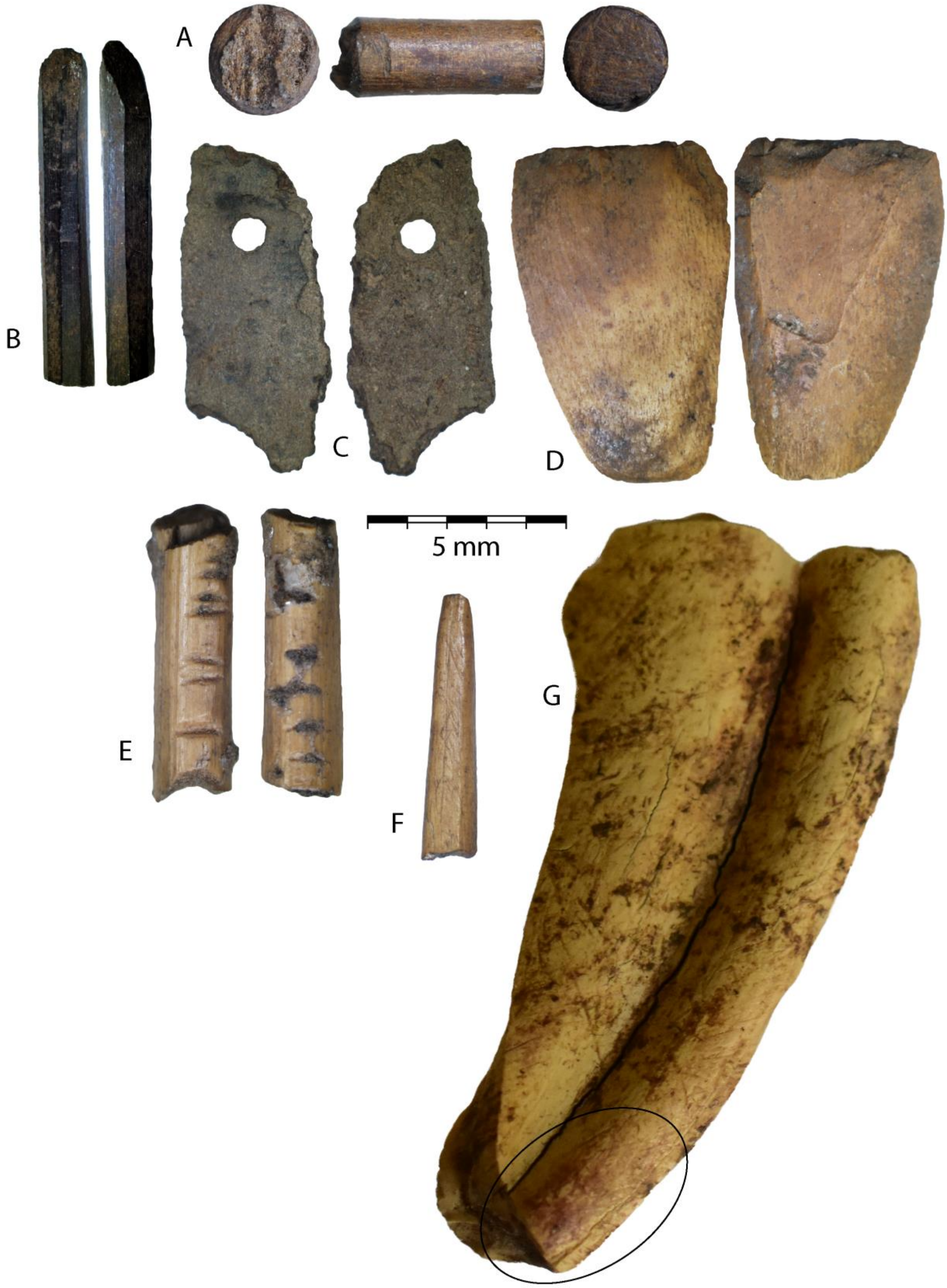

Figure 9. Worked bone and ivory. a) ring-snapped and edge abraded shaft from BC slump; b) a rare hexagonally faceted whittled bone shaft from BC slump; c) abraded piece of bone with perforation from BC VDGB I; d) ivory flake from BC VDB I; e) bone shaft with two sets of parallel incised decorations from FG LB; f) tip of a bone point from FG slump; g) warthog ivory tooth with ochre paint remnant near tip from FG slump, encircled.

Table 3. Showing cultural categories. The presence of burnishing (*), decoration (**) and perforation (#) per level is indicated, not necessarily the number of examples.

Square and layer		Modified bone	Butchered bone	OES bead	Ivory	Pottery	Perforated shell
BC 8	Slump	6	1	-	-	5**	-
	VDG	-	-	-	-	-	-
	Brwn I	1	-	-	-	-	-
	VDGB I	1#	-	1	-	-	-
	LG I	-	-	-	-	-	-
	Blck	-	-	-	-	-	-
	VDGB II	1	-	-	-	-	-
	Gry	-	-	-	-	-	-
	Brwn II	-	-	1	-	-	-
	VDGB III	-	1	--	-	-	-
	LBG I	-	-	1	1	2*	-
	DGB I	-	-	1	-	1	-
	VDGB IV	-	1	1	-	2*	-
	GB	-	-	-	-	-	-
	VDGB V	-	1	1	-	-	-
	VDB I	1	1	4	1	2	1
	DGB II	-	-	11	-	-	-
	LG II	-	-	1	-	-	1
	LBG II	-	-	1	-	-	-
	DB	-	-	-	-	-	-
	VDB II	-	-	1	-	-	-
	Total	**10**	**5**	**24**	**2**	**12**	**2**
FG 22	Slump	1	5	9	2	1	-
	VDGB	-	-	1	-	-	-
	LB	2**	-	1	-	-	-
	DB	-	2	1	-	-	-
	Brwn I	-	3	5	-	-	-
	RB	1	4	-	-	-	-
	VDB I	-	3	-	-	-	-
	Blck I	-	-	-	-	-	-
	Brwn II	-	3	-	-	-	-
	Blck II	-	-	-	-	-	-
	SB	-	-	-	-	-	-
	VDB II	-	-	-	-	-	-
	Blck III	-	-	-	-	-	-
	Total	**4**	**20**	**17**	**2**	**1**	**0**

Botanical remains consisted primarily of charred seeds, twigs and chewed bark, and occurred throughout the deposit of both excavations (Table 1). At least six types of seed were noted. Although a full taxonomic identification of the seeds is pending, they appear to represent the same species identified by Friede (1987), with *Mimusops* sp., *Strychnos* sp. and *Sclerocarya* sp. being the most common (Fig. 13). Several pieces of *Strychnos* exocarp were recovered from the FG slump material. One of these pieces appears to have a decorative line carved into it (Fig. 13e). This line has smooth, straight edges and does not resemble the pathological or taphonomic damage prevalent on most other pieces. Instead, its overall size, morphology and depth resemble the decorative carvings on *Strychnos* fruit that are still sold today (Sotran: dekorativ n.d.). Unfortunately, our attempts to refit the pieces of exocarp were largely unsuccessful, probably indicating that the remains are from several fruits. Nothing similar was reported by Mason. Chewed bark was recovered from the FG slump, FG LB and BC VDGB III (Fig. 13a). Many similar pieces were found in Mason's excavation and are identified by Friede (1987) as *Acacia natalia* (sic). This plant taxon has subsequently been reclassified as *Vachellia karroo* (Dyer 2014).

Figure 10. Ostrich eggshell beads from Kruger Cave (a-c=BC8; d-g=FG22). a) VDGB IV; b) VDB II; c) DGB II; d) VDGB I; e) LB; f) Brwn I; g) slump.

Figure 11. Articulated tortoise carapace and catfish dermal bone recovered from FG22 Blck II.

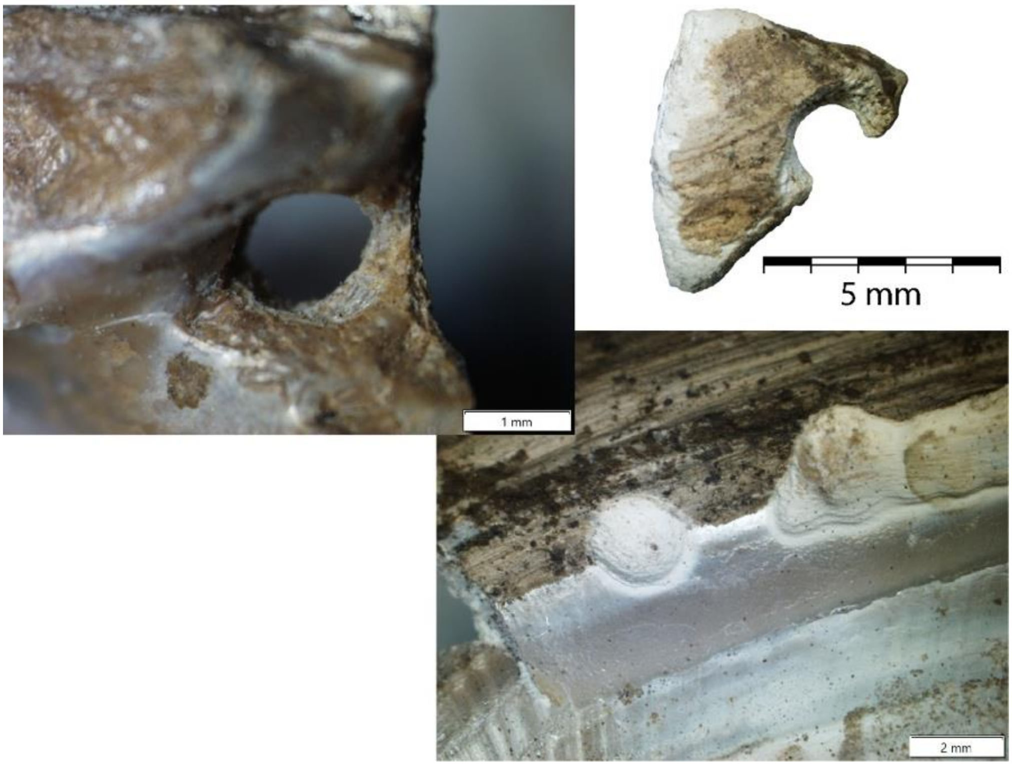

Figure 12. Perforated and near-perforated freshwater mussel shell. The broken abraded piece comes from BC LG II; the other two come from BC VDB.

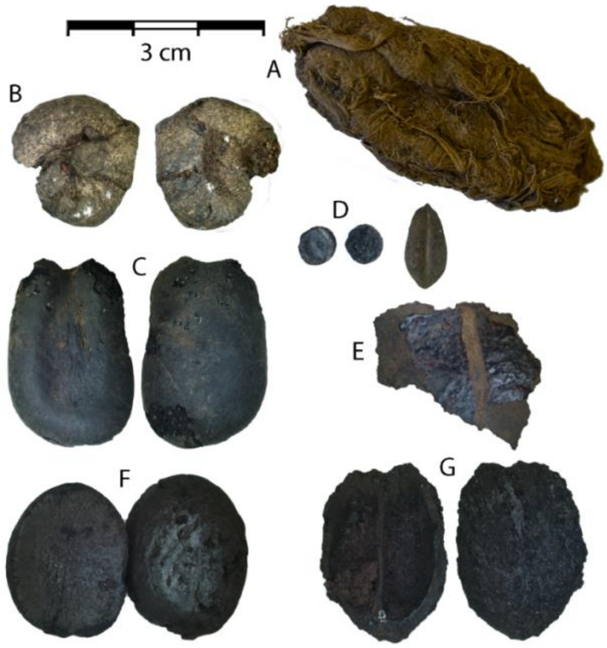

Figure 13. Botanical remains. a) chewed bark from FG slump; b) unidentified seed from BC VDGB I; c) *Strychnos* sp. seed from BC LBG II; d) unidentified seeds from BC LBG I; e) *Strychnos* sp. exocarp with putative decoration from FG slump; f) *Mimusops* sp. seed from FG Blck II; g) unidentified seed from FG Blck II.

Thirteen pieces of pottery were recovered from our excavation (Table 3). These included three rim sherds, of which two are decorated (Fig. 14), and two painted and burnished pieces. The rim sherds all come from the BC slump and match the motifs illustrated by Mason (1988: figure 59). The painted and burnished pieces come from BC LBG and BC VDGB IV and display a polished red hue on one or both sides respectively. Mason attributed the incised motifs to Kaditshwene Phase people, which correlates to Huffman's (2007) Uitkomst facies, although to us the decorative style seems more akin to facies within the Kalundu tradition than to what Huffman has illustrated as exemplars of Uitkomst (cf. Huffman 2007: 173). Mason noted the absence of Bupye (Huffman's Buispoort) pottery in the cave, despite its abundance in the surrounding countryside. We too did not recover anything that resembled Buispoort, although painting and burnishing is a feature common to this facies (see Huffman 2007).

Figure 14. Decorated rim pot sherds recovered from the BC slump.

Recording the rock paintings

In 2021, we photographed the entire length of the NE wall and ran all our photographs through the DStretch colour decorrelation algorithm. We were able to relocate only 38 of the 57 images recorded by Pager and were able to identify one that he missed. Paintings occur in two colours: red and black. The black figures are clustered together on the lower panel just inside the perimeter fence and may have been done at a different time or by a different artist than the other images. Figures 15-17 present some of the better-preserved images, with the originals on the left and colour-augmented versions on the right. The one that Pager missed is an antelope shown in Figure 17b, which is partly obscured behind an efflorescence flow. We were able to identify several red blotches through DStretch, which may be the degraded missing images that Pager recorded, or they may be mineral discolourations in the rock. Except for four images, all the missing paintings are from a 5 m densely clustered stretch near the base of the NE wall. Pager noted the generally poor preservation of the images consequent upon the effects of lichen growth and dust.

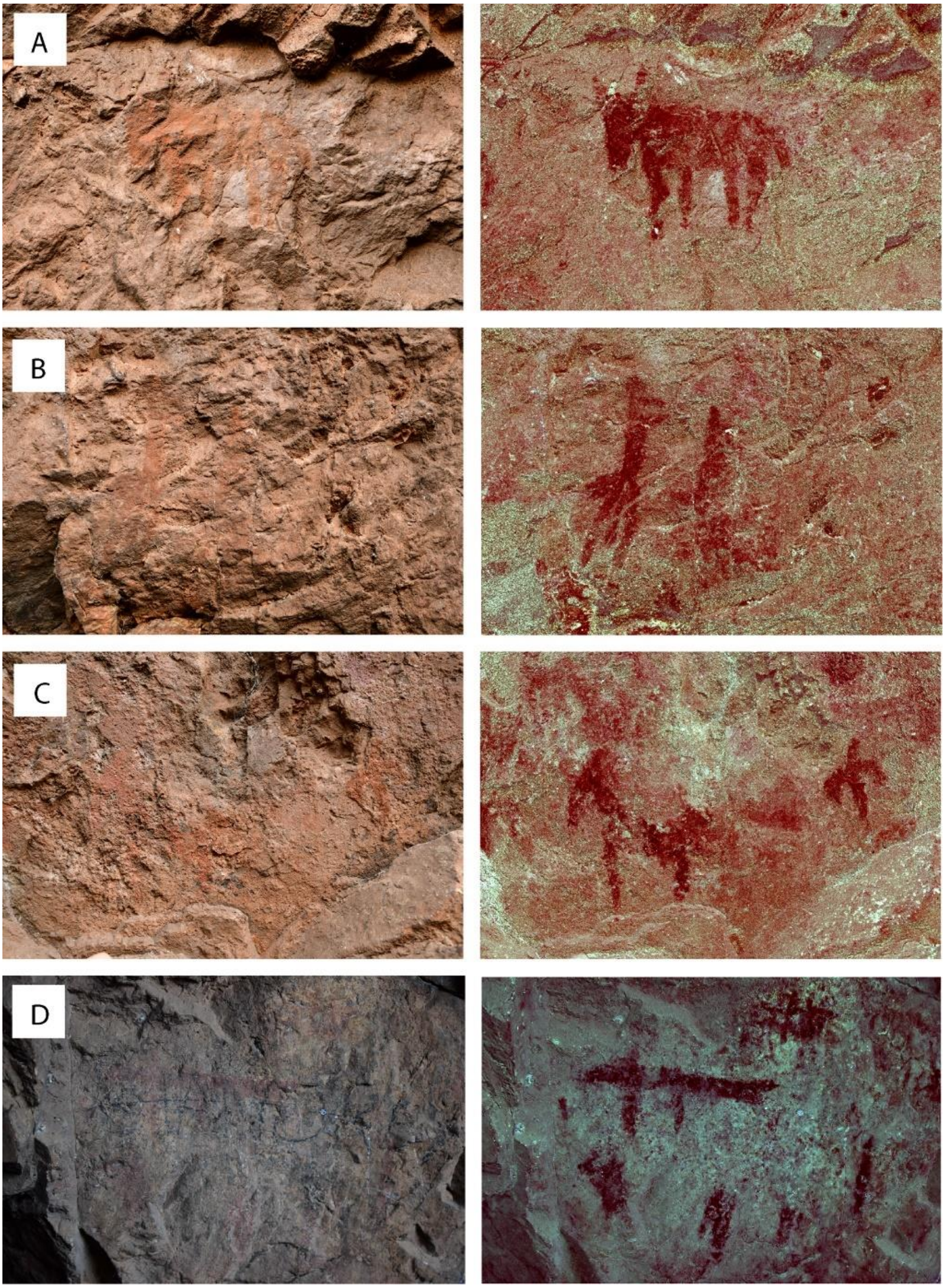

Figure 15. Rock paintings at Kruger Cave with digital photographs shown on the left-hand side and DStretch colour augmented images on the right.

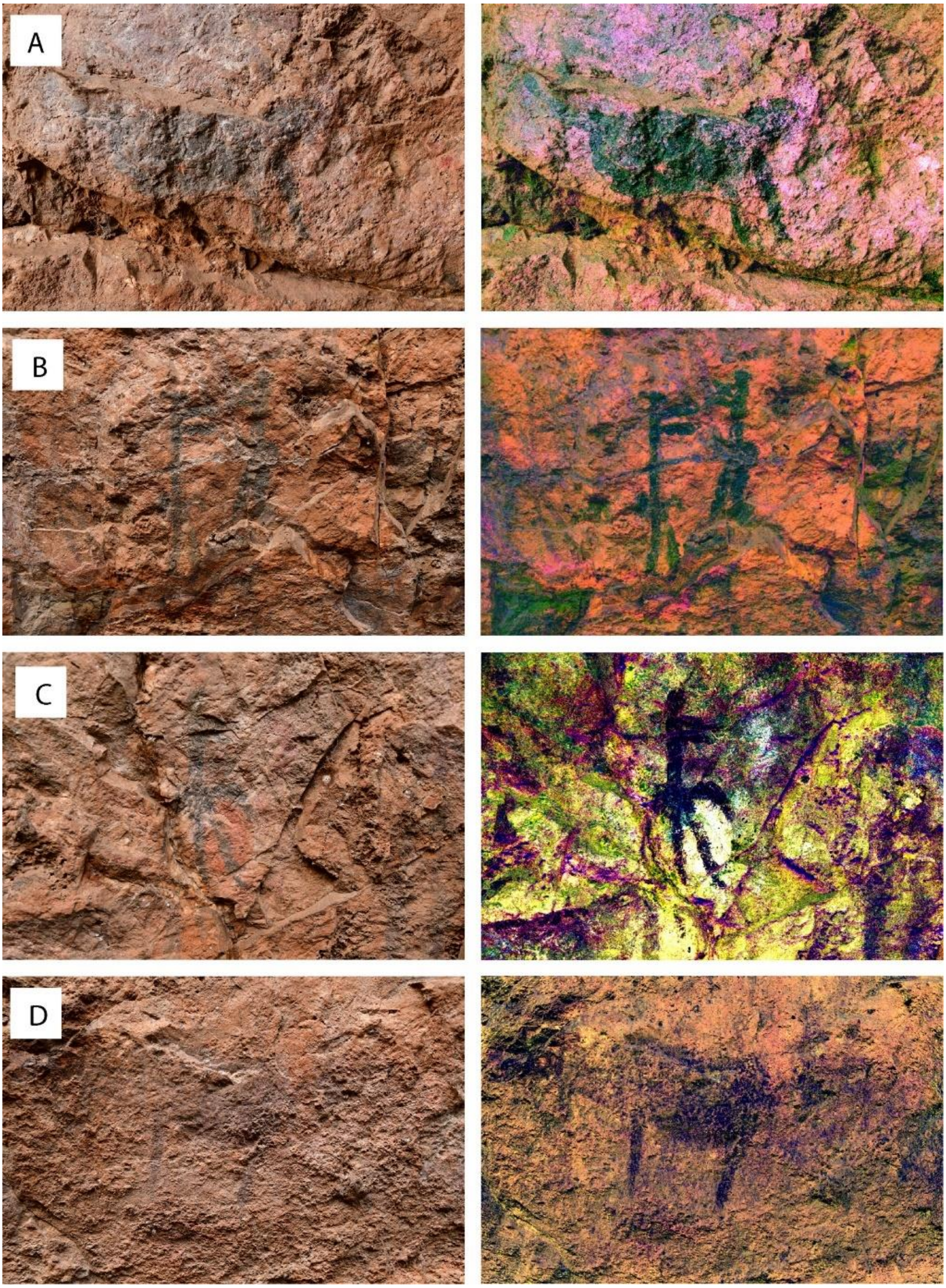

Figure 16. Additional rock paintings at Kruger Cave. Digital photographs shown on the left-hand side and DStretch colour augmented images on the right.

There is much graffiti on the wall at Kruger Cave. Most of the graffiti clearly mimics the paintings in theme, being drawings of stickmen carrying bows. The rest is of seemingly random assortments of letters and names – possibly of the 'artists'. There is only one case where graffiti overlays a painting (Fig. 15d). Pager (1987) does not mention graffiti in his report, but whether this is because it was not present at the time or because he simply did not regard it as relevant is impossible to say.

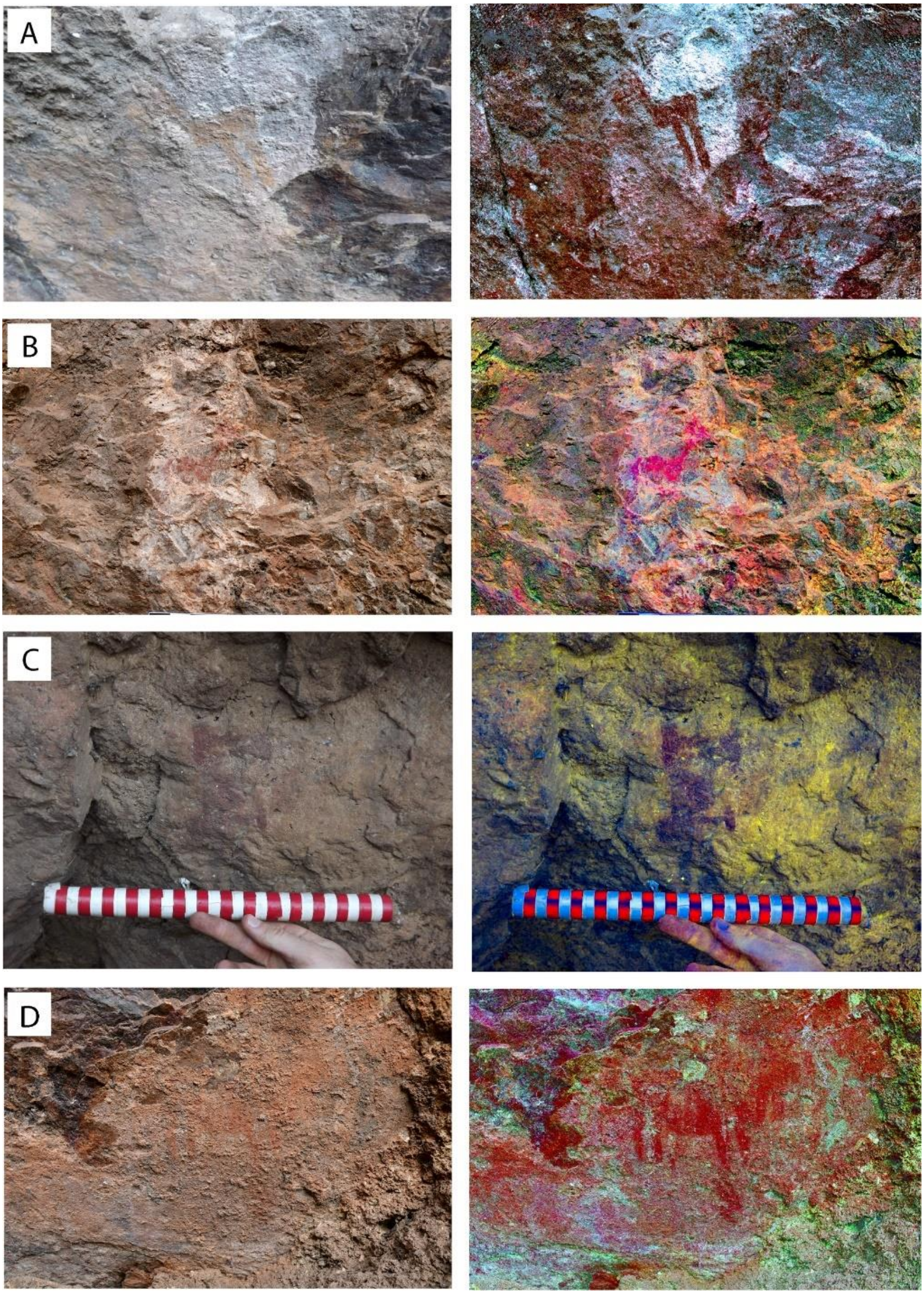

Figure 17. More rock art. Digital photographs shown on the left-hand side and DStretch colour augmented images on the right. The antelope image (b) which Pager did not record is partly obscured by efflorescence.

Stabilisation of the deposits

As a site that is currently occupied, Kruger Cave poses some challenges to traditional rehabilitation measures. Ordinarily, when closing a site, the excavated trench is partially filled with sandbags, which are then covered with loose sand closely approximating the natural sediment (Du Toit & Küsel 2015; Vogelsang 2017). The edges of the trench are lined with a geotextile tarp and then hidden by the loose sand, thus effectively camouflaging the excavation. This would not be an effective approach at a site that needs to serve the purposes of habitation. Simply walking around and sweeping the floor clean of leaves would soon remove the camouflage layer. Besides, our view is that disguising a site actually detracts from its authenticity (*sensu* Matero 2008). A site that has been excavated will always remain so, and there is no need to hide that fact. The excavation is part of the site's history. At Kruger Cave there are two places where sediment was removed in antiquity and replaced by more recent archaeological deposits. The first is in the rear of the cave where the grass bedding layer from the 5000-7000 BP occupation was dug into a hollow that removed some of the older 9000-10 000 BP deposit. The second is along the NE wall in the fore of the cave where the first millennium AD occupants removed the underlying deposit, which was subsequently filled in with their own material culture. The process of archaeological removal and accrual is part of the living heritage of Kruger Cave.

We therefore opted for a remedial approach, focused on stabilising those bulks of intact archaeological deposit that hold potential for future excavations, and left the rest of the site as is. Each of the five bulks was covered with an 8 mm thick geotextile blanket (Fibretex F1000 AFS). This geotextile is designed for large groundwork projects and is a highly durable, non-abrasive fabric that allows water filtration and evaporation, and acts as a protective padding for the underlying deposit. It is easy to sweep clean and will protect the underlying sediment from further erosion and deflation. The geotextile fabric is held in place with woven polypropylene sandbags propped against the exposed profile walls to further protect the profiles from accidental damage occasioned by human activity (Fig. 18). Mason's excavation trench was left as is to allow a walkway through the site and also to serve as a drainage channel for the Pastor's washing water and other effluent. This arrangement protects the remaining archaeology while still allowing the site to be responsive to the daily needs of its occupant and, together with the signboard to be erected in front of the site, highlights to visitors that this is a protected archaeological site.

Custodial conservation

Some might argue that the visibility of our remedial action might encourage curiosity that will lead to further vandalism of the site. Visible intervention measures have a poor track record in Africa. Mason's fence, which was intended to discourage visitors, failed to do the job for which it was designed. Even sophisticated protective panelling erected to safeguard Blombos Cave, located along a remote stretch on the Southern Cape Coast, proved to be a spectacular failure (Henshilwood 2016), probably because it increased the site's visibility and served to attract the unwanted attention of passing fishermen. Barricades are patently ineffectual. It is human nature to peer behind the curtain wherever one is found. But Kruger Cave is different.

It has been argued elsewhere that Kruger Cave's current occupant, Pastor Voyi, serves both as a psychological deterrent to visitors and an informal custodian of the site (Bradfield & Lotter 2021). Most visitors would have a natural aversion to an unknown occupant whom they may perceive as dangerous or threatening and would therefore avoid the cave. Those who do venture to the cave would be more inclined to behave due to the presence of another person (*sensu* Bentham 1791). At the same time, the pastor keeps the site clean and can be elicited to help protect the remaining paintings and deposit from further effacement. It is not uncommon for archaeological sites in Africa to be managed *de facto* by traditional custodians, if not for their physical fabrics then at least for their spiritual values (Pwiti 1996; Ndoro 2005; Chirikure et al. 2015, 2017). In the absence of any ancestral community that claims an atavistic connection to Kruger Cave, it is apparent that the pastor is the only person to whom the site currently has a spiritual connection and relevance, and is therefore a natural choice for custodian (Bradfield & Lotter 2021). The pastor must therefore necessarily be involved in any conservation efforts that pretend cognisance of the continuing process of archaeology and the changing associations and functions of the site (Agnew 1997; Jokilehto 2007; Matero 2008).

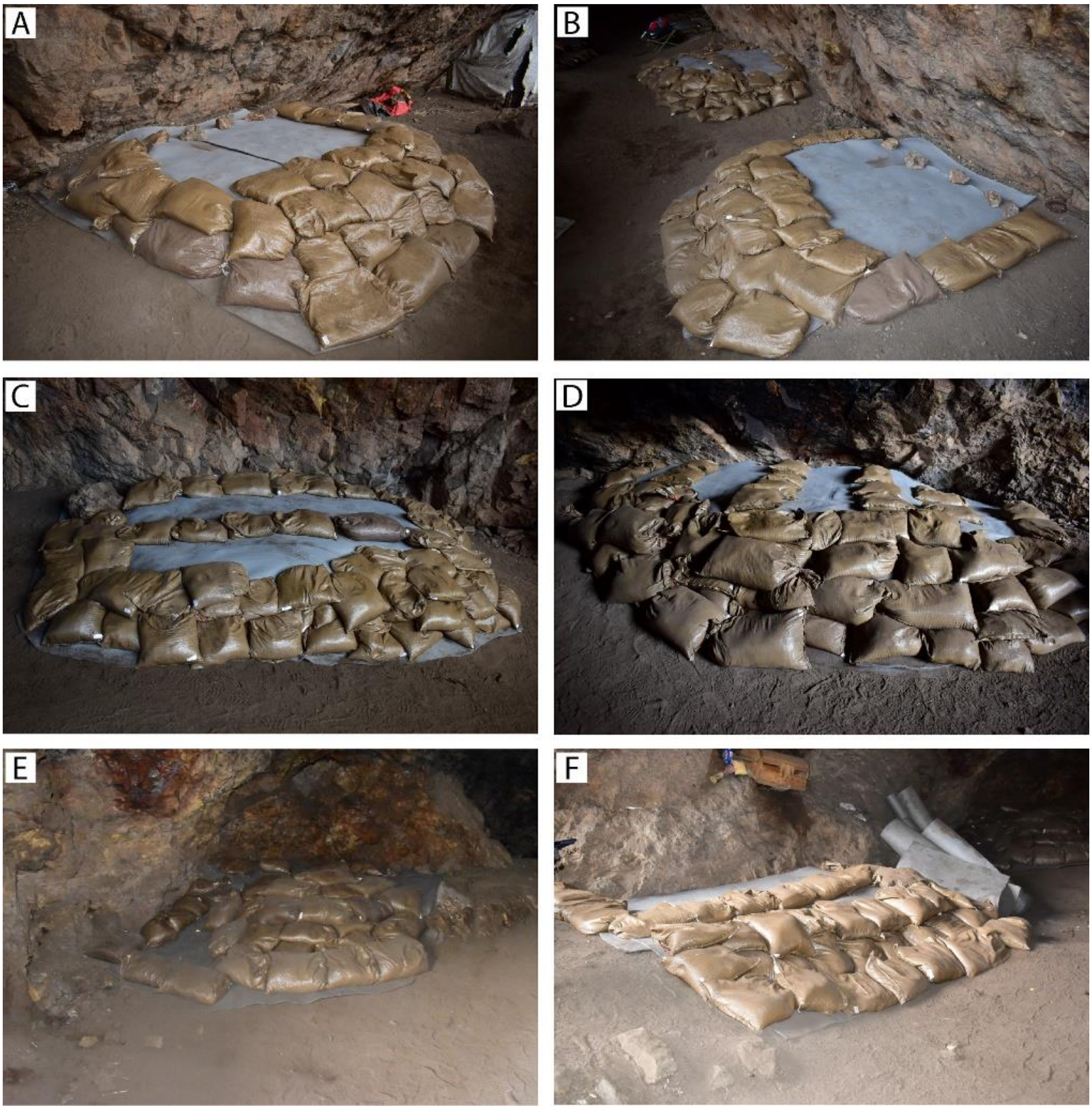

Figure 18. Stabilised bulks of intact archaeological deposit. Corresponding to the map in Figure 2, a) shows bulk A; b) showing bulk A in foreground and bulk B in the background; c) showing bulk B; d) showing bulk C; e) showing bulk D situated in the rear of the cave; and f) showing bulk E.

Pastor Voyi is aware of the archaeological significance of Kruger Cave and assisted with the stabilisation work. Together with other local stakeholders, including the ward council, angling club and irrigation board, we hope to formalise the pastor's role as custodian of Kruger Cave. Having a semi-permanent resident at the site will help protect it from intruders and will ensure that the sandbags and geotextile blankets stay in place, and that further graffiti on the walls is prevented. Formalising his role with relevant government and business entities that have an interest in developing the touristic potential of Kruger Cave will help to raise awareness of the site within the local Rustenburg and Olifantsnek communities. Through these channels, the pastor can help facilitate access to the site for legitimate visitors interested in learning about the archaeological history of the area. The site can serve a dual purpose that both honours and maximises the heritage potential of the site, and which also is sensitive to the pastor's functional and spiritual needs. In this way, Kruger Cave can become a signal example of a living heritage site.

5. Conclusion

Kruger Cave is one of those rare sites that preserves a wide array of organic remains in exceptional condition. There is still much scientific information that can be gleaned from the site, both in terms of what has been excavated and what remains to be excavated in the future. Grass bedding, fibrous rope, poisoned arrowheads and human hair are among the perishable material items that have preserved and from which we may yet derive information, such as palaeopharmacology and DNA. Just in our two small excavations we have found several things that were not recovered from the Mason excavations, including perforated shells, potentially decorated *Strychnos* exocarp, and the remains of a catfish. We also found a painted image not previously recorded. The direct date obtained from the bladder cap highlights the relative antiquity of the upper layers of the cave deposit – the very layers most at risk of deterioration. Kruger Cave is one of only two early Holocene sites in the Magaliesberg, making it important for understanding human responses to changing environments at this time (Mitchell 2002), and, if properly managed, has the potential to draw visitors and provide a source of revenue that could benefit the local community. It is unfortunate that the site was left to degenerate into such disrepair, despite being well known to the archaeological community. Nevertheless, about a fifth of the original deposit remains.

We have presented our efforts to stabilise the remaining deposit from further erosion and deflation. In line with recent heritage management practices (*sensu* Acabado et al. 2014), our approach has tried to foster the participatory involvement of the only local community that currently has a vested interest in the site, namely the pastor. Although the pastor's presence in the site subtracts from the archaeology, it simultaneously adds to it in the same way that has been ongoing at the site for millennia. Our remedial work has attempted to stabilise what remains of the archaeological deposit in a manner that is authentic and does not try to hide the fact that this is an archaeological site, while being accommodative of the pastor's needs. We have digitally documented what remains of the rock paintings, which now allows us to gauge their relative rate of decay and which we hope are better than Pager's tracings, which he admitted were at best "approximations or interpretations" of the faded paintings (Pager 1987: 228). Our ongoing analysis of the excavated material should yield new information regarding aDNA, mass spectral data and chronological refinement of certain levels. Further efforts at the site will focus on 1) the erection of an information board outside the cave for visitors, 2) fostering greater awareness of the site and its potential among local businesses and tourism agencies, and 3) formalising the pastor's role as a custodian at the site, which is, in our opinion, the best way to protect and manage the site.

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PRELIMINARY RESULTS FROM ARCHAEOLOGICAL INVESTIGATIONS AT SUDWALA CAVES, MPUMALANGA, SOUTH AFRICA

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ABSTRACT
People seldom used deep cave systems during the late Holocene in South Africa. Consequently, excavations were conducted in 2010 to establish the origins of artefacts found during tourist infrastructure developments at Sudwala Caves. These excavations focused on an area near the mouth of the cave where there was, what appeared to be, intact deposit. Four squares were excavated, bearing cultural remains that point to three use episodes. The first use episode, indicated by Marateng pottery, related to the people of Bokoni. The second, characterised by undecorated pottery, could be linked to Swazi speakers, who were known to have used the caves as a refuge during the 1800s. The third use episode, associated with historical objects, signified cave usage during the second half of the 20th century as a tourist attraction. Material culture removed from the caves during the development of tourism infrastructure, however, might point to a much longer use history.

Keywords: Sudwala Caves, farming communities, Bokoni

1. Introduction

Southern African caves, such as Wonderwerk Cave, Sibudu Cave, Peers Cave, Lion Cavern, Historic Cave, and Lepalong Cave, contain rich archaeological deposits and show repeated use over hundreds, sometimes thousands, of years (e.g., Thackeray et al. 1981; Hall 1995; Backwell et al. 2008; Stynder et al. 2009; Esterhuysen 2010; Porraz et al. 2015; Morris 2016; Bader et al. 2021). Boomplaas Cave, for example, was used as a residential site during the Pleistocene, and as an outlying stock post and short-term shelter by herders during the last 2000 years (Von Den Driesch & Deacon 1985; Pargeter et al. 2018). Wonderwerk Cave also contains Earlier (ESA), Middle (MSA) and Later Stone Age (LSA) deposits, as well as LSA rock art that points to ritual or religious purposes (Thackeray et al. 1981; Morris 2016). Caves, such as Lepalong, Historic and Echo (Fig. 1: EC), were used as refugia during periods of unrest or upheaval (Mönnig 1978; Hall 1995; Pikirayi & Pwiti 1999), while other caves were used for storage (Wood et al. 2009; Morris 2016). Caves were also mined for fertiliser, ochre, and other precious materials (Unknown Author 1911; Morris 2016; Bader et al. 2021).

How these caves were used depended on numerous factors, including their geological or landscape characteristics (e.g., their location, depth, and the surrounding environment), the economic and political context at the time, and the cultural and religious beliefs of the people who used, or avoided, them. Belief systems appear to play a distinct role in the Holocene use of deeper cave systems, with LSA hunter-gatherer use and rock art being restricted to the natural daylight zones at Wonderwerk Cave. This constituted a significant shift from their more prolific use during the MSA (Chazan & Horwitz 2009; Morris 2016). Similarly, the use of deeper caves by farming Communities is restricted to mining (e.g., Oxley Oxland & White 1974; Friede 1976; Grant 1994; Chirikure 2015) and ritual purposes (e.g., the use of Matonjeni Cave in Zimbabwe; Daneel 1971; Bucher 1980), or in times of trouble (e.g., Hall 1995; Esterhuysen 2010).

In this context, the multiple use episodes of the Sudwala Caves (Figs 1 & 2) are of interest. This cave system is in the Crocodile River Valley at the eastern end of Schoemanskloof, one of the easier routes through the Drakensberg escarpment that separates the Highveld from the Lowveld in northeastern South Africa. In the 20th century these caves became a popular tourist attraction that is well-known for its crystal caves, speleothems and fossilised plant remains (Unknown Author 2021).

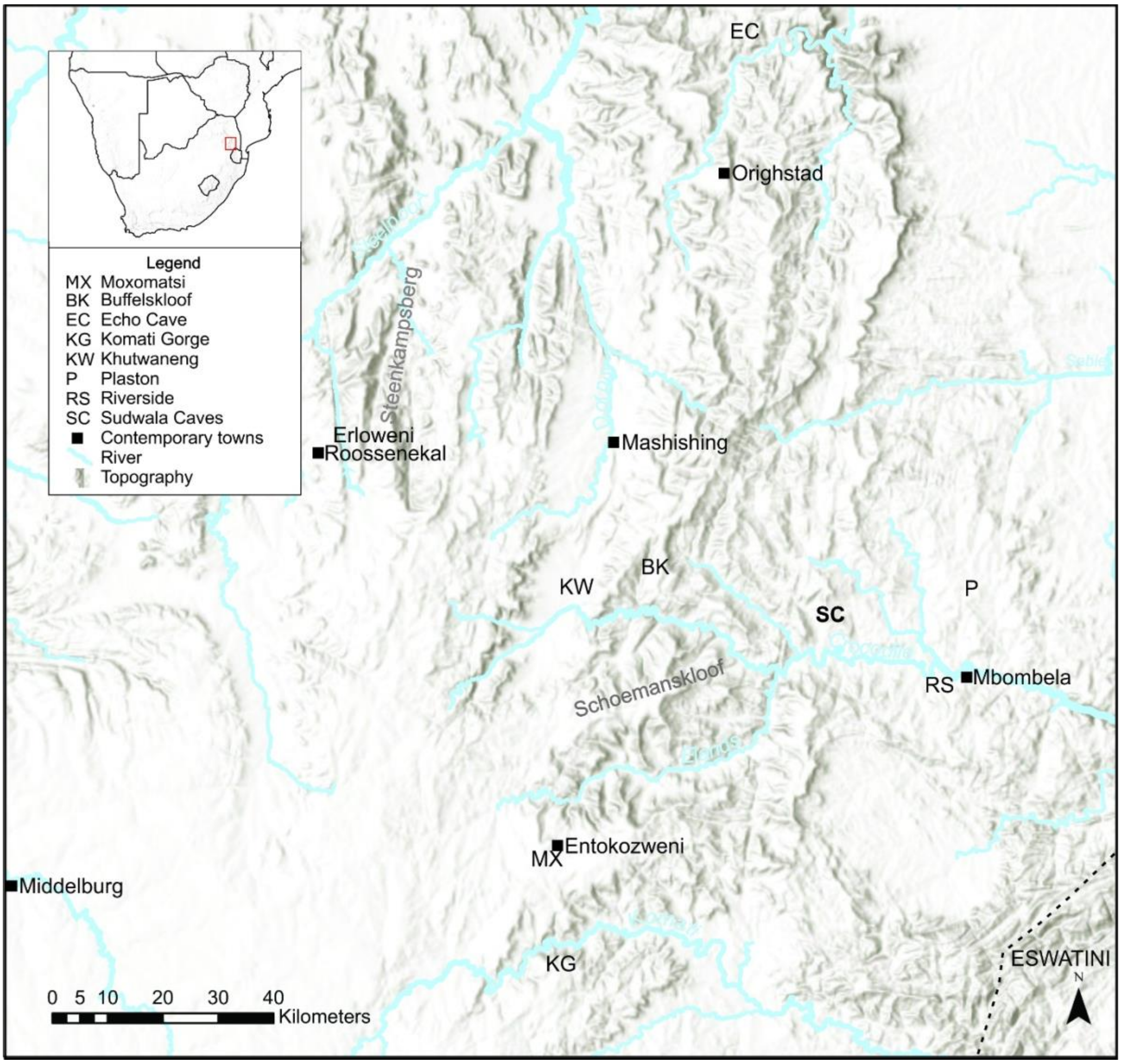

Figure 1. Map of the area surrounding the Sudwala Caves (SC) and location of sites mentioned in this paper.

During the development of tourist infrastructure, including the construction of stone walls and a paved stepped amphitheatre, soil and possibly archaeological deposit were removed from/moved in the cave. This led to the discovery of archaeological artefacts, including ESA handaxes, K2 and Marateng ceramics, as well as firearms. The provenance of the collected objects is uncertain, and in the absence of sound archaeological and historical research on the caves it was unclear how they articulated with the regional context. During 2010, two test excavations were conducted to explore the use of the cave complex through the later Holocene sequence. We report the results of these excavations here, starting with a review of the research context and regional settlement history.

2. Regional settlement history

Prior to the 1900s

Farming communities had moved into northeastern South Africa by the 4th century AD (Klapwijk 1974; Klapwijk & Huffman 1996) and expanded to the area around the Sudwala Caves in the following centuries. To the east of the Sudwala Caves the sites Riverside and Plaston (Fig. 1: RS & P) were occupied in the 6th and 8th centuries, respectively (Evers 1977; Huffman 1998), and to the northwest Early Farming Communities (EFC) had settled in the area around Mashishing (formerly Lydenburg) by the 7th century AD (Evers et al. 1982; Whitelaw 1996). Initially these EFC settlements were scattered, but by the 10th century AD more complex systems and related site-clustering started to develop in the Mashishing area (Evers & Hammond-Tooke 1986).

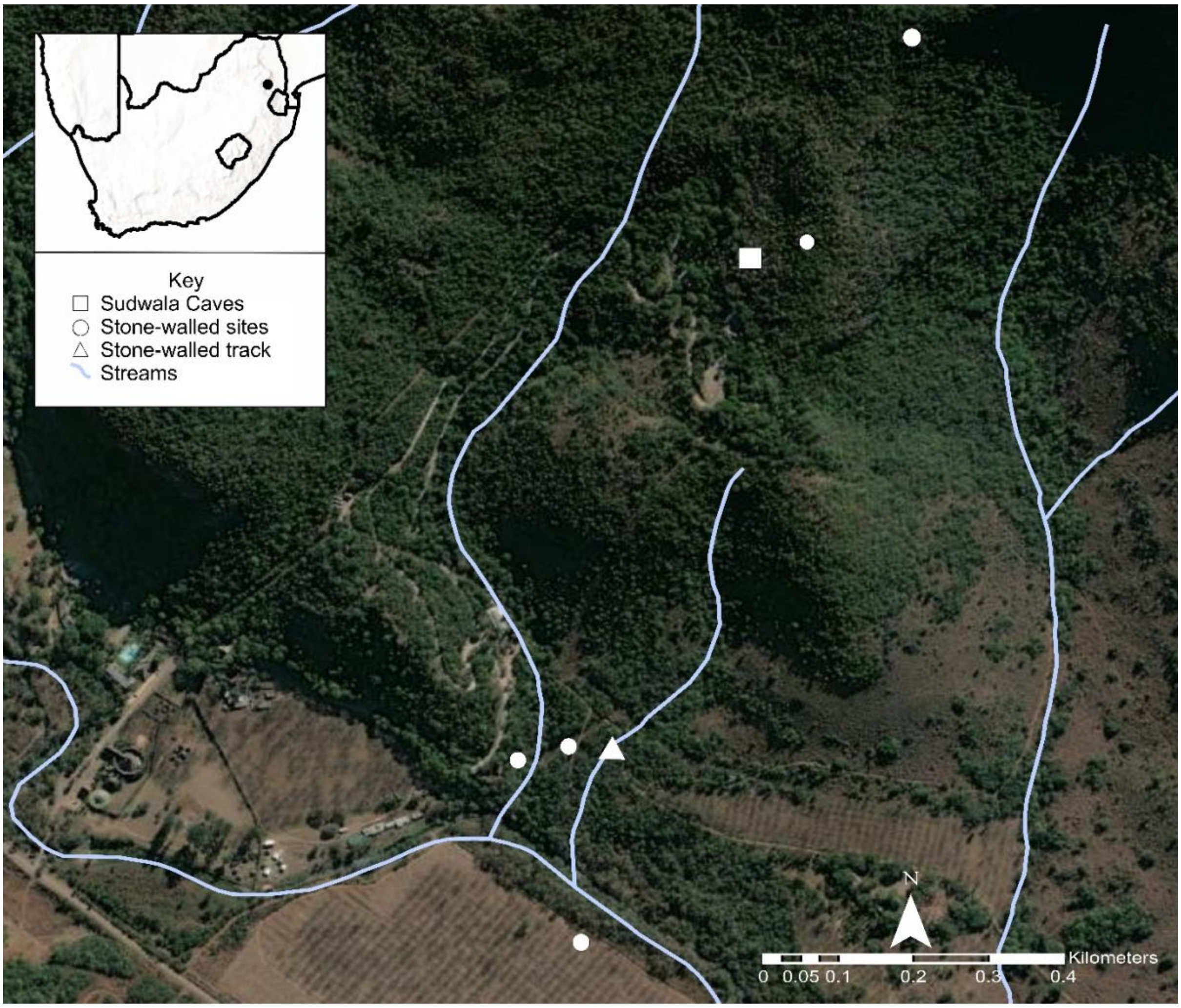

Figure 2. Map showing the location of the Sudwala Caves, five surrounding Bokoni sites and a possible stone-walled Bokoni track. Map inset shows the location of the Sudwala Caves within South Africa.

Several of these first millennium farming communities engaged in regional exchange and trade. Initially salt was a key commodity (Evers 1974a, b; Antonites 2013, 2016), but after AD 800 international trade goods, such as glass beads and ivory, were exchanged along networks that reached west into Botswana (Wood 2011) and south into KwaZulu-Natal (Couto et al. 2016; Gavin Whitelaw pers. comm. July 2018).

Population density further increased when additional farming communities, visible through the Moloko pottery they made, moved into the area early in the second millennium AD. In the Lowveld, specialist metal production centres developed (van der Merwe & Scully 1971; Killick & Miller 2014; Moffett 2017) and by the 17th century several historically know polities started to expand into the Eastern Highveld. These included southern Ndebele, Pedi and Bokoni Kingdoms (Delius 1983; Schoeman 1998a, b; Delius & Schoeman 2008; Maggs 2008; Delius et al. 2012). By the 19th century, the Swazi Kingdom was also a significant player in regional processes (Bonner 1977, 1978, 2002; Makuru 2008).

Between the 16th and the mid-19th century, Schoemanskloof, where the Sudwala Caves are located, formed part of Bokoni. The Bokoni archaeological zone stretched between the towns of Carolina in the south and Ohrigstad in the north. The Steenkampsberg formed the western border and the Drakensberg the eastern edge of this archaeological zone. Bokoni settlements are characterised by stone-walled towns and villages, which comprise circular homesteads surrounded by terraces with interconnecting paths and roadways (Delius & Schoeman 2008; Maggs 2008; Delius et al. 2012; Widgren et al. 2016; Birin et al. 2021).

Excavations of Bokoni settlements have recovered Marateng pottery, glass beads and metal implements (Evers 1975; Collett 1979, 1982; Delius & Schoeman 2008, 2010; Maggs 2008; Delius et al. 2012). Glass beads were an important commodity in the east coast trade, and their presence, Bokoni's location, and literature sources, suggest Bokoni played a role in the trade networks (Evers 1973; Schoeman 1997; Delius & Schoeman 2008; Coetzee 2017). Cattle tracks and terraces, the remains of metal hoes, and evidence of domesticated plants and animals have been used to infer that the people of Bokoni were mixed farmers (Delius & Schoeman 2008). It is possible that cattle and surplus grains formed part of the items that were traded to the coast (Delius & Schoeman 2008). Trade routes, along with the location of resources, for example, water and wood, as well as soil fertility, climatic conditions and regional conflict, may have influenced settlement distribution as has occurred elsewhere across South Africa (Maggs 1980; Greenfield et al. 2005; Delius et al. 2012).

Evers (1971), Collett (1979, 1982) and Coetzee (2017) noted that many of the Bokoni settlements were clustered on gentle sloping grassland hills in open valleys close to water sources, as well as in inaccessible mountainsides. Delius et al. (2012; also see Birin et al. 2021) proposed that these sites were linked to different periods of occupation. Indefensible, open-air sites such as those in the Komati Gorge (Birin et al. 2021), Moxomatsi (Masolo 2020), and Khutwaneng (Collett 1979, 1982; Henshall 2016; Solomon 2016) (Fig. 1: MX & KW), formed part of the first and second occupation phases. Whereas sites that are difficult to access, such as the kloofs near Khutwaneng and Buffelskloof (Delius & Schoeman 2008; Hattingh 2014; Schoeman et al. 2019) (Fig. 1: BK), formed part of the third occupation phase and were used from the late 18th century to the early 19th century, when violence swept through the region during an era commonly referred to as the *mfecane*. As a result of the growing tensions and constant attacks, sites throughout the broader region, for example the region between Middelburg and Mbombela, show increased fortifications. The Ndzundza capital, Erloweni, near Roossenkal, is one such site (Schoeman 1997, 1998a, b, 2020).

The *mfecane* was in part the result of expanding states, and associated competition over trade and wealth between and within societies at the beginning of the 1800s (cf. Delius 1983; Eldredge 1995; Schoeman et al. 2019). The rise of several power blocks also played a role. These included the Pedi polity, which from the late 1700s embarked on a process of aggressive territorial expansion into, amongst others, Bokoni and Ndzundza Ndebele territories (Delius 1983). To the southeast the Zulu state under the leadership of Shaka, the Ngwane polity (which later became the Swazi state) under the leadership of Sobhuza, and the Ndwandwe polity of Zwide, also embarked on expansionist processes. Some (e.g., Hall 1976; Schoeman et al. 2019) have suggested that climate change and resulting droughts and famine also played a significant role in the conflict. This interpretation is not shared by Wylie (2006) and Cobbing (1988) who challenged traditional assumptions and argued that the *mfecane* was caused by the increase in slave trade. Cobbing's challenge reshaped *mfecane* scholarship, but his data have been contested; for example, Eldredge (1995) pointed out that slave trade at Delagoa Bay did not play a significant role before the 1820s.

By the early 1800s the Koni, Pedi and Ndzundza heartlands were attacked, and people scattered to seek refuge. Some attributed these attacks to Mzilikazi's Ndebele given that oral traditions record their movement through the area (Rasmussen 1975; Schoeman 1997). It is also possible that the attackers were the Ndwandwe, but their defeat in 1826 caused them to fade from history (Delius & Schoeman 2008; Makuru 2008; Wright 2008). The impact of this conflict was exacerbated by the arrival of small groups of Boers, who settled in Mpumalanga. Although the Boers formed a small community, their horses and firearms gave them the upper hand in battle, and they entered into strategic alliances with some local African communities (Delius & Cope 2007).

The Boers' move into northeastern South Africa was partly motivated by their desire to control the lucrative and well-established trade networks linking the interior to the Mozambican coast (Delius & Cope 2007; Esterhuysen & Smith 2007; Coetzee 2008; Delius & Schoeman 2008). Once settled, they started to acquire land for settlement and farming. This was bound to lead to conflict, because in the context of expanding populations and polities land was already at a premium. In some cases, land was traded for arms and ammunition, in many others land was acquired illegally and without the consent of the African communities living there. In some instances where land was taken over, people had to work for settlers. Payment for their labour included cattle, and in some cases, firearms (Delius & Cope 2007).

Parallel to Boer expansion, the Swazi state extended their raiding into the Mashishing (formerly Lydenburg), Carolina and Ermelo areas, at times displacing (Makuru 2008), killing, or enslaving people (Prins 1999) already living in the area. Internal Swazi disputes also impacted the region (Makuru 2008). Relevant to the archaeology of Sudwala are the disputes between Mswati, who ruled Eswatini during the early 1800s, and his brothers Malambule, Fokoti and Somcuba. Somcuba used the conflict between Mswati and his other brothers to expand his own power base, to the point where he was de facto ruling parts of Mpumalanga, which included entering into treaties with the Boers. Because of the conflict with his brothers, Mswati was distrustful of Somcuba and acted to limit his power (Bonner 1978).

During the 1840s Somcuba had been installed in a village in Mpumalanga and he oversaw a large herd of Mswati's cattle. The relationship between the brothers deteriorated when Somcuba treated the herd of cattle as his own and refused to send them to Eswatini. In addition, Mswati realised that the proximity of Somcuba's settlement to the Boers had created a strong relationship between the two communities and that he could no longer depend on the Boers for support (Bonner 1978). Mswati sent troops to attack Somcuba, but his forces were repelled (Bonner 1978). Oral histories recount that Somcuba and some of his forces took refuge in caves, including in the Sudwala Caves. Here, Somcuba's commander, Captain Sidwaba, guarded the entrance until a Lydenburg Commando saved them from the attack. Subsequently, the area became part of Boer territory and Somcuba lived in a territory controlled by the Ohrigstad Boers until he was defeated in battle (Bonner 1977, 1978). The cave is said to have been named after Sidwaba (Unknown Author 2021).

Use of the Sudwala Caves during the 1900s

Since the second South African War (AD 1899-1902), tales of the 'Kruger Millions' have abounded. This is gold that was supposedly hidden by the Boer Republic for later use in their campaigns against the British Forces. The Sudwala Caves are one of the locations in which treasure was thought to be hidden, and the pursuit of this treasure led to several illegal excavations. This, however, was not the only treasure that was hunted because, as Hardingham (1943) noted, people had romantic views of caves, which included the idea that they were used by bandits and smugglers.

One such excavation was by two men, identified only as De Wet and Enslien. During 1910 and 1911, they searched for treasure while pretending to dig for guano. This treasure is rumoured to have consisted of five pots of gold sovereign and one pot of diamonds. While rummaging through the caves they found several African pots and associated artefacts, but they were regarded as unimportant and with echoes of Hall's (1905) looting of Great Zimbabwe, were cast aside. The area where the treasure was rumoured to occur was completely dug out, but there is no record that treasure was ever found (Unknown Author 1911). Despite the absence of any treasure, valuable guano was found and guano mining continued after the quest for treasure was abandoned. It is said that by April 1911, 250 bags of guano had been removed from the caves (Unknown Author 1911).

In the 1960s the caves, and the farm on which they are located, were bought by Phillipus R. Owen. He wanted to preserve the caves and to make them accessible to the public. Some of the earliest tourism infrastructure developments resulted from his endeavours. These, among others, included the installation of the first electrical lighting and the development of benching, which required the removal of large amounts of soil containing archaeological deposit (Phillipus Owen pers. comm. April 2010).

In addition, one of the earliest developments was the P.R. Owen Hall, which functions as an amphitheatre. The hall was used for several concerts, including a performance by Ivan Rebroff, a famous Russian opera singer, in July 1970. The caves were also used during the production of various films, such as *Creatures the World Forgot* (Phillipus Owen pers. comm. April 2010). However, this use of the caves was problematic since Mr Owen and his staff could not monitor the large volumes of people, and vandalism resulted. Consequently, concerts inside the caves were limited (Phillipus Owen pers. comm. April 2010), but guided tours in the caves are still an attraction (Unknown Author 2021). During the 1960s the caves and its natural wonders were surveyed and mapped as part of the tourist infrastructure developments. The latter also included display cases that were built at the entrance of the cave. Archaeological artefacts are on display in these, yet the focus of the guided tours is not archaeological but rather, on the natural beauty of the cave system.

3. Materials and methods

Surveys

The authors could not find any published archaeological research pertaining to Sudwala Caves or the surrounding area. To better understand the use of the main cave, its occupation phases and the surrounding landscape, a foot survey was conducted in April 2010. It was difficult to see artefacts on the surface due to dense vegetation on the hills surrounding the caves, nevertheless several sites were identified (Fig. 2).

Excavations

The extensive guano mining and tourist infrastructure developments left only a small portion of what appeared to be in-tact deposit near the main cave entrance. This area was situated in the far right-hand corner of the cave entrance, against the cave wall and behind the tourist infrastructure developments (Figs 3 & 4).

Four squares, namely B, R, P and Q, were excavated (Fig. 3) in 2010. Stratigraphy was followed during the excavations, where possible; 5 cm spits were dug where there was no visible stratigraphy. All sediments were sieved using 5 mm and 1 mm wire mesh. A combination of dry and wet sieving was performed to eliminate clay masses and recover small artefacts, for example beads and microfauna. Artefacts were stored in labelled plastic and paper bags. Basic excavation recordings included photographs, section and plan drawings, as well as field notes.

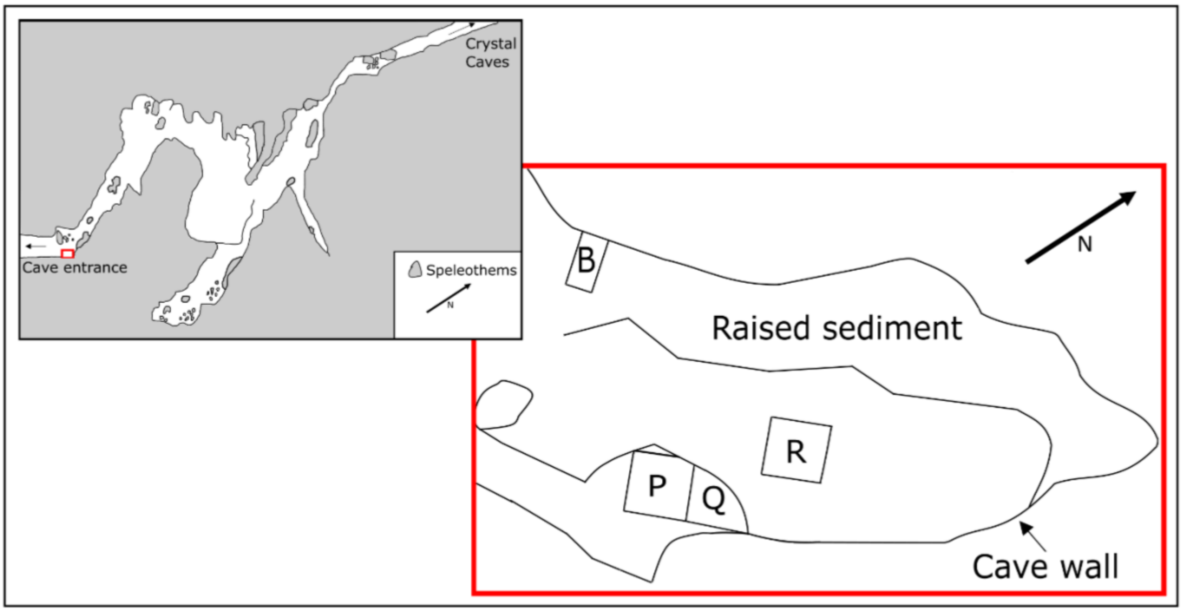

Figure 3. Map of the Sudwala Caves and site plan (adapted from Green et al. 2015). Note the varying sizes of the excavation squares.

Figure 4. Photograph of the excavation area at the cave entrance.

Analysis
Bones were sorted into identifiable and unidentifiable specimens. The comparative collection at the Ditsong National Museum of Natural History was used to determine the species or size class (i.e., Bovid 1 to Bovid 4) of the specimens. During analysis, modifications to the bones, e.g., cut marks and burns, were also noted.

Pottery sherds were analysed visually and sorted into categories based on the portion of the vessel they originated from, as well as their decoration. Rim sherds were used to extrapolate the rim diameters of the vessels they originated from. A standard diameter measurement template was used (cf. Jordaan 2016).

4. Results: Surveys
Sites located in the immediate vicinity (i.e., a 1 km radius) of the caves included five stone-walled settlements, one terraced site, and a possible cattle track. Sites were classified using the criteria discussed in Coetzee (2017). Four were level one sites, which comprise single, lone-standing stone-walled enclosures. The remaining stone-walled site was classified as a complexity two site, which comprises two or more complexity one sites either grouped together or connected.

5. Results: Excavations
Square B
Square B abutted the cave wall (Fig. 3) and was 1 x 0.5 m. The deposit was unstratified and comprised dark brown clay soils with fragments of red and yellow clay. Bedrock was encountered approximately 5 cm below the surface. This square may have been disturbed given the proximity of cabling and lighting that form part of the tourist infrastructure. It also yielded little material culture (Tables 1-5 in the following section).

Square R

Square R was in the centre of the intact deposit and was 1 x 1 m (Fig. 3). Two main stratigraphic layers were identified. One layer comprised dark brown soils and the other, red soils. Bedrock was reached 30 cm below the surface (Fig. 5). Square R was rich in material culture, including ceramics and beads, as well as faunal remains (Tables 1-5 in the following section).

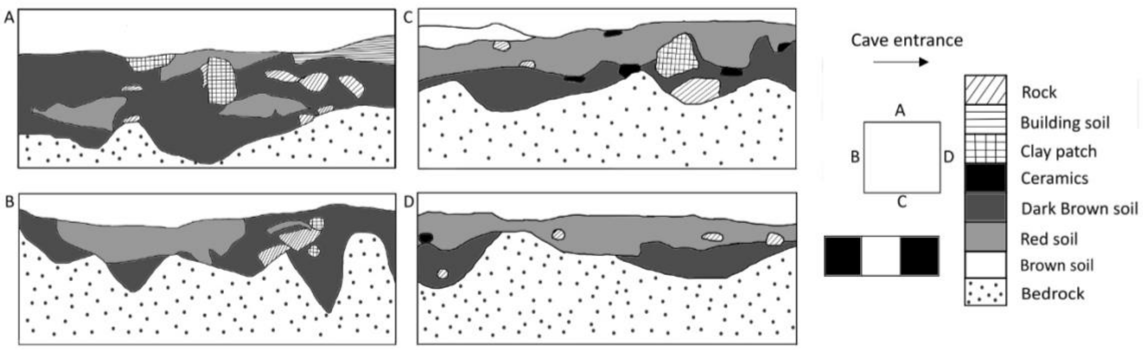

Figure 5. Section drawings from Square R (scale=30 cm).

Square Q

Square Q was on a slight slope, next to the cave wall (Fig. 3). Four distinctive stratigraphic layers were identified. The layers consisted of dark brown, red, brown and speckled red, soils. The excavation ended when bedrock was encountered 35 cm below the surface (Fig. 6). Finds included ceramics, beads, faunal remains, and shell (Table 5 in the following section). Due to its location against the cave wall, this square was not 1 x 1 m (Fig. 3), but rather 0.9 x 0.9 m on sides that did not abut walls.

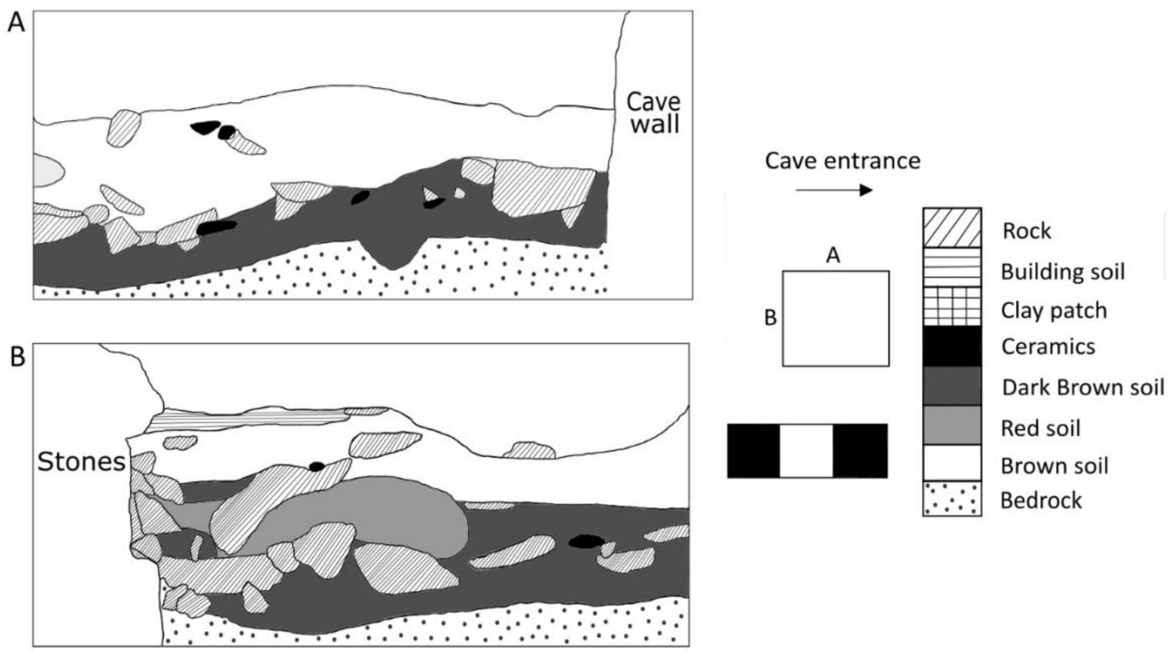

Figure 6. Section drawings from Square Q (scale=30 cm).

Square P

Square P was adjacent to square Q, near the display cases (Fig. 3). This shallow 1 x 1 m square was excavated to a depth of 5 cm in some areas, but deposits were barely 1 cm deep in others. Two soil colours were noted, namely red and brown. The shallow deposit depth was probably due to the removal of a substantial amount of the topsoil during tourist developments in the cave.

6. Results: Finds

Ceramics

A total of 1641 ceramic sherds were collected at the Sudwala Caves. Most of these sherds (n=1328) were recovered during the excavations, whereas the rest were found by Sudwala Caves' personnel during infrastructure developments that were subsequently catalogued as out of context.

The ceramics were distributed unevenly throughout the squares and stratigraphic layers, with squares R and Q yielding the highest number of sherds. Decorated vessels comprised a very small percentage of the total amount of excavated ceramics (Table 1). The remaining sherds were burnished either red or black (Fig. 7). As a result of the fragmentary nature of the ceramics from the archaeological excavation, it was difficult to identify the ceramic style. Only Marateng facies pottery could be identified due to its distinctiveness (Fig. 7). The extrapolated rim diameters suggest that the assemblage included storage vessels (Table 2) (cf. Lawton 1967). Ubiquitous Marateng style vessels made up a large portion of the assemblage collected by the cave's staff; however, pottery that resembled K2 ware from the Shashe-Limpopo Confluence Area was also observed and some of it is on display in the cave's entrance. This unburnished ware had deep incised, filled-in half-moons on the shoulders (for more on K2 pottery, see Meyer 1980; Huffman 2007).

Table 1. Distribution of ceramics (n=1641), including materials without context (dec.=decorated, undec.=undecorated).

Square (soil colour)	Dec. rims	Undec. rims	Dec. neck/shoulder/base	Undec. neck/shoulder/base	Dec. body	Undec. body
B	0	2	0	0	0	23
R (Red)	0	2	0	2	0	83
R (Dark Brown)	1	15	0	1	1	234
Q (Brown)	0	35	1	4	3	615
Q (Red)	1	10	0	1	2	171
Q (Dark Brown)	1	5	0	1	1	149
Q (Speckled Red)	0	3	0	0	0	50
P (Brown)	0	9	0	0	1	81
No context	0	0	0	0	0	133
Total	**3**	**81**	**1**	**9**	**8**	**1539**

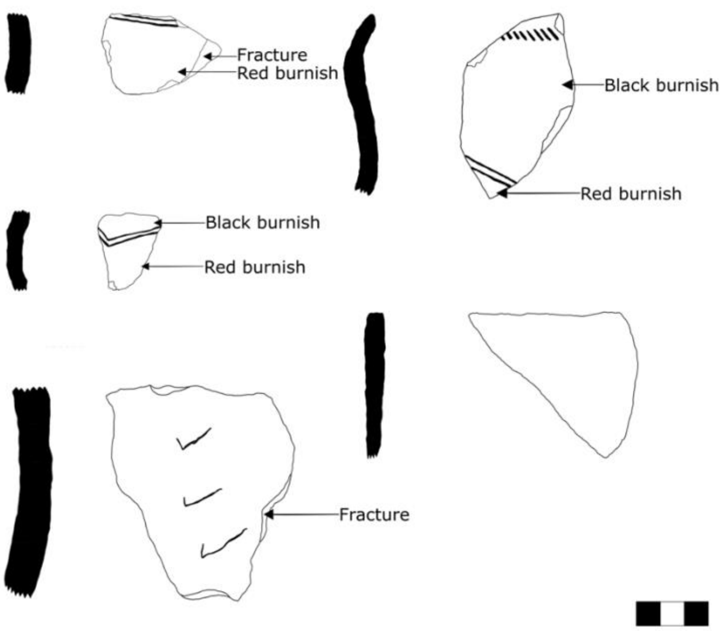

Figure 7. Examples of ceramics found during the excavations. Marateng ceramics from the red soils of Squares Q and R (top left and right, and middle left). Undecorated rim sherd from the brown soils of Square Q (middle right). Undecorated sherd from a storage vessel (bottom left), excavated from the brown soils of Square Q (scale=3 cm).

Table 2. Extrapolated rim diameters.

Square (soil colour)	8 cm	16 cm	19 cm	24 cm	34 cm	>34 cm
B	0	0	0	0	0	0
R (Red)	0	0	0	0	0	0
R (Dark Brown)	0	0	3	4	0	0
Q (Brown)	0	3	6	1	0	1
Q (Red)	0	1	2	1	0	0
Q (Dark Brown)	1	0	0	1	0	0
Q (Speckled Red)	0	0	0	2	0	0
P (Brown)	0	1	1	4	1	0
Total	**1**	**5**	**12**	**13**	**1**	**1**

Fauna

A total of 4286 bone fragments were collected during surface surveys, excavations, and salvage operations during the tourist infrastructure developments. Most of these fragments were undiagnostic, but 8.8% were identifiable (Tables 3 & 4). Like the ceramics, identifiable bone fragments were unevenly distributed throughout the squares. Squares Q and R contained the most identifiable fragments.

The most common faunal remains were from rodents. Bovids, however, were also widespread. Remains identified to species level included *Bos taurus* (cattle), *Lepus saxatilis* (shrub hare), *Caracal caracal* (caracal), and *Phocochocrus africanus* (common warthog). The majority of remains identified to a species level were from the out of context materials. *B. taurus* and *L. saxatilis* remains, which formed part of the out of context materials, contained cut marks (Table 3). Additionally, several unidentified bone fragments bore cut marks, or evidence of burning (Table 4).

Table 3. Distribution of all identifiable faunal remains (n=388), including materials without context.

Square (soil colour)	Bov 1	Bov 2	Bov 3	Bov 4	Rodent	Other
B	2	1	0	0	4	0
R (Red)	1	0	0	0	19	0
R (Dark Brown)	6	3	0	0	87	0
P (Red)	0	0	0	0	1	0
P (Brown)	4	0	0	0	2	2 (crab)
Q (Brown)	16	6	3	0	85	1 (large rodent), 2 (crab)
Q (Red)	3	0	0	0	9	2 (crab)
Q (Dark Brown)	5	6	1	0	7	0
Q (Speckled Red)	0	1	0	0	4	0
No context	15	29	19 (*Bos Taurus*), 14 (1 with cut marks)	8	9	4 (*Lepus saxatilis* with cut marks), 1 *Caracal caracal*, 1 medium carnivore, 2 *Phacochoerus africanus* (common warthog), 1 large mammal, 2 (crab)
Total	**52**	**46**	**37**	**8**	**227**	**18**

Table 4. Distribution of unidentifiable faunal remains (n=4286), some with modifications, including materials without context.

Square (soil colour)	Amount	Burnt	Cut	Worked
B	27	0	6	-
R (Red)	702	4	7	-
R (Dark Brown)	163	0	18	-
P (Brown)	138	0	2	-
Q (Brown)	1082	7	33	1
Q (Red)	361	-	13	-
Q (Dark Brown)	686	-	10	-
Q (Speckled Red)	146	-	10	-
No context	395	57	30	-
Total	**3700**	**68**	**129**	**1**

Metal
Six individual iron beads and two clusters (beads were fused together because of corrosion and could not be counted) of copper beads, as well as unidentifiable metal fragments, were found in the excavations. These finds were distributed in the upper layers of squares Q and R. The out of context material also included metal items (Table 5). Metal objects found during square surface sweeps, before excavation, were linked to modern infrastructure developments.

Beads
Various types of beads formed part of the assemblage. Copper, iron, glass, and ostrich eggshell beads (OES) were found. OES beads were the most abundant (n=85). Glass and metal beads were rare (Table 5).

Miscellaneous
Shell fragments found during the excavation were identified as *Achatina* and *Barbatia foliate*. Pieces of unidentifiable baked clay were also found (Table 5). Floral remains, including charcoal, were absent from the squares.

Table 5. Miscellaneous finds (*=cluster of copper beads, **=less than 0.5 cm, #=fragments <1 cm).

Square (soil colour)	Metal	OES beads	Glass beads	Metal beads	Glass#	Other
B	0	1	0	0	2	-
R (Red)	1 fragment	5	0	1*	9	1 *Achatina***
R (Dark Brown)	1 unidentified lump, 3 fragments	12	1	6 iron, 1*	7	1 shell fragment**, 3 *Achatina***
P (Brown)	2 wire (<2 cm)	8	0	0	0	Several shell fragments
Q (Brown)	2 fragments, 1 spear point? (0.5 x 20 cm)	6	3	-	1	1 upper grinding stone, several shell fragments
Q (Red)	0	0	0	0	2	Several shell fragments
Q (Dark Brown)	0	30	2	0	1	1 *Achatina***, 1 part of a bi-valve seashell (*Barbatia foliata*), several shell fragments
Q (Speckled Red)	0	1	1	0	0	-
No context	1 implement, 1 screw, 1 unidentified piece, 1 unknown piece of building material	22	0	0	3	1 upper grinding stone (broken), several shell fragments
Total	**14**	**85**	**7**	**6 iron, 2***	**25**	**5 *Achatina*, multiple shell fragments, 1 part of a bi-valve seashell, 2 upper grind stones**

7. Discussion

Material culture unearthed during tourist infrastructure developments at Sudwala Caves included artefacts on display in the cave entrance (such as ESA tools, K2 pottery, and pistols), as well as several boxes of material in storage that included bone fragments, ceramics, iron implements, and grinding stones (Tables 1, 3-5). Based on these artefacts, it is possible to conclude that the caves were used a multitude of times over millennia. The K2 sherds are particularly intriguing as it could suggest that the Sudwala Caves were on a route linked to the Shashe-Limpopo Confluence Area. However, the damage to the archaeological deposits, caused by looters, miners and developers, is extensive and as a result it is difficult to verify the provenance and authenticity of these artefacts. Without the artefacts' original context, it is problematic to link them to specific occupational periods and thus, it is impossible to gain an in-depth account of the caves' occupational history.

The excavations and subsequent analysis of the artefacts and faunal remains facilitated the identification of three periods of cave use. Two of these use episodes were of long enough duration to leave evidence for subsistence activities, in the form of abundant pottery, possibly used for storage, and faunal remains.

The first episode relates to cave use during the Bokoni period (16th to 19th century AD), and it is represented by the dark brown and red deposits of squares R and Q. The second use episode, represented by the brown layers of deposit, might reflect Swazi use during the early to mid-19th century AD. It may also represent use of the caves by traders. The last use episode is historical (early 20th century AD to present), and it includes material culture from tourist infrastructure developments, and the use of the site as a tourist attraction. Data supporting these interpretations will be discussed in this section, starting with ceramics.

Marateng ceramics were most frequently observed in the dark brown and red layers of squares R and Q. This ceramic style is present across large swathes of pre-colonial Mpumalanga, including in areas controlled by the Ndzundza (Schoeman 1997, 1998a, b) and Pedi polities (Lawton 1967; Schoeman 1997), as well as in Bokoni (Schoeman 1997; Delius & Schoeman 2008). Using the nearby stone-walled settlements that follow the Bokoni settlement pattern as co-indicators, we propose that people from Bokoni used the caves. Since it was not possible to date the materials directly, we cannot be certain if the artefacts are linked to one period, or multiple periods of use. Noting the inaccessibility of the sites and the caves, this period of use might be linked to the conflict-riddled third phase of the Bokoni sequence, but it also is possible that the caves were used for storage, temporary shelter, or trade-related purposes, which continued through time.

The caves would have been highly suitable for use as a temporary refuge, because of its natural defences and close proximity resources, such as water and wood. The caves are on a well-known historic trade route from the Highveld to the Lowveld, which follows the Crocodile River (Coetzee 2017). As indicated earlier it is possible that the K2 pottery unearthed during infrastructure development could be evidence of this trade in the 11th to 12th centuries. It is less speculative to suggest that the OES beads, as well as the 19th century glass beads, reflect trade running through the area.

The Marateng pottery, and the coarse-grained ceramics with red or black burnish, may represent less transient use of the caves. Marateng pottery is relatively easy to identify and attribute, but the origin of the coarse-grained ceramics is more difficult to trace. Rim sherd diameters indicate that these vessels were larger storage vessels, which speaks to longer term planning, storage or use. Similarly, the grindstones speak to some form of occupation. However, no botanical remains were identified, which makes it impossible to determine which plants were being consumed by the people who occupied the caves.

The faunal assemblage that included rodent and bovid remains might help to clarify the nature of these occupations. Whether the rodent remains are natural, or whether they were trapped for food along with the small antelope present in the assemblage, is unclear (Tables 3 & 4). What is clear is that the assemblage is different from that found at Later Farming Community (LFC) homesteads in Mpumalanga, which are dominated by large- and medium-sized bovids (e.g., Nelson 2009). In contrast, the Sudwala Caves faunal assemblage is skewed towards smaller animals, which suggests that it did not accumulate through large-scale hunting parties, but rather when access to large game was more restricted. This signature read in combination with the rather extraordinary act of reconfiguring a cave as home speaks to times of trouble.

Reconfiguring sites, such as caves, that are not normally residential places into homes was a frequent occurrence in the late 18th and 19th century. Excavations at refugia, for example Lepalong (Hall 1995), Esikhunjini and Erloweni (Schoeman 1997, 1998b), Historic Cave (Esterhuysen 2010) and Buffelskloof (Hattingh 2014; Schoeman et al. 2019), showed evidence of preparation and long-term occupation. This included the remains of structures, such as walls, floors and storage pits. Material remains often mirrored the types of remains that would have been found at open-air sites, including grindstones, remains of foodstuffs, baskets and pottery (Hall 1995; Schoeman 1997; Esterhuysen 2010). This re-creation of normal lives and dwellings, while sheltering, speaks to preparation and an attempt by the refugees who utilised caves to reconfigure these spaces as home (Hall 1995).

There are two moments in the known history of the Sudwala Caves in which it probably acted as a refuge. The first is the late 18th and early 19th century, when the regional troubles forced people in Bokoni to seek refuge in the hills surrounding their towns and villages (Delius & Schoeman 2008; Delius et al. 2012; Schoeman et al. 2019). The second is the use of the caves by Swazi refugees during internal political upheavals of the 1800s, recorded in various sources such as oral traditions and other literature (Bonner 1977, 1978; Phillipus Owen pers. comm. April 2010). It is possible that the undecorated pottery can be linked to this period of use since it falls into the suggested shape and size of the pottery mentioned for the Swazi potters, by Lawton (1967) and Celliers (2009).

After the Swazi occupation the caves were reconfigured from place of refuge to economic resource. These activities, which included guano mining, treasure hunting and development of tourist infrastructure, were destructive and further blurred the archaeological signatures of previous occupations.

8. Conclusion

Though artefacts on display in the Sudwala Cave entrance suggest a long history of occupation and use, stretching from the ESA to the historical period, only evidence of use over the last 500 years were found during excavations. This is probably due to the destruction of much of the intact archaeological deposit in the 20th century.

Despite the dearth of intact deposit, we unearthed information about different use episodes, some more intensive than others. These included use by the people of Bokoni, probably as a refuge during the *mfecane*, as well as use during conflict stemming from internal processes in Eswatini during the mid-19th century. These pulses of use suggest that people in northeastern South Africa viewed cave systems in a manner similar to the occupants and users of other South African caves; as places of ritual and refuge, but not quotidian use.

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ENTANGLED LIVES, RELATIONAL ONTOLOGY AND ROCK PAINTINGS: ELEPHANT AND HUMAN FIGURES IN THE ROCK ART OF THE WESTERN CAPE, SOUTH AFRICA

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ABSTRACT
From the form and composition of painted images of humans, elephants and 'elephanthropes' (elephant human therianthropes) from the northern Cederberg, we propose that elephants were considered as 'other-than-human-persons' by painters. This is supported by the role of elephants in San stories, the ethnography of relational ontologies among hunter-gatherer communities in southern Africa and beyond, and the selective choices of painters in constructing images. We argue that paintings and stories of deliberately associated elephant and human subjects from a range of San expressive contexts are evidence for this ontological position, derived from ecological entanglement in 'real life'. Painters considered their and elephants' lives to intersect at conceptual as well as ecological levels. From the contexts in expressive culture, elephants were viewed as intelligent and socially coherent beings, occasionally difficult neighbours, and sensitive affinal relatives, needing respect and careful treatment. Paintings of elephants reference these relationships.

Keywords: rock paintings, relational ontology, Soaqua, elephants, Cederberg

1. Introduction

The Olifants River in the fynbos biome of South Africa is so named because the earliest European travellers observed some 300 elephants as they first crossed into the valley on December 8th, 1660, guided both by advice from local 'Soaqua' hunter-gatherers and likely the preexisting elephant paths (Parkington 1984). Soaqua is the most frequently used version of the name, almost certainly not self-referential, that indigenous guides from the Cape gave for local, non-stock-owning hunter-gatherers, linking them to the later, more widely applied but no less problematic, term 'San' and likely distinguishing them from local pastoralists, whom they referred to as Namaqua or Chariguriqua (Parkington 1977). We do not know how the painters labelled themselves and use Soaqua, because of its hunter-gatherer reference, in the absence of such a term. Rock art surveys show clearly that this valley may have been an elephant landscape long before these encounters (Johnson & Maggs 1979; Paterson 2007, 2018; Parkington & Paterson 2017, 2021; Parkington & de Prada-Samper 2021). The iconic elephant is one of the most frequently painted animal species locally (Wiltshire 2011). The Soaqua painted elephants in ways that reveal a complex human-elephant relationship that we hope to understand better. Our recent fieldwork in the Agter Pakhuis region of the northern Cederberg (Fig. 1) has focused on drone-based site mapping, re-photographing and digitally enhancing painted images (see Supplementary Online Material [SOM File 1] for enhancement methods used), and clarifying these as clues to the creations of personhood, place and landscape. Obviously, this presupposes that we can approach the mindset of the painters rather than imposing our own (for an extensive treatment of this academic mission in another geographic context, see the essays in *The American Indian and the Problem of History* by Martin 1987).

In the absence of knowledgeable local informants, we use the most relevant contexts to assess painters' perceptions of their relations with elephants and other animals. We judge these contexts, in order of usefulness, to be the extensive accounts of /Xam (San) experiences gathered in the Bleek and Lloyd project from 250 km away (Bleek & Lloyd 1911; Hewitt 1986; Bank 2006; Skotnes 2007), San folklore and ethnographies from further afield (Lee 1979; Biesele 1993, 2009; Marshall 1999; Guenther 2020), and a recently expanding set of relational ontologies from hunting and gathering societies beyond southern Africa (Bird-David 1999; Willerslev 2004; Hill 2011, 2012, 2013). We follow Ingold (2000) in viewing a landscape as an integrated network of places, that is locations given meaning by their ongoing use ('dwelling' following his terminology); we regard local paintings as valuable clues to those meanings (Parkington & de Prada-Samper 2021; Parkington & Paterson 2021), in this case to Soaqua elephant relations.

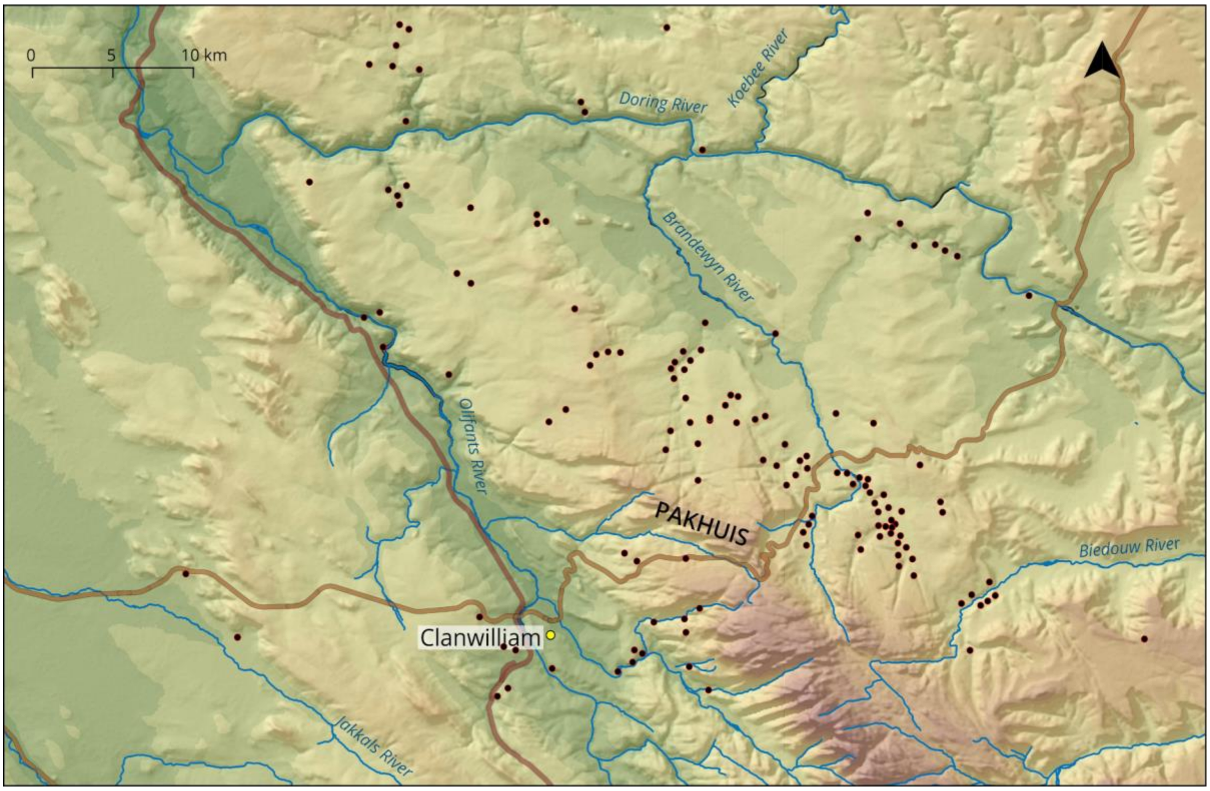

Figure 1. Map of sites with elephant paintings, marked by red dots, in the Agter Pakhuis of the northern Cederberg.

In this we hope to add to the inspirational project of Mathias Guenther (2015: 302) by filling out his assertion that "the central, unifying theme in San ontology is that of ontological flux, of human and non-human person beings" and his brief reference (Guenther 2015: 279) to "rock art, which the European interlocutors [Bleek & Lloyd] also brought into the discussion because of its linkages to myth (Bank 2006: 242-243, 314-339)". Our focus, then, is on rock paintings, elephant societies, and the life histories of painters and elephants that we judge to have been linked by ecological circumstances but, more significantly, in the minds of painters. We claim that the coherence around sociality, communication and interspecific relations between people and elephants, visible in texts and images of southern San groups, and paralleled in other ethnographies with other species, broadens the range of possible, rooted painted image interpretations available to us. Conflations of human and animal characteristics in painted images, for example 'therianthropes' in rock art terminology, may be solutions to representing 'other-than-human-persons' (*sensu* Bird-David 1999; Willerslev 2004).

2. Therianthropes, personhood and 'other-than-human-persons'

How do we access the minds of painters? About halfway downstream along the course of what is now known as the Olifants River, within a few metres of the water, a line of therianthropes (Fig. 2) marks a place in what must have been viewed as a landscape containing 'elephant-headed men', as we have previously, and informally, termed them (Parkington & de Prada Samper 2021: 226). Are these "human figures wearing elephant trunk disguises" (from a 1961 South African Archaeological Bulletin cover caption); are they therianthropic ritual practitioners, depicted 'trance-formed' into their elephant helpers (*sensu* Lewis-Williams & Pearce 2004: 172-175); are they elephant human conflations that reflect the 'ontological instability' that "pervades San (especially /Xam [and we would include Soaqua]) cosmology" (Guenther 2015: 277)? Although recently consensus may favour a shamanist answer, possibly buoyed by the cross-hatched component of the imagery, we argue the viability of the ontological option here.

Figure 2. A line of elephanthropes, conflations of elephants and humans, from the middle reaches of the Olifants River (tracing by Royden Yates).

We are in agreement with Lewis-Williams (1998: 86-87), under his heading *Pan-San Beliefs*, that "rock art research would not progress towards some idea of the meaning(s) of the art without recourse to San ethnography"; that "there were [are?] striking commonalities between twentieth century Kalahari San ethnography and the ethno-historical records of the 1870s that were compiled far to the south"; that "'scenic' groups (loosely called 'compositions'), made by one or more painters, and complex groupings, including superimpositions, of many images" show "the interdigitating of the spirit realm and the material world" (Lewis-Williams 1998: 87). He concluded that "the shamanistic explanation certainly proposes a focus on diverse shamanistic beliefs and activities, but it does **not** deny other meanings. What we need to study is **how** and **what** other meanings are encoded in the images" (Lewis-Williams 1998: 87). Our purpose here is to work within that space of 'many meanings' by referring to the global and local literatures on hunter-gatherer notions of personhood.

Nurit Bird-David (1999: S71) argues that:

> Personhood concepts and ecological perception are two fruitful areas from which to re-evaluate our theories of animist practices and beliefs. Irving Hallowell's ethnography of the Ojibwa (from fieldwork conducted in the Lake Winnipeg area of northern Canada during the 1930s) and especially in his paper *Ojibwa Ontology, Behavior and World View* (1960) are provocative starting points for our reassessments of theories of animism. Hallowell observed that the Ojibwa sense of personhood, which they attribute to some natural entities, animals, winds, stones, etc., is fundamentally different from the modernist one. The latter takes the axiomatic split between "human" and "non-human" as essential, with "person" being a sub-category of "human". The Ojibwa conceives of "person" as an overarching category within which "human person", "animal person", "wind person", etc., are subcategories. Hallowell furthermore argues that, contrary to received wisdom and in the absence of objectivist dogma, experience itself does not rule out Ojibwa ideas. On the contrary, he argues, experience is consistent with their reading of things, given an animistic dogma.

Referring to her own work, Bird-David (1999: S73) explains that the Nayaka of South India "make their [own] personhood by producing and reproducing sharing relationships with surrounding beings, humans and others" and "they share the local environment with some of these beings, often objectified by kinship terms". In sum, "[**a**]**s** and **when** and **because** they engage in and maintain relationships with other beings, they [Nayaka] constitute them as kinds of persons: they make them 'relatives' by sharing with them and thus make them persons" (Bird-David 1999: S73). Elephants are among these relatives. This habit of **relating to** rather than **separating from** others (stones, winds, plants, animals) gives rise to the term 'relational ontology' and allows 'other-than-human-persons' to exist in a shared environment.

Ojibwa- and Nayaka-like notions of 'other-than-human-persons' are widespread. Writing of the Yukaghirs for example, a small group of hunters in northeastern Siberia, Willerslev (2004: 629) notes:

> It is a commonly held assumption in the West that attributes of personhood, with all that this entails in terms of language, intentionality, reasoning and moral awareness, belongs exclusively to human beings. Animals are understood to be wholly natural kinds of being, and their behaviour is usually explained as automatic and instinctual. However, among the Yukaghirs a different assumption prevails. In their world, persons can take on a variety of forms, of which human beings are only one. They can appear in the shape of rivers, trees, and spirits, but it is, above all, mammals that Yukaghirs commonly see as 'other-than-human-persons'.

Similarly, Robin Ridington (1987: 130) records from the Canadian subarctic 'other-than-human-persons' in the experiences of his Dane-zaa informant Japasa (which translates as 'chickadee'), partly told by Japasa's son just before he (Japasa) died:

> My dad said that when he was a boy, about nine years old, he went into the bush alone. He was lost from his people. In the night it rained. He was cold and wet from the rain, but in the morning he found himself warm and dry. A pair of silver foxes had come and protected him. After that the foxes kept him and looked after him. He stayed with them and they protected him. Those foxes had three pups. The male and female foxes brought food for the pups. They brought food for my dad too. They looked after him as if they were all the same. Those foxes wore clothes like people. My dad said he could understand their language. He said they taught him a song.

In these dense but revealing thoughts, Ridington lays out the differences between the "filters, prisms and mirrors" by or through which "people comprehended themselves and construed the world" (Martin 1987: 7).

As Hill (2011: 407) explains in the context of Canadian Ojibwa:

> 'Other-than-human-persons' were considered by the Ojibwa to be capable of acting as agents; that is, they had the ability to think and behave in ways that resembled or mirrored the ways that humans thought and behaved. This sort of ontology, or set of beliefs about the nature of being and existence, privileged certain animals with agency, intentionality and sentience, abilities usually reserved for humans in Western thought.

Were these ideas of 'non-human person-beings' (Guenther 2015) prevalent among southern African hunter-gatherers? Likely so, if, as Bird-David (1999: S78) asserts, notions of 'other-than-human-persons' are widespread among "cultures of peoples we call hunter-gatherers".

Initially introduced into the southern African San context by Dowson (2007) and Low (2014), 'the ontological turn' has been championed and expanded by Mathias Guenther (2015, 2020). He has argued that (Guenther 2015: 277):

> Studies of the relational ontologies of such peoples in Amazonia, sub-arctic America, Siberia and south Asia have revealed a number of commonalities, chief of them human-non-human

> ontological instability and continuity and, deriving from it, the attribution of personhood to non-humans. This [his] article is concerned with the first aspect, ontological flux, which pervades San (especially /Xam) cosmology, manifested in myth, ritual and hunting, through such ontological and experiential processes as hybridity, transformation, mimesis and sympathy, as well as trance-induced transcendence.

By his acknowledgement of the integrated breadth of San expressive spheres, and his innovative and overarching use of concepts of 'instability', 'mutability' and 'flux', Guenther has invited us to view rock paintings as manifestations of, in his term, '(S)animism' (Guenther 2015: 277). We present some examples of elephant imagery from the northern Cederberg and offer a (S)animistic understanding of them, arguing that what has become an almost obligatory resort to 'shamanism' is limiting.

3. Elephant depictions

A relational ontology is harder to demonstrate in the material archaeological record than it is in the attitudes, practices and stories of living communities, where it may be overtly expressed. Archaeologist Erica Hill (2013: 122) suggests that "through the study of imagery, species frequencies, and the contexts of animal remains, archaeologists may identify animals of symbolic or religious import". We follow her advice on painted imagery here. In the paintings of the greater Cederberg region, but not necessarily throughout southern Africa, elephants and people are only rarely deliberately juxtaposed and intentionally associated, although more often than appears to be the case with other species. Note that we do not argue that these 'compositions' (*sensu* Lewis-Williams 1998) are simple narratives, but rather that some lifelikeness is needed to convey whatever meanings are intended (Parkington & Paterson 2021). Virtually all inter-specific associations involve humans.

Numbers

In a large sample of some five thousand mapped and recorded sites and likely tens of thousands of individual images in the Western Cape (Wiltshire 2011), we have recorded over two hundred sites with a combined total of more than six hundred elephant paintings, demonstrating a substantial interest in elephants by the painters.

Sociality

This sample of elephant paintings illustrates an engagement with sociality, life history and communication among these iconic animals, none of which feature nearly as strongly in depictions of eland (Paterson 2007, 2018; Parkington & Paterson 2017) or other less frequently depicted species (baboons, rhinoceros, hartebeest, equids). Eland imagery is related to the significance of the hunt and the association of hunting with sex (McCall 1970). Among the elephants, by contrast, mother and calf pairs, domestic matriarch-led herds, consort pairs and male-only 'bachelor' groups are discernible, and depictions of single large elephants may represent adult males, as otherwise elephants are rarely seen isolated from conspecifics. Recognisable social configurations are, very occasionally, found among depictions of other animals in Cape paintings, but never with the regularity of those among elephants, implying, as Paterson (2007) has noted, that painters were well-aware of the life histories and social coherence of elephant society.

Therianthropes

The therianthropic elephant/human figures from Groot Hex Rivier (Fig. 2) are clothed, equipped, and presented in a way reminiscent of nearby lines of male armed and cloaked human figures (Parkington & de Prada-Samper 2021). Those at Groot Hex Rivier are far more carefully drawn than those at Monte Cristo (Fig. 3), although the latter are more numerous, more variable and more clearly integrated with images of both people and elephants. The paintings at Monte Cristo are next to a secluded waterfall, placed on a sloping rock face offering almost no domestic living potential. In both locations, paintings of conflated human and elephant forms are critical to place creation. 'Dwelling' in both cases may have meant the use of sites as painting opportunities.

Sound-lines

At Monte Cristo 'elephanthropes' are located in a web of elephants surrounded by nested, crenelated and lobed lines that touch the elephants at the foot, the trunk, the belly, and the groin in ways that we have suggested, pioneered by Paterson (2007), depict sound lines (Parkington & Paterson 2017) and reference the physiological loci of sound generation and detection. Lines of figures – adjacent to these and including possible elephanthropes, humans and others with accentuated penises – 'dancing' together, expand this elephant human relationship into ritual contexts. Enclosing lines similar to those from Monte Cristo but not identically arranged, surround elephant figures at Klipfonteinrand and Floreat, images we have also suggested reflect elephant sound (Parkington & Paterson 2017), effectively a recognition of elephant communication, if not language.

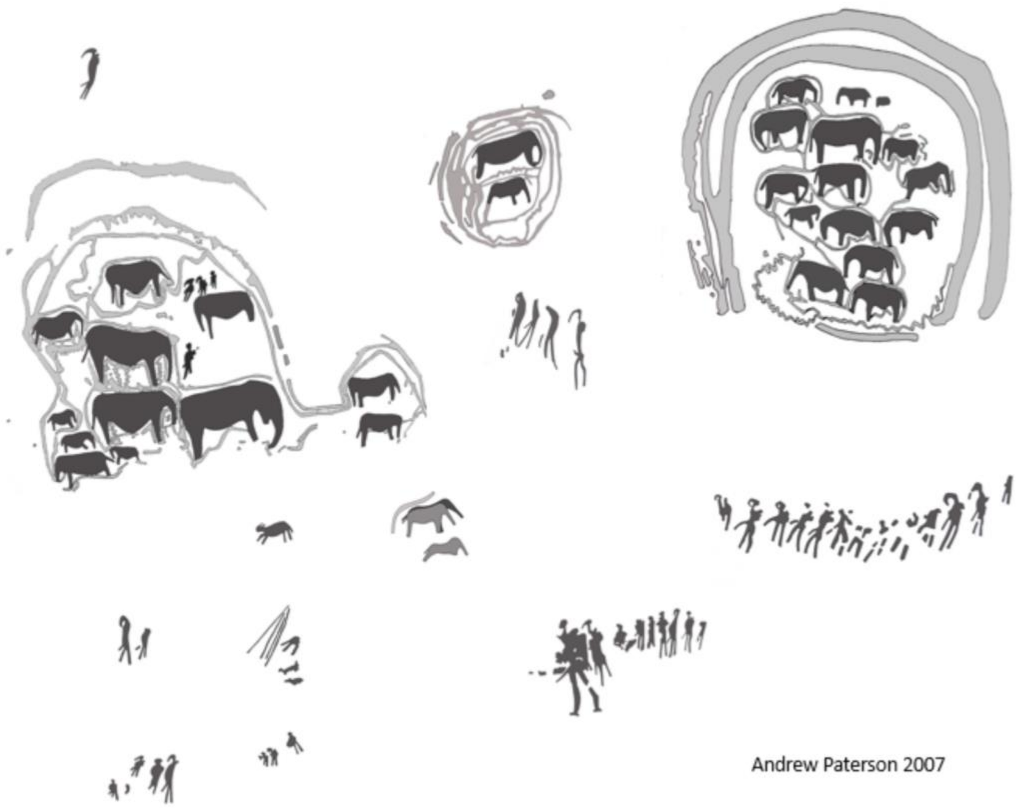

Figure 3. Human, elephant and elephanthrope figures from Monte Cristo, immediately west of the Olifants River Valley.

Inter-specific associations

Four additional examples of plausibly associated paintings of human and elephant figures are included here. The first (Fig. 4) is from the 'Elephant Hunt' site on the Bushmanskloof property and involves at least two armed hunters with drawn bows confronting two distressed elephants, seemingly mother and calf. The mother, breasts depicted, has a set of what look like arrows embedded in her trunk and the calf is trumpeting with a raised trunk. The second, from another Bushmanskloof site near to a very prominent waterfall and pool, also depicts a mother and calf in a circumstance of distress. Here (Fig. 5), two adult elephants, likely a mother and close female relative, are lumbering to the left toward an isolated small, stationary calf threatened by at least two armed, presumably male, bow-wielding humans. There are white arrows, revealed by digital enhancement, lodged in the baby elephant. This rock shelter shows substantial evidence of domestic use. These two 'compositions' appear to emphasise the vulnerability of elephants with young to human attack.

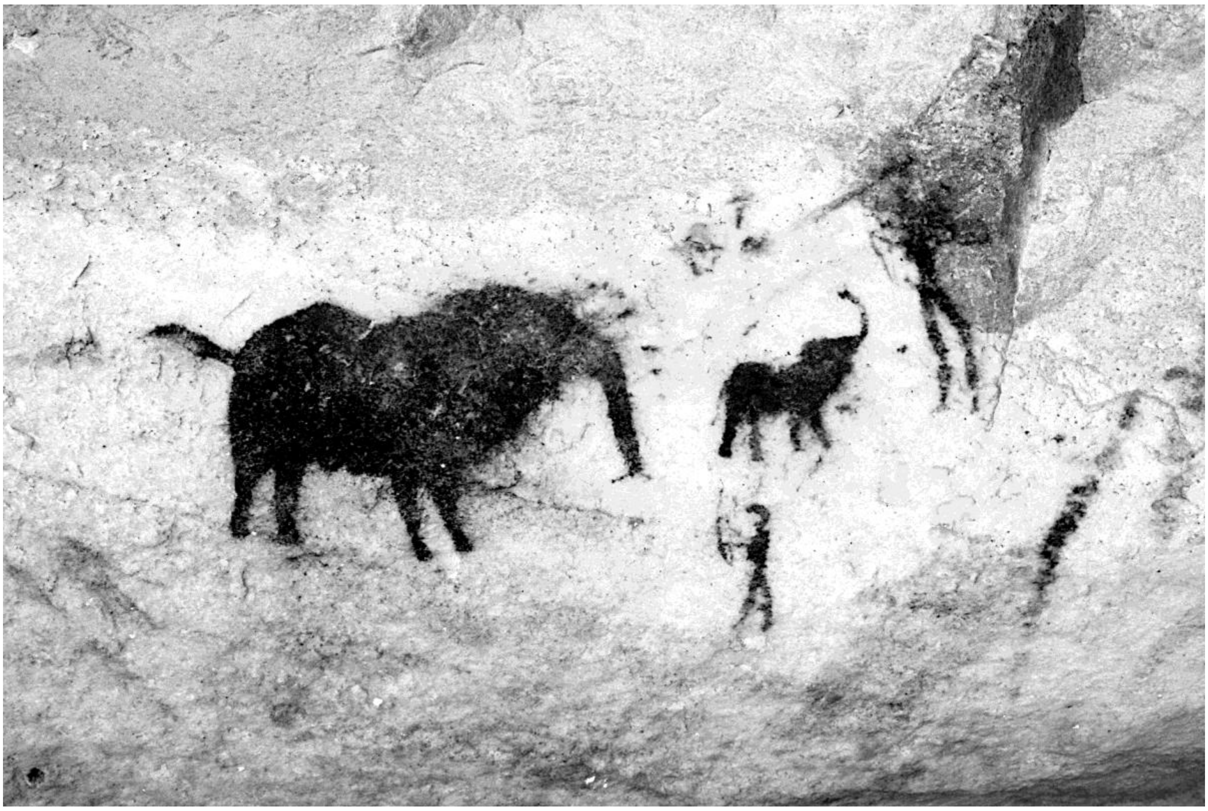

Figure 4. 'Elephant Hunt' site on the Bushmanskloof property (photograph by John Parkington, enhanced by Royden Yates).

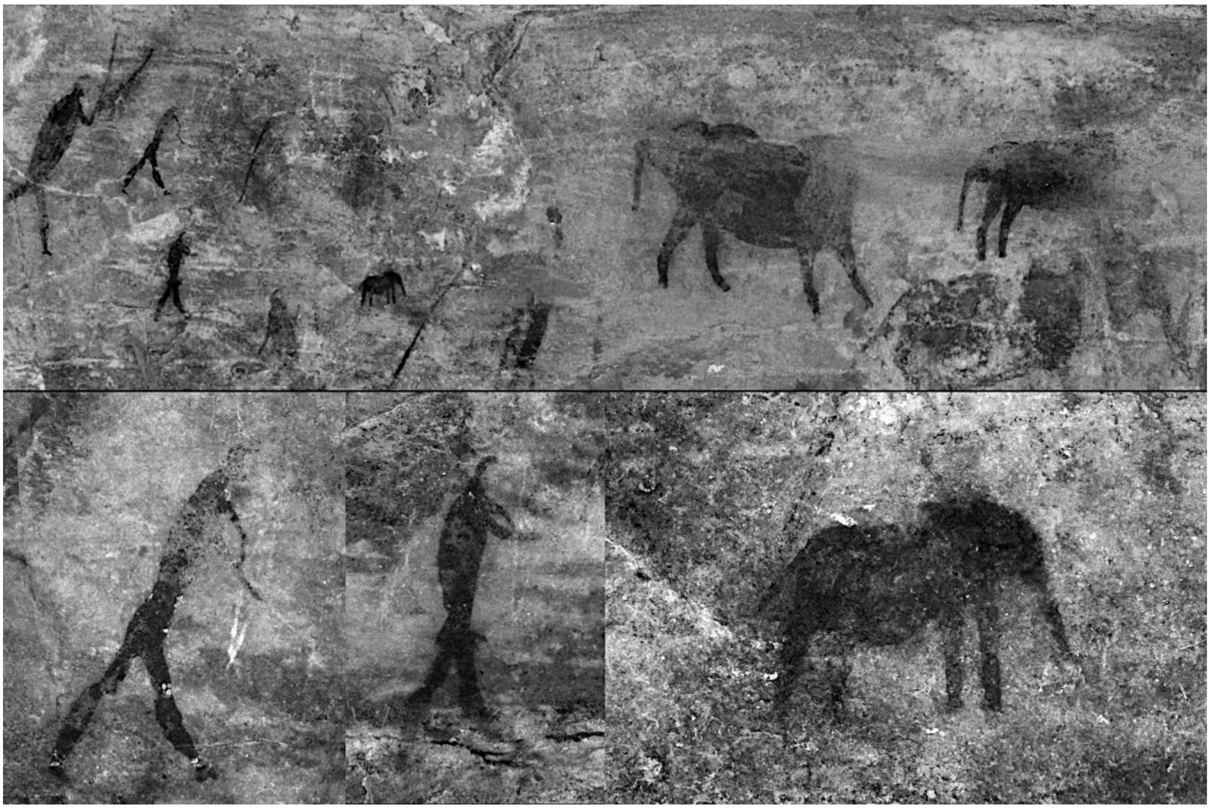

Figure 5. Elephants and human figures in an apparent composition at Meidegat on the Bushmanskloof property (photographs by Stephen Wessels, enhancement by Royden Yates).

At Zuurvlakte, another site but with minimal signs of domestic use, painters have delivered an unquestionable 'scene' by juxtaposing at least twenty-seven human figures and a mother and calf elephant (Fig. 6). Of the human figures, eleven have only their upper bodies painted, eight or nine appear male with penises and hunting bags, none are definitively female, and most of the males are shown in 'bow-holding' posture but without surviving bows. No arrows are visible. One male is positioned between the mother's trunk and her front legs, and all humans are clearly painted after the elephants and oriented toward the mother and calf elephant pair. This 'composition' does not appear to be a straightforward hunting occasion, but, along with the previous two examples, does reflect some risks of violent interactions between elephants and people, although a general antagonism between the two species is not frequently portrayed. Frequent involvements of extremely young elephants may signal the vulnerability of calves and their pivotal significance in potential interspecific tensions.

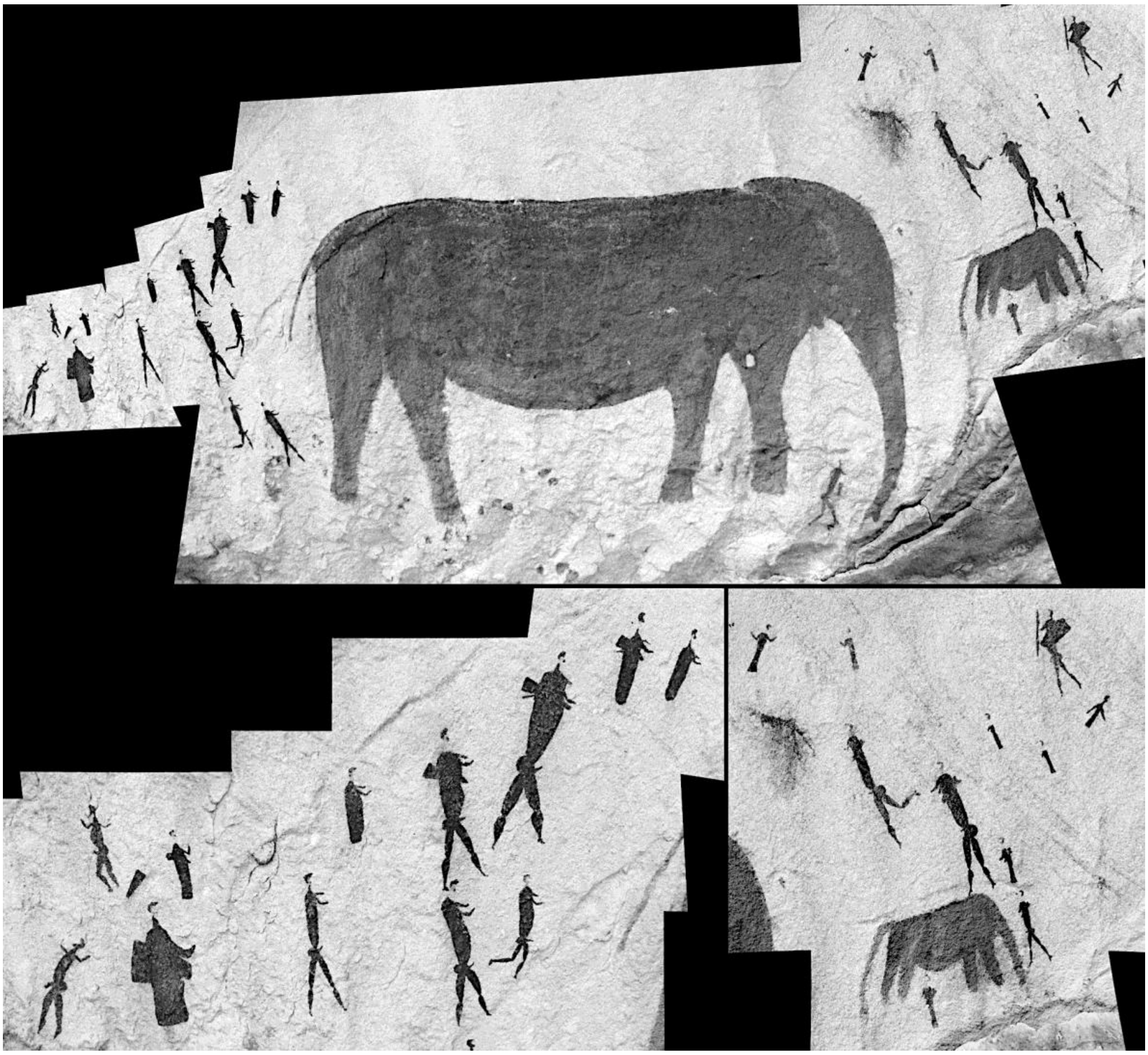

Figure 6. Elephant and human figures at Zuurvlakte (photographs by John Parkington, enhancements by Royden Yates).

A somewhat different, but equally evocative, juxtaposition of human and elephant figures is the painting at a site, again without signs of domestic use, near Stadsaal in the central Cederberg (Fig. 7). About nineteen humans, most of them male, and six elephants, arguably all male in the absence of a size gradient, have been arranged in three opposed lines, humans and elephants juxtaposed but facing one another. In the upper line of humans, all are naked, whereas in the lower two all are cloaked. In the centre of the group, the elephant at the front of the middle line is seemingly scenting from very close range a small, white-cloaked human figure. His is the only white cloak among red ones. It is hard not to read in this deliberate 'composition' (*sensu* Lewis-Williams 1998: 87) a special interspecific, in this case clearly non-combative, relationship between humans and elephants, focused on the central pair where a personal link may be depicted.

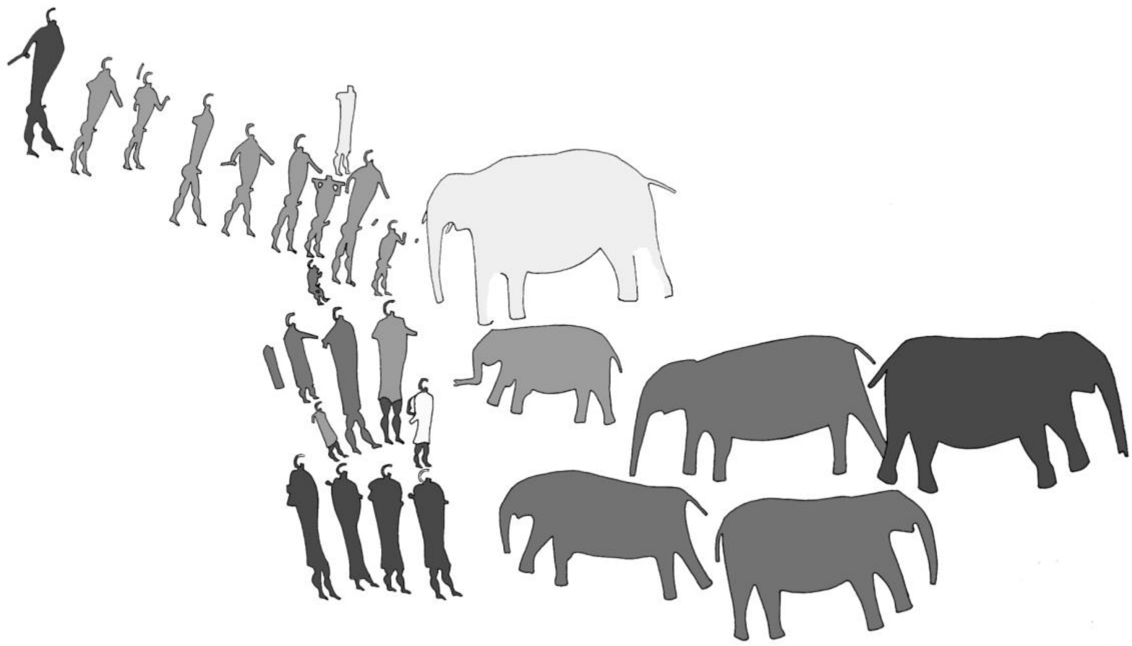

Figure 7. Elephant and human figures at Stadsaal (tracing by Andrew Paterson).

Elephants on heads

We also illustrate a series of small elephant figures painted on the heads of humans, some recently and dramatically recognised through our digital image enhancement. The two examples from Sevilla (Fig. 8) are on the hook-headed shapes of naked male dancers. Those from Uitsig in the Olifants River Valley are also on hook-headed males (Fig. 9). At the Bushmanskloof site, one small elephant is on a cloaked and heavily-equipped male human figure, the other on a (likely) woman standing behind him (Fig. 10). In the line from Rocklands (Deacon 1993: 69) at least one of six male human figures, some cloaked and some naked, has what is likely to be a small elephant painted on his head (Fig. 11). It may be significant that, once again, domestic artefact and food waste remains are insubstantial. These sites, and there will be many more as digital enhancement proceeds, reveal a significant entanglement in the minds (and on the heads) of painters. At least one context for this is in male initiation events.

Entanglement

Along with imagery not reproduced here (shown in Paterson 2007, 2018), these paintings emphasise the painters' recognition and celebration of the intense sociality of elephants, of elephant life histories, of the centrality of motherhood in generating social cohesion, and of the underpinning of cohesion by communication. There is an additional hint of human elephant tensions, perhaps resulting from a recognition of the similarity between painter and elephant values and practices. If we had to pick out the features of this 'entanglement' of people and elephants ('engagement, respect with caution') we would point to the intersection of these components. The majority of sites are not marked as domestic places, but would appear to be significant in terms of visual recording of elephant-human relations.

4. Why elephants?

The Kalahari San stories of elephants, related by Biesele (1993, 2009) among the Ju/'hoansi, and Guenther (2020) among the Naro, for example, focus on affinal (in-law) relations between elephants and humans, sometimes extending to other species, brokered through the exchange of wives. Stories include episodes of deceit, violence and vengeance, which presumably reflects not only the tensions between in-laws but also a perceived underlying tension between elephant-beings and human-beings. As with other 'animal' participants (vultures, lions, the mantis, hyenas) in San stories in both the Kalahari and Karoo, elephants seem a deliberate choice to represent human issues with 'other-than-human-person' actors.

Figure 8. Small elephants depicted on the heads of two human figures at Sevilla (photographs by Joe Alfers, enhancements by Joe Alfers and Royden Yates).

Prompted by two stories told to him by the Naro elder Qhomatca, Guenther (2020: 378) asks "why elephants? Why is this species repeatedly featured as the 'animal wife' and 'woman meat'". In answering, he observes that "the animal (the elephant) is not a girl but a married woman and mother of at least one small child, living with her in-laws at her husband's place" (Guenther 2020: 378). Biesele (1993) makes it clear that this 'why elephants?' question is situated and may derive from a widespread and broad acceptance of elephants as being 'like people' in many ways, behavioural as well as physiological. Whereas the eland figures in issues of sex and marriage, the elephant's role lies in marital relations, social reproduction and ongoing social coherence. More specifically, "[t]he Elephant Wife attains the status in San orature as a charter myth for in-law tension" (Guenther 2020: 380).

From a context closer to the northern Cederberg, in a story related by /Han=kass'o to Lucy Lloyd in February and March 1878 (Digital Bleek and Lloyd 2005: L.VIII.4: 6334-6413, L.VIII.5: 6414-6455), !gwa!nuntu (/kaggen the creator/trickster figure in another version) is digging honey and has left his granddaughter, whom he is minding, above ground and out of his sight. A group of passing elephants steal the young girl and take her away to their home, leaving one of their own young daughters behind in her place. When !gwa!nuntu realises what has happened he pursues the elephants to their village and retrieves the human girl. All ends well (except for the elephant child, whom !gwa!nuntu kills) and the story seems, in part at least, to refer to the exchange of young women between groups that creates difficult, sometimes confrontational, relations between in-laws. It is notable that there is an attempted exchange of young girls, human and 'other-than-human' equivalents, by the elephant mother that is rejected by the human grandfather.

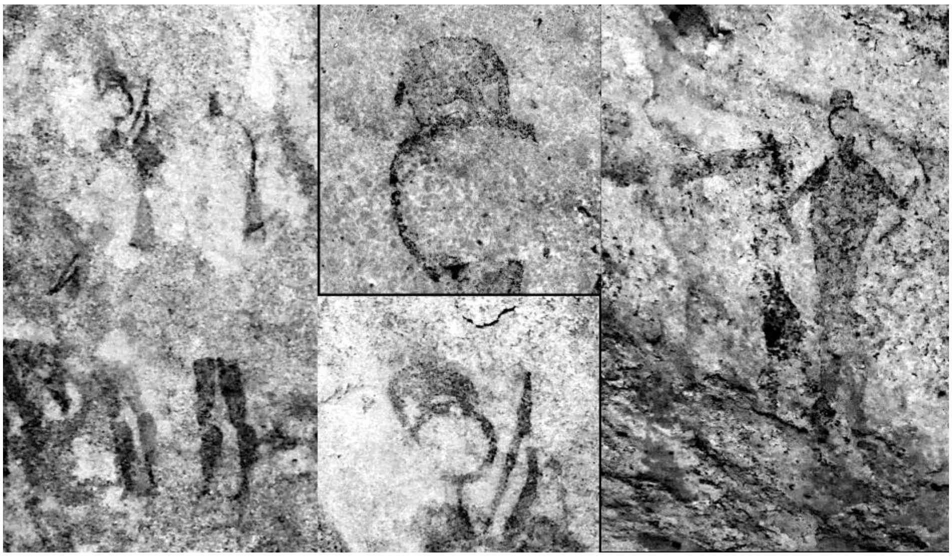

Figure 9. Small elephants depicted on the heads two human figures at Uitsig (photographs and enhancements by Royden Yates).

Figure 10. Small elephants depicted on the heads of two human figures at Mike's shelter, Bushmanskloof (photographs and enhancements by Royden Yates).

Figure 11. Small elephants depicted on the heads of (one or more) human figures at Rocklands (photograph by Janette Deacon, enhancement by Royden Yates).

Another response to the 'why elephants?' question is suggested by Erica Hill's (2011) insightful account of Yupiit 'other-than-human-person' thinking and a comparison between the roles of subarctic bear and fynbos elephant. Many human-animal relationships are those between a human predator and an animal prey, with the relationship often presented as one of respectful negotiations around the hunt and the kill. "Elk, for example, a key prey animal, were understood as human ancestors, mythic kin with whom humans maintained special relationships" (Hill 2011: 409). Such a relationship may apply to the eland in southern Africa. In the cases of non-prey, Hill (2011: 409) records that "bears in circumpolar societies occupied a privileged ontological position as other-than-human-persons. Such animals could be considered kinfolk and behaved in ways that paralleled human society – living in houses, organising themselves in social groups and engaging in exchange relationships". This was because the bear was among species "considered especially powerful, dangerous or similar to humans in key respects" (Hill 2011: 409). Elephants meet these requirements, competing with their human neighbours not for food, but for water. Human and elephant societies in the Olifants River were organised as fission and fusion social units with movements co-ordinated by communication, and arrangements based on social coherence, a commonality that must have been obvious to San painters.

5. Transformation or permanent instability?

In these ethnographies, 'other-than-human-persons' are often not strictly instances of transformation, in the sense of shifts from one category to another through time. Willerslev refers to "in-between identities" (2004: 638), and "not **not**-animal" (2004: 629). Similarly, Japasa's foxes are not people transformed, they are 'in-between' beings whose identity, in Guenther's terms, is unresolved. Robin Ridington (1987: 133-134) noted "I can be a frog or a fox and still be a person. I can know them as I know myself. If I am an Indian, I can be led toward a place where this knowledge will come naturally", an interesting reference to the role of place in identity creation.

Nearer, in a context more relevant to that of Soaqua painters, "in the context of such an ambiguous, mutable, often capricious world and the apparent comfort with this conveyed by the /Xam informants" (Skotnes 2009: 39), Pippa Skotnes (2009: 39) argues that:

> The perception of things not being what they seem is not a perception of ambiguity. It is not just about seeing something as one thing at one moment and as another thing at another. It is about perceiving the two simultaneously, about observing one thing and seeing another at once bound up within its differing form.

Referring to a young man 'turned into a tree' after receiving the forbidden gaze of a young girl at her first menstruation, Skotnes (2009: 40) extracts from a narrative by //Kabbo to Lucy Lloyd:

> He has his eyes, because he was a man
> he has his head, he has his head hair,
> because he is a tree, which is a man,
> he is a man, he is a tree,
> he has his feet, he is shod,
> he has his nails, he has his ears,
> he is a tree, because he is a man, he is a tree
> …
> While he is a tree, he is a man.

In explanation, Skotnes (2009: 40) offers:

> Yet this is not a simple transformation from one state to another. What //Kabbo struggles to describe is the simultaneous condition of being both a tree and a person. What he conveys is a man with the appearance of a man yet the ontology of a tree.

//Kabbo's struggle reminds us of Lewis-Williams' (1980: 20) wrestling with the identity of the /Xam "trickster-creator figure //kaggen, a name which the Bleeks translated as 'Mantis'". Lewis-Williams (1980: 20) concludes that "//kaggen neither **is** nor **is not** a praying mantis", in effect a mantis who is married to a hyrax and hunts with bow and arrow. This anticipates the notion of an 'other-than-human-person', in the sense of being a 'cannot-tell' (Parkington 2003) or an 'in-between' (Willerslev 2004). Japasa's foxes are foxes who are people, !gwa!nuntu's elephants are elephants who are people, the Groot Hex Rivier images are of elephants who were people. Beings are persons or people by what they do rather than what they look like. If you stride around cloaked and equipped you are a person, in this case an elephant person. When /han=kass'o told Lucy Lloyd that "all things were once people" (Digital Bleek and Lloyd 2005: L.VIII. 7593v), he did not mean that they were human beings, but rather they were 'other-than-human-persons' at a time before personhood became more regularly restricted to human persons.

We are suggesting a painters' world where an elephant is sometimes just that, an elephant encountered in the veld, but at other times manifests as an 'other-than-human-person' capable of communicating, interacting and, potentially, harming. 'Other-than-human-personhood' is thus a capacity or a potential, situationally manifested to and recognised by hunter-gatherers who share the world with such unstable neighbours. Pippa Skotnes (2001, 2009: 17) has described the capacity of an object to be "precisely what it did not appear to be" as 'real presence', using the example of the Roman Catholic host, which is neither wafer nor body but both.

Referring to the most appropriate context from which we have detailed first hand San, in this case /Xam, accounts of identities and landscapes some 200 to 300 km to the east of the Agter Pakhuis, Skotnes (2001: 9) writes:

> The knowledge of things being what they do not appear to be is evident in many of his [//Kabbo, the Bleek and Lloyd's chief instructor on /Xam ontology] accounts. In //Kabbo's world there once existed an Early Time, a First Order in which things were different from how they became. Sentience was resident in almost everything from the wind to the moon to the stars. Every object had conferred upon it the qualities of being alive and taking responsibility for what happened in the world. After the Early Times animals became wild and lost their humanity, people developed

> laws and the forms of creatures and heavenly bodies became more stable. Yet the First Order continued to permeate the Second.

The Soaqua lived in this permeated Second Order, where, given the commonalities asserted by Lewis-Williams (1998), 'other-than-human-persons' should be anticipated in painted imagery. Referring to the inchoate 'netherworld' of the First Order, Guenther (2014: 196) suggests that "ordinary people know, and are in touch with it, through dreams and visions or by means of sacralised sites in the landscape that are physical manifestations of beings or states from the world beyond". Groot Hex Rivier, Monte Cristo and other painted sites mentioned above, may well have been the 'sacralised sites', and the references to 'manifestations of beings' to which Guenther refers. We view these painted sites as places of memory in an enculturated landscape.

6. Religion or ontology, rituals and specialists

We subscribe to the view that these frameworks are better described as ontological than religious from the following perspective (Hill 2011: 420-421):

> Whilst the category of 'religion' is dependent on a dichotomy between the known and the unknowable, the natural and the supernatural, the mundane and the numinous, Eskimo [sic, as used by author] understood other-than-human-persons as social actors with whom they shared the world. Relations with these persons involved sets of rules and expectations and were predicated upon mutual respect, just as one's relations with human kin were.

For Yupiit, Ojibwa, Yukhagir, Nayaka and, we argue here, for Soaqua painters, 'other-than-human-persons', including elephanthropes in the Cederberg painted record, were as real as themselves, inhabiting (Riley 2007: 292):

> A place where 'reality' or temporal certainty, what one would regard as 'real time' or 'real interactions' of nature and common life, was constantly being interrupted by beings and powers from another dimension and history.

The impacts of 'other-than-human-persons' could be, in fact had to be, mitigated by the attitudes and practices of **all** hunter-gatherers. Hill (2011: 407) concludes that:

> Focusing on shamanism in the study of hunter-gatherer belief obscures the roles of hunters and their wives. Their thoughts and actions established and maintained relationships with prey animals and may be more productively conceptualised as dynamic social behaviours, embedded within the context of daily life, than as privileged ritual acts.

Riley (2007: 292) has written:

> The Early Times constantly emerged into the daily lives of the /Xam and it seems that they experienced these incursions of time and space not just as hallucinations or linked with the activities of people, living and dead, such as healers and rainmakers or game sorcerers, but in the daily lives of all people.

In many regions of the world game and other animals were and perhaps still are thought to display agency, intentionality and sentience, when interacting with human hunters and gatherers. Elephants display these criteria, supported by extensive wildlife observations (Moss et al. 2011) and as San stories, ascribing personhood, confirm (Biesele 1993, 2009; Guenther 2015, 2020). Regarding relations between human and other-than-human-persons, Riley (2007) suggests and Hill (2011: 411) states:

> We should not relegate interacting and communicating with other-than-human-persons to the realm of the religious or the supernatural. Rather, such encounters are part of life [for Eskimo of Alaska and Chukotka] and often did not require either the presence or mediation of ritual specialists.

Relational ontology and the belief in animal personhood provide the conceptual space for a healer entering trance to access the potency of an animal helper; a mature woman at an eland dance to welcome the young 'new maiden' into the herd; a male initiate to feel the presence of the eland and 'own' the skills and success rate of the mantis at the initiation camp; a skilled hunter to enter the mind of, and thus control, the kudu he's trying to kill; and a Soaqua family to have confidence that their relatives, the elephants, feel respected, more inclined to share and less prone to violence. These understandings of the world provide the umbrella for distinguishing the 'many potential meanings' of rock art images (Lewis-Williams 1998), perhaps especially of the therianthropes.

7. Why paintings?

Megan Biesele's (1993) comments on the adaptive value of expressive forms is persuasive. She argues that these forms, among which we should include painted imagery, "may accomplish things for society", among which things we may include dealing with 'other-than-human-persons', "that can be done in no other way" (Biesele 1993: 192). Stories and paintings "codify and condense meaning" and, using metaphor, have "a multiplier effect on experience" (Biesele 1993: 201), that perhaps in Lewis-Williams' (1992: 59) words, "informs attitudes and affective responses to many of life's situations". Relations between people and elephants in the northern Cederberg were likely to have been among these 'situations'.

References in San folklore, ethnography and, we argue here, rock art support the suggestion that San hunter-gatherer-painters viewed elephants as 'other-than-human-persons'. Painters shared with elephants the physical landscape of the Olifants River and surrounds, tracking between water holes and pools and likely following paths used by elephants and people alike. With their similar lifespans, comparable land use habits and shared water dependence, it is not hard to envisage life-long relations of mutual respect between families of both species with human persons, no doubt, exercising some caution in their dealings with very large, intelligent competitors. The prominence and specific manifestations of elephants in the rock art no doubt reflect the reciprocal obligations and responsibilities among fellow-travelling painters.

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Supplementary online material

Parkington & Alfers Supplementary Online Material File 1

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TRUE COLOURS: ANALYSING APPARENT SEDIMENTARY DIVISIONS IN THE STRATIGRAPHIC SEQUENCE OF UMHLATUZANA ROCKSHELTER (SOUTH AFRICA) USING MUNSELL-BASED COLOUR DETERMINATIONS

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1. Introduction and background

Sediment colour is one of the main characteristics used to differentiate stratigraphic sequences together with texture, consistency, and plasticity (Kyrillidou 2006; Ward et al. 2016). In archaeology, layers and contexts are often described based on their colour difference (e.g., Mitchell 1995 – Sehonghong Cave; Wadley & Jacobs 2006 – Sibhudu Cave; Morrissey et al. 2022 – Klasies River Main Site; Rhodes et al. 2022 – Wonderwerk Cave). This is also the case at Umhlatuzana rockshelter (hereafter Umhlatuzana), a site that contains a rich Middle and Later Stone Age archaeological sequence spanning the last 70 000 years (Kaplan 1990; Lombard et al. 2010; Sifogeorgaki et al. 2020).

The original excavator, Jonathan Kaplan (1990), observed a very homogeneous sequence of Pleistocene deposits, which he divided into two main stratigraphic entities: Purple Brown Sands and Red Brown Sands. The contact between these two entities is not a horizontal break, but instead a diagonal/lateral change in sediment colour. He interpreted the contact of these two layers to represent the surface over which a slumping event occurred: the upper part of the sequence (Red Brown Sands) slid towards the rockshelter's dripline (Kaplan 1990). This suggests that part of the archaeological assemblage is not *in situ* which led to doubts about incorporating the site's archaeological material into the discourse on the Middle and Pleistocene Later Stone Age (Deacon & Deacon 1999; Mitchell 2002). During renewed excavations at the site the same colour offset was observed, but various analyses demonstrate that no large-scale sediment translocation has occurred in the sequence (Sifogeorgaki et al. 2020; Reidsma et al. 2021; Sifogeorgaki et al. submitted).

At the original excavations, it was interpreted that the lateral colour difference was caused by different oxidation states of iron minerals in the deposits (Kaplan 1990: 5). A difference in moisture content between the Purple Brown Sands and the Red Brown Sands was also noted. The lateral colour difference in the Pleistocene sediments was used by Kaplan (1990) to argue for the slumping of the deposits.

We observed moisture and colour differences between the deposits during excavations in 2018 and 2019 (Figs 1 & 2). The boundary between the dark deposits (Purple Brown Sands) and light deposits (Red Brown Sands) was diffuse. Kaplan (1990: 5) suggests this may be caused by mixing of the different sediments at the boundary. Several lines of evidence refute this, such as the analysis of piece-plotted archaeological materials that demonstrate discrete zones of high- and low-find density (Sifogeorgaki et al. 2020), in addition to no visible differences between the deposits in their micromorphology samples (Sifogeorgaki et al. submitted).

To explore the difference between the deposits further, we analyse the sediment colour from samples across the Umhlatuzana sequence in laboratory conditions. We sampled the sediments across a tight grid over the western profile and analysed them using the Munsell colour system that is based on the hue (basic colour), chroma (colour intensity), and value (lightness) properties (Cleland 1921; Kuehni 2001). Additionally, we compare those results with Munsell readings from the field that were published by Sifogeorgaki and colleagues (2020). Here we explore whether there is an actual colour difference between the Purple Brown Sands and Red Brown Sands, the existence of which was one of the arguments for the sediment sliding (Kaplan 1990: 5-7).

2. Materials and methods

The stratigraphic sequence of Umhlatuzana comprises 10 stratigraphic units corresponding to Holocene deposits (Group H – Units H1 to H10) and 17 units corresponding to Pleistocene deposits (Group P – Units P1 to P17) (new excavations, for details see Sifogeorgaki et al. 2020). The lower and southern parts of the Group P units have a noticeably higher moisture content (Fig. 1). We attribute this to water flowing through the rockshelter walls towards the dripline. The higher-moisture units appear darker in colour than the rest of the deposits and correspond to the Purple Brown Sands that were discussed by Kaplan (1990).

To assess sediment colour, we use the Munsell Soil Colour chart which is frequently used by archaeologists and has proven to be reliable and reproducible (Gerharz et al. 1988; Bloch et al. 2021). We assess the colour sequence using 123 samples deriving from the western profile of the new excavations (for sample location see Reidsma et al. 2021: figs 2 & 4). We do so in a controlled laboratory environment on homogenised and dried sediments to minimise measurement bias. The colour was determined on air-dried sediments under natural light.

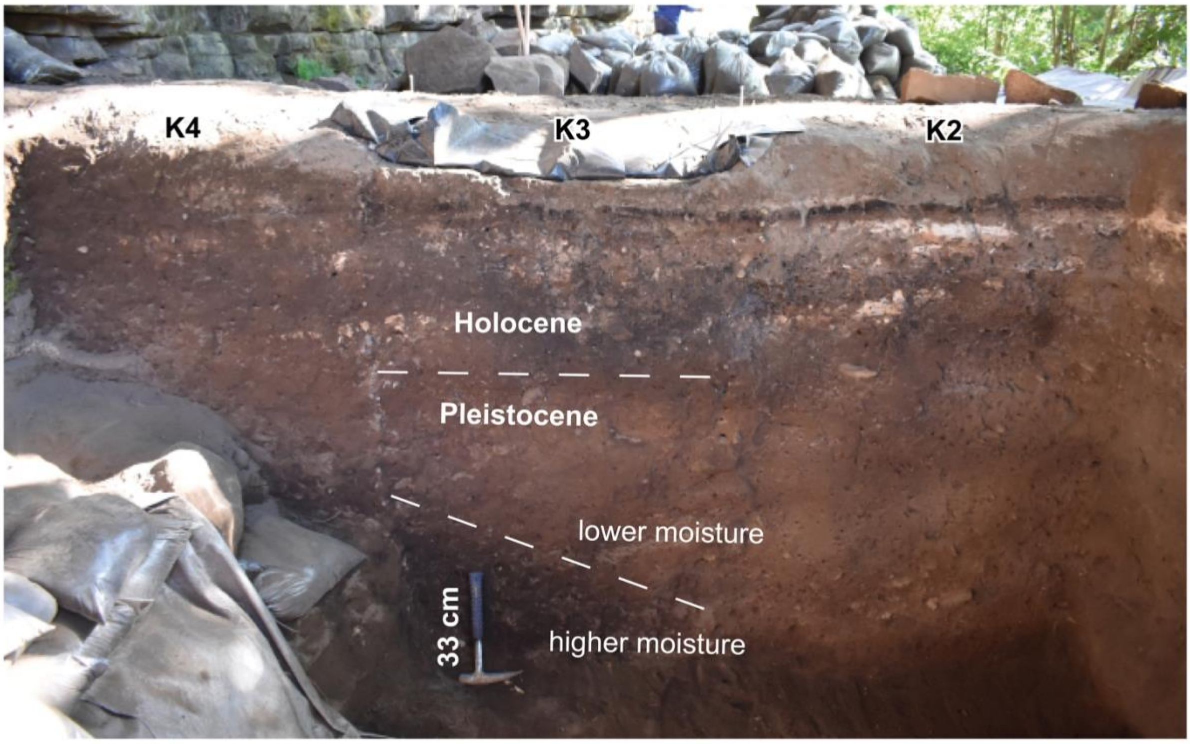

Figure 1. Overview of the western profile of the K squares excavated by Kaplan (1990), highlighting the differences between the higher- (Dark Brown Sands) and lower- (Red Brown Sands) moisture sediments and across the approximate Pleistocene (Group P)/Holocene (Group H) boundary. This picture was taken prior to the 2018-2019 excavation. Image after Sifogeorgaki et al. (2020).

3. Results

The results are presented in Table 1 and indicate that the sequence predominantly has a dull yellowish brown colour (10YR4/3, 70% of the samples) followed by brown (10YR4/4, 18%), dark brown (10YR3/3, 7%), and greyish yellow brown (10YR4/2, 4%). The dark brown and brown sediments tend to correspond to the lower part of the Group P units (Fig. 2). When analysing the air-dried sediments, the southern part does not demonstrate darker sediment colours than the northern part. No further patterning was detected based on the colour identification.

Table 1. Colour determination results and stratigraphic context of the samples (Sq.=square). Munsell colour codes and descriptions are as follows: 10YR5/2 grey yellow brown; 10YR5/3 dull yellowish brown; 10YR5/4 dull yellowish brown; 10YR4/2 grey yellow brown; 10YR4/3 dull yellowish brown; 10YR4/4 brown; 10YR3/2 brown black; 10 YR3/3 dark brown; 10YR3/4 dark brown.

Grid ID	Sq.	Unit	Code	Grid ID	Sq.	Unit	Code	Grid ID	Sq.	Unit	Code
A2		H4	10YR4/3	C13		P12	10YR3/3	F6		P3	10YR5/3
A3		H5	10YR4/3	C15		P1	10YR4/3	F7		P4	10YR5/3
A4		H9a	10YR4/3	C16		P3	10YR4/3	F8		P5	10YR5/3
A5		P1	10YR4/3	C17		P4	10YR5/3	F9		P8	10YR5/3
A6		P2	10YR4/3	D1		H1b	10YR4/3	F10		P8	10YR5/4
A7		P4	10YR4/3	D2		H5	10YR4/3	F11		P11	10YR5/3
A8		P5	10YR4/3	D3		H7	10YR3/3	F12		P13	10YR5/4
A9		P6	10YR4/3	D4		H10	10YR4/2	F13		P13	10YR5/4
A10		P7	10YR4/3	D5		P1	10YR4/3	F14		H10	10YR4/3
A11		P9	10YR3/3	D6		P3	10YR4/4	F15		P1	10YR4/3
A12		P12	10YR3/4	D7		P4	10YR4/4	F16		P3	10YR4/3
A13		P14	10YR3/4	D8		P5	10YR5/3	F17		P4	10YR4/3
A14		H10	10YR4/3	D9		P8	10YR5/3	G1		H1b	10YR4/3
A15	L3a	P1	10YR5/3	D10		P8	10YR4/4	G2		H	10YR3/3
A16		P3	10YR5/3	D11		P10	10YR4/4	G3		H8b	10YR4/3
A17		P4	10YR5/3	D12		P13	10YR4/4	G4		H10	10YR4/3
B2		H4	10YR4/3	D13		P13	10YR4/4	G5		P1	10YR4/3
B3		H	10YR4/3	D14	L2b	H10	10YR3/3	G6		P2	10YR4/3
B4		H	10YR4/3	D16		P3	10YR4/4	G7		P3	10YR4/3
B5		P1	10YR4/3	D17		P4	10YR4/4	G8		P5	10YR4/3
B6		P3	10YR5/3	E1		H1b	10YR4/4	G9	L2a	P5	10YR4/3
B7		P4	10YR5/3	E2		H	10YR4/3	G10		P8	10YR4/4
B8		P5	10YR4/3	E3		H8b	10YR3/2	G11		P11	10YR4/4
B9		P8	10YR4/3	E4		H10	10YR4/3	G12		P13	10YR5/4
B10		P7	10YR4/3	E5		P1	10YR4/4	G13		P13	10YR5/3
B11		P9	10YR4/3	E6		P3	10YR5/3	G15		P1	10YR4/3
B12		P12	10YR4/2	E7		P4	10YR5/3	G16		P3	10YR4/3
B14		H10	10YR4/3	E8		P5	10YR5/3	G17		P4	10YR5/3
B15		P1	10YR4/3	E9		P8	10YR4/4	H1		H1b	10YR4/3
B16		P3	10YR5/3	E10		P8	10YR4/4	H2		H5	10YR3/3
C2		H4	10YR4/2	E12		P13	10YR4/4	H3		H	10YR4/3
C3		H5	10YR4/2	E13		P13	10YR4/4	H4		H10	10YR4/3
C4		H10	10YR5/2	E14		H10	10YR4/4	H5		P1	10YR4/3
C5	L2b	P1	10YR4/3	E15		P1	10YR5/3	H6		P2	10YR4/3
C6		P2	10YR4/3	E16		P3	10YR5/4	H7		P3	10YR4/3
C7		P4	10YR5/3	E17		P4	10YR5/3	H8		P5	10YR5/3
C8		P5	10YR5/3	F1		H1b	10YR4/4	H9		P5	10YR4/3
C9		P8	10YR4/4	F2		H	10YR4/3	H10		P8	10YR4/3
C10		P8	10YR4/3	F3	L2a	H8b	10YR4/3	H11		P11	10YR4/4
C11		P10	10YR4/4	F4		H10	10YR4/3	H12		P13	10YR4/4
C12		P9	10YR3/3	F5		P1	10YR4/3	H13		P13	10YR5/4

4. Discussion

Inconsistent colour determinations can be the result of light source, moisture, and texture of the sediments (see Bloch et al. 2021 and references therein). We show that the colour difference observed in the Pleistocene sequence at Umhlatuzana does not reflect post-depositional events such as the sediment movement proposed by Kaplan (1990). Laboratory sediment descriptions of the western profile show limited colour variation that does not appear clearly patterned. The consistent colour of the sediments within the Pleistocene is supported by micromorphology that show similar fabrics throughout the sequence (Reidsma et al. 2021; Sifogeorgaki et al. submitted). Moreover, grain-size data point to a single source for the sediments present across the 2.5 m deep sequence (Sifogeorgaki et al. 2020). Finally, geochemical differences in the deposits do not correspond to changes in sediment colour. For instance, iron content is higher in the lowermost part of the sequence (Reidsma et al. 2021: fig 6), but such patterning is not reflected in the hue and chroma of the sediments. The fact that the iron content does not mirror the colour change between the wet and dry sediments is also an argument against seeing them as different sedimentary packages characterised by differing oxidation.

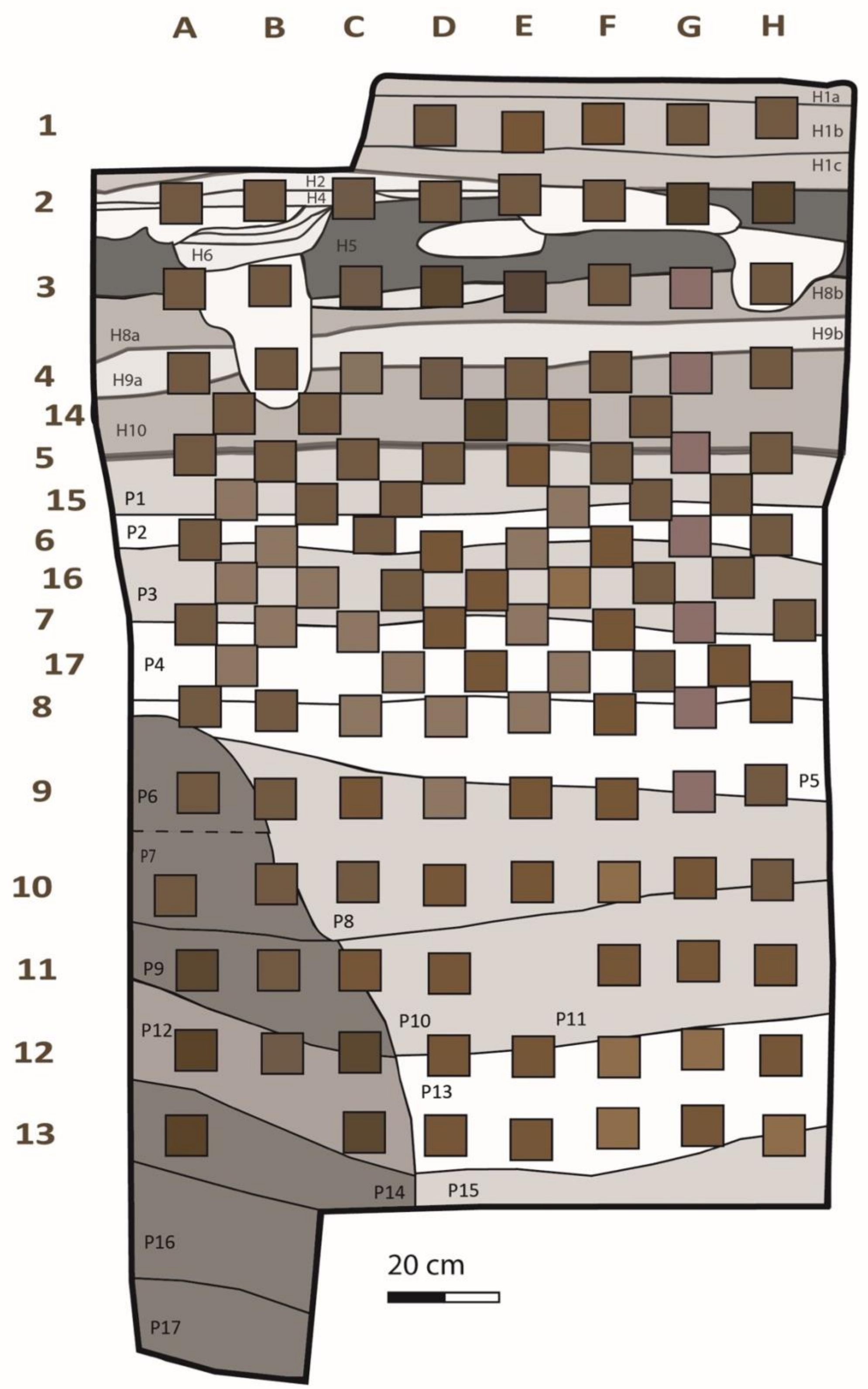

Figure 2. Stratigraphic drawing of west profile with sample locations (square frames) and sample naming system (numbers indicated on the left, letters indicated at the top). The hues selected for the frames resemble actual colours based on the colour code results.

It is important to note that for this study we used dry sediments for the colour determination (as suggested in guidelines by Gerharz et al. 1988). When the sediment determination is performed in the field, it is often conducted on freshly excavated samples that retain their original moisture level (e.g., Goldberg & Macphail 2006) or on wet samples (e.g., Ayala et al. 2015). Most guidelines agree that colour determination is an important aspect of stratigraphic descriptions and that the conditions in which the colour was determined should be clearly stated (e.g., Goldberg & Macphail 2006; Kinne 2016; SIKB 2018). Depending on the colour determination conditions used (moist vs. wet/shade vs. light) the results will be different. Indeed, this was the case in the colour determinations published by Sifogeorgaki and colleagues (2020) where the colour was determined on freshly excavated sediments that maintained their original moisture content. There, the colour of the high-moisture deposits was determined dark brown (Units P6, P17 – 10YR3/3), dark reddish brown (Units P9, P12, P14, P16 – 5YR3/3 and 5YR3/2), and black (Unit P7 – 10YR1.7/1) (Sifogeorgaki et al. 2020: table 2).

Sediment colour remains an important characteristic for stratigraphic description and analysis, but it is crucial to separate out the influence of differing sedimentary input (e.g., anthropogenic input, such as ash; charcoal at Umhlatuzana does create colour differences in the Holocene) from diagenetic processes (e.g., weathering, soil formation, hydrological features) in describing the sedimentary units and their characteristics. Moreover, the use of a non-arbitrary technique, such as the Munsell colour system, to support colour determination is important to limit inter-observer errors relating to colour perception and to promote comparability of the results. Finally, determining soil colour in the controlled environment of laboratory facilities proved essential for avoiding inconsistencies.

5. Conclusion

The results of this study reinforce previous results on the geoarchaeology of Umhlatuzana rockshelter, which suggest that the Purple Brown Sands and the Dark Brown Sands do not represent different depositional sedimentary packages. Rather, they appear to represent a single horizontally deposited sedimentary package in which lateral colour differentiation was caused by post-depositional subsurface water flow through the sediments nearest to the rockshelter wall, and not by sedimentary differences (e.g., in organic matter content and/or iron oxidation state; also see Bloch et al. 2021). Characterised by higher moisture content, they appear darker in the field (Purple Brown Sands) than the drier sediments near the valley edge (Red Brown Sands). When dried and analysed under artificial light, the sediments at Umhlatuzana have a similar colour throughout the analysed stratigraphic profile. This study serves as a reminder that aspects like moisture content and light circumstances should be considered and be clearly communicated before publishing sediment colour data. More so if the sediment colour is used as an argument for the occurrence of depositional and/or post-depositional processes.

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