

Research Article

THE LATE PLEISTOCENE ARCHAEOLOGY OF KLEIN KLIPHUIS ROCK SHELTER, WESTERN CAPE, SOUTH AFRICA: 2006 EXCAVATIONS

ALEX MACKAY

*School of Archaeology and Anthropology, Australian National University, Acton, 0200, Australia**E-mail: alexander.mackay@anu.edu.au*

(Received February 2010. Revised August 2010)

ABSTRACT

This paper reports on the late Pleistocene component of the 2006 excavations at Klein Kliphuis rock shelter in the Western Cape. Some 40 000 flaked stone artefacts and 2.5 kg of ochre were recovered from the excavation, along with minimal quantities of charcoal and other organic finds. Chronometric data suggest that the cultural sequence at the site began to accumulate around or slightly before 65 ka. The basal unit is assigned to the Howieson's Poort which has two discernible components or 'modes', separated by a decrease in artefact numbers and interesting changes in material prevalence centred on 62 ka. The sequence also includes two different post-Howieson's Poort components, the older of which appears to begin with the cessation of MIS 4 around 58 ka and the younger of which appears to end some time between 33 ka and 22 ka. Differences in rates of artefact discard suggest relatively intensive use of the shelter in late MIS 4 and more ephemeral use thereafter. The youngest component of the late Pleistocene sequence can be described as late Pleistocene microlithic LSA and dates to around 22 ka. While there appears to be no transitional Middle to Later Stone Age component to the sequence, there are few clear differences between the oldest LSA at the site and the youngest MSA, possibly implying that the transition occurred over an extended period from late MIS 3 to early MIS 2.

Keywords: Middle Stone Age, Howieson's Poort, lithic technology, Klein Kliphuis, South Africa.

INTRODUCTION – SITE, SETTING AND EXCAVATION HISTORY

The rock shelter site of Klein Kliphuis (KKH) is located approximately 200 km north of Cape Town (Fig. 1). The Kliphuis River runs immediately below the shelter, which is located in a cliff-like valley wall. Approximately 4 km from the site the Kliphuis River joins the Olifants River – the largest drainage feature in the area.

The shelter itself is approximately 18 m wide and 9 m from the drip line to the rear wall at its deepest point (Fig. 2). The dominant geology in the area is Table Mountain Sandstone (TMS), which contains quartzite and quartz suitable for the manufacture of flaked stone artefacts. Silcrete is also known to occur in the area (Roberts 2003), and has been identified in unworked boulders less than 10 km from the site (Mackay 2008).

In 1984 W.J.J. van Rijssen excavated KKH as part of a research programme exploring the interaction of hunter-gatherers and early herders in the Western Cape. Excavation at this site was probably encouraged by the presence of pottery on, and immediately below the sediment surface. Limited sub-surface visibility was afforded by a number of small 'scours' into the archaeological sediment. These are the result of

faults in the shelter roof through which water leaks during and after rainfall. A bucket placed under one such fault accumulated ten litres of water in one wet week in 2006.

Van Rijssen's 1984 excavations yielded a relatively small late Holocene component (~200 mm), and a more substantial (~700 mm) component ascribed by Van Rijssen to the MSA (cf. Van Rijssen 1992). While the Holocene material was removed from several square metres of the site, only a single one metre square was excavated into the underlying sediments. Excavation ceased at bedrock, at a depth of approximately 900 mm below surface. Four broad stratigraphic units were identified in the pre-Holocene sediments, each of which was excavated without subdivision into spits. The excavation was quite coarse by recent standards – the smallest MSA excavation unit being 105 mm and the largest 250 mm – but sufficient to allow broad characterisation of the sequence. Fine stratigraphy is not visible in the KKH deposits, and it appears reasonable to suggest that moisture and the rootlet activity that it has encouraged are largely responsible for this lack of stratigraphic differentiation.

Analysis of the stone artefacts from Van Rijssen's four pre-Holocene units suggested the presence of a stratified sequence of Howieson's Poort, late MSA, final MSA, and possibly some late Pleistocene LSA (Mackay 2006). The excavation produced a substantial sample of stone artefacts and ochre, including an engraved ochre fragment from the MSA unit D2 (Mackay & Welz 2008). Unfortunately, the 1984 excavation units did not cohere precisely with culture-historic units. Thus, in the case of excavation unit D2, the artefact assemblage indicated the presence of both Howieson's Poort and late MSA. The resulting inseparability of some cultural units made a refined reading of the sequence difficult, and precluded recognition of more subtle technological changes. The site was re-excavated in 2006, with the dual aims of refining the cultural sequence and establishing a sound chronology. Along with pursuing those objectives, this paper provides bracketing ages for Van Rijssen's unit D2, and thus for the engraved ochre recovered in 1984.

DESCRIPTION OF THE 2006 EXCAVATIONS

Four 500 mm × 500 mm squares were excavated in 2006, resulting in a total excavation area of approximately 1 m².¹ The selected squares formed an 'L' shape around the west edge of Van Rijssen's original 1 metre square, I1 (Fig. 2). Holocene material had been removed from two of these squares during the previous excavation. In the remaining two squares, ~150 mm of grass bedding and sediment was removed before apparently Pleistocene deposit was encountered². Excavation followed stratigraphic units subdivided into 25 mm spits. All sediment was dry-sieved on site through 3 mm mesh.

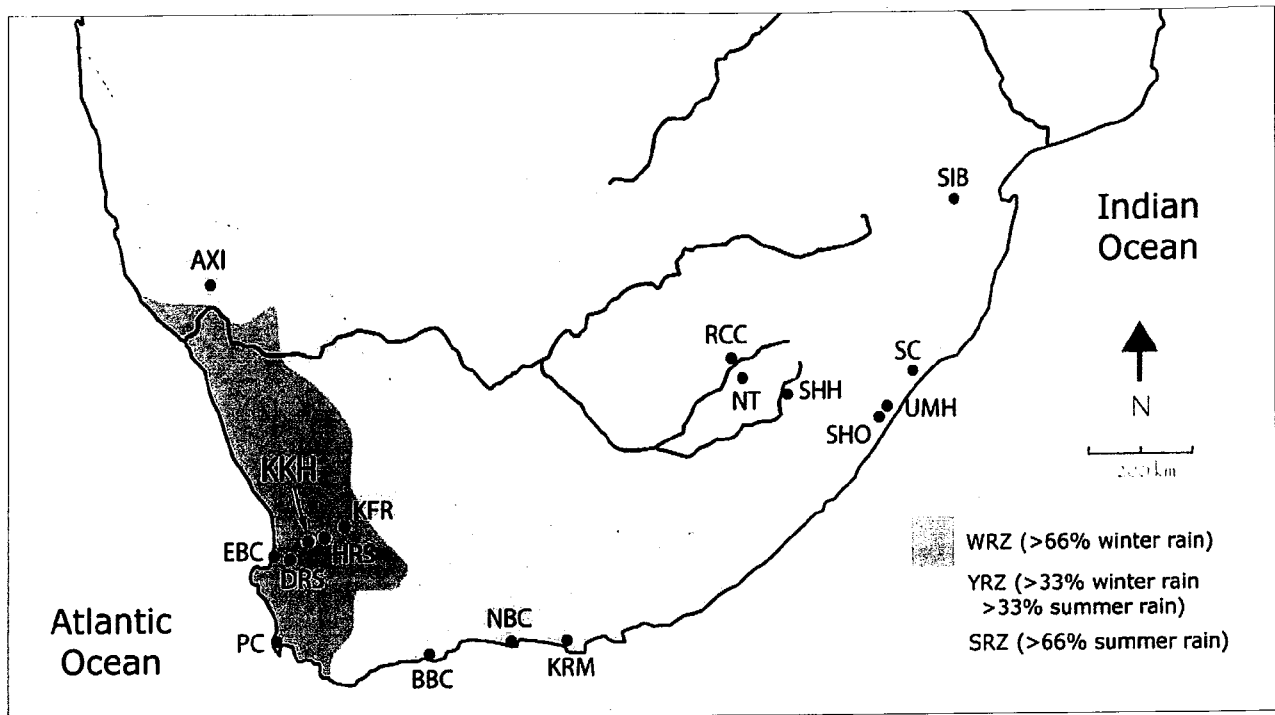


FIG. 1. Location map showing rainfall zones and sites mentioned in the text. Rainfall zones follow Chase and Meadows (2007). Abbreviations as follows: AXI = Apollo XI, BBC = Blombos, DRS = Diepkloof, EBC = Elands Bay Cave, HRS = Hollow Rock Shelter, KFR = Klipfonteinrand, KKH = Klein Kliphuis, KRM = Klasies River Main, NBC = Nelson Bay Cave, NT = Ntloana Tsoana, PC = Peers Cave, RCC = Rose Cottage Cave, SC = Sibudu Cave, SHH = Selonghong, SHO = Shongweni, SIB = Sibede, UMH = Umhlatuzana.

Additionally, one square was sieved through 1.5 mm mesh with all residues kept. Though not ideal, the abundance of naturally fractured rock from the walls and roof of the shelter necessitated a degree of on-site sorting. Overall, approximately 290 kg of roof spall was discarded during the course of the excavation.

STRATIGRAPHIC SEQUENCE

Van Rijssen (1992) divided the KKH sequence into five broad stratigraphic units, referred to in this report as 'zones'. Van Rijssen's zones were labelled A, bedding, B, C and D. All except zone D were divisions of the late Holocene. Zone D encompassed the Pleistocene component and constitutes that part of the sequence of interest here. In order to facilitate comparison, the 2006 stratigraphic sequence is divided into the same five zones (Figs 3 and 4). Within D, Van Rijssen identified four stratigraphic units – D, D1, D2 and D3. In the 2006 excavation, seven stratigraphic units were identified within zone D, each of which was allocated a lower case Roman numeral; thus, Di, Dii, Diii etc. Each of these units was further subdivided into ~25 mm spits, denoted using standard numbers; thus, Di1, Di2, Di3 etc.

Three issues complicate the reading of the stratigraphic sequence. The first is the existence of a hollow filled with grass at the rear of the shelter (identified stratigraphically as the 'bedding' unit). Such hollows have been recorded in other late Holocene deposits in the area, such as Elands Bay Cave and De Hangen (*cf.* Parkington 1977). In the case of the KKH deposits, the digging out of this hollow appears to have involved removal of the late Pleistocene component Di from all of squares H1B, H1C and part of squares H2C and I2D.

The second complicating factor is the presence of a pit against the rear wall of the shelter, occurring below the sleeping hollow and extending from zone C into zone D. The pit was not initially recognised during excavation, but became

apparent with the drying of the western section. This pit, and the layer from which it appears to have derived, are indicated on the Fig. 3 by the letters Cp – zone C, Pit. While the pit, as it appears in the section, is largely constrained to square H1C, it cannot be guaranteed that it did not extend further into square H1B. Van Rijssen (1992, unpublished excavation notes) makes no mention of a pit in the Western section of II, and it thus appears unlikely that it extended more than 50 cm east of the 2006 west section. Notably, no typical LSA markers were observed in the zone D finds from the 1984 excavations, and thus there is no indication of intrusive material in the earlier sample. Nevertheless, to minimise presumptions, all layers in H1B within the depth range of the pit are considered to be compromised (Dc – zone D, Compromised), and data are presented separately. There is no obvious reason to extend this inference into squares H2C and I2D.

The final complicating factor derives from the backfilling of the 1984 excavation. After the Holocene material had been removed from the upper surface of a number of squares, plastic bagging was laid down over most, but crucially not all, of the Pleistocene sediment surface before backfilling occurred. Consequently, the upper sediments in square H2C were compromised by the minor mixing of intact deposit and backfill. The affected unit is indicated in Fig. 4 as Db – zone D, Backfill.

Of the seven uncompromised units identified in the 2006 excavation, one of these (Diii) was highly ephemeral, while another (Dvi) accounted for more than half of the zone D deposit. Table 1 presents descriptions of the stratigraphic units within zone D. The table makes clear the gross similarity of sediments, particularly through the upper units of the sequence. Units were primarily distinguished on the basis of minor variations in sediment colour and texture. The lowest two units, and the basal unit most specifically, were, however, quite distinct in colour from the upper units. The basal unit was also far coarser than any of the overlying units.

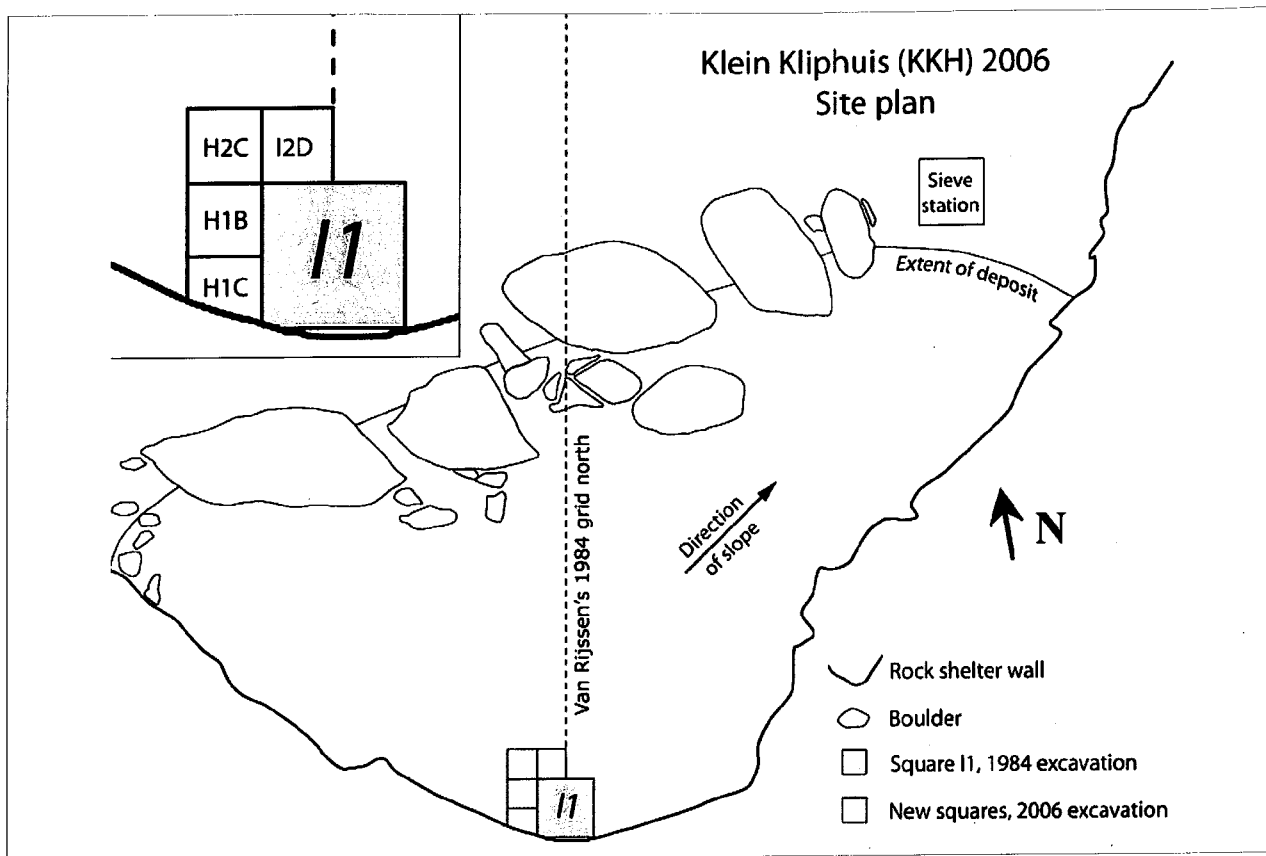


FIG. 2. KKH site plan.

SITE FORMATION PROCESSES

WATER MOVEMENT

While the shelter itself is almost certainly located too high in the gorge wall to have been subject to fluvial processes in the Pleistocene, water is regularly introduced to the site through cracks in the shelter roof. Water drips through these cracks into the sediment body during rainy periods. As well as increasing the acidity of the sediment, this water movement is also likely to have induced some loss of fine sediments from the deposit, which slopes appreciably down to the eastern edge of the shelter mouth. The deposit might thus be described as lagged, with the result that artefact density is exaggerated.

BIOTURBATION

Evidence of bioturbation in the forms of insect and root activity was present at all depths of the excavation. Insect casings probably related to wasps or solitary bees (S. van Noort, pers. comm. 2007) were encountered in approximately one in twelve excavated contexts. Root activity was present throughout the excavation, though with one exception all roots encountered were ≤ 1 mm thick. The exception was a single ~ 30 mm thick rotten root located along the rear wall of the excavation. Ongoing root/rootlet activity over tens of thousands of years may be partly responsible for the homogenisation of the sediments, and would likely have assisted in the destruction of organic remains through the introduction of humic acid.

Ordinarily, recurrent evidence of bioturbation would be considered likely to have affected the stratigraphic integrity of the sequence. However, as discussed below, the potential of bioturbation to have induced vertical redistribution of archaeological finds is significantly limited by the persistence of roof spall throughout the sequence.

ROOF SPALL

Laminar fragments of naturally fractured quartzitic sandstone were a pronounced feature of the KKH deposit. Figures 3 and 4 only depict fragments over 2 cm – by mass, smaller fragments would add an extra $\sim 32\%$ to those represented in the section figures. When excavating the deposit, no substantial patches of sediment were encountered that were entirely free of spall. One implication of this is that it would be exceedingly difficult for any object moving under the effect of gravity to undergo much vertical displacement. Thus, although the site displays evidence of bioturbation, it is doubtful that this had a significant impact on the vertical distribution of finds. Aspects of the stone artefact sequence bear out this suggestion. The effects of bioturbation are probably more pronounced in the destruction of organic matter than in changes to the site's stratigraphic integrity.

CHRONOLOGY

^{14}C

Four ^{14}C determinations (two standard, two AMS) are available from the 2006 excavations at KKH, which can be added to the three determinations which resulted from the 1984 excavations (Table 2). All determinations were made on charcoal. One determination of 851 ± 48 cal yr BP (Wk-20240) was made from the upper part of the disturbed context zone C. Though compromised, the date is worth mentioning as it underlies the 1167 ± 71 cal yr BP (Pta-4672) date from the 1984 excavation. The presence of younger charcoal in the lower layer appears to confirm some disturbance in the upper part of sequence. It seems possible that the charcoal dated from the bedding zone of the 1984 excavation was brought up from older layers during the digging out of the sleeping hollow or the pit.

Klein Kliphuis (KKH) 2006 excavation Western Section

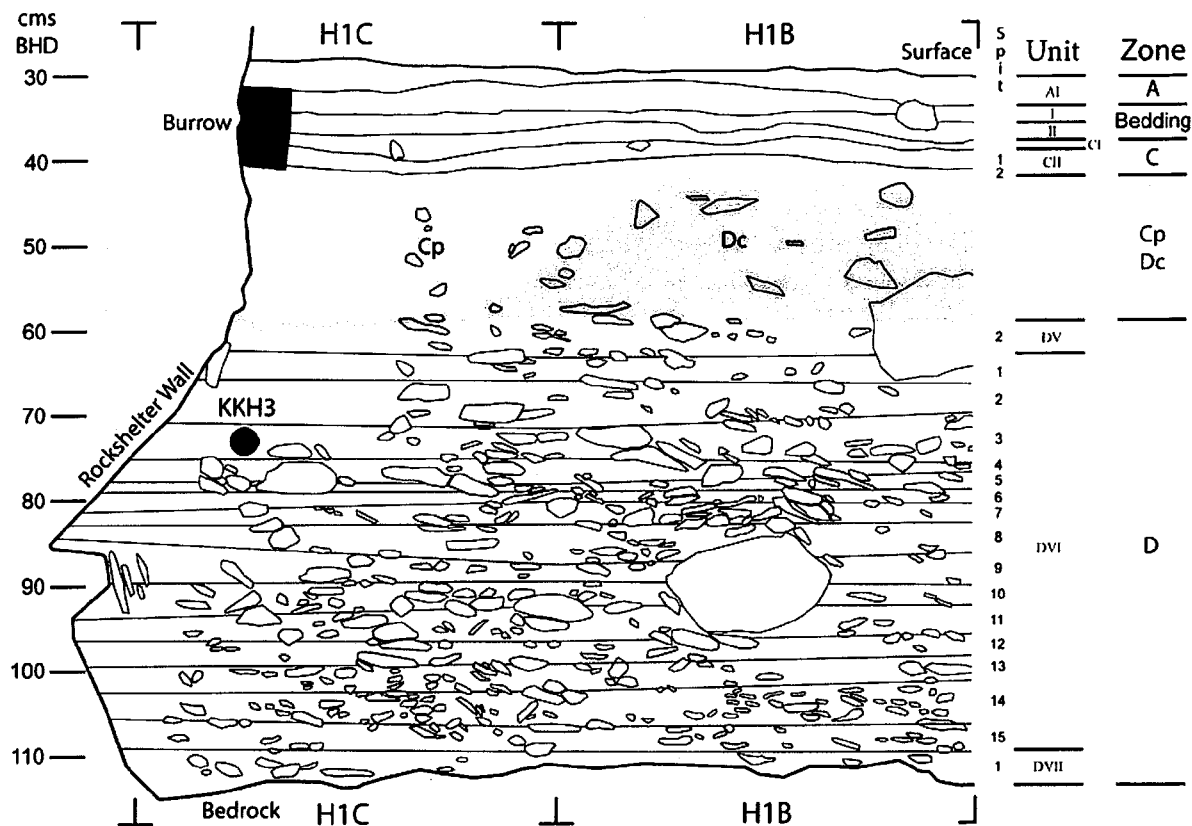


FIG. 3. KKH, 2006 excavations, west section.

Bulk charcoal from the lowest spit of unit Di produced a determination of $22\,315 \pm 344$ cal yr BP (Wk-20241), placing occupation of this layer around the peak of the Last Glacial Maximum (LGM) and confirming the Pleistocene antiquity of the uppermost part of zone D. It should be noted that unit Di was only encountered in squares H2C and I2D – those furthest from the shelter wall. Closer to the wall, this unit appears to have been removed with the formation of the late Holocene hollow. Consequently, more extensive late/terminal Pleistocene deposits are expected to occur elsewhere in the site.

A single determination was also made on a charcoal fragment recovered from close to the base of unit Dii, approximately 6 cm below the date of ~22 ka. An AMS determination on this piece returned an age of $>35\,000$ ^{14}C yr BP (Wk-20242). The result implies a hiatus between the formation of unit Dii and unit Di, though this appears to be contradicted by OSL ages (discussed below). The determination of $>35\,000$ also appears to place the entire sequence below Di beyond the radiocarbon range. A second AMS determination on a charcoal fragment from spit Div likewise yielded a result of $>35\,000$ ^{14}C yr BP (Wk-20243).

OSL

OSL determinations were undertaken on sediments from KKH by Zenobia Jacobs, and have been published elsewhere (cf. Jacobs *et al.* 2008). The results of this work are summarised here.

Eight OSL ages are available for the KKH sequence (Table 3). Two of these were taken from Van Rijssen’s 1984 east section, five from the northern section of the 2006 excavation, and one from the western section.

A determination of 33 ± 1 ka (KKH8) was returned from the lowest part of unit Di – the same unit dated by conventional radiocarbon to ~22 ka. As noted in Jacobs and colleagues (2008), however, the single grain analysis on which the OSL age was based suggested the presence in the dated sample of two separate components – one dating to around 33 ka and the other to around 18 ka (Jacobs *et al.* 2008: supporting online material). This can be reconciled with the ~22 ka radiocarbon age, given that bulk charcoal was used in the ^{14}C assay. Incorporation of both older and younger charcoal in the sample would have produced a result skewed towards the younger age. It may thus be that both ~20 ka and ~30 ka components are present in unit Di, or that there was an ephemeral lens between Di and Dii (dated to >35 ka) which was not recognised during excavation.

Of the remaining OSL determinations, those made at the interface of Dv and Dvi in the 2006 excavation, and at the interface of D1 and D2 in the 1984 excavation almost certainly date the same stratigraphic change. Both returned comparable age estimates of 56 ± 3 ka (KKH4) and 55 ± 2 ka (KKH3) respectively. Combined with the ^{14}C ages and the OSL sample KKH8, these determinations provide age brackets of ~35 ka and ~55 ka for stratigraphic units Dii through Dv, thus relating them to MIS 3.

Klein Kliphuis (KKH) 2006 excavation North Section

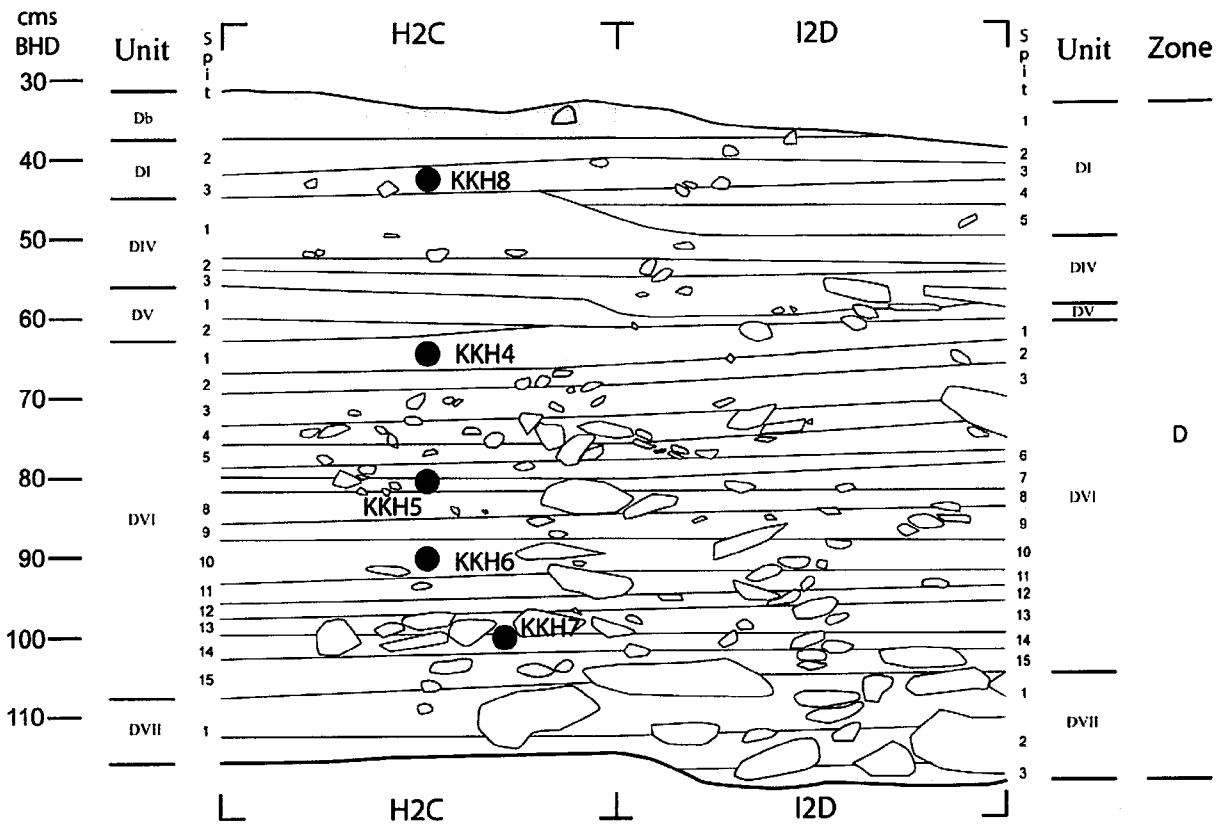


FIG. 4. KKH, 2006 excavations, north section. Note that units Dii and Diii are not present in the north section, nor are the lowest spits in units Di and Dvi.

Three of the remaining determinations were made within Dvi, returning ages of 58 ± 2 ka (KKH1, taken in Dvi3), 65 ± 3 ka (KKH5, taken in Dvi6) and 60 ± 3 ka (KKH6, taken in Dvi10). The last two ages are inverted. In the context of the available dates, the age of 65 ± 3 ka appears to be out of sequence.

The final two determinations date the interface of Dvi and Dvii in the 2006 excavation, and D2 and D3 in the 1984 excavation. Again, these probably reflect the same stratigraphic change. An adequate sample could not be taken from the precise point of transition in the new square due to the abundance of rock in the section, and in consequence the sample was taken slightly above the transition point. Nevertheless, the returned ages were again relatively similar; 64 ± 3 ka at Dvi13 (KKH7) in the new square, and 66 ± 3 ka (KKH2) in the old square. It can be noted that the determinations of 55 ± 2 ka (KKH3) and 66 ± 3 ka (KKH2) provide bracketing ages for Van Rijssen's unit D2, and thus for the engraved ochre discussed by Mackay and Welz (2008).

The OSL samples KKH7 and KKH2 provide the oldest dates for the sequence, but they are not basal, only near-basal. Some 100–150 mm of archaeological deposit lies between these ages and bedrock. A linear age–depth curve incorporating all mean ages for Dvi and Dvii follows the formula $age = 0.23 \times depth + 41.41$, with an r^2 value of 0.71. If the out-of-sequence date of 65 ± 3 ka is removed, the fit line changes to $age = 0.24 \times depth + 39.56$, and the r^2 improves to 0.96. These curves are based only on the mean ages, and as such do not allow for the effects of dispersion. When the curve is regenerated for simu-

lated populations of appropriate mean and 2 sigma dispersion (n is arbitrarily set at 40 for each age), r^2 falls to 0.86, but the shape of the curve does not change. The curve as fitted to mean values with appropriate dispersion provides estimates of between 65.6 ka and 68.1 ka for the mean age of the base of the sequence.

ARCHAEOLOGICAL SEQUENCE

ORGANIC FINDS

Organic finds were a negligible component of the archaeological remains excavated from late Pleistocene layers at KKH. A total of 2.9 g of bone was recovered, the vast majority of which was so heavily fragmented as to preclude identification⁴. The only pieces allowing detailed identification were two fragments of tortoise from Dvi2 and a small-medium bovid pre-molar from Dvi11. Charcoal was present throughout; however, heavy mechanical fragmentation (roof fall and root activity) meant that in many cases it was only represented in the sub-sampled 1.5 mm fraction.

STONE ARTEFACTS

GENERAL

In total, the 0.9 m³ excavation at KKH resulted in the recovery of more than 40 000 stone artefacts⁵. Table 4 presents general data on the number of artefacts of different classes by unit. Due to the presence of the disturbance feature which affects the

TABLE 1. Description of sediments by stratigraphic unit (all zone D).

Unit	Max depth (m BHD)	Colour	Description
Di	0.53	Very dark yellow-greyish brown 10YR 3/2 <1% coarse (5–10 mm) fraction ~5% fine (1–2 mm)-medium (2–5 mm) fraction	Very fine sandy clay (sand component <20%) Some charcoal (<1%)
Dii	0.56	Very dark yellow-greyish brown 10YR 3/2 One piece very coarse (>10 mm diameter) ~2% medium fraction 2% fine fraction	Very fine sandy clay (sand component ~5%) Some charcoal (<1%)
Diii	0.55	Dark yellow-greyish brown YR10 4/2 3–5% medium fraction 3–5% fine fraction	Very fine sandy clay (sand component ~30%) <1% coarse fraction
Div	0.6	Very dark yellow-grey 10YR 3/1 <1% medium fraction ~3% fine fraction	Very fine sandy clay (sand component <10%) <1% coarse fraction
Dv	0.65	Blackish yellow-brown 10YR 2/1.5 ~5% fine-medium fraction	Very fine sandy-clay (sand component <10%) Some charcoal (<1%)
Dvi	1.08	Blackish brown 7.5YR 2.5/1 (upper spits) Blackish brown 5YR 2.5/1 (lower spits)	Very fine clay (sand component <5%). 3% fine fraction Very fine clay-sand (sand component ~50%) ~20% fine-medium fraction
Dvii	1.19	Dark brown 7.5YR 3/2.5	Sand (clay component <30%) >50% coarse – very coarse fraction ~10% medium and fine fraction

TABLE 2. Radiocarbon age estimates from 2006 and 1984 excavations.

Lab code	¹⁴ C technique	Excavation year (2006 equiv)	Layer (BP)	Uncal. age (BP)	Cal age
Wk-20240	Conv*	2006	C Pit	922 ± 36	850 ± 49
Wk-20241	Conv.	2006	Di5	18 664 ± 103	22 315 ± 344
Wk-20242	AMS	2006	Dii2	>35 000	–
Wk-20243	AMS	2006	Div1	>35 000	–
Pta-4672	Conv.	1984	Bedding (same)	1 230 ± 50	1 167 ± 71
Pta-4671	Conv.	1984	Base of C (same)	1 990 ± 50	1 949 ± 52
Pta-4685	Conv.	1984	D2 (Dvi)	32 300 ± 1400	37 047 ± 1773

*Conventional.

upper five units in squares H1C and H1B, data for spits in these units derive from only 0.5 m², rather than the full 1 m². The artefacts from the disturbed contexts are presented as a separate unit.

Most of the artefacts recovered (81.5%) were less than 15 mm in maximum dimension. This category does not include cores, core fragments or retouched flakes, all of which were included in their respective separate categories regardless of size. Of the artefacts greater than 15 mm, unretouched flakes (both complete and broken) dominate. Cores and retouched flakes are present throughout the sequence, and though they are numerically most common in the lower units, they are proportionately most common in the upper units.

Figure 5 presents data on numbers of artefacts greater than 15 mm, by spit, through the KKH sequence. As can clearly be

TABLE 3. All OSL ages from 2006 and 1984 sections.

Sample code (from Jacobs <i>et al.</i> 2008)	Excavation year (2006 equivalent)	Layer (ka)	OSL age
KKH8	2006	Di5	33 ± 1
KKH4	2006	Dvi1	56 ± 3
KKH1	2006	Dvi3	58 ± 2
KKH5	2006	Dvi6	65 ± 3
KKH6	2006	Dvi10	60 ± 3
KKH7	2006	Dvi13	64 ± 3
KKH3	1984	D1/D2 (Dv/Dvi)	55 ± 2
KKH2	1984	D2/D3 (Dvi/Dvii)	66 ± 3

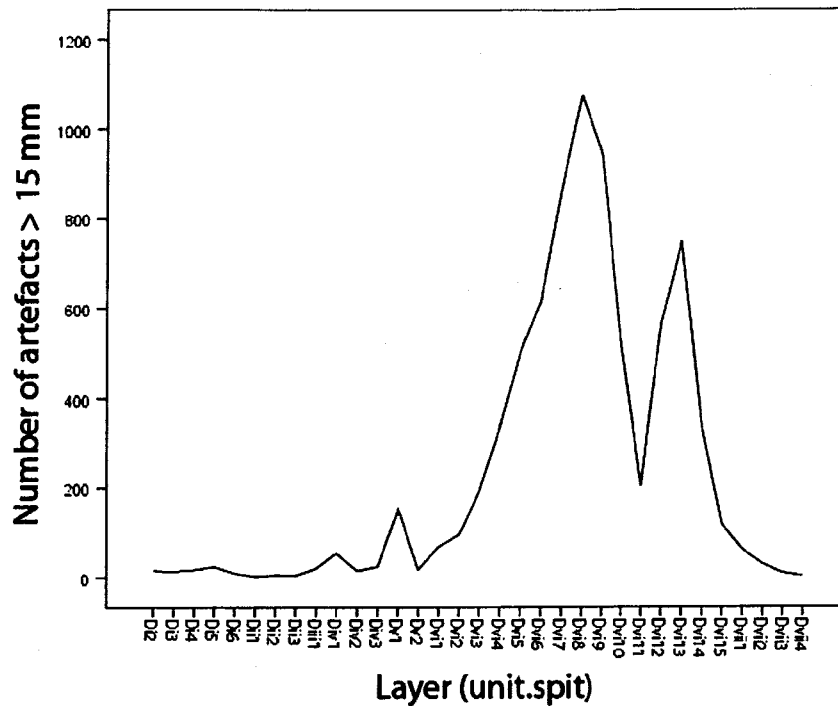


FIG. 5. Artefact numbers by spit.

discerned, the vast preponderance of artefacts occurred between spits Dvi2 and Dvi15. Artefact numbers in the upper spits in particular were generally very small, even allowing for the reduced area from which they were recovered. Another notable feature of Figure 5 is the pronounced bimodality in artefact numbers in unit Dvi. Two peaks notable in spits Dvi3 to Dvi10 and Dvi12 to Dvi15 are separated by a well-defined trough centred on Dvi11.

Blades are another artefact class the prevalence of which is of general interest. As noted elsewhere (Mackay 2006), the identification of blades often involves significant inter-observer variability. For that reason, blades are coarsely (but reliably) identified here as flakes which are more than twice as long in percussive length as they are in maximum width. Figure 6 presents data on changes in elongation through the KKH sequence. Flakes are classified into three groups – those with elongation values <1, those with elongation values between 1 and 2, and those with elongation values >2. This last grouping might be considered to be blades. Only complete flakes are used – the numbers per spit are provided in Table 4. The figure suggests that the prevalence of blades is not particularly variable through the sequence, though blades are largely absent from the upper units, and values in the lower spits of Dvi are

generally less than those in the upper spits of the same unit.

A final aspect of the general assemblage worth discussing concerns the distribution of flakes with faceted platforms. These are of interest because prepared cores and flakes with faceted platforms are part of the original definition of the MSA (Goodwin & Van Riet Lowe 1929) and their disappearance is one of the markers of the onset of the LSA. In the Pleistocene sequence at KKH flakes with faceted platforms did not occur in unit Di (Table 5), though it should be noted that the sample of flakes with platforms from this unit was small ($n = 30$). Nevertheless, in the underlying unit Dii, from which the sample of intact platforms was considerably smaller ($n = 4$), faceting was recorded on 50% of pieces. In the three units below Dii, faceting occurred on 33.3%, 20% and 40.9% of flakes with intact platforms respectively. Overall, faceting occurred on 16.4% of flakes with intact platforms below unit Di.

MATERIALS

Table 6 presents data on the frequencies of different materials by unit. Silcrete is the dominant material overall in the KKH assemblage, accounting for 68% of the total, though there are notable diachronic changes in its relative prevalence.

Figure 7 presents changes in the relative prevalence of the

TABLE 4. Stone artefact classes by unit (all Zone D).

Unit	Flakes	Flaked pieces	Retouched flakes	Cores	Other	Artefacts <15 mm	Total
Di	58	8	4	13	0	321	404
Dii	7	2	1	4	0	57	71
Diii	14	1	2	3	1	0	21
Div	81	5	5	4	0	346	441
Dv	170	14	14	10	10	268	489
Dvi	6059	327	358	307	115	30 625	37 795
Dvii	94	2	6	4	0	306	412
All disturbed	246	24	21	15	15	680	1 001
Total	6729	383	411	364	144	32 603	40 634

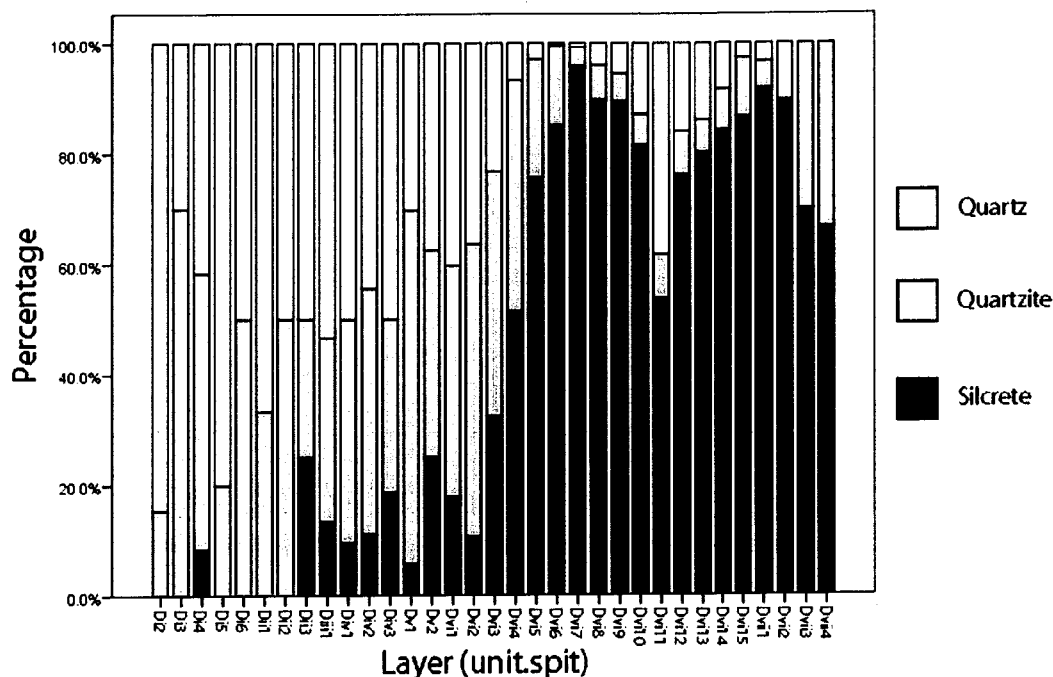


FIG. 7. Material prevalence by spit showing silcrete, quartz and quartzite only.

pronounced bimodality which follows the distribution of total artefact numbers (Fig. 9).

Notched artefacts (predominantly notched blades) exhibit distributional similarities with backed artefacts, with only three (8.8%) occurring above Dvi6. More specifically, it can be noted that most of the notched pieces occurred in the lower of the two peaks in artefact numbers. The notched pieces take several forms, including single, double and rare multiple notched pieces (Fig. 8g–l). Again, the notches were usually small (<20 mm) and composed of multiple scars applied to either the dorsal or ventral face. Notched artefacts are quite distinct from denticulate retouched pieces, the notches on which commonly result from a single removal. Denticulate artefacts were generally rare in the KKH sample ($n = 6$).

Scrapers and unifacial points have similar distributions in the sequence, which might broadly be described as contrasting with the distributions of backed artefacts and notched flakes/blades. Scrapers are rare in the lower layers of the sequence, and only become common above Dvi9. A single unifacial point occurs in Dvi7, but otherwise all examples of this type occur above Dvi8.

Pieces which do not cohere with any specific implement type make up the majority of the retouched flake category ($n = 228$). This includes 23 flakes with crushing damage to both the dorsal and ventral faces of opposed margins which might reasonably be interpreted as *pieces esquilles*. Whether these

should be classed as retouched or simply as damaged is open to debate. Such pieces occur in all contexts, though they are more common in the larger assemblages of Dvi and Dvii.

In addition to these finds it is worth noting the presence of a single shale point with retouch to both the dorsal and ventral margins (Fig. 8v). Though invasive, retouch to the ventral is limited to the proximal end. The retouch which produced or exaggerated the pointedness of the flake was applied exclusively to the dorsal face. The artefact might reasonably be described as a 'parti-bifacial' point. The artefact was recovered from zone Dc – that part of zone D compromised by the pit – and its association is thus unclear.

CORES

Cores were generally abundant in the late Pleistocene layers of KKH. In total the 2006 excavation recovered more than 350 cores and core fragments. Table 8 presents frequencies of different core types through the uncompromised part of the zone D sequence for complete cores only. The typology is kept general and is based on simplified reduction systems, including platform, rotated, bipolar, Levallois and other prepared forms (*cf.* Mackay 2006; also Conard *et al.* 2004).

Bipolar cores (19.2%) and platform cores (18.6%) were the two most common core types, followed by radial (16.1%), rotated (11.9%) and Levallois (9.7%) cores. A large proportion of cores (25.6%) could not be assigned to any specific type.

TABLE 7. Implement types by unit.

Unit	Backed	Denticulate	Notched	Scraper	Unifacial point	Other retouched
Di	1	0	0	0	0	3
Dii	0	0	0	0	0	1
Diii	0	0	0	0	0	2
Div	0	0	0	1	0	4
Dv	0	0	1	1	1	11
Dvi	85	6	40	13	10	204
Dvii	2	0	1	0	0	3
Total	88	6	42	15	11	228

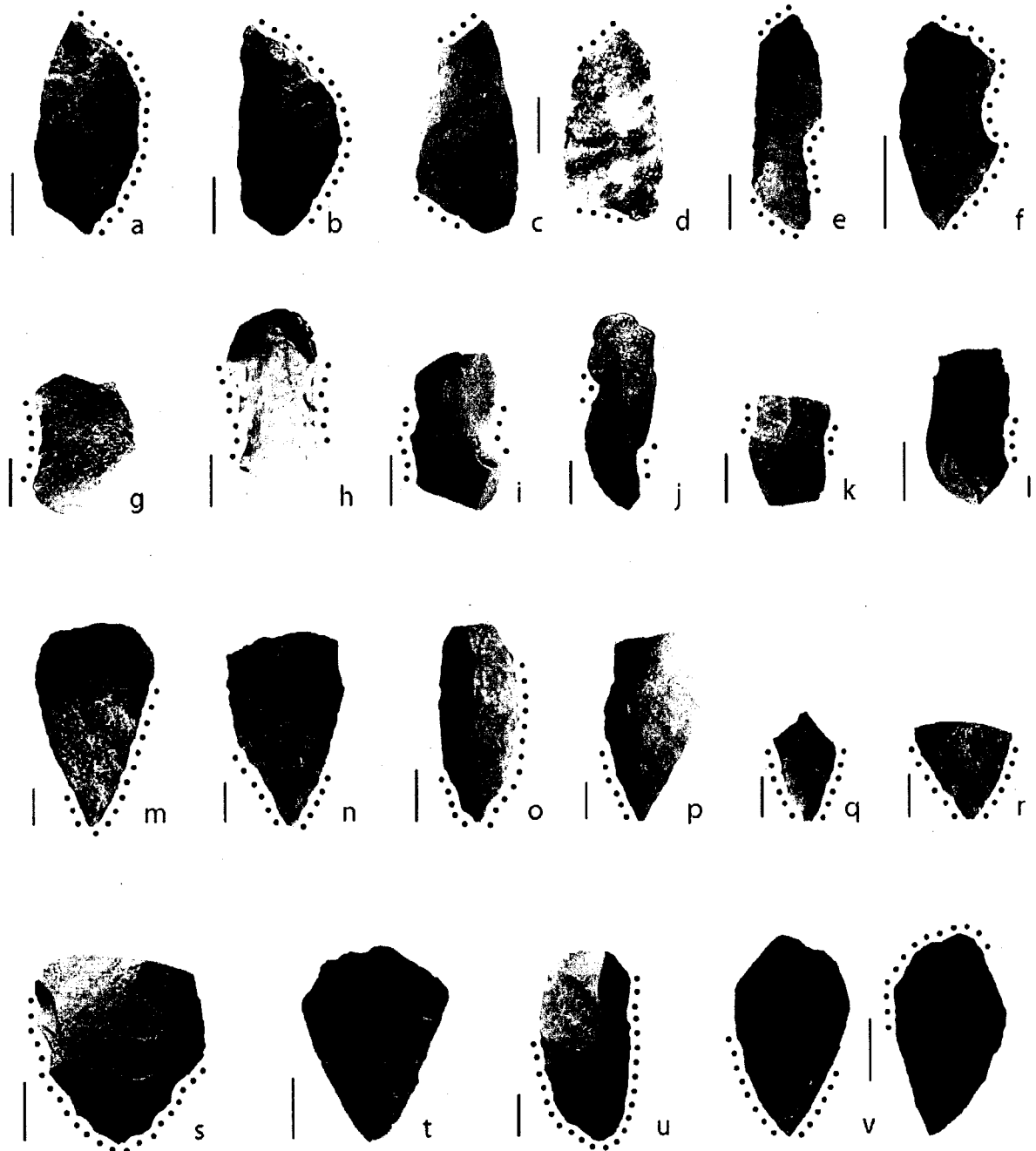


FIG. 8. Implements from 2006 excavation. (a & b) Segment forms; (c & d) truncated flakes; (e & f) backed and notched pieces; (g) single large complex notch; (h) opposed large complex notches; (i) opposed small complex notches; (j) opposed small simple notches; (k) opposed small complex notches; (l) single small complex notch; (m–p) unifacial points; (q, r) unifacial point tips; (s) ventrally-retouched pointed form; (t) Levallois point; (u) flake with dorsal retouch to both lateral margins, classified as a scraper; (v) parti-bifacial point.

Again, there is a marked diachronic pattern to the data. Radial cores were not recorded above unit Dv, nor were Levallois cores (Fig. 10). In contrast, though bipolar cores occur in most units, they are overwhelmingly dominant above Dv, accounting for 66.7% of the total. There is quite probably a link between the prevalence of bipolar reduction in these units and the preponderance of quartz, which is usually only attainable in small nodules in the surrounding area.

OCHRE

In addition to stone artefacts, the 2006 excavations resulted in the recovery of 2936 fragments of ochreous rock, with a

combined weight of ~2647 g. One hundred and seventy five of these fragments, totalling 832.4 g, exhibited one or more grinding facets. No new pieces of ochre which could be described as engraved in the terms discussed by Mackay and Welz (2008) were recovered.

Table 9 presents data on the number and weight of ochre pieces by unit through the sequence at KKH. Also presented are data for total artefact numbers per unit and the ratio of ochre weight to artefact numbers. In absolute terms, ochre is most common in unit Dvi which is also by far the largest of the units identified. Interestingly however, when compared with artefact numbers, ochre is proportionately least common in this

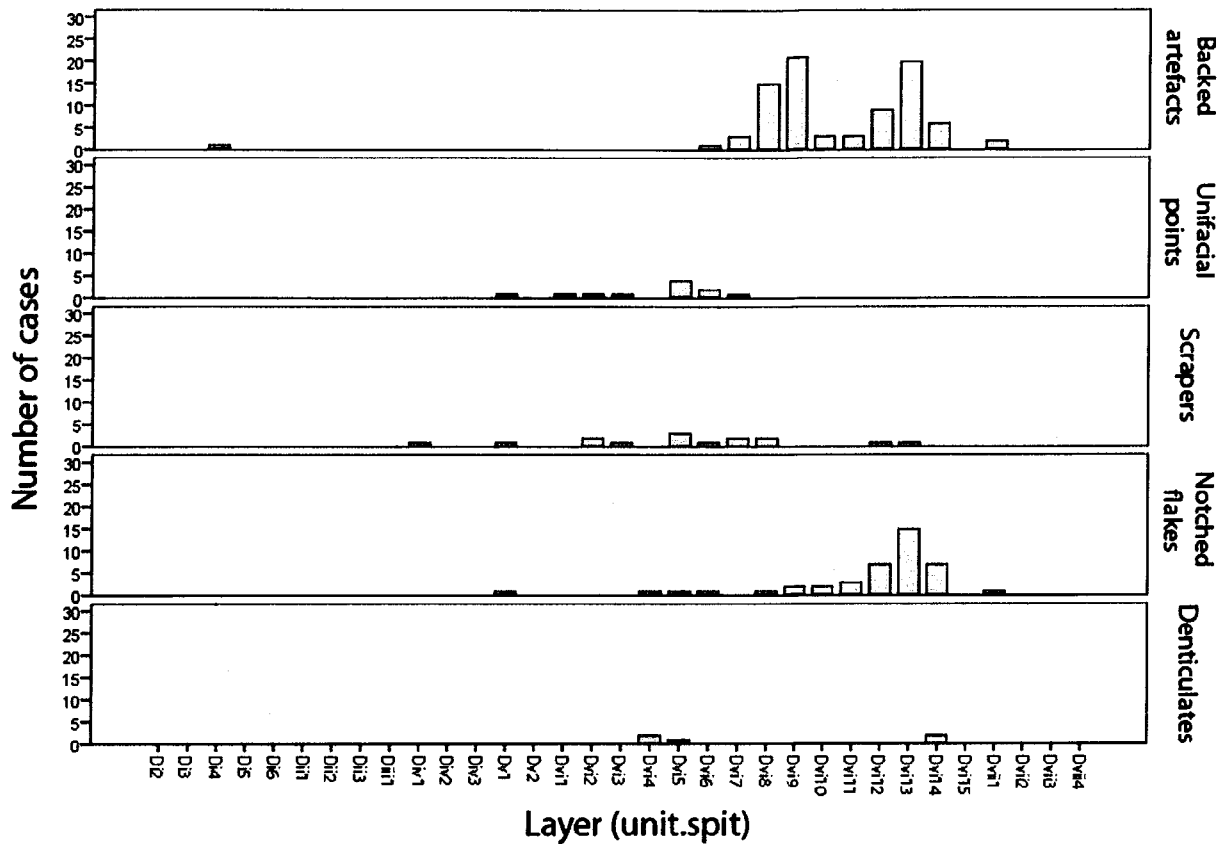


FIG. 9. Implement types by spit.

unit. Ochre is proportionately most common in the units with the smallest artefact assemblages (Diⁱⁱⁱ and Diⁱⁱ). While these data should be treated with some caution given the small area from which the assemblages were drawn they suggest at the least that the drop-off in ochre prevalence above Dvi is far less marked than the drop-off in artefact numbers.

CULTURE-HISTORIC SEQUENCE

ARTEFACTS AND AGES

Analysis of stone artefacts from the previous excavation at KKH suggested the presence of Howieson’s Poort, post-Howieson’s Poort MSA, with the additional possibilities of an MSA/LSA transition and some Pleistocene LSA. The post-Howieson’s Poort assemblages were further divided into late and final MSA, following Wadley (2005). The data presented above appear to support these divisions to some extent, and provide some ages for points of transition (summarised in Table 10).

Howieson’s Poort markers occur in the sequence from the basal unit through to Dvi6. These spits contain backed artefacts and notched pieces, and lack unifacial points until Dvi7. They are also conspicuously rich in silcrete. There are no indications of pre-Howieson’s Poort occupation at KKH in the form of bifacial points or denticulate-rich layers (cf. Singer & Wymer 1982; Rigaud *et al.* 2006; Wadley 2007; Avery *et al.* 2008). The former implements are absent from the sequence, and the latter are only poorly represented.

Backed artefacts and unifacial points occur together in Dvi6 and Dvi7. Above this point, backed artefacts disappear until unit Di. The prevalence of silcrete decreases incrementally across this transition, with quartzite becoming more common in concert with the emergence of unifacial points. The age–depth curve constructed from OSL ages suggests that the disappearance of backed artefacts and decrease in percentages of silcrete – effectively the end of the Howieson’s Poort – occurred some time between 57.6 ka and 59.5 ka, though, again, this is based on mean data only. Nevertheless, the change can

TABLE 8. Core types by unit.

Unit	Bipolar	Platform	Rotated	Prepared		Other	Total
				Levallois	Radial		
Di	7	1	1	0	0	4	13
Di ⁱⁱ	3	1	0	0	0	0	4
Di ⁱⁱⁱ	3	0	0	0	0	0	2
Div	3	0	1	0	0	0	4
Dv	5	1	0	0	1	3	10
Dvi	36	62	39	34	57	83	311
Dvii	1	0	2	1	0	0	4
Total	90	57	35	65	58	43	349

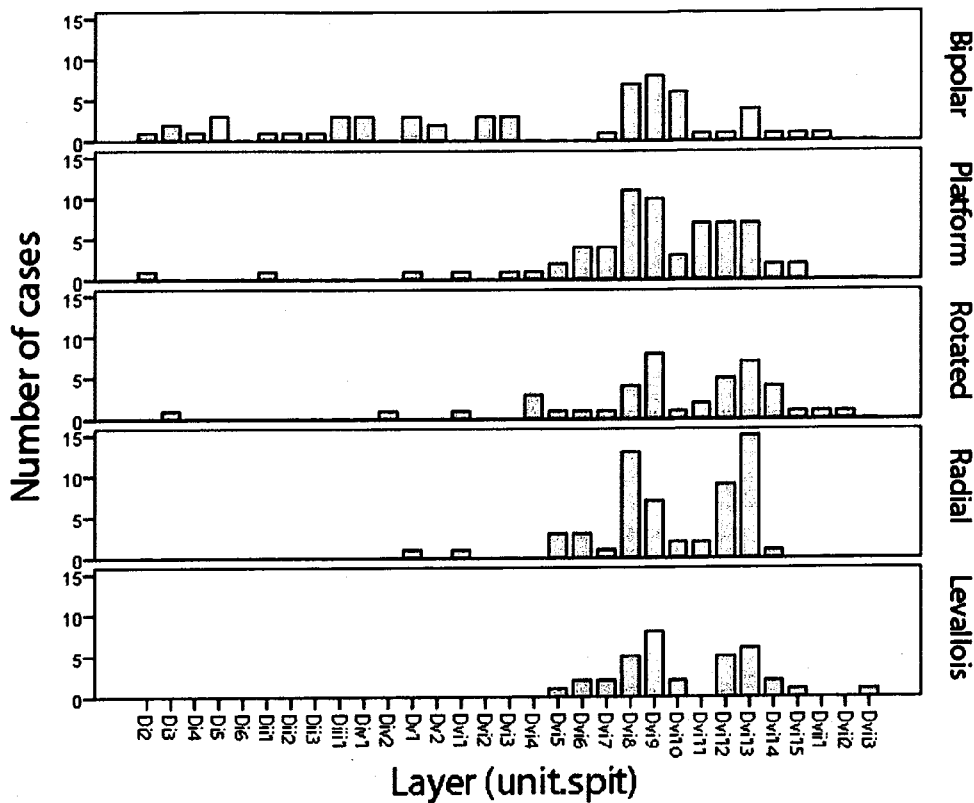


FIG. 10. Core types by spit.

TABLE 9. Quantities of ochre by unit.

Unit	Number of pieces	Total weight (g)	Total artefacts (n) 1000	Ochre (g) per artefacts
Di	83	56.8	404	140.6
Dii	14	147.2	71	2073.2
Diii	21	26.8	21	1276.2
Div	95	102.0	441	231.3
Dv	218	206.2	489	421.7
Dvi	7170	2012.6	37 795	53.3
Dvii	106	37.5	412	91.0
Total	7707	2589.1	39 633	65.3

be seen to be broadly coeval with the end of MIS 4.

The ‘post-Howieson’s Poort’ component of the site can be divided into two groupings. In the lower grouping (Dvi6–Dv1) silcrete remains common, though quartzite and quartz are the dominant materials. Unifacial points are the most common implements at this time, followed by scrapers. Cores demonstrate the presence of prepared, rotated, platform and bipolar reduction systems. Above Dv prepared cores (including radial and Levallois) disappear, to be replaced by a preponderance of bipolar reduction. Concomitant with this change is a change in

dominant material from quartzite/silcrete to quartz. Unifacial points are absent with a single scraper the only implement recorded, though the presence of the single parti-bifacial point recovered from a compromised context somewhere between Dv1 and the Holocene hints at interesting possibilities. There are no specific dates for the change between these two groupings; the available ages place the transition somewhere between 55 ± 2 ka/ 56 ± 3 (dating the top of 1984 unit ‘D’ and 2006 spit Dvi1 respectively) and $> 35\ 000$ uncal ^{14}C yr BP (Div1).

Though these groupings appear to be relatively robust, they do not cohere with previously asserted divisions of the post-Howieson’s Poort as well as originally thought (cf. Mackay 2006). Specifically, the increase in quartz in the more recent grouping, thought originally to have been the result of mixing with a possible late Pleistocene LSA component, can now be recognised as integral to that part of the MSA. The evidence for a final MSA assemblage featuring backed artefacts and scrapers is also lacking, and again, it may be that mixing of MSA and late Pleistocene LSA components in the 1984 excavation was responsible for this (mis-)classification.

Another important aspect of the upper part of the KKH sequence (Dv through to Di) is the small number of artefacts, particularly in comparison to the oldest two units. Allowing for an age of ~ 55 ka for the interface between Dv and Dvi, and accepting an age of 22 ka for unit Di, an elapse of some 30 000

TABLE 10. Technological groupings at KKH.

Grouping	Units	Dominant implements	Dominant cores	Dominant materials	Ages
Pleistocene LSA	Di	None, some backing	Bipolar	Quartz	~ 22 ka
Late post-Howieson’s Poort	Dii, Diii, Div	None, some scrapers	Bipolar	Quartz	Ending ~ 33 ka?
Early post-Howieson’s Poort	Dv, Dvi1–7	Unifacial points, some scrapers	Radial, Levallois	Silcrete, quartzite	Starting ~ 58 ka
Howieson’s Poort	Dvi8–15, Dvii	Backed pieces, notched pieces, burins	Radial, platform	Silcrete	~ 66 ka – ~ 60 ka

years can be suggested for this part of the sequence. Even if the numbers of artefacts in units Di–Div are doubled to overcome the small area from which they were recovered, the discard rate in this period would be in the order of 14.2 artefacts > 15 mm per thousand years across the metre square. The rate for units Dvi and Dvii, given a start age of around 68 ka and an end age of around 55 ka (e.g. the maximum probable range), is 566.3 artefacts > 15 mm per thousand years across the metre square. The results suggest a remarkable drop-off in the intensity of site-use after 55 ka, and, quite probably, a shift from relatively consistent to more ephemeral site occupation.

The absence of points, prepared platform cores or flakes, the preponderance of bipolar reduction and quartz, and the near-absence of implements all suggest that the uppermost component of the Pleistocene sequence (unit Di) can be classified as late Pleistocene microlithic LSA (*cf.* Mitchell 1988). More specifically there is nothing in this unit that suggests that it could reasonably be classified as MSA. If we accept the age of ~22 ka as indicative for Di, the age of >35 ka from the immediately underlying unit (Dii) suggests that there was a considerable hiatus between the youngest MSA and the oldest LSA at the site. An alternative reading of this part of the sequence can be derived from an interpretation of two components – one around 20 ka and the other around 30 ka – in the OSL age of 33 ± 1 ka for the base of Di. As discussed earlier, this date implies either that unit Di contains both a ~30 ka and a ~20 ka component, or that there was a unit intervening between Di and Dii dating to around 30 ka which was not identified during excavation, and which must necessarily have been highly ephemeral. Given the technological consistency of artefacts in the unit Di assemblage, the latter explanation is favoured here, but the former cannot be precluded.

The different readings of the sequence produce different interpretations with respect to the age of the MSA/LSA transition and the presence or absence of assemblages representing this transition at KKH. Accepting the ^{14}C ages alone leads to the conclusion that there is no MSA/LSA transition at the site, and that the MSA ended some time before 22 ka. Accepting the OSL evidence necessitates accounting for a ~30 ka component, and opens up the possibility of a transition but not, within the constraints of the sample as it was excavated, a discernible assemblage to mark this transition.

One point that might be raised in relation to this issue is how similar in many respects the purported late Pleistocene LSA assemblages from unit Di are to those from the latest MSA (units Div – Dii). Both are dominated by bipolar reduction of quartz with few implements. The main difference between the two is that there are still some flakes with faceted platforms in the older grouping. It may thus be that the transition at KKH was a very long one, initiating with a shift to bipolar reduction of quartz as the dominant core reduction strategy sometime after 55 ka and culminating in the disappearance of prepared core systems some time before 22 ka. The transition would, on this reading, have played out over much of late MIS 3. At the very least it can be noted that there is nothing in the earliest LSA at KKH that is not present in the latest MSA.

OCHRE

The ochre assemblage from KKH is substantial and is perhaps deserving of fuller consideration than there is space to give it here. Nevertheless, one important point can be made based on the new data presented. The initial collection of ochre from KKH, derived from the 1984 excavations, consisted of 919 pieces. The 2006 excavations have increased that sample to nearly 4000 pieces with no additional engraved items. In abso-

lute terms then the KKH ochre assemblage is large, with few larger assemblages reported (Watts 2002) and perhaps none reported from so small an excavated area. One of the few sites from which a larger assemblage of ochre has been recovered is Blombos (Henshilwood *et al.* 2001). That Blombos is also the only other site from which finds of engraved ochre have thus far been reported (Henshilwood *et al.* 2002, 2009) may imply that the probability of recovering such items is sample-size dependent.

KKH IN CONTEXT

The 2006 excavations from KKH produced a sequence largely conforming to that discerned from the earlier (1984) excavations. Consistent with the aims of the new excavation, groupings within the sequence have now been more clearly defined, ages have been presented, and some subtle but important variations have been identified. The following conclusions consider the KKH sequence in broader context.

With respect to the timing of the onset and cessation of the Howieson's Poort, the KKH sequence largely coheres with evidence from other sites in southern Africa (*cf.* Jacobs *et al.* 2008). It would appear that the Howieson's Poort at the site was confined in time to late MIS 4, and probably ended around the transition to MIS 3. An interesting facet of the Howieson's Poort at KKH is the evidence for a bimodality in artefact numbers, and, to some extent, in implement types. Evidence that the bimodality is other than an anomalous fluctuation comes in the form of material changes. Quartz increases incrementally from Dvi14 before reaching a marked peak in Dvi11 when artefact numbers plummet. Interestingly this is also the layer in which edge length to mass values for complete flakes peak, as reported by Mackay (2008). Patterns in the distribution of hornfels may also be significant in this respect. Hornfels is exceedingly rare in the KKH sequence, yet 70% of all hornfels artefacts in the assemblage occur from Dvi12 to Dvi10. Given that the material is not locally available, its sudden increase at this time may imply that short-lived but significant changes to mobility or inter-group interaction occurred sometime around 62 ka, as inferred from the age-depth model.

Whether this bimodality is part of a widespread pattern or whether it is isolated to KKH is presently unclear though there is some evidence from other sites for complexity within the Howieson's Poort. Specifically it can be noted that there is a bimodality in artefact numbers and material prevalence in the Singer and Wymer Howieson's Poort sample from Klasies River (Singer & Wymer 1982). The earliest and latest components of the Howieson's Poort at Nelson Bay Cave similarly display a change in material selection from silcrete and quartz to quartzite (Volman 1981). At Diepkloof notched artefacts are more common in the earlier part of the Howieson's Poort and perhaps immediately before (Mackay 2009; also Porraz *et al.* 2008) but not in the later part. The Howieson's Poort at Diepkloof is also notable for the late appearance of engraved ostrich eggshell (Texier *et al.* 2010) though the degree of correspondence between changes in notched flakes and EOES is unknown. At Sibudu, the later Howieson's Poort tends to contain more crystal quartz segments and these are generally of different dimensions to those found earlier (Wadley 2008).

One facet of the KKH Howieson's Poort which is less equivocally part of a broader pattern concerns the very large size of the stone artefact assemblage. At Klasies River, approximately 46% of all Pleistocene-aged artefacts recovered in the Singer and Wymer sample relate to the Howieson's Poort (Singer & Wymer 1982); at Nelson Bay Cave, this figure is ~90% (Volman 1981). At Apollo XI, Jacobs and colleagues (2008: supporting

online material) note that the Howieson's Poort-assigned units produced both the largest and most dense assemblage of the various MSA units identified. A similar pattern is noted at Umhlatuzana, where the three most artefact-rich layers in the sequence all occur in the Howieson's Poort (Kaplan 1990). At the nearby site of Sibudu, Wadley and Jacobs (2006) suggest a higher density of artefacts in Howieson's Poort than in other contexts. Precisely what this pattern implies is not necessarily straightforward, though interpretations phrased in terms of changes in settlement organisation seem plausible (e.g. Mackay 2009). Alternative explanations in terms of population increase might also be considered (e.g. Jacobs & Roberts 2009), though these would need to account both for why populations spiked at a time of glacial cold, and also why populations then decreased during subsequent warming. Ultimately, single cause explanations, whether favouring settlement organisation, population, environment or social choice are unlikely to be satisfying. Complex multi-causal explanations have thus far been under-considered.

With respect to the end of the Howieson's Poort, the KKH data suggest a relatively smooth transition. Shifts in material prevalence from silcrete to quartzite and quartz occur incrementally as dominant implement types shift from backed artefacts to unifacial points and scrapers. The fact that there is some overlap in backed artefacts and unifacial points may indicate their concurrent manufacture or may alternatively be an artefact of excavation in horizontal spits. It can also be noted that the prevalence of elongate flakes exhibits minor but consistent decreases from Dvi10 to Dvi4. This evidence of a gradual transition out of the Howieson's Poort into the early post-Howieson's Poort is consistent with evidence from other sites in different parts of South Africa (e.g. Soriano *et al.* 2007; Villa *et al.* 2010) and suggests that explanations in terms of site abandonment cannot readily be sustained (e.g. Singer & Wymer 1982; Jacobs *et al.* 2008). That the transition appears to correlate with the end of MIS 4 implicates underlying environmental drivers (McCall 2007; Villa *et al.* 2010), though specifying the ways in which environments and technology interact is a challenge awaiting better understanding of local environmental reactions to global temperature changes (*cf.* Chase 2010), of the relationship between local environments and subsistence opportunities, and of the costs and benefits of different technological systems relative to the configuration of those subsistence opportunities.

The early post-Howieson's Poort at KKH resembles that at sites across South Africa such as Diepkloof, Klasies River, Ntloana Tsoana, Peers Cave, Rose Cottage Cave, Sehonghong, Shongweni, Sibebe, Sibudu and Umhlatuzana, at least insofar as it sees the replacement of backed artefacts by unifacial points (Peers 1929; Davies 1975; Price-Williams 1981; Volman 1981; Singer & Wymer 1982; Kaplan 1990; Mitchell & Steinberg 1992; Mitchell 2002; Villa *et al.* 2005; Wadley 2005; Cochrane 2006; Rigaud *et al.* 2006). It also resembles other Western Cape sites in that quartzite increases at the expense of silcrete, though material changes generally are not necessarily characteristic of the post-Howieson's Poort in all sequences (e.g. Villa *et al.* 2005).

The second, more recent post-Howieson's Poort unit identified here, however, lacks ready corollaries with other sites. While the latest MSA at Umhlatuzana is also quartz rich, backed artefacts and bifacial points are present in these levels, as they are at Rose Cottage Cave and Sibudu (Kaplan 1990; Wadley 2005). Neither of these implement types are in evidence in the KKH sample. At Klasies River, earlier (MSA III) and later (MSA IV) post-Howieson's Poort units are differentiated largely on the basis of increases in the prevalence of platform

cores (Volman 1981), which are poorly represented in the MIS 3 component at KKH.

The lack of an obvious relationship between the later post-Howieson's Poort at KKH and at other sites may well be a product of the small size of the excavated sample. Indeed this caution can be offered against the KKH assemblage generally, though it should be noted both that KKH is a small site and that there is a reasonable degree of correspondence between the two samples excavated from the site so far. If we accept, as is necessary in all archaeological sites, that the recovered sample is a reasonable representation of the deposited sample until proven otherwise, then we need to search for other explanations for this lack of correspondence.

One point that might be made is that there is little *local* comparative material for the MIS 3 archaeology of KKH. Sites with robust sub-divisions of the post-Howieson's Poort such as Sibudu and Umhlatuzana occur in the modern southern African summer rainfall zone (SRZ – following Chase & Meadows 2007). Numerous sites in the SRZ and year-round rainfall zone (YRZ) show signs of occupation in late MIS 3 (e.g. Vogel & Beaumont 1972; Davies 1975; Wendt 1976; Price-Williams 1981; Kaplan 1990; Opperman & Heydenrych 1990; Clark 1999; Mitchell 1994; Deacon & Deacon 1999; Henderson *et al.* 2006). In contrast, there are very few sites in the winter rainfall zone (WRZ), where KKH is situated, which shows signs of occupation in this period (Mackay 2009). Sites near KKH such as Elands Bay Cave (Parkington, pers. comm. 2009), Diepkloof (Parkington 1977; Rigaud *et al.* 2006), Hollow Rock Shelter (Evans 1994) and Klipfonteinrand (Parkington 1977) have late Pleistocene sequences, but little or no evidence of occupation in late/terminal MIS 3. The same is true of Klasies River, Nelson Bay Cave and Blombos. The reasons for the paucity of late MIS 3 archaeology in the WRZ are not immediately obvious – the period does not appear to have been particularly dry in the WRZ (Mitchell 2008; Bowdery 2009) and was warmer than either MIS 4 and MIS 2, both of which have well-expressed signatures in the region. Further evidence relating to rates of environmental fluctuation and the composition of floral and faunal communities are clearly needed to understand variance in these occupational patterns.

With respect to the end of the MSA, Klein Kliphuis, like Elands Bay Cave, suggests that prepared core systems had largely fallen into disuse some time before 22 ka in the WRZ. In that respect the KKH data are consistent with evidence from most other sites in South Africa, particularly those in coastal and montane areas, though perhaps not those in the interior (Deacon & Deacon 1999; Mackay 2009). The period over which the abandonment of these systems occurred at KKH, however, cannot be identified with any precision using the available ages. Nevertheless, it can be noted that assemblages from the latest component of the MSA at the site share important characteristics with those of the earliest LSA. A transition which occurred over a long period of time must be considered a possibility, though this should not be construed as implying that there was a trajectory towards the LSA, or that the abandonment of prepared core systems was inevitable. Both contentions are questionable if not simply teleological.

CONCLUSIONS

The 2006 excavations at KKH had two principle objectives. The first was to provide a refined sequence of cultural changes. The second was to provide a chronology for the sequence. Those objectives have been met, particularly for the lower part of the sequence, although work remains to be done in order to clarify changes in the MIS 3 component of the site. Beyond

these objectives the principle contribution of the 2006 excavations has been the identification of two 'modes' within the Howieson's Poort. These modes have faint echoes in the sequences at Klasies River and Nelson Bay Cave, and potentially also Diepkloof. This finding implies that it may be appropriate to view the Howieson's Poort as a complex and internally variable suite of adaptations, rather than as a single undifferentiated entity.

ACKNOWLEDGEMENTS

The 2006 excavation of KKH was funded by grants from the Australian National University, the South African Archaeological Society Kent Bequest and the Palaeontological Scientific Trust of South Africa. The excavation would not have been possible without the technical and logistical assistance of Iziko Museums of Cape Town, and the Department of Archaeology at UCT. The field team included Will Archer, Charlie Arthur, Mariagrazia Galimberti, Phillip Hine, Jayson Orton, and Riashna Sithaldeen, and their hard work is gratefully acknowledged, particularly Charlie Arthur for remaining through those last few cold, wet and hungry days. Delores Jacobs sorted much of the excavated material with great patience, skill and humour. Christian Reepmeyer kindly provided the sediment characterisations. Special thanks goes to Aara Welz for helping to organise and direct the excavations, for sorting the resulting material, and for discussion and insights into the nature and meaning of the sequence. Charlie Arthur, Sabina Wansleben and Aara Welz provided useful and much welcome critical comment on this paper as did the two reviewers, Sarah Wurz and Marlize Lombard.

NOTES

¹The wall of the shelter intruded into the rear-most square, H1C, making the area somewhat less than 1 m².

²Holocene finds recovered during 2006 are discussed by Orton and Mackay (2008).

³All finite ¹⁴C ages are present as calibrated years before present, with calibration undertaken using www.calpal-online.de (cf. Danzeglocke et al. 2009). Infinite ages are presented as ¹⁴C years BP.

⁴Analysis of the faunal remains was kindly undertaken by Genevieve Dewar of the University of Toronto.

⁵Includes artefacts from compromised areas and the Holocene component of the sequence (cf. Orton & Mackay 2008).

REFERENCES

- Avery, G., Halkett, D., Orton, J., Steele, T. & Klein, R.G. 2008. The Ysterfontein 1 Middle Stone Age Rockshelter and the evolution of coastal foraging. In: Lombard, M., Sievers, C. & Ward, W. (eds) *Current Themes in Middle Stone Age Research*: 66–89. Cape Town: South African Archaeological Society Goodwin Series 10.
- Bowdery, D. 2009. Klein Kliphuis rockshelter site, Western Cape South Africa: phytolith analysis report. In: Mackay, A. History and selection in the late Pleistocene archaeology of the Western Cape, South Africa. Unpublished PhD thesis. Canberra: Australian National University.
- Chase, B.M. 2010. South African palaeoenvironments during marine oxygen isotope stage 4: a context for the Howieson's Poort and Still Bay industries. *Journal of Archaeological Science* 37: 1359–66.
- Chase, B.M. & Meadows, M.E. 2007. Late Quaternary dynamics of southern Africa's winter-rainfall zone. *Earth-Science Reviews* 84: 103–138.
- Clark, A.M.B. 1999. Late Pleistocene technology at Rose Cottage Cave: A search for modern behaviour in an MSA Context. *African Archaeological Review* 16: 93–119.
- Cochrane, G.W.G. 2006. An analysis of lithic artefacts from the 60 ka layers of Sibudu Cave. *Southern African Humanities* 18: 69–88.
- Conard, N.J., Soressi, M., Parkington, J.E., Wurz, S. & Yates, R. 2004. Developing a unified lithic taxonomy based on patterns of core reduction. *South African Archaeological Bulletin* 59: 13–17.
- Davies, O. 1975. Excavations at Shongweni South Cave. *Annals of the Natal Museum* 22: 627–662.
- Danzeglocke, U., Joris, O. & Winninger, B. 2009. CalPal-2007online. <http://www.calpal-online.de/>
- Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: Uncovering the Secrets of the Stone Age*. Cape Town: David Phillip.
- Evans, U. 1994. Hollow Rock Shelter, a Middle Stone Age site in the Cederberg. *Southern African Field Archaeology* 3: 63–73.
- Goodwin, A.J.H. & Van Riet Lowe, C. 1929. The Stone Age Cultures of South Africa. *Annals of the South African Museum* 27: 1–146.
- Halkett, D.J. 1987. Archaeology of the Putslaagte. In: Parkington, J.E. & Hall, M. (eds) *Papers in the Prehistory of the Western Cape, South Africa*: 377–392. Oxford: British Archaeological Reports International Series 332(ii).
- Henderson, Z., Scott, L., Rossouw, L. & Jacobs, Z. 2006. Dating, palaeoenvironments and archaeology: a progress report on the Sunnyside 1 site, Clarens, South Africa. *Archaeological Papers of the American Anthropological Association* 16: 139–149.
- Henshilwood, C.S., d'Errico, F. & Watts, I. 2009. Engraved ochres from the Middle Stone Age levels at Blombos Cave, South Africa. *Journal of Human Evolution* 57: 27–47.
- Henshilwood, C.S., d'Errico, F., Yates, R., Jacobs, Z., Tribolo, C., Duller, G., Mercier, N., Sealy, J., Valladas, H., Watts, I. & Wintle, A. 2002. Emergence of modern human behaviour: Middle Stone Age engravings from South Africa. *Science* 295: 1278–1280.
- Henshilwood, C.S., Sealy, J., Yates, R., Cruz-Uribe, K., Goldberg, P., Grine, F., Klein, R., Poggenpoel, C., Van Niekerk, K. & Watts, I. 2001. Blombos Cave, Southern Cape, South Africa: preliminary report on the 1992–1999 excavations of the Middle Stone Age levels. *Journal of Archaeological Science* 28: 421–448.
- Jacobs, Z. & Roberts, R.G. 2009. Catalysts for Stone Age innovations. What might have triggered two short-lived bursts of technological and behavioral innovation in southern Africa during the Middle Stone Age? *Communicative and Integrative Biology* 2: 191–193.
- Jacobs, Z., Roberts, R.G., Galbraith, R.F., Deacon, H.J., Grün, R., Mackay, A., Mitchell, P., Vogelsang, R. & Wadley, L. 2008. Ages for Middle Stone Age innovations in southern Africa: implications for modern human behavior and dispersal. *Science* 322: 733–735.
- Kaplan, J. 1990. The Umhlatuzana Rock Shelter sequence: 100 000 years of Stone Age history. *Natal Museum Journal of Humanities* 2: 1–94.
- Lombard, M. & Pargeter, J. 2008. Hunting with Howieson's Poort segments: pilot experimental study and the functional interpretation of archaeological tools. *Journal of Archaeological Science* 35: 2523–2531.
- Mackay, A. 2009. History and selection in the late Pleistocene archaeology of the Western Cape, South Africa. Unpublished PhD thesis. Canberra: Australian National University.
- Mackay, A. 2008. A method for estimating edge length from flake dimensions: use and implications for technological change in the southern African MSA. *Journal of Archaeological Science* 35: 614–622.
- Mackay, A. 2006. A characterization of the MSA stone artefact assemblages from the 1984 excavations at Klein Kliphuis, Western Cape. *South African Archaeological Bulletin* 61: 181–188.
- Mackay, A. & Welz, A. 2008. Engraved ochre from a Middle Stone Age context at Klein Kliphuis in the Western Cape of South Africa. *Journal of Archaeological Science* 35: 1521–1532.
- McCall, G. 2007. Behavioural ecological models of lithic technological change during the late Middle Stone Age in South Africa. *Journal of Archaeological Science* 34: 1738–51.
- Mitchell, P. 2008. Developing the archaeology of Marine Isotope Stage 3. In: Lombard, M., Sievers, C. & Ward, W. (eds) *Current Themes in Middle Stone Age Research*: 52–65. Cape Town: South African Archaeological Society Goodwin Series 10.
- Mitchell, P. 2002. *The Archaeology of Southern Africa*. Cambridge: Cambridge University Press.
- Mitchell, P.J. 1994. Understanding the MSA/LSA transition: the pre-20 000 BP assemblages from new excavations at Sehonghong Rock Shelter, Lesotho. *South African Field Archaeology* 3: 15–25.
- Mitchell, P.J. 1988. The late Pleistocene early microlithic assemblages of southern Africa. *World Archaeology* 20: 27–39.
- Mitchell, P.J. & Steinberg, J.M. 1992. Ntloana Tsoana: a Middle Stone Age sequence from western Lesotho. *South African Archaeological Bulletin* 47: 26–33.
- Opperman, H. & Heydenrych, B. 1990. A 22 000 year old Middle Stone Age camp site with plant food remains from the north-eastern Cape. *South African Archaeological Bulletin* 45: 93–99.

- Orton, J. & Mackay, A. 2008. New excavations at Klein Kliphuis rock shelter, Cederberg Mountains, Western Cape, South Africa: the late Holocene deposits. *South African Archaeological Bulletin* 63: 69–76.
- Parkington, J.E. 1977. Follow the San. Unpublished PhD thesis. Cambridge: Cambridge University.
- Peers, B. 1929. Preliminary report on the archaeology of the Fish Hoek–Noord Hoek valley. Unpublished Manuscript. Cape Town: South African Museum.
- Porraz, G., Texier, P.-J., Rigaud, J.-P., Parkington, J., Poggenpoel, C. & Roberts, D.L. 2008. Preliminary characterization of an MSA lithic assemblage preceding the 'classic' Howieson's Poort complex at Diepkloof rock-shelter (Western Cape Province, South Africa). In: Lombard, M., Sievers, C. & Ward, W. (eds) *Current Themes in Middle Stone Age Research*: 105–121. Cape Town: South African Archaeological Society Goodwin Series 10.
- Price-Williams, D. 1981. A preliminary report on recent excavations of Middle and Late Stone Age levels at Sibebe Shelter, north-west Swaziland. *South African Archaeological Bulletin* 36: 22–28.
- Rigaud, J.-P., Texier, P.-J., Parkington, J. & Poggenpoel, C. 2006. Le mobilier Stillbay et Howieson's Poort de l'abri Diepkloof. La chronologie du Middle Stone Age Sud-Africain et ses implications. *Comptes Rendus Palevol* 5: 839–849.
- Roberts, D.L. 2003. *Age, Genesis and Significance of South African Coastal Belt Silcretes*. Pretoria: Council for Geoscience, Memoir 95.
- Singer, R. & Wymer, J. 1982. *The Middle Stone Age at Klasies River Mouth in South Africa*. Chicago: University of Chicago Press.
- Soriano, S., Villa, P. & Wadley, L. 2007. Blade technology and tool forms in the Middle Stone Age of South Africa: the Howieson's Poort and Post-Howieson's Poort at Rose Cottage Cave. *Journal of Archaeological Science* 34: 681–703.
- Texier, P.-J., Porraz, G., Parkington, J., Rigaud, J.-P., Poggenpoel, C., Miller, C., Tribolo, C., Cartwright, C., Coudenneau, A., Klein, R., Steele, T. & Verna, C. 2010. A Howieson's Poort tradition of engraving ostrich eggshell containers dated to 60,000 years ago at Diepkloof Rock Shelter, South Africa. *Proceedings of the National Academy of Sciences* 107: 6180–6185.
- Van Rijssen, W. 1992. The late Holocene Deposits at Klein Kliphuis Shelter, Cedarberg, Western Cape Province. *South African Archaeological Bulletin* 47: 34–39.
- Villa, P., Soriano, S., Teyssandier, N. & Wurz, S. 2010. The Howieson's Poort and MSA III at Klasies River main site, Cave 1A. *Journal of Archaeological Science* 37: 630–655.
- Villa, P., Delagnes, A. & Wadley, L. 2005. A Late Middle Stone Age artefact assemblage from Sibudu (KwaZulu-Natal): comparisons with the European Middle Paleolithic. *Journal of Archaeological Science* 32: 399–422.
- Vogel, J.C. & Beaumont, P.B. 1972. Revised radiocarbon chronology for the Stone Age in South Africa. *Nature* 237: 50–51.
- Volman, T. 1981. The Middle Stone Age in the southern Cape. Unpublished PhD thesis. Chicago: University of Chicago.
- Wadley, L. 2008. The Howieson's Poort industry of Sibudu Cave. In: Lombard, M., Sievers, C. & Ward, W. (eds) *Current Themes in Middle Stone Age Research*: 122–132. Cape Town: South African Archaeological Society Goodwin Series 10.
- Wadley, L. 2007. Announcing a Still Bay Industry at Sibudu Cave, South Africa. *Journal of Human Evolution* 52: 681–689.
- Wadley, L. 2005. A typological study of the final Middle Stone Age stone tools from Sibudu Cave, KwaZulu-Natal. *South African Archaeological Bulletin* 60: 51–63.
- Wadley, L. & Jacobs, Z. 2006. Sibudu Cave: background to the excavations, stratigraphy and dating. *Southern African Humanities* 18: 1–26.
- Wendt, W.E. 1976. 'Art mobilier' from the Apollo 11 Cave, South West Africa: Africa's oldest dated works of art. *South African Archaeological Bulletin* 31: 5–11.
- Watts, I. 2002. Ochre in the Middle Stone Age of southern Africa: Ritualized display or hide preservative? *South African Archaeological Bulletin* 57: 64–74.