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Article *in* Journal of Archaeological Science · April 2001

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Journal of Archaeological Science (2001) **28,** 421–448
doi:10.1006/jasc.2000.0638, available online at http://www.idealibrary.com on IDEAL®

Blombos Cave, Southern Cape, South Africa: Preliminary Report on the 1992–1999 Excavations of the Middle Stone Age Levels

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(*Received 24 June 2000, revised manuscript accepted 30 November 2000*)

0305–4403/01/040421+28 $35.00/0

The Later- and Middle Stone Age levels at Blombos Cave (BBC) were excavated over four field seasons between 1992 and 1999. Here we report on the results from the Middle Stone Age (MSA) levels. The taphonomy and depositional history of the MSA levels is complex due to faulting, folding and spalling. Careful observations during excavation have assisted in understanding some of these taphonomic and site formation processes; microstratigraphic analysis, currently in progress, will add to this information. The uppermost MSA level, the Still Bay phase, contains high densities of bifacial points, the *fossile directeur* of the Still Bay Industry. Placing the Still Bay within the MSA culture sequence has been problematic in the past because Still Bay assemblages are rarely found *in situ* and previous excavations were inadequately recorded. However with the regional data discussed in the text, the Still Bay can be securely placed before the Howiesons Poort dated at 65–70 ka.

Flaked stone makes up the greatest proportion of all artefacts with the highest incidence of retouch and use of fine grained, non-local materials found in the Still Bay levels. The ochre assemblage is remarkable for the mass of material compared to other MSA sites. Finds uncommon in an MSA context are two pieces of ochre from the Still Bay phase engraved with a geometric design; a fragment of deliberately engraved bone; also, 28 shaped and polished bone tools recovered mainly from a phase just below the Still Bay. Blombos Cave is the first site where well preserved faunal remains have been recovered in association with the Still Bay allowing for unique insights into human subsistence behaviour and palaeoenvironmental reconstruction. Large fish bones, marine shells, seals and dolphins attest to extensive exploitation of aquatic resources and a wide range of terrestrial animals were hunted and gathered. The few human teeth recovered are heavily worn and damaged thus the issue of morphological modernity cannot be addressed.

The BBC findings are a useful adjunct to findings from other MSA coastal sites in the southern Cape, especially Klasies River (KR) and Die Kelders Cave 1 (DK1); uniquely, BBC provides insights into human behaviour during a phase of the MSA never before studied in detail.

Keywords: MIDDLE STONE AGE, STILL BAY, MODERN HUMAN BEHAVIOUR, COASTAL SUBSISTENCE, SOUTHERN AFRICA.

Introduction

The origins of "modern" human behaviour are a contentious issue and the subject of ongoing and extensive debate. Currently there are two main viewpoints; one supports a late African origin for "modern" behaviour at ~50 ka ago (Klein, 1989*a*,*b*, 1994, 1995, 2000; Clark, 1989, 1993; Ambrose, 1998; Ambrose & Lorenz, 1990), the other links predominantly the Howiesons Poort Industry in southern Afica with early "modern" cognitive behaviour at ~70 ka ago (Deacon, 1989, 1993, 1998; Deacon & Wurz, 1996; Wurz, 1997, 1999). Most models for behavioural modernity draw heavily on the European Upper Palaeolithic (UP) transition at ~40 ka ago and/or the currently known archaeological record of southern Africa. Problems specific to "modern" behaviour paradigms are defining what is "modern", establishing a time frame(s) and place(s) for the behavioural transition and whether the transition to modernity was of a linear or mosaic nature.

Excavation of the greater than 70-ka-old Middle Stone Age (MSA) layers at Blombos Cave (BBC) has produced artefacts that are unusual for this time including a range of bone tools (Henshilwood & Sealy, 1997; Henshilwood *et al.*, in prep. *b*), large numbers of finely worked bifacial points, two pieces of engraved ochre (Henshilwood *et al.*, in prep. *a*) and a fragment of deliberately engraved bone (D'Errico *et al.*, submitted)—the latter two artefacts may have symbolic connotations. These finds are directly relevant to the "modernity debate". Faunal remains from BBC show that a wide range of marine and terrestrial resources were exploited including, unusually, fish and suggest exploitation patterns not dissimilar to that of Later Stone Age (LSA) people in this region. The results presented here and ongoing analysis will significantly expand our understanding of the behaviours, or variation in behaviours, of some African MSA people, test existing behaviour models and contribute further to the already lively debate concerning the origins of human modernity.

The first excavation at BBC was initiated by CSH in 1991 and led to the recovery of only LSA deposits dated at less than 2 ka old (Henshilwood, 1995). A second excavation in 1992 produced bifacial foliate points, typical of the Still Bay phase of the MSA, located beneath the upper ~70 cm of LSA deposits. Further MSA sub-stages, probably MSA 2b (cf. Volman, 1984), are located below the Still Bay. Excavation of the LSA and MSA levels continued in 1997, 1998, 1999 and 2000.

The principal objectives for the BBC project are: (i) to document in detail and understand the complex taphonomy, stratigraphy and site formation processes, particularly the stratigraphic layers within and below the Still Bay; (ii) to recover a reasonable quantity of artefactual and faunal samples of the Still Bay phase and other MSA deposits so we can better address behavioural and taphonomic questions; (iii) date the MSA deposits using a variety of techniques and (iv) reconstruct palaeoenvironmental conditions at the time of occupation.

Analyses of the recovered deposits from BBC are ongoing and in this paper we present some of the preliminary results from the 1992–1999 excavations. Some valuable insights gained during the 2000 excavations have also been incorporated in this report.

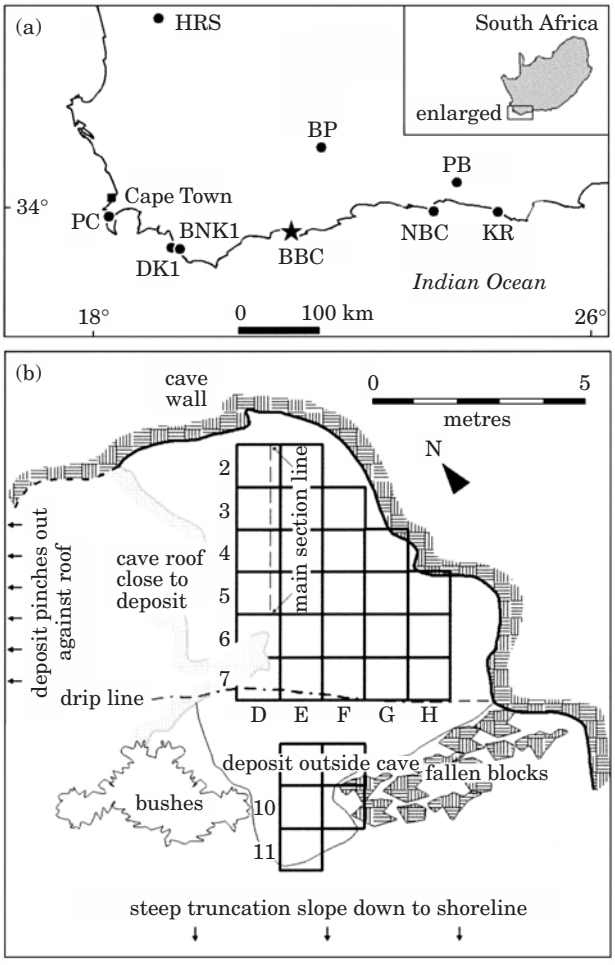

Figure 1. (a) Location of BBC and sites mentioned in the text. BP=Boomplaas; BNK1=Byneskranskop 1; DK1=Die Kelders Cave 1; HRS=Hollow Rock Shelter; KR=Klasies River; NBC=Nelson Bay Cave; PB=Paardeberg; PC=Peers Cave. (b) Map of BBC, with excavation grid.

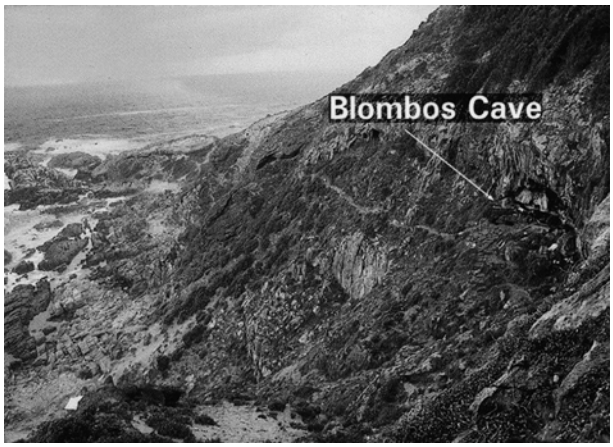

Figure 2. View of BBC and immediate surrounds. The steep slope below BBC is a truncation of the cave deposits, presumably by higher sea levels.

Figure 3. Entrance to BBC, with field crew for scale. The generator (square object, lower right) sits on one of the large, fallen blocks that retain the LSA and upper MSA deposits.

Site Background

Blombos Cave is located at 34°25′S, 21°13′E, some 100 m from the Indian Ocean and 34·5 m above sea level (Figure 1(a)). Still Bay village lies 25 km to the east and Cape Town is 300 km to the west. The cave is situated in an ancient wave-cut cliff formed in calcified sediments of the Bredasdorp Group (Figures 2 & 3). The present surface area of the cave floor behind the drip line is about 50 m^2 (Figure 1(b)). Forward of the drip-line, fallen calcarenite boulders act as a barrier and retain around 18 m^2 of *in situ* deposit. Between 1992 and 2000 about 13 m^3 of MSA deposit was recovered, as well as LSA material. Prior to excavation, the height of the roof above the cave floor ranged from 1 to 1·5 m. Table Mountain Sandstone of the Cape Supergroup forms the basal layer of the cave, probably 4–6 m below the surface deposits.

The generally alkaline environment is conducive to the preservation of bone and shell, particularly near hearths and ash deposits. However, shell and bone is observably less well preserved near the eastern cave wall. This may be due to raised pH levels (humates) caused by the decomposition of plant materials possibly brought in as food, fuel and bedding and/or discarded animal remains.

Excavation Methodology

The surface area of BBC is divided into square metres further subdivided into 0·5-m quadrates (Figure 1(b)). Within the cave interior, behind the drip line, a surface area of 12·5 m^2 of MSA has been excavated; forward of the drip line a test trench of 3 m^2 was excavated in 1999. Excavation by brush or trowel followed individual strata or layers. The word "layer" is used to describe a single stratum that accumulates through natural or human deposition, or both. Layers may differ from those above or below and are identified

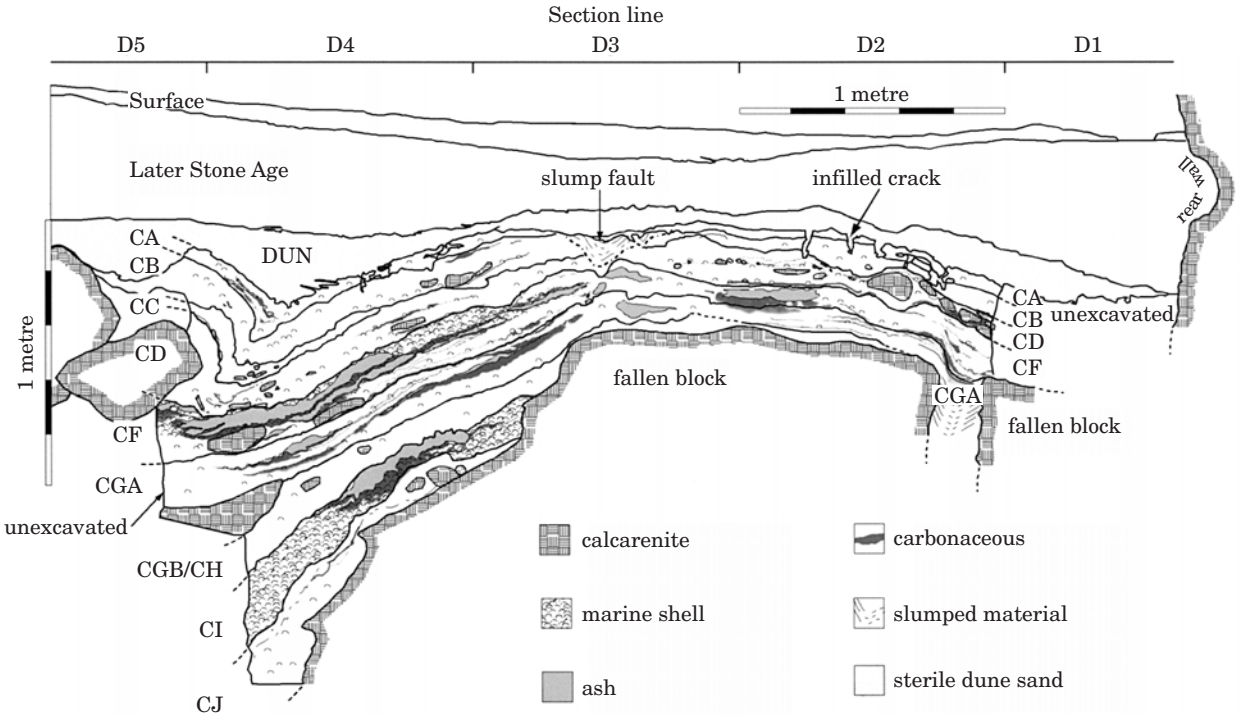

Figure 4. BBC main section along grid-line "D" (see Figure 1(b) for location).

with regard to texture or composition (or both), as well as colour, thickness and features. Counts of full and fractions of full buckets of deposit provide a measure of the volumes of excavated sediment.

Since 1998, depositional features, surfaces, artefacts, cobbles larger than 15 cm, and in some cases bone, were in most instances recorded in three dimensions. Recovered deposits were wet sieved through both 1·5 and 3·0 mm meshes using seawater. Recovered material was later re-washed in freshwater and shade dried. Initial sorting into major groupings, namely bone, shell, stone and "other" was carried out on site or post-excavation at the South African Museum. Various specialists undertook further detailed identification and analysis of materials, mostly at the South African Museum.

Sedimentology and Stratigraphy

When first excavated in 1991 the cave entrance was almost blocked by aeolian dune sand. It is likely the cave was sealed by sand from just after the final MSA occupation until it re-opened during the mid- to late Holocene, possibly through erosion at the cliff base due to higher sea levels. A *c.* 70 ka relative date (see lithics section) for the Still Bay suggests its deposition during a late stage of oxygen isotope (OI) stage 5a or an early part of OI 4, a period of rapid marine regression and probable massive mobilization of marine-derived sand. Evidence for this is the thick layer of sterile dune sand that blankets the upper Still Bay levels. However, at this stage we are unable to assign the Still Bay or lower MSA levels to definite OI phases (Figure 6).

Most of the MSA deposits are finely bedded to laminated, with cm thick bedding; occasionally, shelly clast-supported lenses up to 5 cm thick are present (Figures 5 & 6). Calcarenite rockfall is confined to large blocks at the base of the excavation and to decimetre size blocks, mostly near the entrance to the cave. The MSA deposits undulate considerably from the back to front due to subsidence that produces a "wrapping effect" over the basal rockfall. Thus, in the front of the cave the deposits dip to the southeast. Towards the back of the cave the deposits continue to follow the basal rockfall, first becoming horizontal (square D3) and then changing dip direction near the rear of the cave (squares D1 & 2). The deposits are faulted and dislocated in a number of places. It needs to be established whether this subsidence is due to diagenesis, as at DK1 (Figure 1(a)) (Goldberg, 2000; Marean *et al.*, 2000), or to some other factors such as physical slumping or reorganization associated with dissolution of the bedrock.

The lithologies and types of sediments at BBC are comparable to those found in similar settings along the southern Cape coast, particularly DK1. As such, the geological histories and human activities in both caves are broadly similar (sandy matrices, the deposition of sterile sand between the MSA and LSA (Figure 4) and reworking and alteration of sandy deposits by wind, water and diagenesis). Taphonomic differences

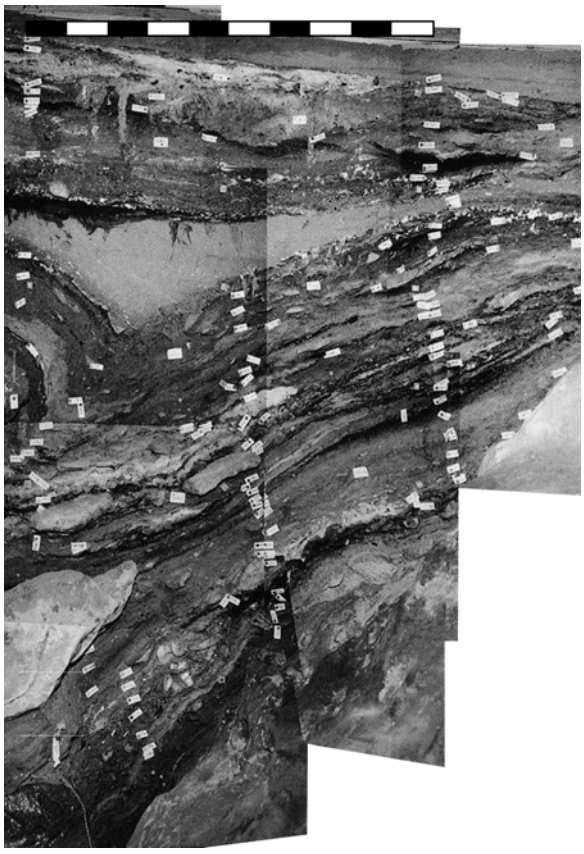

Figure 5. Composite ortho-photograph of BBC main section (see Figure 4), sqs D3 (part) and D4.

between the two sites probably account for the prominence of evidence for fire and burning and shell collecting at BBC. Ongoing micromorphological analyses should contribute to an understanding of these processes.

The stratigraphy of the MSA levels at BBC is complex with common faulting, slumping and draping. Near the rear of the cave faulted and slumped MSA sediments fill a 0·5-m-wide gap formed between two large basal roof blocks (Figure 4). Excavations in this area of faulting were completed in 1992 and 1997 before the distortion was recognized. Charcoal and shell recovered from 30-cm-deep deposits, thought to be MSA, in and near the slumped area was ^{14}C dated in 1993. Four charcoal samples date to ~1·5–2·1 ka ago; one charcoal piece and five marine shell opercula (*Turbo sarmaticus*) date to *c.* 32–39 ka ago. These dates indicate the admixture of younger and older material near the rock gap (Figure 4). After cross-cutting of layers was noticed in 1997, individual layers were redefined by a system of markers for both content and basal stringers and a new nomenclature was introduced that is still in use. This strategy has been successful and provides confidence that MSA materials recovered from the 1998 and subsequent excavations are temporally and spatially secure.

The sterile DUN layer (Figures 4 & 5) that separates the LSA and MSA provides a secure visual marker for the separation of the LSA and MSA layers over the whole site with the exception of the area excavated in 1992/97. In most instances in this report the 1992/97 observations are separated from those of 1998/99 or only the results from 1998/99 are presented. The macromammal and tortoise data from all excavation seasons are combined. Results exclude material of mixed provenience.

Layers and phases

In 2000 all the excavated MSA layers were divided into three major phases based on their stratigraphic location and composition: an upper Still Bay phase named BBC 1; a middle MSA phase, BBC 2, and a lower phase, BBC 3. A phase is defined as a chronologically limited cultural unit within a local culture sequence. Each phase is made up of a number of different layers with similar diagnostic traits that sets it apart from other phases. This subdivision forms the stratigraphic basis for the various analyses presented in this paper.

BBC 1 phase

Layers CA, CB, CC, CD and CE: Medium brown sands with thin, discontinuous lenses of shell, stone and bone. The deposit is scattered with numerous small basin-shaped ash and carbon hearths of up to 0·5 m diameter. Carbonized sand and organic "partings" of a few millimetres thick act as visual markers for the separation of discrete occupation layers. Partings are comprised of dune sand mixed with plant material, possibly used for bedding or fuel, animal scats and other organic material that has become compressed, humified and/or burnt and are generally dark in colour. The sediment becomes more organic towards the rear wall of the shelter along the D section line. In addition to the general trend imparted by the basal rockfall, layers CA to CE drape steeply over the smaller rocks present in the front of the excavated area and are markedly folded in squares E4 & D4. Roof spall is more common in CC, CD and CE relative to CA and CB. Small débitage characterizes all layers in BBC 1 but is most notable in the upper two layers CA and CB. The BBC 1 phase is sub-divided into BBC 1a and 1b to accommodate variation within these sub-phases.

BBC 2 phase

Layers CFA, CFB/CFC and CGA: Layer CFA is a medium brown sand with a low density of shell, stone and bone and lies above the shell midden layer CFB/CFC. Stone artefacts are generally infrequent in CFB/CFC but in some areas large quantities of decomposing roof spall lie within the unit. Carbonized

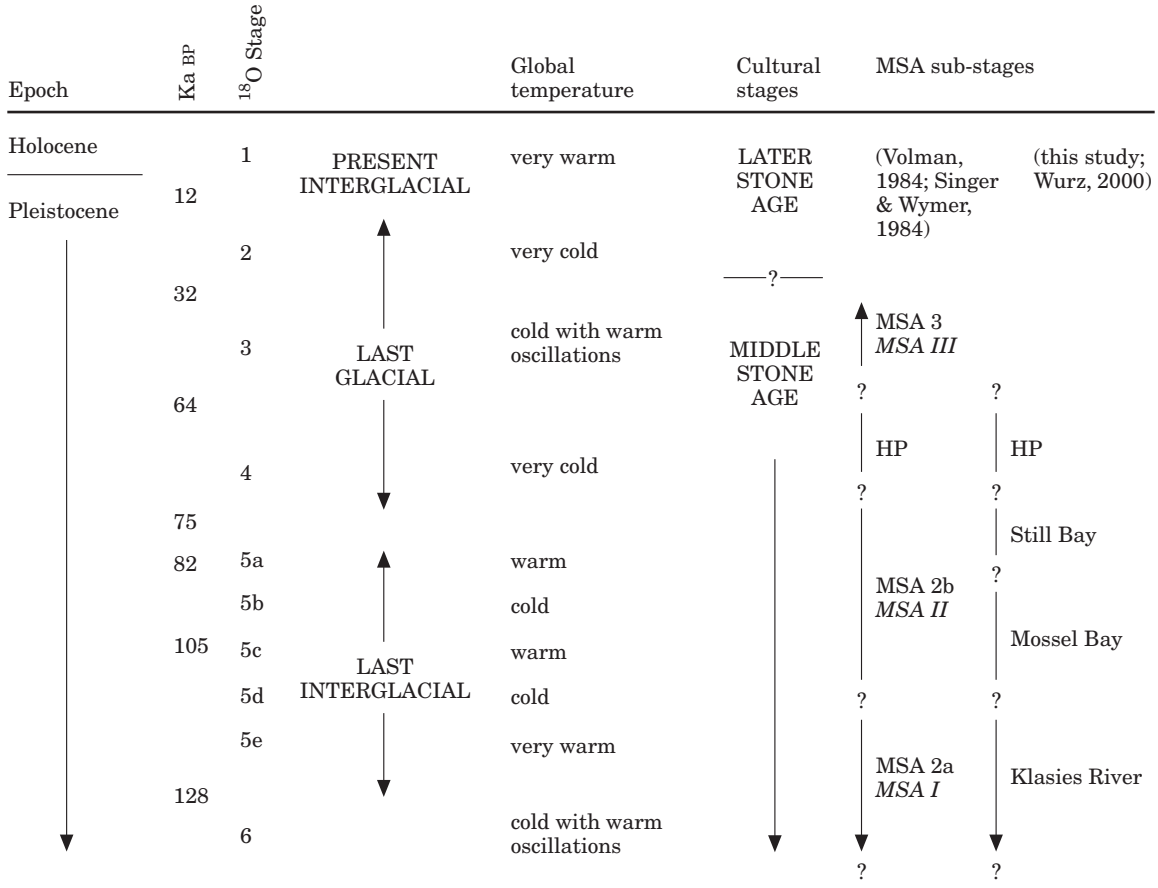

Figure 6. The MSA sequence for southern Africa with equivalent oxygen isotope stages (OI). The naming of the LBS member material at KR, ''Klasies sub-stage'', is a new suggestion by Wurz and H. J. Deacon (Wurz, 2000).

deposits and thin partings are prominent and large hearths lie within the dense shelly layer near the shelter entrance. The amount of shell in CFB/CFC decreases towards the rear wall of the shelter; along the D section line humified and carbonized partings become prominent. The lowermost layer CGA is sandy and less shelly but contains many hearths. BBC 2 post-dates the rockfall in the shelter front.

BBC 3 phase

Layers CGB/CH, CI, CJ, CK, CL, CM, CN, CO and CP: Layer CGB/CH is a light to medium brown sandy layer and relative to all other layers has few artefacts, shells and bone but the highest quantities of microfauna. The large rockfall near the cave mouth fell onto layer CGB/CH. Layer CI is the thickest, most dense midden with shell, bone and stone excavated at BBC and contains extensive compact *in situ* hearths and ash deposits. Layer CI thins markedly towards the back wall where it pinches out against the basal roof fall. All the layers below CI (CJ to CP) are sandy with thin carbonaceous partings and lenses of shell with some bone and lithics. BBC 3 post-dates the basal rockfall. Layers below CK are poorly sampled due to restricted access.

Dating

The MSA levels are being dated using luminescence techniques: single-grain laser luminescence (SGLL), single aliquot optically stimulated luminescence (OSL and IRSL), multiple aliquot OSL on sediments and also TL of burnt lithics and electron spin resonance (ESR). The results from these methods will be submitted for publication in 2001.

Using the TL subtraction method to overcome the problems of erroneous ages due to changes in surrounding radioactivity, Vogel *et al.* (1999) obtained a preliminary date of *c.* 103+ − 9·8 ka for the uppermost MSA level at BBC. This age is 10% higher than the mean of the ages for the TL and IRSL, but these ages are within the high uncertainty limit of the subtraction age. However, all these ages are likely to be overestimates since the sample came from an occupation layer that may have contained roof spall (Woodborne, pers. comm.). For this reason, single

Table 1. Definitions of stone artefact categories

Category	Definition
Flaked stone	Detached pieces, cores, retouched pieces
A. detached pieces	Deliberately produced flakes, flake-blades, and the debris of retouch and flake production >10 mm
B. cores	Pieces used for the systematic production of flakes or flake-blades and displaying three or more negative flake removals
C. retouched pieces	Pieces with systematic modification of primary flake margin (see Volman, 1981 for definitions)
i. convex scrapers	Tools with systematic, closely spaced retouch forming an even convex edge(s) and a retouch angle or ~50 deg (after Deacon, 1984)
ii. bifacial point	Bifacial, invasively flaked piece where many of the retouch scars reach or exceed the mid-line of the tool; when completed the retouch forms one or more acutely pointed tips

Table 2. Characteristics of lithic raw materials

Raw materials	Availability
qzt	Quartzitic sandstones occur near the cave but are mostly coarse, foliated and poorly isotropic; quartzite cobbles, generally of high quality, predominate in modern beach gravels
qu	Quartzitic sandstones near the cave contain numerous veins of good quality milky quartz; modern beach gravels contain some quartz
silc	*In situ* deposits of silcrete occur on the Tertiary land surface near Riversdale more than 40 km away from BBC and probably in gravels of the De Hoopvlei Formation nearby the cave (Malan *et al.*, 1994)
CCS and "Other"	"Other" rock consists mostly of metamorphosed shale-like material; CCS include cherts and other amorphous siliceous rock. Both materials may occur locally

Quartzite=qzt; quartz=qu; silcrete=silc; crypto-crystalline silicates=CCS.

grain OSL measurements are currently being applied to this and other sedimentary units at the site (Wintle, pers. comm.).

Locating the Still Bay (for a full definition of the term "Still Bay" see lithics section) within the local MSA cultural sequence provides a handle on its estimated age that is additional to absolute dating methods. Excavations at Peers Cave (Figure 1(a)) on the Cape Peninsula in the 1920s showed that "true" Still Bay (Peers, 1929: 6) with "typical Still Bay laurel-leaf spearheads" lay beneath the Howiesons Poort (Peers, 1929: 9), although by the mid 1900s archaeologists regarded bifacial points as an integral component of the Howiesons Poort as well (Goodwin, 1952; Malan, 1955). Recent, well-controlled excavations support both views. At KR, flakes with bifacial retouch are most common just below and within the lower part of the Howiesons Poort (Singer & Wymer, 1982; Wurz, 2000). Bifacial points also occur within and below the basal Howiesons Poort at Nelson Bay Cave (Volman, 1981) and in a Howiesons Poort-like assemblage at Paardeberg (Wurz, 2000). There is no evidence for bifacial points in MSA 3, the final phase post-dating the Howiesons Poort (Volman, 1984), at Peers Cave (Peers, 1929: 5). Boomplaas (Deacon, pers. comm.), DK1 (Grine *et al.*, 1991; Thackeray, 2000), KR (Wurz, 2000) or Strathalan (Opperman, 1996). The bulk of available evidence indicates that the Still Bay sub-stage lies immediately below the Howiesons Poort dated at about 65–70 ka ago (Miller *et al.*, 1999; Vogel, in press).

Cultural Artefacts

Lithics

Nearly 50,000 lithic pieces recovered from a 3-mm sieve during the 1999 and part of the 1998 field seasons have been analysed. Subdivisions of the lithic assemblage and availabilities of raw materials are given in Tables 1 & 2. "Detached pieces", as used here, are a temporary category for flakes, flake blades and retouch debris and will be further sub-divided in later analyses.

Results

Abundance and raw materials

Densities of 30,208 and 29,284 pieces of stone per m^3 from BBC 1a and BBC 3 respectively show that high numbers of flaked stone occur at the top and bottom of the sequence (Table 3). In comparison, the quantity of stone in BBC 2 is 10-fold less at 2935 per m^3. The density of stone in BBC 1b lies between the value for BBC 1a and that for BBC 2.

Table 3. Raw materials of detached pieces by percentage and the density (number of pieces per m^3) of all flaked stone in each phase of the BBC sequence

	Silc	Qu	Qzt	CCS	"Other"	Total %	*N*=	Density
BBC 1a	70·6	15·7	13·5	0·0	0·2	100·0	18,966	30,208
BBC 1b	73·7	17·0	9·1	0·0	0·2	100·0	9459	13,443
BBC 2	30·3	50·7	18·0	0·1	0·9	100·0	2801	2935
BBC 3	62·9	20·2	16·0	0·2	0·6	100·0	16,736	29,284

Table 4. Composition of assemblage by percentage

Phase	Detached	Cores	Retouched	Total %	*N*=
BBC 1a	99·0	0·03	0·9	100·0	19,152
BBC 1b	98·3	0·2	1·5	100·0	9623
BBC 2	98·7	0·8	0·5	100·0	2839
BBC 3	99·5	0·3	0·2	100·0	16,828

Table 5. Core raw materials by percentage

Phase	Silc	Qu	Qzt	CCS	Total %	*N*=
BBC 1a	60·0	20·0	20·0	0·0	100·0	5
BBC 1b	37·5	56·3	6·3	0·0	100·0	16
BBC 2	21·7	65·2	13·0	0·0	100·0	23
BBC 3	38·2	45·5	12·7	3·6	100·0	55

Cores

Cores in BBC 3 (Table 4) are predominantly for the production of flakes rather than flake-blades (cf. Wurz, 2000: 42–50). In plan view, most silcrete cores display evidence for platform preparation around about two-thirds of the margin. Flake removals are mostly centripetal and more rarely unidirectional with prominent bulbs of percussion, probably achieved by hard-hammer percussion (Inizian *et al.*, 1999; Whittaker, 1994). The majority of the BBC 3 cores in silcrete and quartzite are exhausted and the retention of a cobble cortex under-surface opposite to the production face is highly characteristic. The BBC 2 silcrete cores are similar to those in BBC 3 but the quartz cores from BBC 2 are irregular or nugget-like in appearance and many are less than 4 cm in maximum dimension.

The overall BBC 1a assemblage is large and so the very low proportion of cores (0·03%) is not a function of sampling size (Table 4). Core frequencies increase below BBC 1a to a peak in BBC 2 and then decline. Comparison of Tables 3 and 5 shows that in BBC 1b, 2 and 3, quartz cores are relatively more common than are quartz detached pieces, whereas the opposite is true for silcrete and quartzite. This implies the production of fewer flakes on average from each quartz core than is the case from cores of silcrete and quartzite.

Detached pieces

More than 60% of detached pieces in BBC 1a, BBC 1b and BBC 3 (Table 3) are in silcrete. Quartz is the second most common lithic material, except in BBC 2 where it constitutes 51% of the total. Quartzite is a subordinate component of all four phases and varies only slightly in frequency. Small amounts of CCS and "Other" occur throughout the deposit but are most frequent in BBC 2 and BBC 3. Cortical silcrete from all phases is mostly of cobble origin. In BBC 1a and 1b about 7% of silcrete pieces are cortical, with 34% in BBC 2 and 40% in BBC 3.

In BBC 1a and BBC 1b, thin, often curved flakes with small, lipped platforms and widening flake margins dominate the assemblage (Table 4) and are the products of soft-hammer biface retouch (cf. Inizan *et al.*, 1999; Whittaker, 1994: 186; Wurz, 2000). There are relatively few pieces in BBC 1a that are large enough to be blanks and this is consistent with the presence of very few cores in this phase. Flakes in BBC 2, predominantly in quartz, differ from those in the younger phases by having well developed, hard-hammer bulbs of percussion. Hard hammer flakes with pronounced bulbs of percussion are also standard in BBC 3 and prepared platforms typical of the MSA are conspicuous in this phase. Flake-blades are not common in BBC 3 but are a more distinctive component than higher up the sequence. The mean weight of silcrete detached pieces is 0·8 g (*N*=5494) in BBC 1a, 1·4 g in BBC 2 (*N*=353) and 1·7 g (*N*=3382) in BBC 3. Detached pieces in BBC 3 are larger because they represent core preparation and reduction debris whereas those in the upper phases are retouch debitage associated with a higher production of retouched tools.

Retouched tools: BBC 1a & BBC 1b

Retouched tools in BBC 1a and BBC 1b are prominent in terms of overall frequency and typological variety (Tables 4 & 6). Retouched tools comprise just less than 1% of flaked pieces in BBC 1a and 1·5% in BBC 1b.

Bifacial points. In BBC 1a 54·7% of retouched tools are bifacially flaked points or parts thereof and 45·3% in BBC 1b (Table 6). Unbroken bifacial points from BBC are elongate in form and most have two opposed points to give them a lanceolate or narrowly elliptic leaf shape (Figure 7).

Table 6. Retouched category by percentage

	BBC 1a	BBC 1b	BBC 2	BBC 3
Bifacial points	54·7	45·3	20·0	0·0
Unifacial points	2·8	2·0	6·7	0·0
End convex scraper	4·4	4·1	0·0	2·7
Side convex scraper	2·2	2·0	0·0	2·7
Circular convex scraper	0·0	1·4	0·0	0·0
Retouched point	1·1	2·7	0·0	0·0
Borer	0·0	0·7	0·0	0·0
Knife	0·6	0·7	0·0	0·0
Notch	1·7	0·7	20·0	8·1
Concave scraper	2·2	0·7	6·7	0·0
Burin	0·0	0·7	0·0	0·0
Convergent scraper	0·0	0·7	0·0	0·0
Denticulate	4·4	6·8	0·0	24·3
Other retouch	26·0	31·8	46·7	62·2
Total %	100·0	100·0	100·0	100·0
N=	181	148	15	37

A few have finely retouched, rounded butts. Whole points vary in length from around 4 cm to nearly 9 cm, but some broken specimens clearly exceeded 10 cm in length. All stages of bifacial point production from preforms and fragments through to finely finished specimens are present in both BBC 1a and BBC 1b. Manufacturing failures occurred at all stages of manufacture and mostly happened through breakage but some points are worked then abandoned unbroken with steep, heavily stepped retouch flake scars. Small, delicate broken-off tips of points, some less than 10 mm in length, dominate the bifacial point assemblage and probably reflect accidents in manufacture as many display bending fractures (Whittaker, 1994: 163, 212–216) and do not exhibit impact burination or fluting (see Whittaker, 1994: 163).

Some bifacial point preforms show remnant platforms and or bulbs of percussion and a number retain cobble cortex. This, along with the high amounts of cortical soft-hammer débitage in BBC 1a and BBC 1b, shows that point makers sometimes used blanks struck from cores with little preparation. At least one unfinished point with cortex on both surfaces of the base was made directly from a silcrete cobble.

The makers of the points used a variety of raw materials (Table 7). Silcrete is the preferred raw material in both the upper phases (67·7% and 88·1%) but in BBC 1a quartzite bifacial points are proportionally much more common. Quartz points vary little in frequency between the sub-phases. The preference for quartzite in BBC 1a is limited to bifacial points, as shown by comparison of the raw material frequencies of bifacial points and other retouched pieces (Table 8). The dominance of silcrete for point making at BBC reflects a distinct preference, as quartzite but not silcrete occurs nearby the cave.

In BBC 1b there are far more early stage or unfinished points than in BBC 1a (Table 7). Such variations in the quality of bifacial working might be due to differences in manufacturing skill and is under investigation. Given the high incidence of points, the various stages of point manufacture and the dominance of bifacial débitage, BBC 1a and BBC 1b represent intensive formal tool production and craft instruction cannot be ruled out.

Published records suggest that Still Bay bifacial points are mostly restricted in their distribution to the Cape Fold Mountains and adjacent coastal regions (Goodwin & van Riet Lowe, 1929). North of the Fold Mountains the most commonly occurring point has a rounded base, a type sub-ordinate in BBC (Goodwin & van Riet Lowe, 1929; Sampson, 1974; Mason, 1967; Price-Williams, 1981; Kaplan, 1990). The Still Bay form of bifacial point thus, is a distinct type and stylistic marker within the MSA (cf. Clark, 1989; Wurz, 2000). We propose "Still Bay sub-stage" as a regional, culture-stratigraphic term for MSA assemblages with fully bifacially flaked, lanceolate to narrowly elliptic shaped points.

Scrapers. Convex scrapers are a significant component in both BBC 1a and BBC 1b and comprise 6·6 and 7·5% of retouched tools respectively (Figure 7; Table 6). End scrapers tend to predominate over side scrapers and in BBC 1b there are two circular examples with retouch around two thirds of the margin. The scraper edges are morphologically comparable to LSA examples (Deacon, 1984) and they may have been used in hide preparation.

"Other". Table 6 shows that no formally shaped tools in BBC 1a and BBC 1b reach frequencies close to those of either bifacial points or scrapers. The "Other" retouch class in BBC 1a and BBC 1b contains a number of pieces with invasive, bifacial edge flaking that are readily identifiable as point preforms (Table 9).

Retouched tools: BBC 2 & BBC 3

The lowest relative percentage of bifacial points in the retouched category is found in BBC 2. The small size of the BBC 2 retouch assemblage precludes any assessment of tool composition; aside from bifacial points, it is mostly made on quartz (Table 8). In BBC 3, the frequency of retouch declines further (Table 4) and, despite the large sample of lithics, there are no bifacial points (Table 6). Retouch in BBC 3 is mostly informal (62·2% "Other") and consistent with the absence of bifacial points, bifacial flaking is rare (Tables 6 & 9). A higher incidence of ventral flaking and denticulate or notched edges distinguish the retouched lithics in BBC 3 from those above. Quartz is favoured markedly over other materials for retouch in BBC 3—51·4% of all modified pieces are in quartz (Table 8), which is considerably greater than the 20·2% overall abundance of the mineral (Table 3).

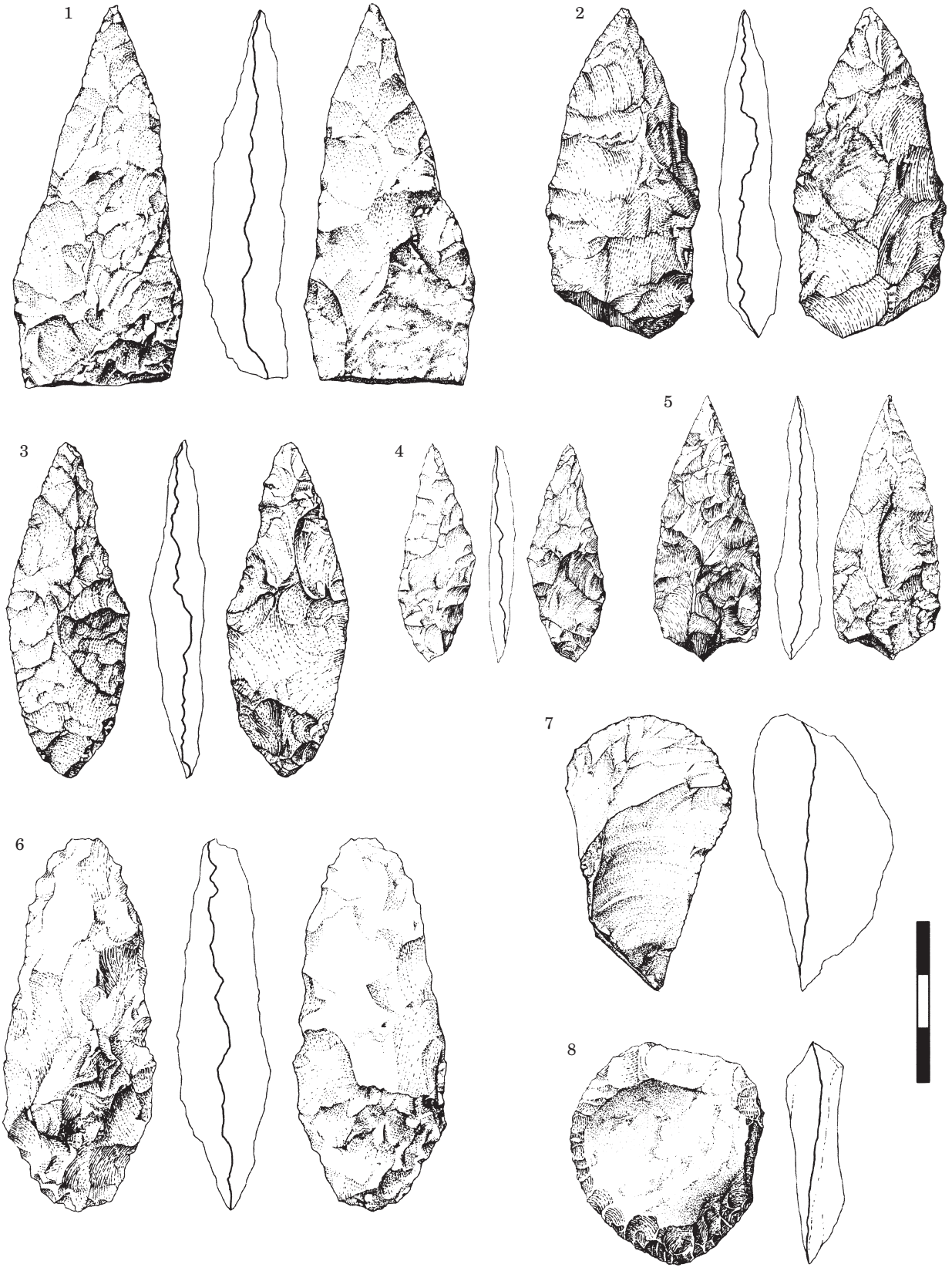

Figure 7. BBC 1 formally retouched stone tools. Numbers 1–6 are bifacial points and 7 and 8 are convex scrapers. The artefacts come from the 1992/97 seasons and correlate with the BBC 1 phase. Scale is in centimetres.

Table 7. Bifacial point raw materials by percentage. Note that the finished:unfinished ratios (fin:unfin) derive from complete as well as broken points but exclude small tips for which the degree of completion cannot be determined

Phase	Silc	Qu	Qzt	CCS	Total %	*N*=	fin:unfin
BBC 1a	67·7	8·1	24·2	0·0	100·0	99	1:6·3
BBC 1b	88·1	6·0	4·5	1·5	100·0	67	1:19·5
BBC 2	100·0	0·0	0·0	0·0	100·0	3	0:1
BBC 3	0·0	0·0	0·0	0·0	0·0	0	0:0

Table 8. Raw materials of retouched tools, excluding bifacial points, by percentage

Phase	Silc	Qu	Qzt	CCS	Total %	*N*=
BBC 1a	75·3	10·4	11·7	2·6	100·0	77
BBC 1b	79·5	9·0	11·5	0·0	100·0	78
BBC 2	18·2	63·6	9·1	9·1	100·0	11
BBC 3	24·3	51·4	18·9	5·4	100·0	37

Ochre

The analysed material from the 1998/99 excavation seasons (excluding the trench in E10/11) comprises 8224 pieces of ochreous material (5831 g). Of these 7914 (5704 g) are categorized as pigments on the basis of streaking properties (colour, pulverulence and staining power). The residual material largely consisted of small, heavily water-worn shale pebbles which, although ochreous, showed no sign of use. These were probably incidentally introduced with shellfish or seaweed. There were also a few very coarse textured iron-stained sandstones, and some pieces that produced no streak. Most pieces in the pigment assemblage are small (81·7% are <10 mm maximum dimension), but this component accounts for only 6·6% by weight. Analysis is restricted to pieces >10 mm (*N*=1448); fine-grained sedimentary forms are collapsed into one category. The data presented here are preliminary.

Pigment densities and raw material profiles

Numerically, and by mass, most of the pigment assemblage was recovered from BBC 3 (77·1% & 82·4% of respective totals). Pigment density in this phase (2665 g per m^3) is almost 16 times that in BBC 2 (169 g per m^3) and 8·4 times that in BBC 1 (316·9 g per m^3). Pigment density peaks at almost 5500 g per m^3 in the BBC 3 shell-midden layer CI. As a percentage of the combined lithic and pigment assemblages (>10 mm), the relative frequency of ochre for BBC 3 is 40·7%, at least three times any previously reported MSA or LSA values (Watts, 1998, 1999; Walker, 1994). Relative frequency collapses to 2·9% in BBC 2, falling further to 0·6% in BBC 1—comfortably within the mid-range of values for MSA 2b, Howiesons Poort, and post-Howiesons Poort sub-stages of the MSA (Watts, 1999).

Table 10. Pigment raw material composition by percentage and weight

	BBC 1		BBC 2		BBC 3	
Raw material	% *N*	g	% *N*	g	% *N*	g
Fine sedimentary	71·5	461·1	81·2	126·6	92·9	3679·5
Sandstone	9·4	90·1	4·7	37·5	2·2	197·6
Haematite	12·2	75·8	11·8	11·7	3·0	155·7
"Other"	3·3	60·0	0·0	0·0	0·2	4·3
Not known	3·7	72·5	2·4	1·7	1·8	344·7
Total	100·0	759·5	100·0	177·5	100·0	4381·8
Total *N*	246		85		1117	

Fine-grained sedimentary forms predominate, but their proportional contribution relative to sandstones and haematites declines in the younger BBC phases (Table 10). Most fine-grained sedimentary material consists of well-bedded siltstone, but both shales and occasional mudstone forms are also present. The siltstone is typically fairly soft (2–3 on Mohs hardness scale), reddish-grey or reddish-brown in colour and micaceous. "Haematite" includes a variety of highly ferruginous forms, most of which are fairly hard (≥4 on Mohs scale). Most of the sandstone is fine-grained and haematitic.

The most likely source of the BBC ochreous siltstone and shale is the Bokkeveld Group. About 32 km inland from BBC, above the level of Tertiary marine transgressions (Rogers, 1988) deeply weathered Bokkeveld shales are commercially quarried for red and yellow ochres. Varying degrees of secondary enrichment and alteration led Visser (1937) to distinguish between "red ferruginous shales" and more haematized "red ochre". Bokkeveld exposures in the marine peneplain are less intensively weathered and ochreous expressions are rare. The nearest Bokkeveld outcrops to BBC are

Table 9. Flake surface modified by retouch on "Other" and denticulate retouched pieces by percentage (see Volman, 1981 for definitions)

Phase	Dorsal	Ventral	Alternate	Alternating	Bifacial	Total %	*N*=
BBC 1a	50·0	16·7	19·2	2·6	11·5	100·0	78
BBC 1b	52·1	16·4	9·6	4·1	17·8	100·0	73
BBC 2	71·4	14·3	0·0	0·0	14·3	100·0	7
BBC 3	51·2	29·3	12·2	2·4	4·9	100·0	41

Table 11. Overall mean pigment weights (g)

	Mean	S.D.	*N*
BBC 1	3·1	11·2	246
BBC 2	2·1	4·1	85
BBC 3	3·9	20·2	1117

approximately 15 km northeast in the Goukou valley and 17 km west along the coast. A contact between the Table Mountain Group (TMG) and Bokkeveld Group lies a short distance north of BBC (Rogers, 1988), but is presently masked by formations of the Bredasdorp Group or the ocean in San Sebastian Bay.

Tiny marine tests are found on 22 pieces of siltstone in BBC 3 and traces of holes bored by pholadids, marine bivalve molluscs (J. Pether, pers. comm.), initially thought to be drilled by humans, are present on 6·3% of the BBC 3 "fine-grained sedimentary" pieces. Much of the ochre in this occupation phase evidently comes from a sub-tidal substrate of the Bokkeveld Group. The large quantities suggest that this source was much closer than presently exposed outcroppings. A sea level slightly lower than present, following the Eemian transgression, would greatly reduce the distance to the nearest coastal exposures west of BBC. As this local ochre source became inaccessible, presumably due to further marine regression and subsequent masking by Waenhuiskrans Formation sands, the rapid decline in pigment densities is accompanied by reduced dispersion around the mean weight, indicating the collection of fewer large pieces (Table 11).

Utilization

The two principal traces of utilization are striae from grinding and scraping. Grinding is inferred where surfaces are abraded to smooth facets bearing multiple, fine, parallel striations, generally fusiform with "u" shaped profiles. With scraping or incising, the striations are less evenly aligned, less densely packed, deeper and wider than grinding striae and have abrupt rather than fusiform terminations. Striation profiles are more variable, with frequent square and "v" shaped profiles. The most distinctive utilized pieces are scraped tablets (Figure 8), largely restricted to BBC 3, and ground "crayons" (Figure 9), encountered throughout the sequence (see above). All use-wear traces are here combined in a single category of "definitely" and "probably" utilized.

The percentage of utilized pieces almost doubles between BBC 3 and BBC 1 (Table 12). Haematite is consistently more likely to be utilized than fine-grained sedimentary forms.

Utilized fine sedimentary and haematite samples have higher mean weights than unutilized counterparts (Table 13), indicating that the latter (particularly in the fine sedimentary category) represents mainly small processing debris. The inference of a very local origin for most of the BBC 3 ochre is based primarily on the large quantities and the indications of a near-shore source; the comparatively low rates of modification and the large size of some modified pieces support such an interpretation. Larger quantities were brought into the site than were likely to be used and several large pieces were discarded after only minimal use. In subsequent phases, the smaller quantities brought into the site and the higher rates of utilization, indicate increased transport costs and more intensive utilization.

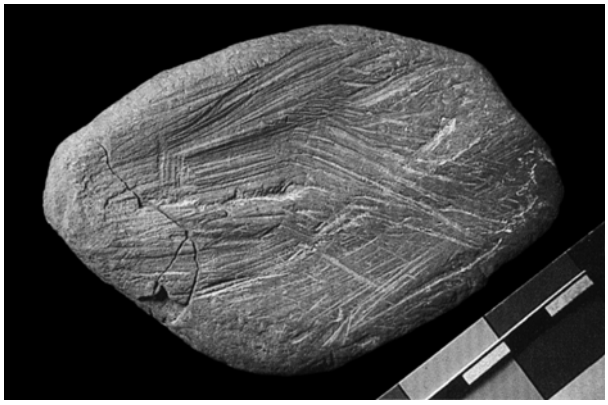

Figure 8. Scraped ochre tablet from layer CIB in BBC 3. Narrow scale bottom right is in centimetres.

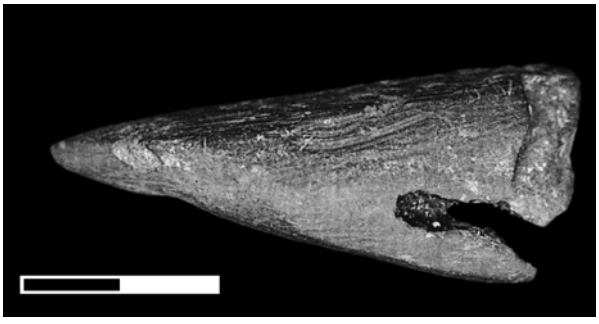

Figure 9. Scraped and ground ochre "crayon" from layer CI in BBC 3. Scale is in centimetres.

Table 12. Utilized pigment percentage by raw material and phase

	BBC 1		BBC 2		BBC 3	
Raw material	*N*	%	*N*	%	*N*	%
Fine sedimentary	176	25·6	69	18·8	1038	16·4
Sandstone	23	47·8	4	25·0	24	12·5
Haematite	30	43·3	10	40·0	33	27·3
"Other"	8	50·0	0	0·0	2	0·0
Not known	9	55·6	2	0·0	20	25·0
Total	246		85		1117	
Average % util.		31·7		21·2		16·7

Table 13. Mean weights (g) of un-utilized and utilized "fine-sedimentary" and "haematite" samples

Raw material	BBC 1 Mean	BBC 1 S.D.	BBC 1 *N*	BBC 2 Mean	BBC 2 S.D.	BBC 2 *N*	BBC 3 Mean	BBC 3 S.D.	BBC 3 *N*
Fine sedimentary									
Unutil.	0·9	1·6	131	1·0	1·8	56	1·9	8·0	868
Util.	7·7	23·5	45	5·5	6·5	13	12·0	42·6	170
Haematite									
Unutil.	2·2	3·6	17	0·7	0·4	6	3·4	8·6	24
Util.	3·0	2·5	13	1·8	1·4	4	8·4	10·7	9

"Crayons" are pieces with three or more ground facets converging to a point. Twelve "definite" and 12 "probable" crayons or crayon fragments have been identified; 22 are longer than 10 mm, with a mean of 4·7 facets (S.D. 1·94). Present throughout, crayons are better represented in BBC 1 where they account for 12·8% ($N=10$) of modified pieces, compared to 5·4% ($N=10$) in BBC 3. Most crayons in BBC 3 are "fine-grained sedimentary" forms while fine sandstones and haematite predominate in BBC 1. Seven of the examples from BBC 1 had a hardness ≥ 4 on Mohs scale; this and the intensity of utilization (based on the number of facets and that most surfaces were ground) suggests that some "crayons" result from several hours—and presumably multiple episodes—of use. As curated artefacts their increased representation in BBC 1 is again consistent with a non-local origin for much of the pigment in this phase. The crayons' form suggests they were applied directly to abrasive surfaces to produce defined areas of colour consistent with a design.

Colour selection

Depending on hardness, the colours of pigments were recorded by rubbing or crushing a small sample on unglazed white ceramic tiles. The resulting streaks were compared with the "Natural Color System" (NCS) Index (1999). To reduce NCS notations, tripartite divisions were made of "nuance" (combined dimensions of chroma and black/white ratio) and hue. Hues were divided into those with more than 50% yellowness ("yellowish-brown"), between 50% and 75% redness ("reddish-brown"), and 75% or more redness ("brownish-red" and "red"). Nuance values were collapsed into three groups ("paste1", "intermediate", "saturated"), arranged in a staggered manner to take account of the reduced chromatic range of darker nuances. Integrating hue and nuance (Table 14) produces a graded scale of preferential utilization.

Within each nuance grouping there are consistent increases in the proportion utilized with increasing redness; between groups, there is an increase in the proportion utilized with saturation. Two minor divergences from this trend are informative, none of the "pastel yellowish-browns" are utilized, and "pastel pinkish-browns" are at least as likely to be utilized as "intermediate yellowish-browns". Almost 40% of the most saturated reds were modified. This suggests that most pieces producing a pastel and/or a yellowish streak (unless saturated) represent low-quality pigments or pigment waste. Of the 39 "saturated" "yellowish-browns", only one had more than 60% yellowness. Fine sedimentary material accounts for more than 80% of all streak categories except the most saturated reds, where sandstone and haematite account for 44·8%.

Among fine-grained sedimentary materials, "saturated reddish-browns" were preferentially utilized largely at the expense of similarly red but less saturated "intermediate reddish-browns" (Figure 10). Among haematites, "saturated reds and brownish-reds" were preferentially utilized largely at the expense of equally saturated but less red "reddish-browns". The high proportion of "saturated reds and brownish reds" in the haematite sample, combined with their preferential utilization, permits the inference that haematite was the most highly esteemed form of pigment, because of its redness (cf. Watts, 1999).

Bone Tools

Studies of bone modification were carried out using a 40× binocular microscope. Bone with deliberate shaping or use–wear or both is classified as a tool. Tools illustrated here (Figure 11) are all pointed at one end with the other end often broken. Some are "awl" shaped, and are flat and broad at the butt; others are more like typical LSA "bone points" and are

Table 14. Utilized percentage for nuance/hue groupings

Nuance/hue groups	Utilized %	*N*
Pastel yellow-brown	0·0	25
Pastel pink-brown	12·3	57
Intermediate yellow-brown	10·6	113
Intermediate red-brown	12·9	572
Intermediate brown-red	16·0	25
Saturated yellow-brown	17·9	39
Saturated red-brown	27·0	492
Saturated red and brown-red	39·5	114
Total *N*		1437
Average util. %	19·6	

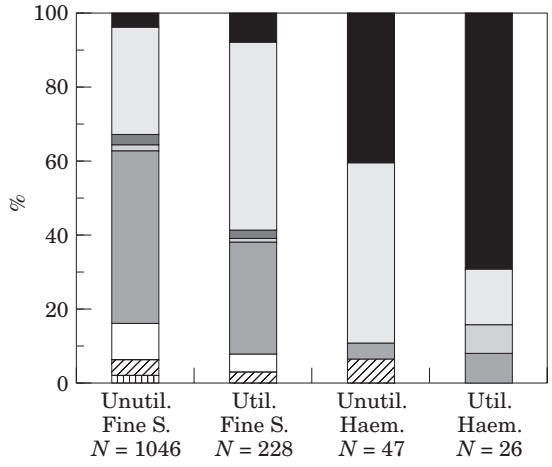

Figure 10. Streak proportions in unutilized and utilized ochre of fine sedimentary and haematite origin. ■ Sat. browny-red; □ Sat. reddy-brown; ■ Sat. yellowy-brown; ▨ Int. browny-red; ▨ Int. reddy-brown; □ Int. yellow-brown; ▨ Pstl pinky-brown; ▥ Pstl yellowy-brown.

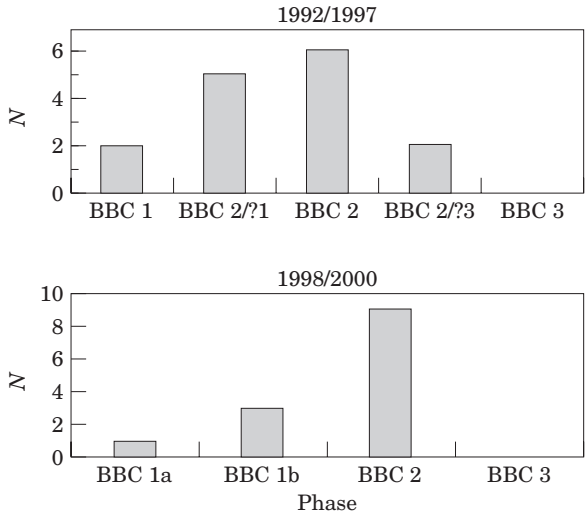

Figure 12. Distribution of bone tools among the BBC MSA phases in 1992/97 (top) and 1998/99/2000 (bottom). Histograms give the numbers of tools.

Figure 11. Selection of bone tools from BBC. The two specimens top right are points, the remainder pointed awl-like pieces. Specimens come from all seasons of excavation.

cylindrical or ovoid in shape with marginal widening at the butt (Figure 11). The majority are shaped on bone fragments or splinters removed from long bone shafts although in some cases the whole bone is shaped. Bovid bone is most widely used but marine mammal bone and a single bird bone were also employed.

Twenty-eight bone tools have been recovered—of these over half (15) were recovered in 1992/97 from 4·0 m^3 of excavated material. Thirteen came from 8·4 m^3 excavated in 1998/99/2000. The 1992/97 excavation was near the rear of the cave and bone tools are most common in this area. Most bone tools from the 1992/97 seasons were found in BBC 2, although two may come from BBC 1 and possibly two from BBC 3 (Figure 12). The crosscutting of some MSA layers in 1992/97 resulted in the misplacement of bone tools in the upper part of BBC 3 and possibly BBC 1. It is highly probable that at least eleven of these actually derive from the BBC 2 phase. In 1998/99/2000 bone tools were only recovered from BBC 1 and BBC 2 with most from the latter phase (Figure 12). No bone tools came from BBC 3. A larger sample is needed to confirm this pattern but results to date suggest bone tools occur predominantly in BBC 2, with limited bone tool manufacture in BBC 1b, the lower part of the phase associated with bifacial points.

Gradual, time-dependent breakdown of bone protein and subsequent leaching of the degraded material occurs in most depositional contexts. The percentages of carbon and nitrogen in buried bone are known to decrease over time. Carbon and nitrogen levels were determined in the two most intensively worked bone tools recovered during 1992/97 excavations and the results compared with those from six randomly selected non-artefactual BBC MSA bones and five from the BBC LSA. The results show these bone tools are securely from the MSA levels; the results for the eleven non-artefactual bones provide additional support for the secure provenience of MSA and LSA artefacts from known uncompromised squares (cf. Henshilwood & Sealy, 1997).

Ongoing analysis of the tools includes identifying the bone source to taxon and body part, the method of blank manufacture, type and method of modification, types of use–wear and polish, breakage patterns, burning, root etching and possible function. Seven bone tools recovered from the LSA deposits at BBC have been compared with those from the MSA. A manuscript of the bone tool study is in preparation (Henshilwood *et al.*, in prep. *b*).

Table 15. Total weights and density of OES found in the MSA phases of BBC

	Total grams	g per m^3
BBC 1	892·1	450·1
BBC 2	400·6	451
BBC 3	255·9	119·5

Ostrich Egg Shell

Fragments of ostrich eggshell (OES) are common but variably present within the BBC MSA sequence (Table 15). The highest densities (1998/99) per m^3 are in the BBC 1 and BBC 2 phases (1998/99), with a total mass of just under 1 kg. As the average weight of an empty modern ostrich egg is 272 g (Humphreys & Thackeray, 1983), this suggests that only a few unbroken eggs were brought to the site, perhaps to consume the contents. OES was probably also viewed as an artefactual resource since flaked modification occurs on one or more margins of 23 OES fragments. On some fragments, along 2 cm or more of the edge, there is deliberate damage that derives from use wear rather than from accessing the egg contents; these fragments are under investigation. Two fragments from the uppermost MSA in the front sounding (not included in Table 15) have been thinned by grinding and perforated and bear some resemblance to the mouths of latter day OES water containers. OES water flasks mouths have been reported in the MSA of Namibia (Vogelsang, 1998).

Fauna

Macromammals and Tortoises

Introduction. The macromammal and tortoise bones excavated from BBC through 1999 are described here with emphasis on their implications for the agent(s) of bone collection, the ancient environment, and the behaviour and ecology of the Stone Age people. Macromammals are defined as species in which adults weigh at least 0·75 kg in order to exclude tiny rodents, insectivores, and other micromammals that barn owls (*Tyto alba*) commonly collect. BBC has provided fewer micromammal bones than many other South African sites, suggesting that barn owls used the cave relatively little. Margaret Avery will describe the micromammal sample.

Through 1999, BBC produced 8193 macromammal specimens that were identified to skeletal part and taxon, together with numerous bones of the angulate tortoise (*Chersina angulata*). The tortoise sample comprises mainly small fragments of carapace and plastron; humeri (655 counted to date) were used to estimate tortoise abundance and average tortoise size. The field excavation layer for each mammal and tortoise bone was recorded, but for present purposes, the fauna is summarized according to the four major culture-stratigraphic layers recognized by the excavators—(from top to bottom) LSA, BBC 1 (=Still Bay), BBC 2, and BBC 3. Bones from probable mixed LSA/MSA layers have been ignored.

Table 16 presents the number of identified specimens (NISP) and the minimum number of individuals (MNI) by which each macromammal taxon is represented in each culture–stratigraphic unit. Klein & Cruz-Uribe (1984) explain the assumptions behind the MNI calculations. Figure 13 uses the MNIs to illustrate the relative abundance of the principal mammalian taxa or taxonomic groups in each culture–stratigraphic unit, and it compares the BBC frequencies to those for the same taxa at DK1 (Grine *et al.*, 1991; Marean *et al.*, 2000; Schweitzer, 1979) and Byneskranskop Cave 1 (BNK1) (Schweitzer & Wilson, 1982). DK1 and BNK1 are located approximately 200 km west southwest of BBC (Figure 1a) in a somewhat moister variant of the same environmental zone, and they have provided similar faunas associated with broadly similar MSA and LSA artefacts. The rightmost column of Figure 13 shows that the DK1 and BNK1 artefacts and bones accumulated mainly in the interval between the Still Bay and LSA layers at BBC, except that the BBC and DK1 LSA occupation are broadly contemporaneous.

The bone collector

The abundance of artefacts at BBC strongly implicates people in the bone accumulation, but it does not rule out other possible contributors. Besides people, the most important agents to consider are porcupines, carnivores (especially hyaenas), and raptors. Each produces distinctive bone damage from which their potential roles can be assessed. Table 17 presents the numbers of identified specimens on which distinctive categories of diagnostic damage are visible to the naked eye.

Table 17 shows that burning (charring) prevails, and its abundance underscores the likelihood that people were important in the bone accumulation. Other types of damage are rare, and cut marks are not common despite the abundance of artefacts. However, post-depositional destruction probably obscured some damage marks, particularly in the MSA layers where the bones are heavily fragmented and leached, and the number of marks might rise significantly if the bone surfaces were examined microscopically (Milo, 1998). Cut marks would probably increase most, since they are often difficult to discern, particularly on the bones of small mammals like those that dominate the BBC assemblage. Carnivore-tooth and especially porcupine-gnaw marks tend to be more obvious, and magnification would probably increase their numbers less. With this in mind, Table 17 suggests that relative to people, carnivores or purcupines were probably not important in the bone accumulation. Hyaenas can be specifically

Table 16. The number of identified specimens (NISP) and minimum number of individuals (MNI) by which each macromammal taxon is represented in the LSA and MSA deposits of BBC. Counts for individual bovid species are based strictly on teeth and horncores. Counts for the bovid size categories are based on all identified elements. In the context of the BBC fauna, small bovids include klipspringer, steenbok, and grysbok; small–medium bovids comprise springbok, common duiker, vaalribbok, and sheep; large–medium bovids are blue antelope, southern reedbuck, and wildebeest/hartebeest; and large bovids include eland, buffalo, and cattle

Species	Common name	LSA		BBC 1		BBC 2		BBC 3	
		NISPs	MNIs	NISPs	MNIs	NISPs	MNIs	NISPs	MNIs
Erinaceus frontalis	Hedgehog	0	0	6	1	10	2	4	1
Lepus capensis	Cape hare	4	1	11	1	4	1	6	1
Lepus saxatilis	Scrub hare	32	3	25	2	15	2	11	2
Bathyergus suillus	Cape dune molerat	997	60	419	14	303	12	168	8
Hystrix africaeaustralis	Porcupine	0	0	1	1	0	0	1	1
Papio ursinus	Chacma baboon	0	0	1	1	0	0	0	0
Homo sapiens	Humans	0	0	1	1	0	0	1	1
Canis mesomelas	Black-backed jackal	0	0	1	1	0	0	1	1
Canis sp.	Dog or jackal	4	1	1	1	0	0	0	0
Ictonyx striatus	Striped polecat	0	0	3	1	2	1	2	1
Mellivora capensis	Honey badger	21	2	1	1	1	1	0	0
Aonyx capensis	Clawless otter	0	0	0	0	0	0	1	1
Genetta sp.	Genet	0	0	2	1	4	1	2	1
Herpestes pulverulentus	Small grey mongoose	1	1	3	1	4	2	10	2
Hyaenidae gen. et sp. indet.	Hyaena	0	0	0	0	0	0	1	1
Felis libyca	Wildcat	6	1	16	1	1	1	2	1
Arctocephalus pusillus	Cape fur seal	285	4	126	3	32	2	60	2
Procavia capensis	Rock hyrax	343	12	169	8	190	10	408	19
Loxodonta africana	African elephant	1	1	0	0	0	0	0	0
Equus capensis	Cape zebra	0	0	0	0	0	0	4	1
Diceros bicornis	Black rhinoceros	0	0	3	1	0	0	1	1
Rhinocerotidae gen. et sp. indet.	Rhinoceros	2	1	13	1	6	1	3	1
Hippopotamus amphibius	Hippopotamus	11	2	3	1	1	1	0	0
Taurotragus oryx	Eland	11	2	48	5	8	2	15	2
Hippotragus leucophaeus	Blue antelope	0	0	6	1	6	1	0	0
Redunca arundinum	Southern reedbuck	0	0	14	2	4	2	6	1
Connochaetes gnou and/or *Alcelaphus buselaphus*	Wildebeest and/or hartebeest	0	0	5	2	0	0	1	1
Antidorcas sp.	Springbok	0	0	0	0	1	1	1	1
Sylvicapra grimmia	Common duiker	0	0	0	0	2	1	0	0
Oreotragus oreotragus	Klipspringer	2	1	0	0	0	0	0	0
Raphicerus campestris	Steenbok	26	8	0	0	1	1	4	4
Raphicerus melanotis	Grysbok	23	8	10	4	2	1	3	1
Raphicerus sp(p.)	Grysbok and steenbok	169	19	101	8	48	6	56	8
Pelea capreolus	Vaalribbok	2	1	6	1	2	1	1	1
Ovis aries	Sheep	26	4	0	0	0	0	0	0
Syncerus caffer or *Bos taurus*	Buffalo or cattle	12	1	0	0	0	0	1	1
Syncerus caffer	Cape buffalo	6	1	2	1	0	0	0	0
	Small bovid(s)	1375	21	382	10	360	6	242	8
	Small–medium bovid(s)	223	5	74	2	51	2	61	2
	Large–medium bovid(s)	163	5	91	3	50	2	62	2
	Large bovid(s)	509	6	183	5	58	2	72	2
Delphinidae indet.	Dolphin	0	0	2	1	1	1	2	1

excluded, because their distinctive coprolites are all but absent, and the BBC fauna contains very few carnivores jackal size or larger. Such carnivores abound in well-documented hyaena accumulations (Klein *et al.*, 1991).

The BBC bones etched or "reduced" by gastric acids imply a possible raptor contribution, and raptors might especially account for many of the molerats, hyraxes, and other small mammals that dominate the fauna. However, acid-etched bones are much less common than in the MSA layers of DK1, where periodic habitation by eagle owls (*Bubo capensis*) is implied by the distribution of bones among field excavation layers (Klein & Cruz-Uribe, 2000). At DK1, layers rich in molerat bones contain little else, while layers rich in artefacts and in bones of antelopes and other large mammals contain few molerat bones. A reasonable interpretation is that eagle owls collected most of the molerats and that they understandably occupied the cave mainly when people were absent. The tendency for molerat bones to vary independently of other items does not extend to the DK1 or BNK1 LSA layers, in which molerat bones are consistently associated with the bones of larger mammals and other objects that people probably introduced. Since acid-etched bones are correspondingly rare in the DK1 and BNK1 LSA

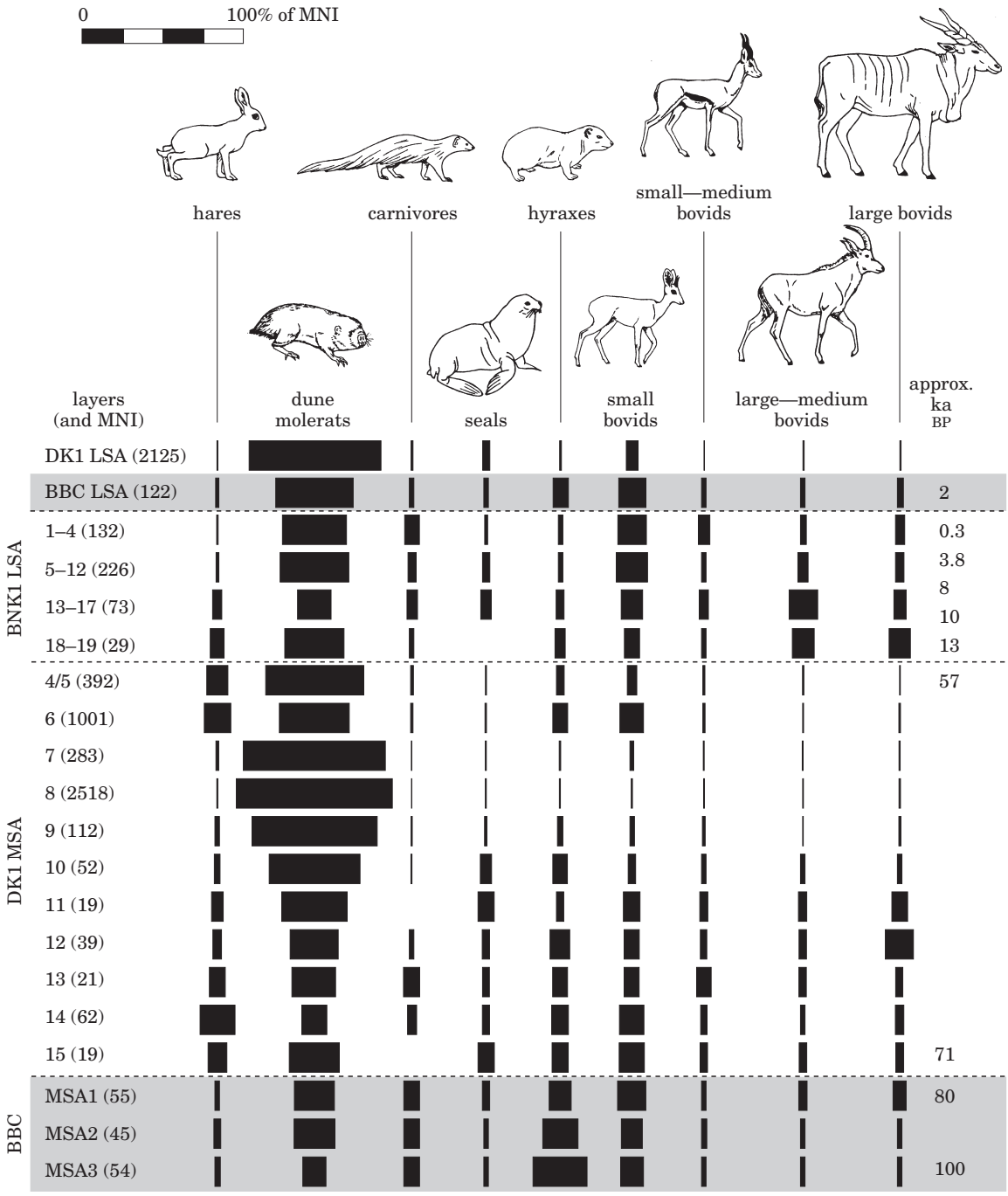

Figure 13. The relative abundance of the main taxa in the MSA and LSA layers of BBC compared to their abundance at Die Kelders Cave 1 (DK1) and Byneskranskop Cave 1 (BNK1). The horizontal bars are proportional to the minimum number of individuals (MNI) by which each taxon or semi-taxon is represented in each stratigraphic layer at each site.

layers, it seems likely that LSA people were the primary bone accumulators. The BBC MSA and LSA layers share the same tendency for molerat bones to be evenly distributed through all excavation layers, and the conclusion is that people were probably more important than raptors throughout. The primacy of people is particularly clear for the LSA, where charring on molerat incisors and premaxillae closely resembles the pattern that people still produce when they bake molerats on coals (Henshilwood, 1997).

The Palaeoenvironment. Historically, the vegetation near BBC comprised a variant of the small-leafed, evergreen, sclerophyllous shrubland or fynbos that covered most of the Western Cape Province of South Africa. In general, fynbos communities contained

Table 17. The number of identified specimens with macroscopically conspicuous damage in the principal culture-stratigraphic layers of BBC

	Burned	Carnivore-chewed	Cut	Acid-etched	Porcupine-gnawed	Total
LSA	161	0	7	10	0	3977
BBC 1	210	1	2	2	1	1532
BBC 2	150	0	1	1	1	1093
BBC 3	58	0	5	5	1	1122

insufficient grass and fresh browse to sustain large numbers of large herbivores (Bigalke, 1979; Skead, 1980). The relative rarity of surface water also limited or excluded many species. Among herbivores on which people could depend, the most abundant was probably the angulate tortoise. The most numerous ungulates were solitary, highly territorial small browsers—steenbok, grysbok, and common diuker. (Linnaean names are provided only when these are not listed in Table 16). Larger ungulates were much rarer and included mainly elephant, black rhinoceros, and eland, all of which probably roamed widely. Hippopotamuses were patchily distributed in the larger streams and in coastal marshes. The only widespread obligate grazer was the red (or Cape) hartebeest, which occurred sparsely in small, highly mobile groups. Rock hyraxes thrived near localities like BBC where rock crevices or crannies provided suitable shelter. Among other non-ungulate herbivorous mammals, the most common were probably hares, porcupine, and dune molerat. Dune molerats were particularly numerous at near-coastal localities like BBC where sandy soils facilitated burrowing. The principal carnivores were black-backed jackal, striped polecat, honey badger, Egyptian (or large grey) mongoose (*Herpestes ichneumon*), grey (or small grey) mongoose, brown hyena (*Hyaena brunnea*), African wildcat, caracal (*Felis caracal*), leopard (*Panthera pardus*), and lion (*Panthera leo*). Cape fur seals (*Arctocephalus pusillus*) inhabited the offshore waters and were often found on the shore.

The same small antelopes, molerats, and hyraxes that were common near BBC historically dominate the BBC LSA fauna, and it contains only species that were observed nearby. On this basis, it seems likely that the LSA environment broadly resembled the historic one. Average dune molerat size supports the same conclusion. Within the molerat's historic range, average adult size increases with rainfall (Klein, 1991), probably because more rainfall increases the density of preferred food plants. Molerats that live in relatively moist conditions, such as those near DK1 (where mean annual rainfall is approximately 600 mm) tend to be significantly larger than those that live in drier environs, like the surroundings of BBC (where mean annual rainfall is near 500 mm). Figure 14 shows that on average, the BBC LSA molerats were very similar in size to their recent counterparts (in the "modern Still Bay" sample). The figure also shows that the BBC LSA molerats were significantly smaller than their DK1 LSA contemporaries. This suggests that drier conditions pertained near BBC not just historically but for the last 2000 years.

In contrast, the BBC MSA fauna indicates that the MSA environment was moister and perhaps grassier than the historic one. Greater moisture is suggested first by the presence of hedgehog and southern reedbuck, neither of which occurred in the fynbos historically, and second by the large size of the MSA molerats (Figure 14). On average, the BBC MSA molerats were significantly larger than their LSA successors, and in mean size, those from BBC phase 3 approached those from the MSA layers of DK1. The DK1 MSA molerats are associated with hedgehog, reedbuck, and other extralimital species that once again imply moister-than-historic conditions, and they are the largest molerats on record. Their exceptional size implies that DK1 enjoyed a particularly wet climate when the MSA deposits accumulated. The BBC 2 and BBC 1 molerats were somewhat smaller than the preceding BBC 3 specimens, and the difference implies that moisture declined, although it apparently continued to exceed the historic or LSA level.

The evidence for grassier conditions is more tentative, pending larger MSA samples. The most compelling indication is the occurrence of springbok in BBC 3 and BBC 2, supplemented by the possible occurrence of black wildebeest in BBC 3 and BBC 1 and of Cape zebra in BBC 3. The black wildebeest identification is uncertain, because BBC has provided only isolated teeth and these are difficult to distinguish from those of hartebeest. The Cape zebra identification is firm, but the species became extinct roughly 10 ka ago (Klein, 1984) and its habitat preferences are thus conjectural. Judging from its closest living relatives, however, it was probably an obligate grazer, and it is most abundant in middle and late Pleistocene faunas in which undoubted grazers prevail. Arguably, it could not have existed near BBC unless grasses were regionally more important than they were historically.

Stone Age behaviour and ecology. The BBC mammals and tortoises support and supplement human behavioural inferences drawn from other sites. The LSA horizons are notable for providing the oldest known sheep bones in South Africa, directly dated to nearly 2000 radiocarbon years BP (Henshilwood, 1996). They have also produced some possible cattle bones, but these cannot be securely distinguished from those of Cape buffalo, which may have existed nearby. The age and sex structure of the broadly contemporaneous sheep sample from DK1 suggests that the occupants were herders (as opposed to rustlers) (Klein, 1986), but the BBC sample remains too small for similar analysis.

The dominance of eland over buffalo in the MSA at BBC recalls the situation in the MSA horizons of DK1 and KR (Klein & Cruz-Uribe, 1996). The BBC result is

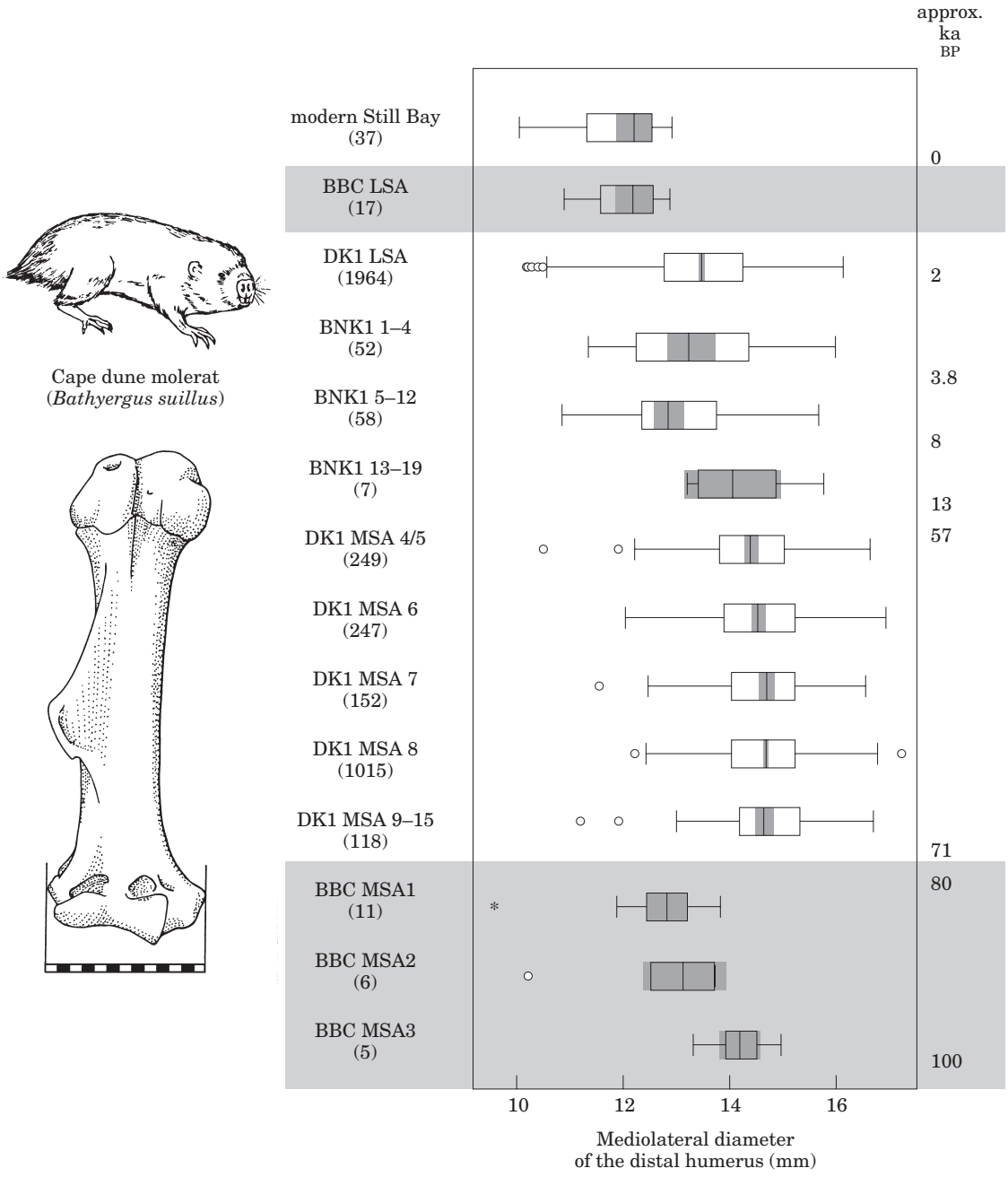

Figure 14. Boxplots summarizing the mediolateral diameters of Cape dune molerat distal humeri in the fossil samples from BBC, DK1, and BNK1. Key elements are the median, indicated by the vertical line near the middle of each plot, the middle half of the data, indicated by the open box around the median, and the 95% confidence limits for the median, indicated by the shaded box. Asterisks and circles mark specimens that are far removed from the main body of data. In conventional statistical terms, two sample medians differ significantly when their 95% confidence limits fail to overlap.

provisional, because the numbers are small (Table 16), but if it is sustained in larger samples, it would support the hypothesis that regional MSA people favoured eland, even though eland were probably less common than buffalo on the ground. Buffalo generally outnumber eland in LSA sites like BNK1, and they could also be more numerous in the LSA at BBC, if the bovine bones come mainly from buffalo (as opposed to cattle). The apparent MSA preference for eland persists across the shift from the Last Interglaciation to the Last Glaciation, which argues against a climatic explanation. The most plausible alternative, founded in MSA and LSA artefacts, is that only LSA people possessed projectile weapons with which they could attack prey from a distance. Eland are much less dangerous than buffalo if they are closely approached

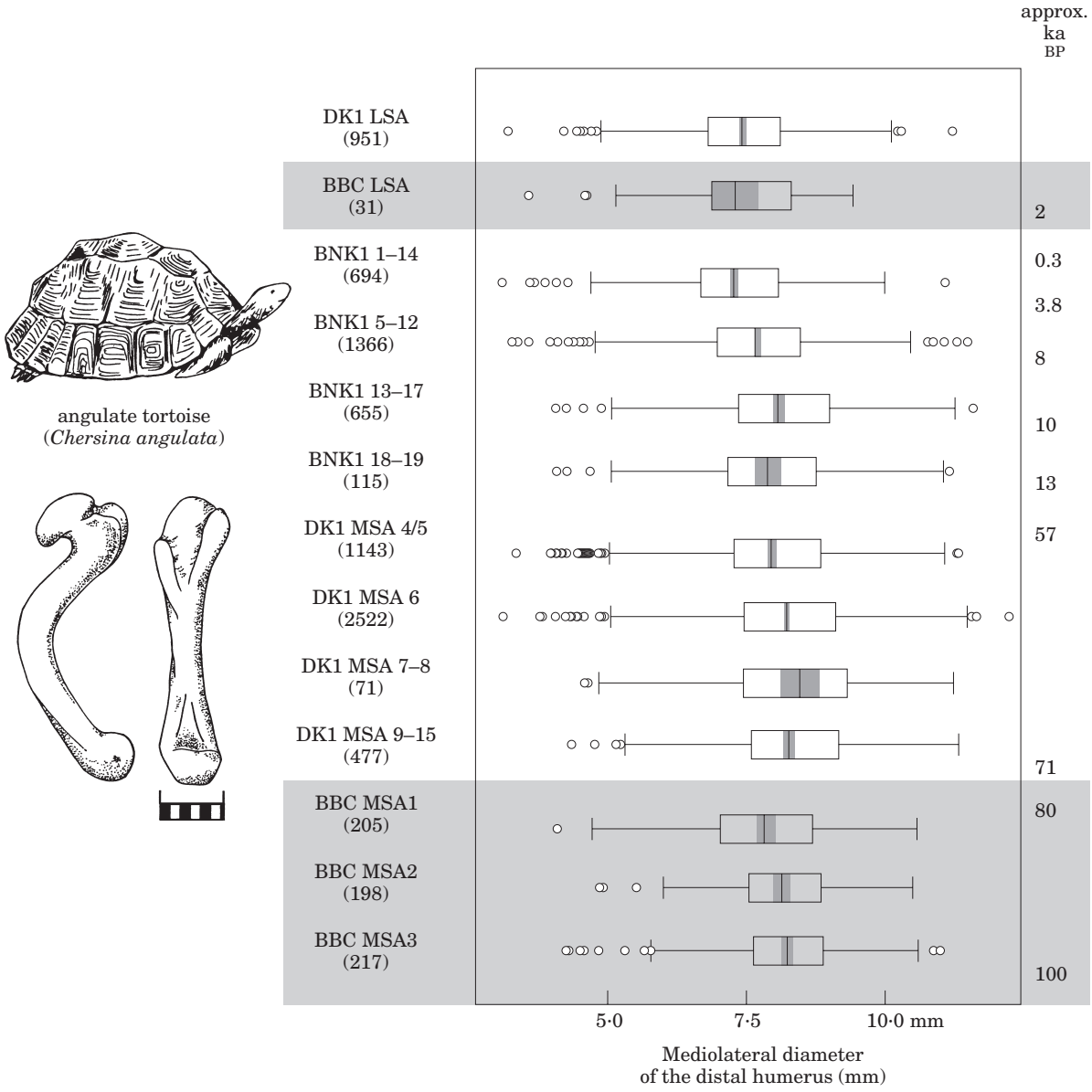

Figure 15. Boxplots summarizing the mediolateral diameters of tortoise distal humeri in the fossil samples from BBC, DK1, and BNK1. The caption to Figure 14 outlines key features of the boxplot format.

on foot, and the apparent MSA preference for eland may actually signal a forced avoidance of buffalo.

The BBC tortoises recall those from other MSA and LSA sites in the tendency for MSA specimens to be significantly larger, and Figure 15 shows that BBC sample size is adequate to demonstrate statistical significance. However, the figure also shows that some LSA tortoises approach MSA specimens in average size and that size varies significantly within both the LSA and the MSA. A strictly cultural cause is thus unlikely, and some environmental contribution seems probable. This is perhaps particularly suggested at BBC, where the youngest MSA layer (BBC 1), for which small molerat size suggests the driest conditions, also provided the smallest tortoises. However, the correlation between tortoise size and molerat size is less obvious at BNK1, and the BBC and DK1 LSA tortoises appear to have been similar in size, despite molerat indications that DK1 was significantly more moist. A reasonable hypothesis is that tortoise size tracks the interaction of culture and environment as this affects the number of human collectors and thus the intensity of collection. If this hypothesis is valid, a large average tortoise size in the MSA horizons of BBC and DK1 implies remarkably small human populations, given that relatively moist surroundings probably increased the availability of suitable plant and animal foods. In contrast, the small LSA tortoises from

BBC and DK1 indicate that LSA populations remained large even when relatively dry conditions probably reduced resource abundance. A fuller test of the basic hypothesis will require fresh tortoise samples from a wider range of MSA and LSA sites.

Shellfish

Marine mollusc shells constitute the most abundant category of food waste in the MSA deposits at BBC. They are of interest as a means of investigating the subsistence practices of MSA people and for the information they can yield on environmental conditions at the time they were collected.

Ocean temperature is a critical factor in determining the abundance, distribution and presence of marine animals and plants. Generally the waters found on the southern Cape coast are warm with periodic lower temperatures due to upwellings of cold water situated off the Agulhas Bank being driven onshore, mainly east of Mossel Bay but with some colder water moving further west (Cohen & Tyson, 1995; Cohen, 1993). The resultant disparate conditions and annual range of sea surface temperatures between 8° and 24°C provide for enormous biodiversity, allowing both cold and warm water faunal communities to co-exist (Smith, 1953; Tietz & Robinson, 1974; Branch & Branch, 1981; van der Elst, 1988).

The analysis presented here is of shells retained in the 3-mm sieve. Material retained in the 1·5-mm sieve (stacked below the 3 mm) is not yet analysed. Previous studies have shown, however, that inclusion of this smaller fraction increases the weights of shell, but is unlikely to alter significantly the minimum numbers of individuals (Thackeray, 1988). Shellfish from the MSA levels in squares F4, F5, E5a and E5b (see Figure 1(b)) have been identified to species, weighed and where possible, numbers of individuals counted. Analysis has thus far been restricted to major food species; very small species, which are of interest primarily as palaeoenvironmental indicators, still await analysis. Gastropods were quantified by counting the number of apices and, in the case of *Turbo sarmaticus*, the number of opercula were identified as deriving from the left or right side, the number from each side counted, and the higher total reported as the minimum number of individuals.

Densities of shell are lowest in BBC 1 (17·5 kg per m^3), intermediate in BBC 2 (31·8 kg per m^3) and highest in BBC 3 (68·4 kg per m^3). These differences in density mean that the sample size (total weight of shell analysed) is very similar in BBC 1 and 2 (26·0 and 26·8 kg respectively), but much larger in BBC 3 (106·2 kg). All these densities are higher than that for the LSA (13·2 kg per m^3). The comparison is complicated by loss of organic materials and greater compaction in the MSA layers compared with the LSA, factors that exaggerate the density differences between the two periods. There is considerable variation in shell density

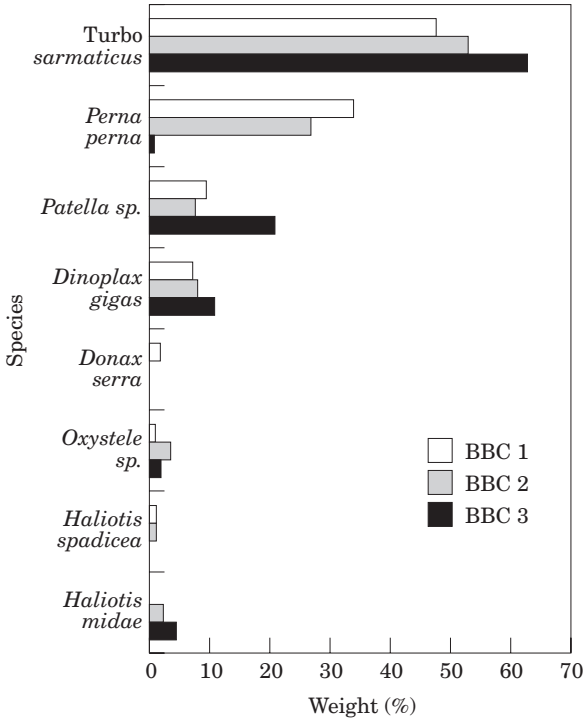

Figure 16. Percentages of the most important shellfish species by weight.

within each of the major stratigraphic sub-divisions within the MSA. The most shell-rich layer in the site is CI, with 163·8 kg per m^3. The underlying CJ has 104·9 kg per m^3, but CK, CM, CN, CO and CP all have <10 kg per m^3. The very abundant shell remains in BBC 1 and 2, and in CI and CJ lead us to expect that the shoreline was fairly close to the cave (i.e. close to its present position) at this time. Unfortunately, only small quantities of deposit have so far been excavated from CM, CN, CO and CP, so we cannot yet tell if the lower densities of shell in those layers reflect variation in shellfish gathering intensity or perhaps a marine regression. Pending analysis of thin sections, cut from vertical section peels taken in 2000, should help determine the changing positions of the shoreline during occupation.

The major species of shellfish represented are given in Figure 16. Most of the species identified from the MSA deposits are found in the area today, viz. *Turbo sarmaticus* (alikreukel or turban shell), *Perna perna* (brown mussel), various species of *Patella* (limpets) especially *P. oculus* and *P. argenvillei*, *Dinoplax gigas* (giant chiton), *Donax serra* (white or sand mussel), *Oxystele* spp. (periwinkles), *Haliotis spadicea* and *Haliotis midae* (abalone, known locally as perlemoen). The same species occur in the LSA levels, dating to within the last 2000 years, although *Dinoplax* is rarer in the LSA, and some species of *Patella* are more abundant (*P. longicosta* and *P. cochlear*) (Henshilwood, 1995). Most of these shellfish are still prized as seafood today (Bigalke, 1973). The

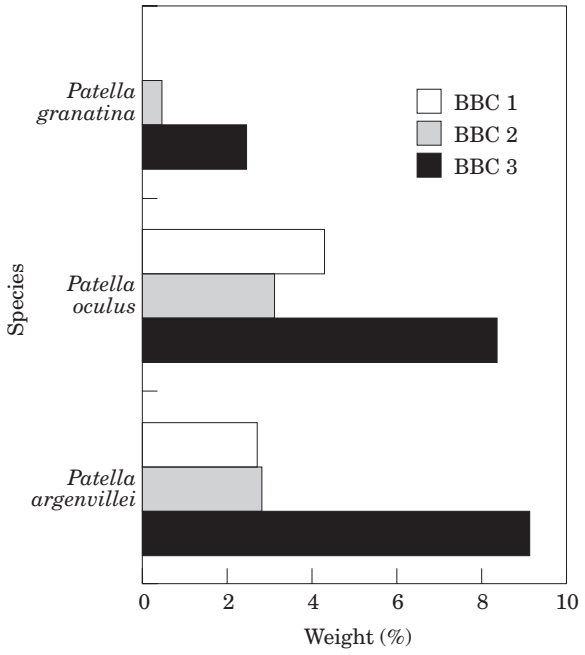

Figure 17. Proportions of different species of *Patella* in the three stratigraphic divisions.

similarity in the species of shellfish found in the MSA and LSA layers, and along the coast today, indicates that the MSA occupation of BBC occurred at a time when sea temperatures were broadly comparable to those of today.

There are some changes in species through the MSA sequence. The BBC 1 layers contain large quantities of *Perna* and modest amounts of *Patella* (nearly all *P. oculus* and *P. argenvillei*). These levels also contain the bulk of *Donax* remains. *Donax* occurs on sandy beaches; the closest sandy beach to the site today is about 3 km to the west. At times of lower sea level, there may have been sandy beaches closer by. Other species are all rocky shore varieties.

The shellfish assemblage from BBC 2 is very similar, except that *Donax* is almost absent. Like BBC 1, there is abundant *Perna* and relatively little *Patella*. *Oxystele* spp. and *Haliotis midae* are slightly more common than in BBC 1. In BBC 1 and 2, *Turbo* is represented mainly by fragments of operculum (ratio of shell weight to operculum weight is 0·3 in BBC 1, 0·7 in BBC 2).

BBC 3, however, has a rather different shellfish assemblage. Note that almost all of this comes from layer CI. *Patella* is more common than *Perna*, and in addition to *P. oculus* and *P. argenvillei*, *Patella granatina* is present in significant quantities for the first time (Figure 17). *Dinoplax* and *Haliotis midae* are more frequent. *Turbo sarmaticus* is more abundant than in BBC 1 or 2, and the ratio of shell fragments to opercula is markedly higher (3·4 by weight).

It is difficult to assess the extent to which differences in the shellfish in BBC 3 relate to large sample size, or reflect differences in species availability or shellfish collecting strategy. Rare species, including *Patella granatina*, *Dinoplax* and *Haliotis midae*, are more likely to be encountered in a larger assemblage. *Patella granatina* is found today mostly on the colder west coast of South Africa, and so might be an indicator of cooler water temperatures in BBC 3 times. Support for this hypothesis comes from the presence of small quantities of *Choromytilus meridionalis* (black mussel), mostly found in BBC 3. *Choromytilus*, too, occurs today predominantly along the Atlantic coastline (Kilburn & Rippey, 1982). Its elevated frequency in BBC 3 is not due to a sample size effect, since the quantity of the dominant species of mussel, *Perna*, is considerably smaller in BBC 3 (<1 kg) compared with BBC 1 & 2 (>15 kg) (see Figure 16). *Perna* and *Choromytilus* have similar habitat preferences, and it is unlikely that MSA mussel collectors would have selected one over the other if both were living on the rocks. Thus the BBC 3 period may indeed have been one in which water temperatures were cooler and sea levels marginally lower than for BBC 1 or BBC 2. Given the abundance of shell in unit CI, it is unlikely that water temperatures were sufficiently low for a substantial drop in sea level. Changes in ocean circulation or currents could, however have resulted in lower temperatures (Cohen & Tyson, 1995).

Differences in shellfish collecting strategies may be relevant here. Buchanan *et al.* (1984) noted that, for Holocene sites along the Cape west coast, mussels seem to have been transported further than limpets, so that middens further from the shoreline are likely to contain more mussels than limpets. It is possible that, in BBC 1 and 2 times, shellfish may have been transported further than during BBC 3. Mussels dominate the upper assemblages, at the expense of limpets. *Turbo* is represented mainly by opercula, not by shell fragments—very likely the result of removal of the shells at or near the collecting place, for easier transport. A similar shucking pattern is reported from other LSA sites near BBC (Henshilwood, 1995). In the BBC 3 phase, by contrast, limpets are more abundant, the frequency of *Turbo* shell fragments increases, and other heavy-shelled species such as *Haliotis midae* are brought back to the cave intact. This scenario could result from a higher sea level during BBC 3 (at least during the deposition of CI). Oxygen isotope analysis of the shells may help to decide between various possible explanations.

The shellfish in the MSA levels are very large. Relatively few specimens of *Patella* have remained sufficiently intact for the measurement of maximum diameter, but the mean size of *P. oculus* in the MSA is 78 mm ($N=64$), compared with only 61 mm in the LSA. The opercula of *T. sarmaticus* are robust, so we have been able to accumulate more metric data for this species. The MSA specimens are clearly larger than those from the LSA, similar to the pattern reported previously from Sea Harvest (Volman, 1978) and KR (Figure 18) (Voigt, 1982; Thackeray, 1988). Klein

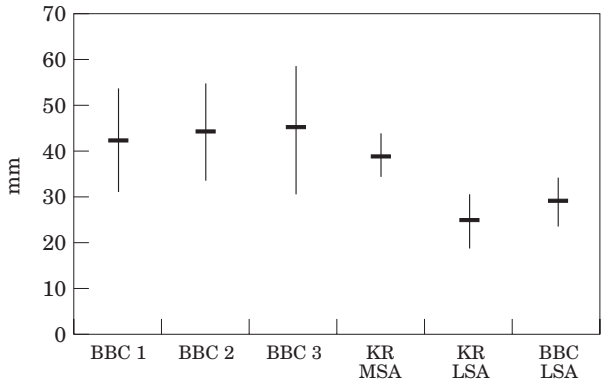

Figure 18. Means and standard deviations of maximum dimensions of *Turbo* opercula from the MSA and LSA at BBC and KR. BBC 1: n=399; BBC 2 n=362; BBC 3 n=555; BBC LSA n=375; KR MSA n=679 (Thackeray, 1988); KR LSA n=26 (Voigt, 1982).

(1998, 1999) believes that the larger size of shellfish in the MSA is the result of less intensive collection by humans, as argued above for tortoises. The alternative hypothesis is that environmental conditions in the MSA favoured growth to larger sizes. Work is in progress to try to resolve this debate.

Fish

Fish bones occur in all phases of the MSA. Most bones are from fish larger than the size seabirds can carry and hence do not represent roost litter. During the 1998/99 seasons, 664 fish bones were recovered and ten varieties of fish identified (Table 18). Fish are most common in the BBC 1 phase inside the cave and in BBC 3 phase in the exterior test excavation. The species composition in the two excavation areas differs markedly. White sea catfish are dominant in the outer test trench, particularly in the BBC 3 phase, possibly because spines from these fish are covered with toxic mucous tissue (van der Elst, 1988), resulting in the bones being discarded from the cave's inner confines, or the fish were cooked outside. Cooking denatures toxins in the spines. Within the cave, black musselcracker (or poenskop) are the most common fish in the BBC 1 and BBC 2 phases and some bones represent large specimens (>10 kg). Fatty flesh deposits, particularly in the head, make these highly regarded eating fish (Biden, 1930). Almost all fish in the MSA levels are species that take a local bait, *Pyura stolifera*, and could have been caught in small gulleys or inlets near the cave by trapping or spearing (see Smith, 1936, 1938). Rapid upwelling of cold water can stun fish resulting in occasional wash-ups, sometimes in large numbers (Bower & Crawford, 1981). Cold water upwelling events seldom occur in the San Sebastian Bay area near BBC today but are reported from east of Mossel Bay, about 70 km east of BBC (Schumann *et al.*, 1982). Fish collected from wash-up events comprise a mixed bag of species and size ranges (Bower & Crawford, 1981) yet fish species found in the BBC MSA are relatively restricted. If wash-up fish were collected, the expectation is that a greater variety of species should be represented. Analysis of fish remains from the MSA levels, and whether they were caught or scavenged, is the focus of ongoing research.

Table 19. Human dental remains from the MSA layers of BBC (1997/98 excavations)

Specimen	Element	Square	Unit
SAM-AP 6292	RP^3	E4	AT
SAM-AP 6293	Rdi^1	E5a	CFB
SAM-AP 6264	Ldm^1	E4	PIP
SAM-AP 6295	RP^4	E4	AS

Humans

Four human teeth were recovered from the MSA strata at BBC during the 1997–1998 field seasons. Two are heavily worn deciduous teeth, and two are incomplete permanent premolar crowns (Table 19; Figure 19). The di^1 (SAM-AP 6293) and dm^1 (SAM-AP 6294) may represent a single individual, although several

Table 18. Fish NISPs for BBC MSA levels 1998/99

Species	Common name	BBC interior				BBC exterior test trench				Site total
		BBC 1	BBC 2	BBC 3	Total	BBC 1	BBC 2	BBC 3	Total	
Sp.?	Unidentified shark		2		2					2
Coracinus capensis	Galjoen		1		1			3	3	4
Cymatoceps nasutus	Black musselcracker	26	31	4	61	1		1	2	63
Argyrosomus japonicus	Kob			1	1					1
Epinephelus andersoni	Cat-face rock cod							1	1	1
Liza richardsonii	Haarder	1		1	2					2
Chrysoblephus gibbiceps	Red stumpnose	3	1		4					4
Galeichthys feliceps	White sea catfish	6	3	5	14	8	7	68	83	97
Spondyliosoma emarginatum	Steentjie	2		2	4			1	1	5
Oplegnathus conwayi	Parrot fish	1			1			5	5	6
	Sp. unid.	167	120	71	358	6	20	95	121	479
	Total NISP	206	158	84	448	15	27	174	216	664

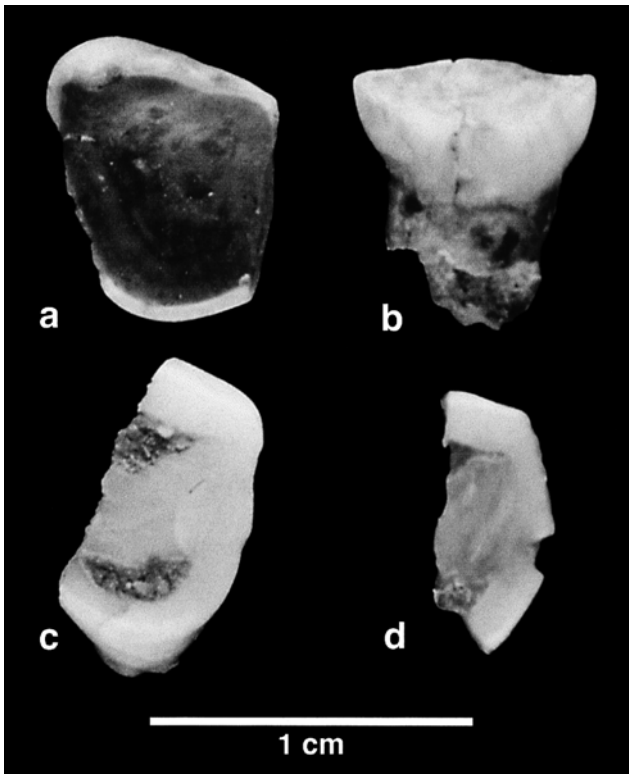

Figure 19. Human dental remains from the MSA of BBC (1997/98 excavations). a: SAM-AP 6294, Ldm^1, occlusal view, mesial to left. b: SAM-AP 6293, Rdi^1, lingual view, mesial to left. c: SAM-AP 6292, RP^3, occlusal view, mesial to right. d: SAM-AP 6295, RP^4, occlusal view, mesial to right.

Table 20. Crown diameters of the BBC MSA human teeth (mm)

Specimen	MD meas.	MD est.	BL meas.	BL est.
SAM-AP 6292 P^3			9·8	9·9
SAM-AP 6293 di^1	7·5	7·8?	5·7	5·7
SAM-AP 6264 dm^1	7·2	7·5	8·9	8·9
SAM-AP 6295 P^4	—	—	—	—

Abbreviations: SAM-AP, South African Museum—Physical Anthropology; MD meas., mesiodistal diameter measured; MD est., estimated original mesiodistal diameter; BL meas., buccolingual diameter measured; BL est., estimated original buccolingual diameter.

stratigraphic layers spanning nearly a metre in depth separate these elements. The two premolar fragments (SAM-AP 6292 and 6295), regarded as the mesial portions of an RP^3 and RP^4 respectively, are similarly worn, and come from adjacent stratigraphic layers in close horizontal proximity. It is probable that they derive from a single individual. It is extremely unlikely that the deciduous and permanent teeth derive from one individual.

Crown dimensions (Table 20) of the di^1 are comparatively large in relation to those for modern African homologues. These values fall within the lower part of the observed Neandertal range (Grine *et al.*, 2000). The diameters of the dm^1 and P^3, however, are comparable to modern teeth and smaller than most Neandertal values.

Occlusal wear and damage to the crowns have obliterated all morphological details of comparative interest. The BBC teeth evince ante-mortem abrasion that is not related to masticatory activity. Both premolars have numerous, fine horizontal scratches on the mesial surface between the interproximal contact facet and the cervical enamel line. In addition, the labial face of the di^1 presents a series of deeper, predominantly horizontal striae.

The circum-cervical striae on the premolars suggest palliative toothpick use. The labial scratches on the di^1 resemble neither the "cut marks" that have been observed on Neandertal incisors, nor the striae that have been recorded on modern human teeth (Grine *et al.*, 2000).

Examination of dental remains from penecontemporaneous MSA sites in South Africa has revealed several premolars and molars with similar faint horizontal striae between the interproximal contact facet and cervical margin. Grooves are apparent in two of the five individuals from KR with postcanine teeth, three specimens from DK1, and one specimen from Equus Cave. In a second specimen from Equus Cave, a relatively broad, deep transverse furrow excavates the subcervical dentine. Finally, one specimen from Border Cave has faint interproximal striae, but the craniodental remains from this site are of questionable antiquity. The predominantly horizontal striae on the BBC di^1 do not appear to bear any special resemblance to striae on the incisors that are currently available from comparably aged MSA sites in South Africa.

Summary and Conclusion

The 1992–1999 excavations of the MSA levels at BBC allow for some important preliminary conclusions to be made and provide a sound basis for future excavations at the site. These conclusions, based on the project's initial objectives, are summarized below.

Cultural artefacts

Lithics. The Still Bay phase, BBC 1, is dominated by soft hammer worked points, predominantly made on silcrete. These are termed Still Bay points, defined here as typically bifacially retouched, narrowly elliptic to lanceolate shaped tools, with two sharply pointed apices. There is a distinct preference for silcrete as a raw material in the BBC 1 phase, as is the case at other Still Bay sites such as Hollow Rock Shelter (Evans, 1993, 1994) and Paardeberg (Wurz, 2000). Increased use of finer-grained stone, relative to earlier MSA

phases, is a characteristic of the Still Bay. Understanding the Still Bay as a technological and social entity holds much promise as it shares a number of traits with the Howiesons Poort in terms of raw material preferences, specialized technology and distinctive tool type. The Still Bay provides evidence, additional to that of the Howiesons Poort, for a period of social and stylistic elaboration within the southern African MSA (Clark, 1988; Wurz, 2000).

Ochre. The BBC ochre assemblage provides further evidence for social and stylistic elaboration. MSA people at BBC seem to have regarded materials producing saturated very red streaks as ideal pigments. However, this ideal could be compromised when slightly less red or saturated forms were locally abundant—as during BBC 3. When pigment was procured mainly from further afield (as inferred for BBC 2 and BBC 1), ochreous siltstone and shale of intermediate nuance may have remained the most frequently encountered potential pigments, but forms that approximate "ideal" red were more likely to be brought back to the site and utilized. Yellow ochres were certainly available in the regional environment, and may have been locally available as well. However, they were seldom brought to BBC, and hardly any of the "saturated yellowish-brown" examples had pronounced yellow streaks. Similarly, the absence of manganese is notable given its occurrence, albeit in small quantities, in recent LSA horizons at BBC (Henshilwood, 1995). If locally available, the absence or near absence of both materials in the MSA would not be predicted by utilitarian hypotheses of supposed "pigment" use (e.g. Klein, 1999), where high metal ion content rather than colour should be the most relevant quality (Mandl, 1961). Additionally, the production of "crayons" does not fit with a utilitarian hypothesis.

The presence of geometric engravings, the production of "crayons", and the preferential modification of the most saturated reds, permits the fairly robust conclusion that ochre's principal role in the MSA at BBC was as an earth pigment. This supports the largely intuitive conclusion reached by most archaeologists that the most likely context of ochre use in the MSA was as a body-paint/cosmetic and possibly for the decoration of organic artefacts (e.g. Clark, 1988; Deacon, 1995; Volman, 1984).

Bone tools. Until recently bone tools were rarely reported in an MSA context (but cf. Singer & Wymer, 1982; Yellen *et al*., 1995) and were thought not to be part of the MSA toolkit (Thackeray, 1992; Klein, 1995, 1999). The BBC bone tools are deliberately shaped mostly to create a point at one end with a broader butt at the other and are reminiscent of LSA "awls"; all the tools are polished, some extensively, from use–wear. They may have been used to pierce leather, possibly to make clothing or bags. Three bones have been extensively shaped and polished and may have served as hafted projectile points; one shows evidence of hafting (Henshilwood & Sealy, 1997) and it is possible that others were also hafted.

Fauna

Macromammals and tortoises. The vast majority of the animal bones were brought to the site by human agency, with porcupines, carnivores and raptors being minor contributors. Climatic variation among the three MSA phases is indicated. Dune mole rats and tortoises in BBC 1 are larger than those in the LSA, but smaller than those in BBC 2 & 3. This suggests that conditions were overall wetter during the MSA than the LSA, but that it was drier during the BBC 1 phase compared to the BBC 2 & 3 phases. A generally higher rainfall in the MSA, compared to the LSA, is supported by the presence of hedgehog and southern reedbuck. Grazers like springbok and wildebeest, found only in MSA levels, also indicate grassier conditions. Relatively larger tortoises and dune mole rats in the BBC 3 phase, compared with those in BBC 1 and BBC 2, may relate to variations in rainfall but may also be linked to population demographics. Smaller tortoise size may signal more intensive collection linked to higher human populations during the Still Bay (BBC 1) phase. The larger relative sizes of tortoises in the earlier BBC 3 phase may signify remarkably small human populations, at least in this region.

Eland were a favoured prey although buffalo were probably more common. At this stage small numbers preclude a final behavioural or ecological explanation although similar eland to buffalo ratios at other DK1 and KR (Klein & Cruz-Uribe, 1996) suggests that MSA people sensibly avoided more dangerous prey like buffalo, perhaps because they lacked longer range projectile weapons, such as the bow.

Shellfish and fish. Marine exploitation added significantly to the protein component in MSA people's diets. Densities of shellfish are higher in the MSA than in the LSA levels and particularly high in the BBC 3 phase. The exploitation of shellfish at BBC complements findings from MSA sites KR (Voigt, 1982; Thackeray, 1988) and Sea Harvest (Volman, 1978).

The relatively small amount of fish bones in the MSA levels suggest fish were a minor dietary component, far less than is the case for the LSA occupations. However, variations in soil acidity and moisture within different sections of the cave suggests taphonomic variability may have resulted in the dissolution of some fish bones. This hypothesis remains to be tested as although there is observable disintegration of shell in some areas, the bones from microfauna seem well preserved across the excavation.

Humans. The amount of human material recovered from the BBC MSA in total is small. The crown dimensions of two teeth described in this paper are

Table 21. A summary of the MSA sequence at BBC

Phase	Lithic raw material	Bifacial points	Ochre quantity and use	Bone tools	Climate (relative to Holocene) Fauna	Shellfish
BBC 1	Mostly silcrete	Common	Moderate and frequent	Present	Moist, ?grassier	Ocean slightly cool
BBC 2	Mostly quartz	Present	Moderate and less frequent	Common	Moist, ?grassier	Ocean cooler
BBC 3	Mostly silcrete	Absent	Large and least frequent	Absent	Most moisture, ?grassier	Ocean coolest

large in relation to those for modern African homologues and fall within the lower part of the observed Neandertal range while the diameters of one other are comparable to modern teeth and smaller than most Neandertal values.

There is no human bone at BBC, apart from teeth. Absence or small quantities of human bone is typical for many MSA sites—possible explanations are that human bodies were not buried or discarded within cave sites or that bodies were processed (cf. Deacon & Deacon, 1999) and the remains mostly discarded away from living sites. Removal of bodies or body parts from sites like BBC by scavengers such as hyaenas may, in part, also account for this apparent absence but the expectation is that some traces of human bone would remain.

Dating

Final results using absolute dating methods are pending. The chronological location of Still Bay type bifacial points within the southern Cape MSA (see above for a full discussion) clearly places the Still Bay before the Howiesons Poort dated at *c.* 65–70 ka (Miller *et al.*, 1999; Vogel, in press).

Palaeoenvironment

Faunal and artefactual data allow for limited reconstruction of palaeoclimatic and palaeoenvironmental variability. Refinements will be possible with the inclusion of results from the microfaunal, micromorphology and oxygen isotope analyses.

Conclusion

The origins of "modern" human behaviour generate lively debate, world-wide. Preliminary results from the BBC excavations complement recent and older findings from a number of African MSA sites that suggest that some aspects of modern behaviour evolved during the early Late Pleistocene. Further analyses of the BBC material and ongoing excavations will help provide a firmer foundation for assessing the behavioural capacity of southern African hominids more than 70 ka ago.

Acknowledgements

Grateful thanks are due to D. M. Avery, G. Avery, G. Bailey, A. Bohlin, H. J. Deacon, J. Deacon, M. de Benedictus, F. d'Errico, D. Heard, D. Henshilwood, N. Henshilwood, T. Hoekstra, A. Jerardino, C. Marean, T. Maggs, D. Miller, R. Milo, P. Nilssen, J. Parkington, J. Pether, D. Roberts, J. Rogers, A. Smith, J. van Niekerk, T. Volman, N. Wessels, S. Winter & S. Wurz. C. Marean gave useful advice on earlier drafts of this manuscript. A. Wintle, Z. Jacobs and S. Woodborne kindly commented on dating issues. We thank M. Albertyn for the lithic drawings. We are grateful to the many people, unnamed here, who have helped. The assistance of people from the Still Bay, Riversdale and Swellendam communities is gratefully acknowledged. We also thank the South African Museum (Iziko Museums of Cape Town), Cape Nature Conservation, State University of New York at Stony Brook, South African Heritage Resources Agency and the University of Cape Town (and students) for their support. Blombos Cave was excavated with permission of the National Monuments Council, now the South African Heritage Resources Agency (Permit Nos 8/96/06/001/51 and 80/00/01/006/51). This work was supported by grants to: CSH from Anglo-American Chairman's Fund, Leakey Foundation, National Research Foundation, National Science Foundation (SBR-99-04540), University of Cape Town, Wenner-Gren Foundation; JCS from Council for Scientific Development (now National Research Foundation) and University of Cape Town; FEG from the Leakey Foundation and National Science Foundation (SBR-97-14589); IW from the British Academy.

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