

## CHAPTER TWELVE

*(Thesis pages 176-201)**Accepted with minor changes December 2006**Journal of Archaeological Science*FINDING RESOLUTION FOR THE HOWIESONS POORT  
THROUGH THE MICROSCOPE: MICRO-RESIDUE ANALYSIS  
OF SEGMENTS FROM SIBUDU CAVE, SOUTH AFRICA

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## CHAPTER TWELVE

### **FINDING RESOLUTION FOR THE HOWIESONS POORT THROUGH THE MICROSCOPE: MICRO-RESIDUE ANALYSIS OF SEGMENTS FROM SIBUDU CAVE, SOUTH AFRICA.**

#### **Abstract**

In this paper I present the results of a micro-residue analysis of stone segments, the type fossils of the Howiesons Poort technocomplex in South Africa, with an age of more than 60 ka. Fifty three segments from Sibudu Cave, KwaZulu-Natal were analysed. The micro-residue distribution patterns and other use-traces are interpreted in terms of hafting and function. It is shown that most of the tools were indeed hafted and most were probably used as inserts for composite hunting tools. There is evidence for differences and changes over time in haft materials and hafting configurations of the segments. The study demonstrates how functional studies might be able to help gain resolution in change and variability in human behaviour during the Middle Stone Age that is often portrayed as static or slow changing.

*Keywords:* Howiesons Poort; Sibudu Cave; backed stone tools; Middle Stone Age; hunting; hafting; residues; human behaviour.

#### **Introduction**

Micro-residue analysis of stone tools, using light microscopy, is increasingly used to solve Stone Age behavioural questions (for example, Fullagar et al. 2006; Hardy 2004; Hardy et al. 2001; Williamson 2005). Analysts are developing and refining methods based on distinct research questions or focus areas (for example, Hardy & Garufi 1998; Haslam 2004, 2006; Horrocks & Weisler 2006; Lombard & Wadley in press; Pearsall et al. 2004; Piperno et al. 2004; Rots & Williamson 2004; Therin 1998; Wadley et al. 2004). These developments are providing increased accuracy and confidence in the approach, and are highlighting areas where caution is required. Sometimes it is possible to gain detailed understanding of stone tool functions and associated hafting technologies (Lombard 2004,

2006a). Where sites have good organic preservation, and tools are extracted with micro-residue research in mind, the method can be used to solve riddles of the past. One such conundrum exists around the geometric backed tools from the Howiesons Poort (HP) technocomplex of South Africa (see Lombard 2005a and references therein). The HP has been described as ‘a remarkably precocious lithic entity’ (Butzer 1982), ‘transient’ (Deacon & Shuurman 1992), ‘unnecessarily burdensome and complex’ (Vishnyatsky 1994), ‘most puzzling’ (Mitchell 2002), and the dating at the name site as ‘an unsolved mystery’ (Deacon 1995). The HP puzzle is mainly centred around the existence of a blade technology with geometric backed tools, sometimes also described as microlithic. These backed tools are reminiscent of Later Stone Age or Upper Palaeolithic industries, and almost indistinguishable from European Mesolithic backed tools. However, they were made thousands of years earlier and are followed by what is often interpreted as a less sophisticated Middle Stone Age (MSA) flake-based technology.

By the time of the HP – about 65 ka ago – people in South Africa were anatomically modern (*Homo sapiens*) (for example, Deacon & Wurz 2005; Grün & Beaumont 2001; Marean & Assefa 2005; McBrearty & Brooks 2000, Wadley 2006a). New archaeological information is becoming available, providing better understanding of the HP timeframe and some cultural aspects (Ambrose 2006; Gibson et al. 2004; Lombard 2006b; Minichillo 2006; Parkington et al. 2005; Rigaud et al. in press; Soriano et al. in press; Valladas et al. 2005; Vogel 2001; Wadley 2005, 2006a; Wurz 2002). Segments (sometimes also referred to as crescents or lunates) are the type fossils for the HP technocomplex, and understanding their use and associated hafting technologies could further contribute to our knowledge of this period. Thus, a series of functional studies have been conducted on HP backed tools (Delagnes et al. 2006; Gibson et al. 2004; Lombard 2005b, 2006b; Wurz & Lombard in press). Here I present the results of an assemblage-level micro-residue analysis of all the unwashed segments from the HP layers at Sibudu Cave, KwaZulu-Natal. Organic material, and by extension residues on stone tools, are extraordinarily well-preserved at

Sibudu Cave making this the ideal assemblage for the project. An interpretation of how these tools could have been used and hafted is provided.

### **The Howiesons Poort at Sibudu Cave**

Sibudu Cave (Fig. 1) has a long sequence of MSA occupations with stone tool assemblages that can be attributed to a pre-Still Bay phase, a Still Bay technocomplex, a Howiesons Poort technocomplex, a post-Howiesons Poort phase, and late and final MSA phases (Fig. 2). I focus here only on the HP of Sibudu Cave that has been excavated from the 2 m<sup>2</sup> trial excavation, but site descriptions and various aspects of ongoing research are widely published and readers are referred to Wadley (2006b), Wadley & Jacobs (2004; 2006) and the references therein. Ages for the older industries, including the HP are not yet finalised, but they fit within Oxygen Isotope Stage (ISO) 4. A large suite of layers with post-HP assemblages at Sibudu Cave have a weighted mean average optically stimulated luminescence (OSL) age of  $60.1 \pm 1.5$  ka (Wadley & Jacobs 2006). The implication is that either the end of the HP at Sibudu Cave is older than this, or that the technocomplex here moves seamlessly into an industry lacking backed tools (Wadley 2006b). Stratigraphically the HP succeeds the Still Bay for which a preliminary OSL age falls within the range published for the Still Bay at Blombos Cave (Jacobs et al. 2003 a, b, 2006; Tribolo et al. 2005, 2006), somewhere between 75 and 73 ka ago. It is not yet known whether there is a hiatus between the HP and the Still Bay at Sibudu Cave (Wadley 2006b). The HP occurs in layers PGS (the deepest HP layer), GS2, GS, GR2 and GR (the uppermost HP layer) and is rich in stone artefacts. No retouched points were excavated from these layers. Segments and other backed tools represent the formal component of the assemblage. The majority of the backed tools are manufactured on dolerite and hornfels, although there are also some quartz artefacts (Delagnes et al. 2006). A higher proportion of blades and more large sandstone flakes than the more recent assemblages accompany the backed tools from Sibudu Cave (Wadley 2006b).

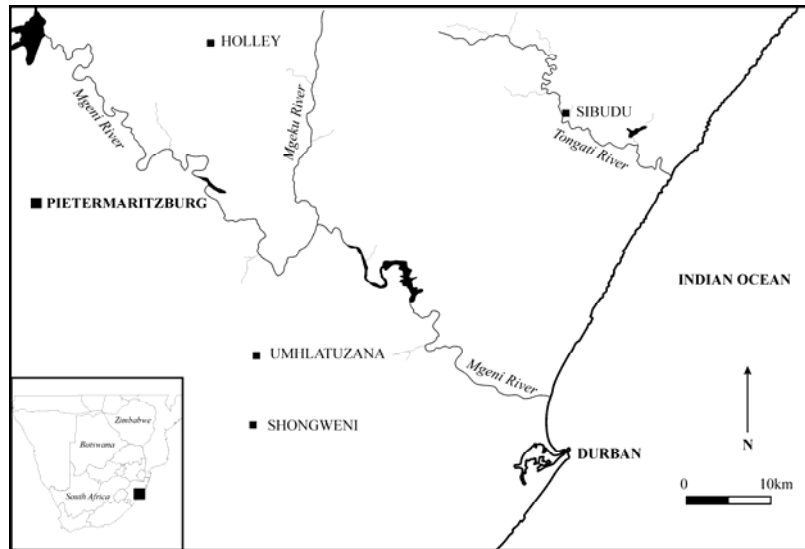


Figure 1. Location of Sibudu Cave in relation to some other excavated Middle Stone Age sites in KwaZulu-Natal, South Africa (map courtesy Lyn Wadley).

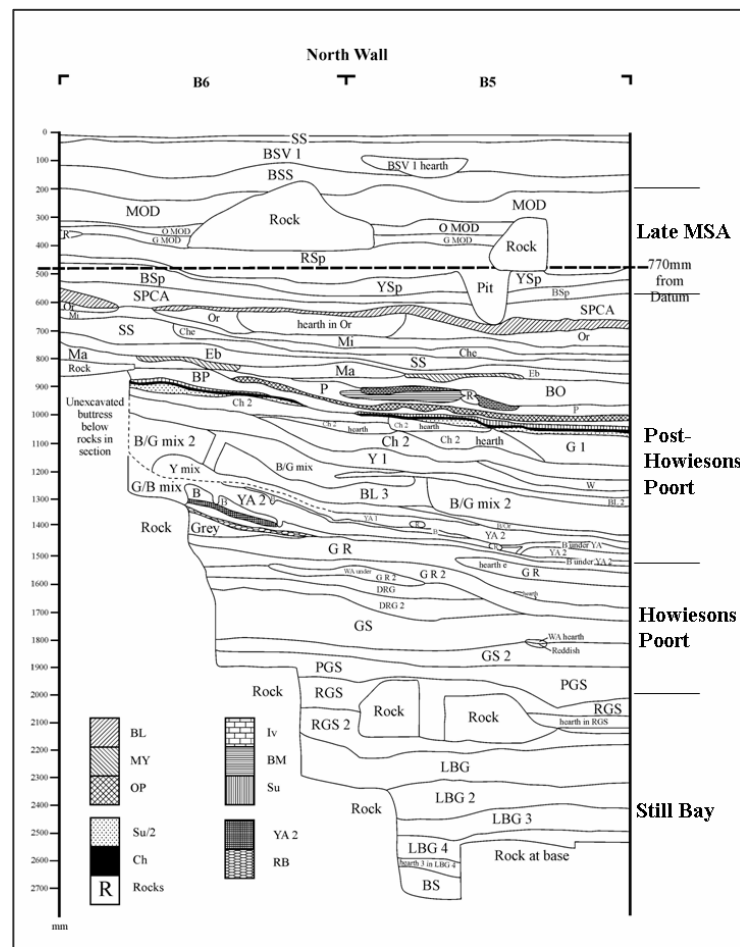


Figure 2. North wall stratigraphy at Sibudu Cave showing the main occupational phases (section drawing courtesy Lyn Wadley).

Bone point fragments that can be refitted have been recovered from the HP layers (Wadley 2006b). Bone, in general, is less fragmented in the HP layers than the bone in younger layers, and possible geomorphological and taphonomical reasons for this are discussed in Cain (2006) and Schiegl and Conard (2006). Faunal analyses of the HP layers are incomplete, but preliminary indications are that the animals represented during the period include a wide range of species, with the blue duiker (*Cephalophus monticola*) predominating. Some worked marine shell is also present in the HP layers. Shells are, however, not abundant, and do not appear to represent food remains. Rather, it seems likely that it was deliberately transported from the coast as a raw material (Plug 2006). Well-preserved circular and sub-circular hearths are present throughout the Sibudu Cave sequence. The small area from which the HP has been recovered prevents an accurate description of the spatial distribution of its hearths. Nevertheless, they are easily recognisable as separate features and seem to be more sparsely dispersed in these layers compared with the younger layers. ISO 4 (75-64 ka) represents a cool event during which there was a 60-70 m fall in sea level (Wadley & Jacobs 2006). Other proxy environmental data indicate a humid climate for the cave with surrounding evergreen forests during the HP (Allott 2006; Glenny 2006; Schiegl & Conard 2006; Wadley 2006b).

### **Sample and method**

The sample for this study comprises all the unwashed HP segments (n = 53). I excavated the tools and placed them in airtight plastic bags immediately after removal from the soil. They were not touched, washed or marked subsequent to excavation. Soil samples were collected from the HP layers and microscope slides were prepared for each soil sample and photographed under the same magnifications and lighting conditions as the residues on the tools. This procedure provides a record of the microscopic morphology of the matrix from which the tools were retrieved, and can be used to compare with the residues, or matrix adhering to the tools. The tools and soil samples were microscopically examined at magnifications ranging from 50x to 500x using an Olympus BX40 stereo binocular metallographic microscope with analysing and polarising filters, and

bright and dark field, incident light sources. A digital camera attachment was also used.

Discussions of the applied method, including the multi-stranded approach and criteria by which micro-residue types are identified and interpreted, are provided in Lombard (2004, 2005c), Lombard & Wadley (in press) and Wadley & Lombard (in press), so that I only provide project-specific aspects here. To establish the distribution patterns of residues and the relationships between various micro-residue types on the segments I divide each tool into six portions (Fig. 3). Each portion includes a dorsal and ventral side. The segments are placed with their dorsal sides facing upwards, but because proximal and distal ends are often difficult or impossible to distinguish, they are all placed with their backed edges to the left. The portions are referred to as upper blade (portion 1), medial blade (portion 2), lower blade (portion 3), lower back (portion 4), medial back (portion 5) and upper back (portion 6). All identifiable micro-residues are recorded, plotted and counted in relation to the portions described above. This method highlights the possible existence of micro-residue and other use-trace distribution patterns and serves as a basis for further interpretation. Although it cannot be considered an accurate quantification of the residues, it does provide a realistic reflection of the distribution patterns and concentrations of micro-residues on the tools.

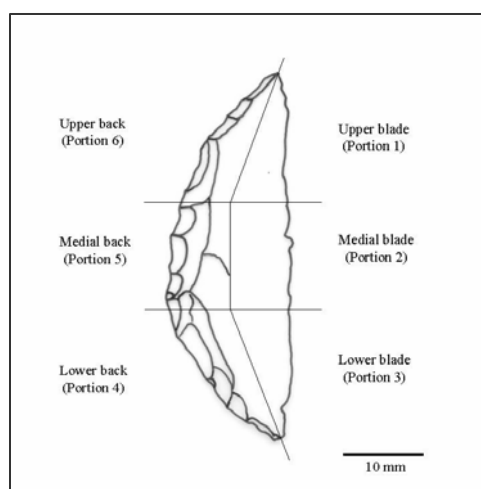


Figure 3. Division of segments for the spatial analysis of micro-residues.

## Results and interpretations

### *Distribution patterns of micro-residues*

On the sample of 53 tools, 1826 organic micro-residue occurrences were documented. These do not include plant residue types associated with evidence for rootlet or fungal growth on nine tools in the sample. Table 1 shows the distribution of all the organic residues (ochre residues and their association with resin have been discussed elsewhere [Lombard 2006b]). Animal residues include animal tissue, fatty residue, collagen, bone residue, blood residue and hair fragments, while plant residues include plant tissue, plant fibres, starchy residue and starch grains, woody residue and resin. Most of the animal residues are concentrated on the blade (sharp, cutting) portions of the segments. This is especially true for animal tissue (84%), collagen (67%), blood residue (84%) and hair fragments (89%): such high percentages on these portions cannot be considered coincidental. The distribution patterns of fatty and bone residues are less distinct.

Table 1. Distribution of animal residues over the complete unwashed Howiesons Poort segment assemblage from Sibudu (n = 53).

	Portion 1		Portion 2		Portion 3		Portion 4		Portion 5		Portion 6		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
<b>Use or hafting related animal residue types</b>													
Animal tissue	44	23	66	34	52	27	15	8	6	3	10	5	193
Fatty residue	44	12	93	25	42	11	74	20	71	19	48	13	372
Collagen	16	19	16	19	24	29	8	10	11	13	8	10	83
Bone residue	33	14.5	35	15.5	35	15.5	42	18	48	21	35	15.5	228
Blood residue	13	15	35	41	24	28	5	6	2	2	7	8	86
Hair fragments	3	33.5	2	22	3	33.5	0	0	1	11	0	0	9
<b>Sub Totals</b>	<b>153</b>	<b>16</b>	<b>247</b>	<b>25.5</b>	<b>180</b>	<b>18.5</b>	<b>144</b>	<b>15</b>	<b>139</b>	<b>14</b>	<b>108</b>	<b>11</b>	<b>971</b>
<b>Use or hafting related plant residue types</b>													
Plant tissue	4	6	2	3	7	11	14	22	18	29	18	29	63
Plant fibres	1	3.5	6	20.5	3	10.5	7	24	9	31	3	10.5	29
Starch res/grains	1	1	6	7	10	11.5	18	20.5	39	45	13	15	87
Woody residues	5	5.5	12	13	7	8	34	37	19	21	14	15.5	91
Resin	22	4	30	5	25	4	133	23	223	38	152	26	585
<b>Sub Totals</b>	<b>33</b>	<b>4</b>	<b>56</b>	<b>6.5</b>	<b>52</b>	<b>6</b>	<b>206</b>	<b>24</b>	<b>308</b>	<b>36</b>	<b>200</b>	<b>23.5</b>	<b>855</b>
<b>Totals</b>	<b>186</b>	<b>10</b>	<b>305</b>	<b>17</b>	<b>232</b>	<b>12.5</b>	<b>350</b>	<b>19</b>	<b>447</b>	<b>24.5</b>	<b>308</b>	<b>17</b>	<b>1826</b>

On the one hand, the line graphs show how animal residues such as tissue, collagen, blood and hair tend to be poorly represented on the backed portions (Fig. 4). On the other hand, bone representation increases slightly on these backed



portions of the segments, while fat does not display a clear distribution pattern (Fig. 5). There is a high fat and marrow content in bone and replication work shows that fatty residues on stone tools often result when they are used to process bone (own observation of residues on replicated tools). Fat and bone residues are thus closely associated, and might occur as a result of the same activity. However, fatty residues can easily be distributed as a result of handling the tools with greasy hands. Fatty residue distribution patterns might therefore be most accurately interpreted in conjunction with associated animal residues. Plant residues are concentrated on the backed portions of the segments (Fig. 6); 83.5 % of all the plant residues are here (and 67% of the plant residue component comprises resin).

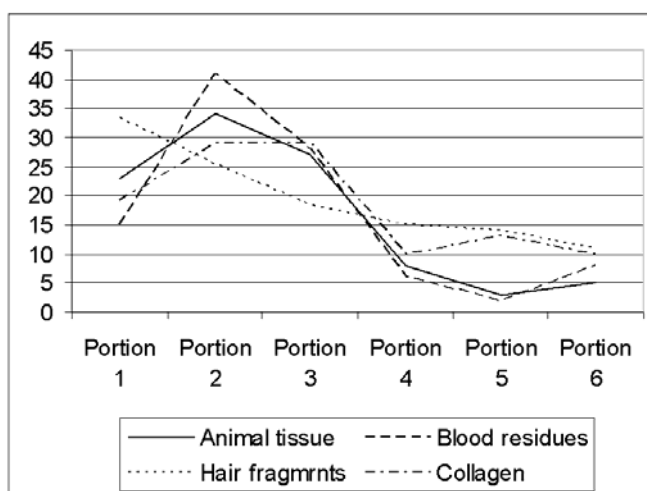


Figure 4. Percentages of animal residues (excluding bone and fat) distributed on the six bifacial portions of the segments.

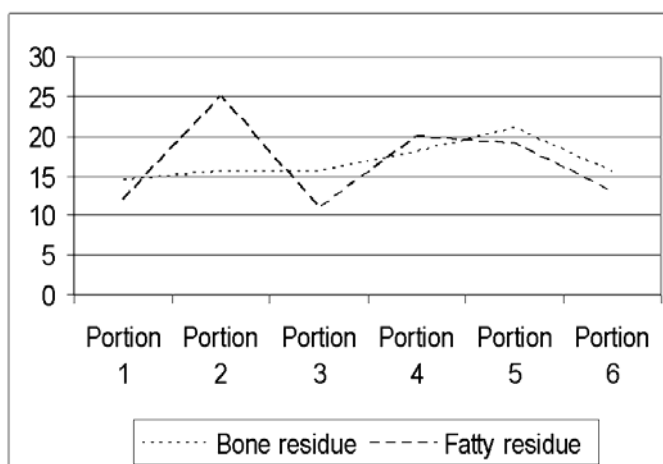


Figure 5. Percentages of bone and fat residues distributed on the six bifacial portions of the segments.

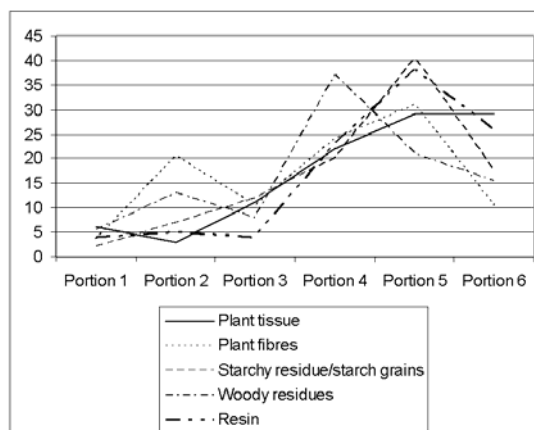


Figure 6. Percentages of plant residues distributed on the six bifacial portions of the segments.

Because of the different trends in the distribution patterns of animal and plant residues, we can infer that they accumulated on the segments as a result of different applications or use actions (Fig. 7). The backed portions of segments are usually considered to have facilitated hafting. This interpretation is based on previous use-trace analyses conducted on tools with similar morphology, as well as ethnographic and archaeological examples (Goodwin 1945; Clark et al. 1974; Phillipson 1976; Clark 1977; Becker & Wendorf 1993; Bocquentin & Bar-Yosef 2004; Gibson et al. 2004). A parallel study, involving the analysis of the distribution patterns of ochre and resin residues on the same sample, provided direct evidence for the hafting of these tools using an adhesive containing these two ingredients. It was shown that 80% of the ochre occurrences and 87% of the resin occurrences are located on the backed portions of the sample (Lombard 2006b).

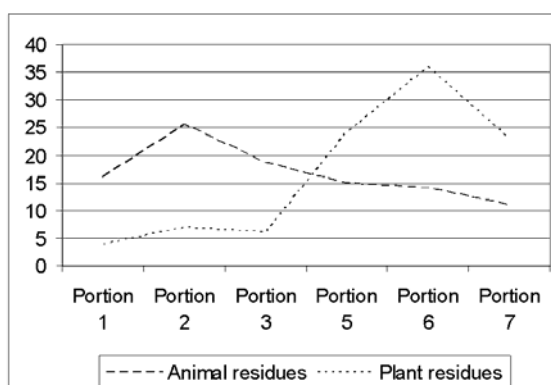


Figure 7. Comparison of the general distribution trends of animal and plant residues on the six bifacial portions of the segments.

### *Haft materials*

With most of the plant residues located on the backed portions it seems reasonable to infer that the tools were hafted to wooden handles or shafts. However, a blind test showed that a range of plant residue types can be expected within resin or tree gum. When gum is collected from trees wood vessels, pieces of bark and starch grains are unintentionally incorporated in the gum (Lombard & Wadley in press). Furthermore, resin or gum sometimes degenerates into a whitish residue that might include starch grains and which has a starch appearance (Fig. 8). This calls for caution when interpreting haft materials. Using multiple lines of micro-residue evidence, as discussed in Lombard & Wadley (in press) and Wadley & Lombard (in press), and including information from other use-traces such as usewear and macrofractures (Lombard 2005b, c), the single tools were interpreted for hafting and function. The data were interpreted according to the macro-stratigraphic divisions of the HP layers at Sibudu i.e., GR and GR2 the uppermost HP layers (n of tools = 11), GS and GS2 the middle HP layers (n of tools = 20) and PGS the oldest HP layer (n of tools = 20) (Table 2). Two tools included in the analysis presented in Table 1 are not from *bona fide* HP layers. One is from YA2 the layer immediately above the HP and the other from RGS the layer immediately below the HP.

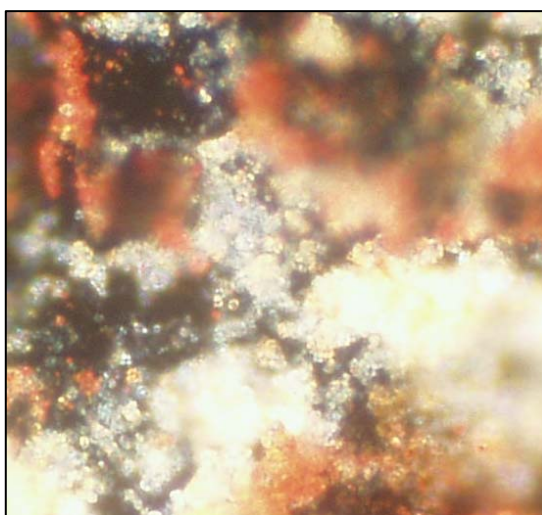


Figure 8. Degenerating tree gum with starch grains from a replicated tool that was hafted to a wooden haft during experimentation, photographed at 500x enlargement.

Table 2. Chronological interpretation of the micro-residue data

Interpretation	GR and GR2 (n = 11)		GS and GS2 (n = 20)		PGS (n = 20)	
	n	%	n	%	n	%
<b>Hafting interpretation</b>						
Wood hafting	6	54.5	3	15	0	0
Bone hafting	0	0	2	10	10	50
Hafting material uncertain	3	27	12	60	8	40
Not hafted	1	9	4	20	2	10
<b>Interpretation of processed materials</b>						
Animal processing	6	54.5	18	90	18	90
Plant processing	1	9	0	0	0	0
Animal and plant processing	2	18	0	0	1	5
Processed materials uncertain	0	0	1	5	0	0
Not used	3	27	0	0	0	0
<b>Interpretation of hafting angle</b>						
Longitudinal/transverse/pairs	5	45.5	5	25	10	50
Diagonal	5	45.5	10	50	6	30
Hafting angle uncertain	0	0	4	20	2	10
<b>Segments interpreted as inserts in composite hunting tools</b>						
	7	63.5	17	85	15	75

More than half (54.5%) of the tools from GR and GR2 show multiple strands of evidence for wood hafting. A further 27% show evidence for being hafted, in the form of adhesive residues and other use-traces, but the abundance or distribution patterns of their micro-residues does not clearly indicate their haft materials. One tool from these layers shows no evidence for hafting. Of the 20 tools from layers GS and GS2 15% could be interpreted as having been hafted into wooden hafts and 10% have evidence for possible bone hafting. For 60% of the segments the hafting material could not be identified, and four tools appear not to have been hafted at all. The segments from layer PGS seem to be telling a different story. Here, 50% of the tools show evidence for possible bone hafting, while none show clear evidence for wood hafting. For 40% of the segments in PGS I was unable to identify the haft materials, and two tools were probably not hafted. If the interpretations of variation in haft materials are correct, the implications are far-reaching. However, we have to consider all other possibilities before bone hafting for the earliest HP layers at Sibudu Cave can be claimed, and I return to this issue in a later section.

*Processed materials and tool function* (here the term 'processed' incorporates any use action including hunting)

One of the main aims of the micro-residue analysis and other functional studies on this sample was to determine whether the tools were used as inserts for composite hunting tools. Core micro-residue indicators for this application are the distribution patterns of animal residues. Over a period of three years much attention was paid to resolving problems concerning the preservation and identification of animal residues, and distinguishing between plant and animal micro-residues (Lombard & Wadley in press; Wadley and Lombard in press). Thus, a series of replication projects and blind tests have aided the interpretations presented here. As already mentioned, there is a clear accumulation of animal residues (except bone) on the blade portions of the segments indicating the processing of animal material. For layers GR and GR2 54.5% (n = 6) of the tools show evidence for animal processing; of the remaining tools one tool could have been used to process plant material, two tools could have been used to process both plant and animal materials, and three tools seem not to have been used at all (Table 2). Based on the evidence presented, it seems that HP segments at Sibudu Cave were hafted and used mostly for the processing (either butchering or hunting) of animal material. However, usewear traces showed very little indication of cutting, sawing or scraping and the segments do not show convincing traces indicating that they have been used as knives or for scraping hides. Most of the cutting edges of the segments remained remarkably sharp with only some linear striations on their edges and surfaces. This lack of well-developed usewear is often noted as characteristic of hunting tools (Fischer et al. 1984; Kay 1996; Lombard 2005b). A macrofracture analysis of all the backed tools and fragments (n = 132) from the HP at Sibudu Cave, including the segments analysed for micro-residues, shows that 24% has fractures that can be considered diagnostic of impact/hunting use (Fischer et al. 1984; Lombard 2005c, 2006c).

Thus, if we take the accompanying usewear and macrofracture evidence into account that could be considered characteristic for hunting tools (also see

Lombard 2005b), 63.5% of the segments in the youngest HP layers, GR and GR2 were probably used as inserts in hunting tools. Micro-residues indicate that 90% of the tools in older HP layers GS and GS2, were used to process animal material. I could not detect any evidence on these segments for plant processing or multifunctional use on plant and animal materials. One tool showed evidence for being used, but I was unable to determine the processed material, and 85% could have functioned as inserts for hunting tools on the grounds of cumulative use-trace evidence (Table 2). Of the 20 segments from the oldest HP layer, PGS, 90% show evidence for processing animal material, while none show clear indications for the exclusive processing of plant material. One tool from PGS could have been used to process both plant and animal materials. From this layer 75% of the tools could have been used as inserts in hunting tools on the grounds of cumulative use-trace evidence (Table 2). When micro-residue, usewear and macrofracture evidence is combined, we have good reason to assume that the main intention for the production of HP segments was to insert them into composite hunting tools. Of course, this interpretation cannot be extended to all backed tool types from the HP until focused research has been conducted on them.

#### *Hafting positions*

Previously, I have suggested that HP backed tools were probably used as interchangeable pieces, such as tips, barbs or cutting inserts in composite hunting weapons (Lombard 2006c). This suggestion was based on the results of macrofracture analyses on backed tools from three HP assemblages – Sibudu Cave, Umhlatuzana Rock Shelter and Klasies River Cave 2 – and the comparison of these results to those from other archaeological assemblages and from replicated tools. The micro-residue analysis of the unwashed segments from Sibudu Cave confirms the possibility of variation in hafting configurations, but it is not possible to distinguish between some of the suggested hafting positions. For example, if the segments were hafted transversely (Fig. 9), as pairs to form a point consisting of multiple stone inserts (Fig. 10), or longitudinally as single or multiple cutting inserts (Fig. 11), the distribution patterns of adhesive residues would be similar – along the backed portions of the segments. However, if some

segments were hafted diagonally, as barbed tips or diagonal barbed cutting inserts (Fig. 12), residues associated with hafting might be concentrated on the medial backed portion and on either the upper or lower backed portions with some spill-over associated residues on the corresponding bladed portions.

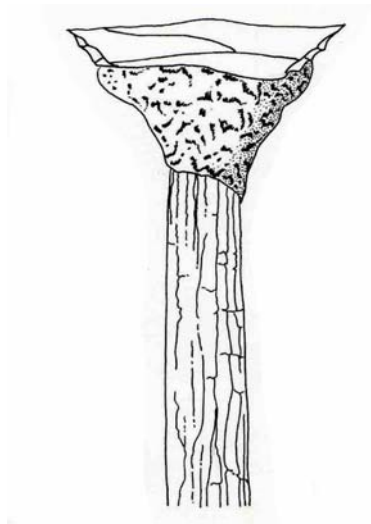


Figure 9. Hypothetical reconstruction of a transversely hafted segment after Nuzhnyj (2000).

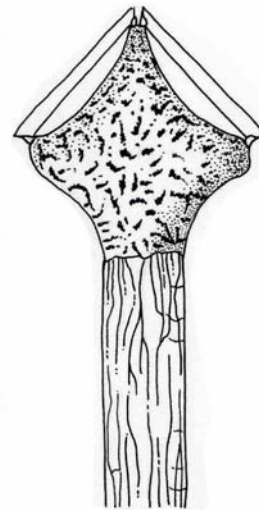


Figure 10. Hypothetical reconstruction of segments hafted as pairs to form a point after Nuzhnyj (2000).

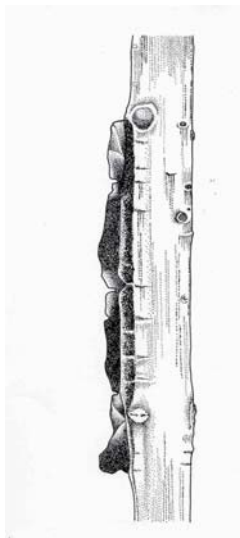


Figure 11. Hypothetical reconstruction of backed tools hafted longitudinally as cutting inserts after Clark and Prince (1978).

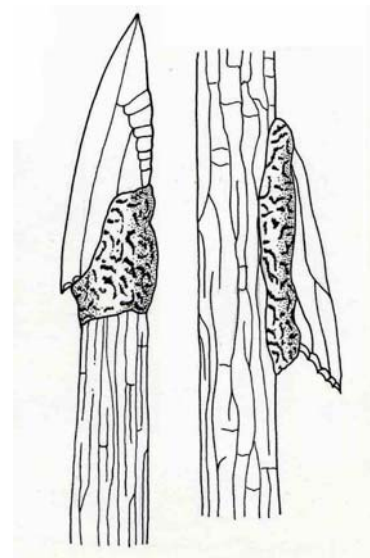


Figure 12. Hypothetical reconstruction of segments hafted diagonally as barbed tips or barbed cutting inserts after Nuzhnyj (2000).

Table 2 presents my interpretation for the hafting positions of the segments according to their stratigraphic layers. This interpretation is based on the micro-residue distribution patterns and in some cases, usewear traces such as polish, edge rounding, edge damage and the direction of striations on the tools. 45.5% of the GR and GR2 segments, show signs of longitudinal, transverse or pair hafting, and 45.5% could have been hafted diagonally (9% were possibly not hafted). GS and GS2 have more segments that were probably hafted diagonally (50%), than segments that were hafted in other configurations (25%). For one tool that was probably hafted I could not establish its hafting position. Segments from PGS were mostly hafted in longitudinal, transverse or paired configurations (50%), with 30% of the tools showing evidence for diagonal hafting. For two tools from PGS I was unable to establish their hafting positions. Thus, not only does there seem to be variability in haft materials over time at Sibudu, but also in preferred hafting configurations. The size ranges and/or morphology of the segments might have influenced their hafting positions. When the data from morphometric and technological studies, currently being conducted on the same sample by co-researchers, become available we might be able to assess if differences in production and morphology also indicate chronological variability, and whether segments of different size and morphology could have been hafted differently.

#### *The possibility of bone hafting and other explanations*

Mineralogical studies conducted on soil samples from Sibudu Cave show that microscopic bone particles, in various stages of degradation and burning, are common in the sediments (Schiegl et al. 2004) and that fat is also present (Schiegl pers. comm.). Fourier transform infrared spectroscopy (FTIR), transmitted polarising light, scanning electron microscopy (SEM-EDAX techniques) and phytolith analyses all show minor degrees of diagenesis of the Sibudu Cave sediments. This is further demonstrated in the rarity of authigenic phosphate minerals and the occurrence of gypsum and calcite. Little loss of bone due to dissolution can be expected in such a sedimentary milieu (Schiegl & Conard 2006). Thus, bone is remarkably well preserved at Sibudu Cave, especially in the



older layers, such as GR and below, where the deposits are enriched with calcite and where gypsum is almost absent (Wadley 2006b).

Although there is relatively less charcoal present in the lower layers, such as the HP, the preservation of internal structures of the charcoal is good, and there simply seem to be fewer hearths in the HP than in the younger layers (Allott 2006). However, the preservation of charcoal might not be an ideal indicator for the preservation of plant material in general. One possible explanation for the decreasing evidence for wood hafting or plant processing could thus be that plant material was preserved less well in the lower HP layers than in the upper HP layers. Table 3 shows a micro-residue count according to the stratigraphy demonstrating that there is not much difference in the numbers of or percentages of plant residues, and therefore probably in the preservation of plant micro-residues. In fact, PGS has the highest over all percentage (42%) of plant residue occurrences on its tools (mostly resin). Yet, most plant *tissue* residues (86%) and *woody* residues (66%) occur on tools from the GR layers. Plant tissue occurs markedly less on tools from the GS layers (10%) and PGS (4%), while woody residues seem to show a more gradual decline, with 24.5% for GS and GS2 and 9.5% for PGS. This is in line with the interpretation that segments from the upper HP layers were probably hafted to wooden hafts, segments from the GS layers possibly to both wood and bone hafts, and those from the PGS layers mostly to bone hafts.

Table 3. Plant residues according to layer

Residue type	GR and GR2 (n = 11)		GS and GS2 (n = 20)		PGS (n = 20)		Total
	n	%	n	%	n	%	
Plant tissue	43	86	5	10	2	4	50
Plant fibres	10	40	3	12	12	48	25
Starch res/grains	10	13	16	21	50	56	76
Woody residues	59	66	22	24.5	8	9.5	89
Resin	127	23	162	29.5	262	47.5	551
<b>Total</b>	<b>249</b>	<b>31.5</b>	<b>208</b>	<b>26</b>	<b>334</b>	<b>42</b>	<b>791</b>

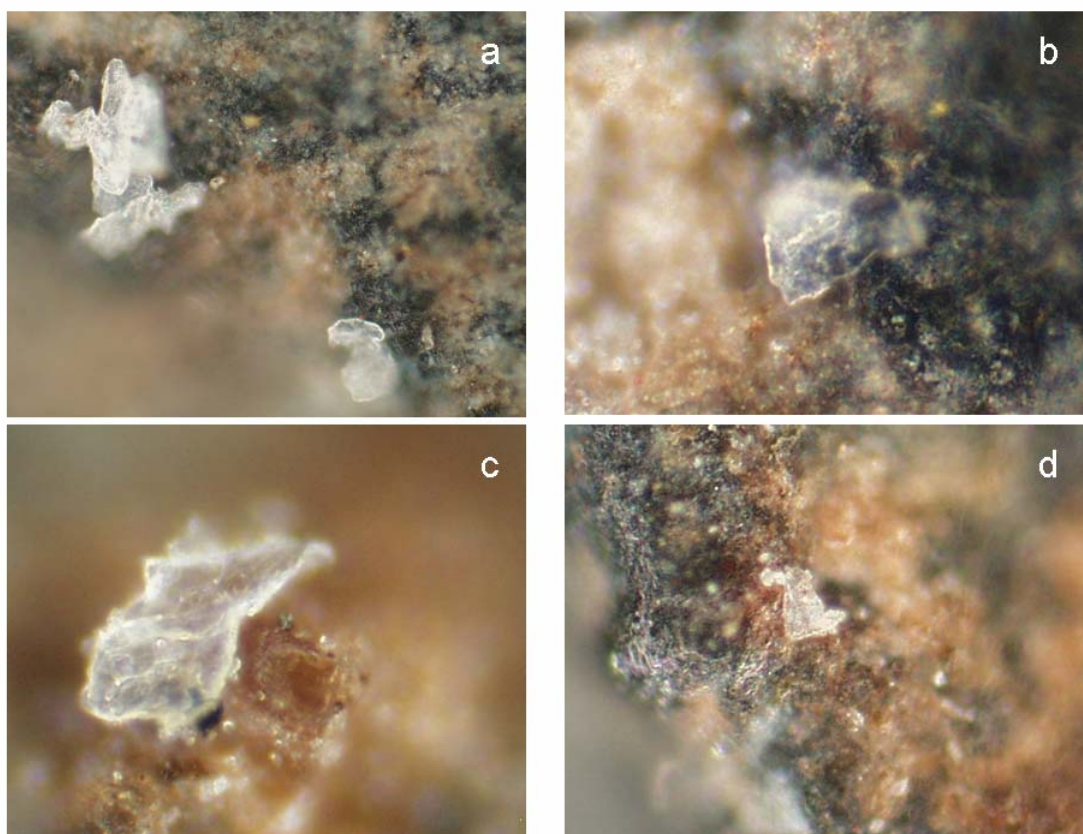


Figure 13. Bone residues superimposed on resinous residues on the backed portions of four different Howiesons Poort segments from Sibudu Cave (illustrations are available in colour in the electronic version of this publication), a) photographed at 100x enlargement, b) photographed at 200x enlargement, c) photographed at 500x enlargement, d) photographed at 200x enlargement.

It could be argued that the distribution patterns of bone and fatty residues might indicate the use of bone tools to blunt the backs of the segments. The layering of residues provides some clues to counter this argument. Microscopic bone flakes were mostly observed on top of the ochre/resin residues (Fig. 13). This layered pattern indicates that the adhesive was in-between the stone artefact and the bone. It also shows that the bone was not deposited before the adhesive was applied, which would have been the case if bone tools were used to shape the segments. Then again, it could be argued that this layering pattern could indicate that the bone flakes were deposited onto the tools as a result of post-depositional contact with bone particles in the soil. As discussed earlier, bone particles are indeed common in the soil composition of Sibudu Cave. However, most bone ‘crumbs’ in the soil are smaller than those on the tools interpreted as use or hafting related.

They are also often burnt and degraded with rounded edges, the latter probably resulting from with the sand in which it was deposited. In contrast, the bone residues on the tools, interpreted as implying use or hafting, have a ‘fresh’ appearance with sharp, angular edges, are un-burnt, and compare well with modern bone residues on replicated stone tools used to process bone (Fig. 14).

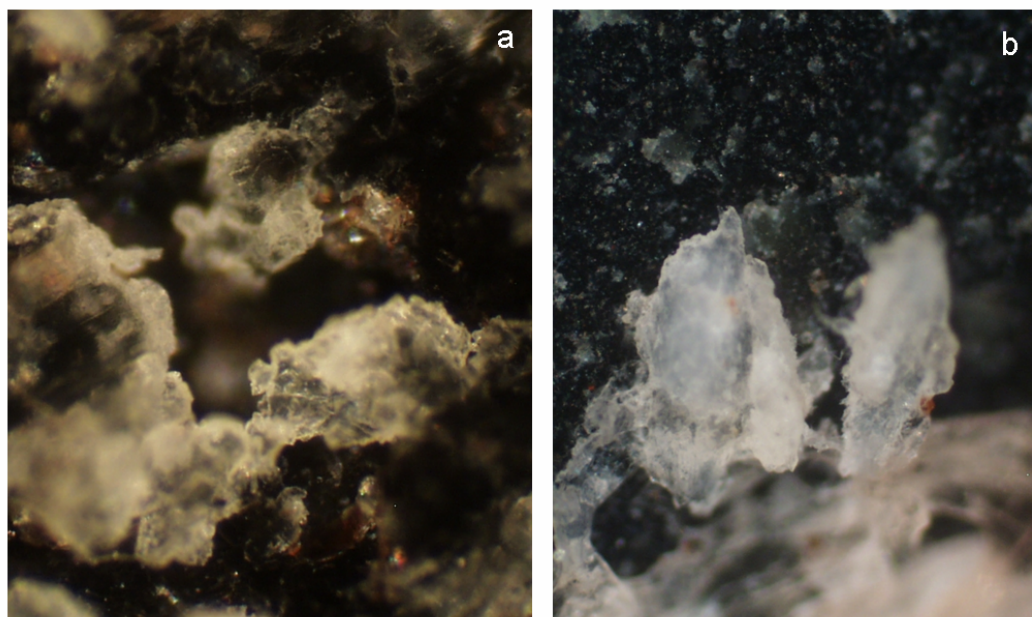


Figure 14. Modern bone residues on replicated stone tools used to process bone (illustrations are available in colour in the electronic version of this publication), a) photographed at 200x enlargement, b) photographed at 200x enlargement.

I do not suggest that the data and arguments presented here for bone hafting during the HP, more than 60 ka ago, are conclusive. But, I do propose that there is a distinct possibility for bone hafting during at least part of this industry. This possibility could stimulate future exploration into the hafting positions of HP segments, or how we envision the hafted tools that HP segments were part of. From the bone point fragments recovered from an HP layer at Sibudu Cave we already know that bone was worked at the site during this period. Future inspection of the fragmented HP bone material from Sibudu Cave, or other Middle Stone Age sites with HP tools and good organic preservation, might provide further evidence for bone being used as a raw material for shaped tools, or for hafts for stone tools.

## Discussion and conclusion

In summary, the results of the micro-residue study on segments from Sibudu Cave indicate that:

- Most segments were hafted.
- There might have been variability in haft materials over time; the oldest segments could have been hafted to bone and the youngest ones to wood.
- Segments were probably hafted in different positions in their hafts, and there might have been differences in preferred hafting configurations during different phases of the HP at Sibudu Cave.
- Segments were mostly used throughout the HP sequence to process animal material.
- There are strong indications that segments were used mainly as inserts (tips, barbs or cutting inserts) for composite hunting tools.
- There is little evidence for HP segments from Sibudu Cave having been used regularly as cutting or scraping instruments.
- Residue distribution patterns cannot be used to distinguish between segments that were hafted longitudinally, transversely or as pairs, because micro-residues might accumulate similarly as a result of all or any these hafting configurations.

Preliminary impressions of the HP faunal material indicate a wide range of species, with the little blue duiker well represented. Wadley (2006b) suggests that such tiny forest dwellers could have been trapped rather than hunted with spears or even arrows. If we accept the interpretation for the principal hunting function of segments and Wadley's suggestion for the use of traps as reflecting real scenarios for meat procurement, it implies that people used highly variable and specialised hunting technologies more than 60 ka ago. While previous research of the post-HP lithic and faunal assemblages at the site indicated skilful and effective hunting for the period since 60 ka ago (Lombard 2005b; Plug 2004), we now have some evidence for such behaviour prior to that. The faunal analysis, once completed, will no doubt help to assess these interpretations, and could provide further information on possible variation in hunting strategies.

The HP of South Africa represents a relative short period in the Middle Stone Age sequence. With the results of new dating techniques its parameters are consistently being narrowed down. Currently the approximate age range lies between 55 and 65 ka (Feathers 2002; Rigaud et al. in press; Tribolo et al. 2006; Valladas et al. 2005; Vogel 2001), with variations of slightly older or slightly younger HP assemblages at some sites (Rigaud et al. in press; Valladas et al. 2005). Almost two decades ago Wadley and Harper (1989) predicted that the HP might contain a developmental sequence comprising two or three phases at Rose Cottage Cave based on their re-analysis of Malan's collection. This suggestion was recently confirmed with a technological analysis on material excavated more recently by Wadley (1991; 1996; 1997). Soriano et al. (in press) distinguished between three HP phases at Rose Cottage Cave, and they conclude that the sequence indicates a slow, gradual abandonment of the technological style of the HP and the adoption of a post-HP technology that is somewhat similar to that of the European Middle Palaeolithic.

While the detailed interpretations for function and hafting provided here remain promising explanations for the data, the micro-residue analysis on the HP assemblage from Sibudu Cave supports change over time within the HP. Future technological and morphometric analyses on the same sample will add to this data and serve as crosschecks for the interpretations based on the use-trace analyses. Considering previous perceptions of an invariable, slow changing Middle Stone Age in southern Africa, it is noteworthy that we are now able to provide evidence to the contrary. If we accept that people in southern Africa behaved in a modern way at least since about 75 ka ago (Henshilwood & d'Errico 2005), we ought to expect that evidence for variability, change and complexity in their behaviours will become increasingly evident in the archaeological record. It is understood that evidence for the presence of these characteristics (variability, change and complexity) do not provide conclusive evidence for 'fully symbolic sapiens behaviour' (Henshilwood & d'Errico 2005), but their discernible traces in the MSA record of South Africa assist in doing away with the previous notions of simple, unchanging technologies and subsistence patterns.

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