



## The Still Bay points of Blombos Cave (South Africa)

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### ABSTRACT

We present the results of a technological and morphometric analysis of all the Still Bay points ( $n = 371$ ) recovered from the 1993 to 2004 excavations at Blombos Cave. We have been able to reconstruct the manufacturing sequence of the bifacial points from initial shaping, by direct internal percussion, to finished morphology, by direct marginal percussion. Identifications of impact fractures and manufacturing breaks are based on comparisons with experimental and archaeological bifacial points of verified function, i.e. Paleoindian points from bison kill sites, replicates of Solutrean points mounted as spear-heads or arrow-heads and shot into adult cattle, and experimental replication on local raw materials. Our analysis shows that: (a) only a minority of the points are finished forms, and that a large number of pieces are production failures, a situation known at bifacial point production sites of later ages; (b) morphometric and impact scar analyses should take into account this process and distinguish finished points from preforms and unfinished points; (c) there were at least three different kinds of raw material sources and that there is a marked increase in the frequencies of silcrete with respect to the M2 and M3 phases at Blombos; (d) three kinds of evidence prove that some of the points were hafted axially and used as spear tips; (e) production of bifacial points was a primary activity at the site but the hypothesis of intergroup exchange of Still Bay points cannot be sustained on the basis of present evidence; and (f) the Still Bay phase appears to initiate a trend to relatively rapid changes in specialized hunting weaponry and that this innovation is congruent with other innovations such as bone tools, shell beads and engraved ochre of the M1 and M2 phases at Blombos.

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### 1. Introduction

The late Middle Stone Age of South Africa between 77 and 35 ka contains three technocomplexes known as the Still Bay, the Howiesons Poort and the post-Howiesons Poort. These lithic phases have a wide distribution, are in stratigraphic succession (two sites, Diepkloof and Sibudu, include all three phases; Rigaud et al., 2006; Tribolo et al., 2005; Wadley, 2007; Porraz et al., in press) and are characterized by quite different hunting weapons and technologies. The Still Bay has foliate bifacial points made on flakes or blocks (Henshilwood et al., 2001a), the Howiesons Poort (HP) has a technology characterized by the production of small blades retouched into segments and other backed pieces (Delagnes et al., 2006; Singer and Wymer, 1982; Soriano et al., 2007; Wurz,

2000, 2002) and the post-Howiesons Poort has mainly unifacial points on flakes, similar to Mousterian points (Villa et al., 2005; Villa and Lenoir, 2006). Formal bone tools, including awls and bone points, that appear in the M1 and M2 phases of Blombos and in the HP technocomplex at Klasies River Mouth and at Sibudu, accompanied by symbolic novelties like shell beads, engraved ochre and incised ostrich eggshells (Henshilwood et al., 2001a,b, 2002, 2004; D'Errico et al., 2005; Parkington et al., 2005; D'Errico and Henshilwood, 2007; Backwell et al., 2008) are clear examples of a tendency to develop new functional ideas, techniques or devices.

To what extent these MSA assemblage changes and precocious innovations were influenced by parallel changes in climate, prey availability, plant food cover, hunting tactics or social practices is, at present, difficult to say. We do not really understand why some newly invented tools, like the bone points which occur in small numbers at a few sites (D'Errico and Henshilwood, 2007; Backwell et al., 2008) were not widely adopted while lithic novelties like the high frequencies of backed tools in the HP assemblages and the associated manufacture of small blades by the marginal percussion

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technique were adopted on a large scale and became, for some millennia, part of the established knowledge for the production of desired tools (Soriano et al., 2007).

Analyses of lithic technologies are needed because they can provide insights into MSA variability and document the degree of continuity and discontinuity in diachronic sequences of stone tools. We present here a technological analysis of the Still Bay points from Blombos Cave, focusing on their manufacture and intended use. Detailed analysis of the Still Bay core and debitage technology is planned. The M1 phase has yielded very large quantities of lithic materials, in the order of 15,000–18,000 pieces, in part byproducts of bifacial point manufacture; debitage analysis will be integrated with an understanding of the point production sequence.

## 2. The sample

Our sample consists of 352 points and point fragments from 1993 to 2004 excavation. We have excluded from analysis 30 items:

- 10 bifaces which do not have the typical Still Bay morphology (i.e. they are not pointed or have a very thick, broad base, see below);
- 7 unifacial points;
- 13 broken specimens originally identified as unfinished point fragments; these are in fact irregular debris or broken flakes which do not fit into the manufacturing phases of Still Bay points (see Section 5).

Twenty-two other specimens had been set aside for residue analysis by Marlize Lombard. Of these only 19 have the typical Still Bay morphology (one is a convergent scraper and the two others are thick bifaces). Analytical data for these 19 pieces are incomplete because the specimens may not be handled out of their storage bags and could not be fully observed. If we include the 19 specimens for residue analysis, the total number of specimens in our database is 371. However, with the exception of raw material counts and counts of square and layer provenience, all other diagrams are based on the sample of 352 pieces.

Two other sites in the Cape region have provided Still Bay assemblages in stratified context: Diepkloof and Hollow Rock Shelter (Rigaud et al., 2006; Porraz et al., in press; Evans, 1994; Minichillo, 2005). Both assemblages are under current investigations by other researchers; technological analysis of the small Still Bay assemblage from Sibudu (Kwa-Zulu Natal; Wadley, 2007) is in progress by one of us (PV) in collaboration with S. Soriano. The Blombos series is at present the richest sample of bifacial points and their manufacture debris available from a well-stratified and well-dated context.

The typical Still Bay morphology is characterized by a pointed or elliptical base with curved sides or a narrow straight end (Fig. 1a, c) and a V-shaped point with straight or curved sides (Fig. 1b, f). The point of maximum width is located at some distance from the base, between one-fifth and one-half of the total length. The maximum thickness is also in the proximal half of the piece but generally at some distance from the base. They differ from the bifacial teardrop-shape points with rounded bases and the triangular “hollow-based” bifacial points of the post-Howiesons Poort layers of Sibudu, layers MOD to Co dated about 50 to 37 ka (Wadley, 2005; Villa and Lenoir, 2006). The post-Howiesons Poort bifacial points are less elongated than the Still Bay points and the hollow-based points have a much wider and concave base.

Three hundred and fifty points were recovered in the M1 phase; 21 come from the top levels of the M2 phase (Fig. 2a). The points come from 66.5 quadrates (50 × 50 cm units) including 8 outside the drip line (Fig. 2b). We have not followed the subdivision of the M1 phase into 1a and 1b used by Henshilwood et al. (2001a) for this

analysis but we believe that a future study of the variation among bifacial points from different layers at the site would be informative.

Based on OSL dates (Jacobs et al., 2006) the temporal range of Still Bay points at Blombos covers the interval between 77 ka (layer CFB/CFC of the M2 phase is dated to  $76.8 \pm 3.1$ ) and ca. 70 ka (date for the sterile dune overlying the M1 deposits). Burnt lithics of the M1 phase have yielded a mean age of  $74 \pm 5$  ka, in good agreement with the OSL dates (Tribolo et al., 2006).

Preliminary analysis of lithics from layer CC, a main M1 subunit, from 1998 to 2000 excavations, suggests that a large proportion of debitage is the byproduct of bifacial point manufacture; retouched pieces other than points may have been introduced into the site ready made or as blanks since there are too few cores (1.2%, that is 6 cores on a total of 500 flakes > 2 cm) from which their blanks could have been obtained, and too few cortical flakes (Soressi, 2005). Table 1 shows that finished points are 38.6% of all formal tools and informally retouched flakes.

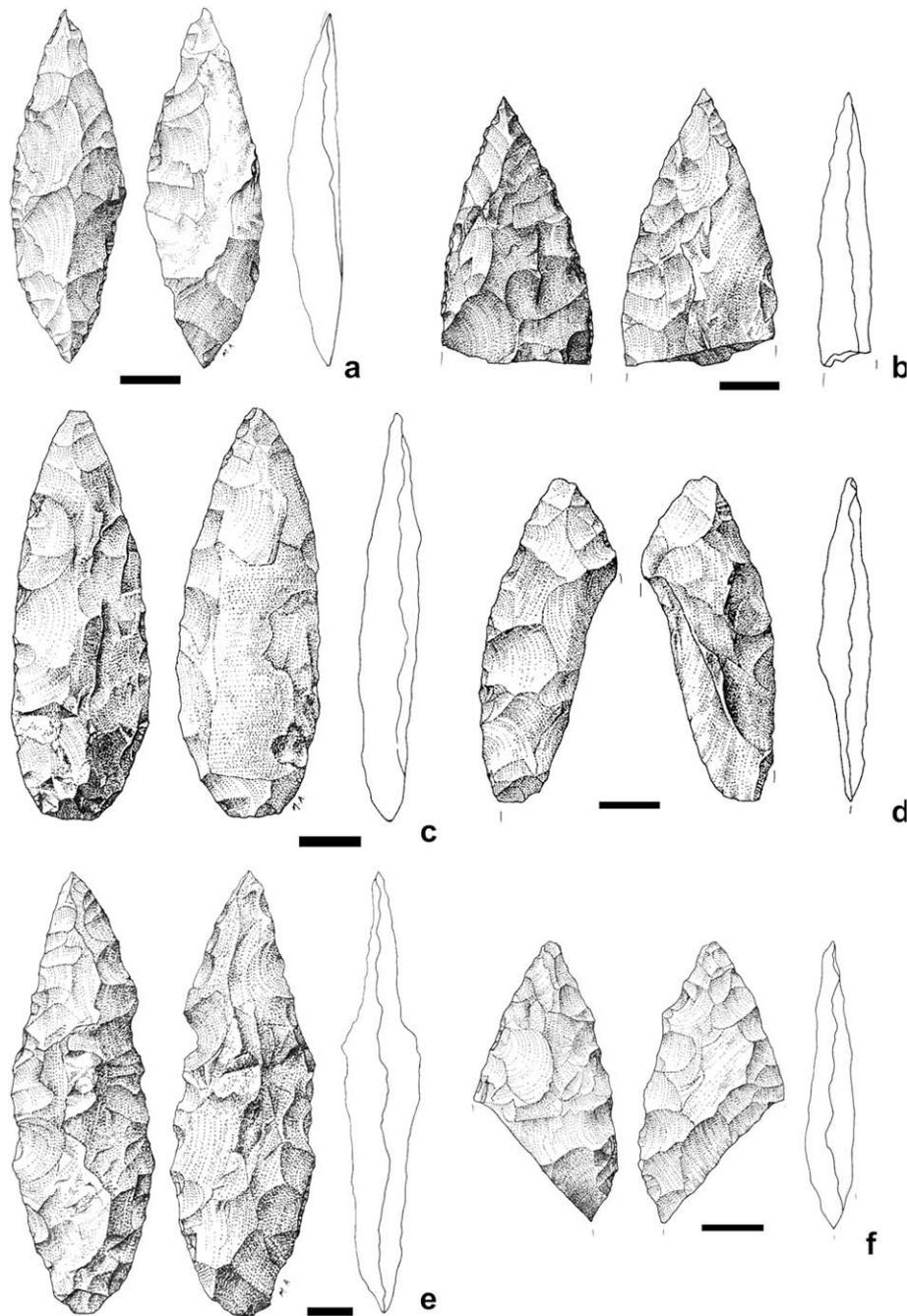
## 3. Raw material

Silcrete, a soil duricrust consisting of clasts of variable size cemented into a hard mass by silica, is the raw material of choice for points. The fabric of silcrete is variable since it contains a detrital component and secondary silica. From a stoneknapper's viewpoint silcrete can be described as occurring in different varieties ranging from a fine-grained rock with microcrystalline matrix and almost no visible grains to a medium and coarse-grained variety. Table 2 shows that quartzite, quartz and, in one case, a cryptocrystalline siliceous stone were also used.

Fine-grained silcrete is slightly predominant (53.0%) over the coarse-grained variety (47.0%). The colors range from red, reddish grey and yellowish red (55.4%, i.e. 144 of 260) to grey, yellow and brown (44.2%, i.e. 115 of 260). Fine-grained green silcrete is rare; one point and some flakes in layers CA and CB are made of this variety.

It has been recently suggested that silcrete in its raw form is difficult to knap and that heat treatment was used on the southern Cape silcrete to improve its flaking qualities; the Still Bay bifaces would otherwise be difficult to knap (Brown et al., 2008). Heat treatment changes the mechanical properties of stone materials and experiments have demonstrated a well-defined reduction in fracture toughness in silcrete. Accompanying visual changes would be to change the color from yellow/brown to red, although color changes may not occur if iron oxides are not present, and a greasy luster visible on the part retouched after thermal treatment in contrast to the non-lustrous appearance of the non-heated surface (Domanski and Webb, 1992; Domanski et al., 1994; Domanski and Webb, 2007; Inizan and Tixier, 2001). Variable quantities of iron commonly occur in South Africa silcreted (Roberts, 2003) so color changes might be expected. Since a large proportion of the Blombos finished points made on silcrete is either light grey or yellow, without any reddish hue, it is possible that heat treatment was not applied or was not systematically applied. Color changes, however, are an uncertain indicator; luster is a better recognition criterion and a systematic search on points and associated debitage is planned. However, according to Australian geologists (Doelman et al., 2001; Webb and Domanski, 2008) the fabric and mechanical properties of silcrete have a strong effect on artifact manufacture; microcrystalline silcrete and some fine-grained silcrete are suitable for blade production and fine retouch. Still Bay points have been replicated in fine silcrete using a soft stone hammer, without heat treatment (Porraz et al., in press; Texier et al., 2008).

The sources of silcrete are not well known. About 10.2% of the pieces (38 of 371) have residual cortex. This cortex appears in three varieties: fresh (i.e. unrolled and unaltered), rolled (from water-



**Fig. 1.** Drawings of Still Bay points from Blombos; the production sequence, which includes phases 1 to 4, is described in the text. Catalogue numbers preceded by a P or a T are those assigned by MS; numbers with PV or PVN have been assigned by PV. Three pieces, kept in a showcase at the Iziko Museum, are listed as Museum 1–3. (a) Double-pointed phase 4 point, fine silcrete (P 71, layer CD); the point was modified after phase 3 by two notches near the tip by hard hammer percussion. (b) Phase 3 broken point of fine silcrete (P 68, layer CD); the manufacturing break is a lateral snap with a lip. (c) Phase 3 point with a narrow straight base of coarse silcrete (PVN 7, layer CD). (d) Lateral-distal fragment of an almost finished point of coarse silcrete with a perverse fracture; this knapping accident occurred during phase 3 (P 67, layer CD). (e) Phase 2a point of fine silcrete, with areas of cortex in the center part (P 70, layer CD). It was abandoned probably because many flake scars are too deep and irregular to be corrected. (f) Phase 3 of fine silcrete (P 42, layer CB), the break is an oblique lateral snap with a curved profile. Scale bars = 1 cm. Drawings by Marycel Albertyn.

worn pebbles) and a weathered, apparently chemically altered, cortex (Fig. 3:1–5). Thus it seems that procurement of these raw materials was from similar sources, one being primary deposits and a second one being beach or river gravels; weathered and silcreted alluvial or colluvial deposits are mapped as being approximately 30 km north of Blombos in the Riversdale region (Roberts, 2003). Note that during the Still Bay occupation (MIS 5a) the mean sea level was similar to the present (Butzer, 2004; Ramsay and Cooper, 2002) and close to the cave; two rivers traversing the inland silcrete deposits exit into the ocean about 20 km east and

west of Blombos. Despite various searches over the past 10 years, silcrete cobbles have never been found on the beach or in the vicinity of the cave or at the mouths of the two rivers mentioned above. This suggests that silcrete may have been collected from river valleys and transported 20–30 km to the cave. Quartz and quartzite cobbles occur near the cave (Henshilwood et al., 2001a).

At other MSA sites, such as Sibudu and Rose Cottage, the raw materials also seems to have been collected locally or transported over short distances ( $\leq 20$  km; Villa et al., 2005; Soriano et al., 2007). This evidence and the very high frequencies of

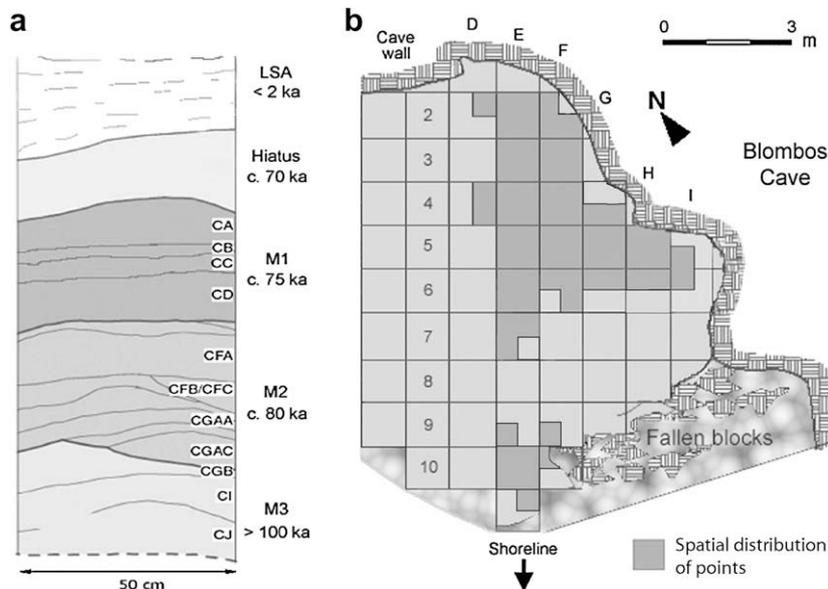


Fig. 2. (a) Stratigraphy of Blombos Cave in square H6 and OSL ages, based on Jacobs et al. (2006); (b) distribution map of Still Bay points and point fragments.

manufacturing breaks on the Still Bay points (see below) run counter to the idea that the making of Still Bay bifacial points was a response to the need to conserve lithic raw material and to patterns of movement away from raw material sources (McCall, 2007).

There is a very marked increase in silcrete use compared to the previous M2 phase: 72% of the Still Bay points are made of silcrete while silcrete frequencies in the M2 and M3 phases are negligible in comparison (18.2% and 24.3, respectively, for the retouched pieces; Henshilwood et al., 2001a).

#### 4. Analytical procedures

Our analysis includes the following: reconstruction of the manufacture sequence, analysis of breakage, morphometric analysis and analysis of impact fractures. Identification of impact fractures and manufacturing breaks is based on comparisons with experimental and archaeological bifacial points of verified function. There is an extensive literature on Paleoindian bifacial points, including morphometric features, functional technology and impact fractures. Particularly useful in this respect are studies of points from bison kill sites where the context provides unambiguous information on point use and damage. One of us (PV) has been able to study 160 points from bison kill sites such as Casper in Wyoming, the Frazier and Dent sites in Colorado and from kill and residential sites such as Jurgens, Claypool, Hell Gap and Horner II sites also in Colorado and Wyoming (Figgins, 1933; Frison, 1974; Frison and Todd, 1987; Slessman, 2004; Wheat, 1979; Muniz, 2005;

**Table 1**  
Counts of points and other tools in layer CC.

Type	N
Finished points (phase 3 and 4, complete and broken)	27
Points in earlier stages of manufacture	40
Circular scrapers	11
Side, transverse and other scrapers	10
Denticulates	3
Retouched, utilized flakes	16
Tool fragments	3

Frequencies of raw materials for tools other than points are: silcrete 69.8%, quartzite 18.6%, quartz 11.6%. These frequencies are almost identical to those of the point assemblage (Table 2).

Larson et al., in press). We do not imply that Paleoindian points are in any way formally homologous to the Blombos points, only that certain aspects of their manufacturing and impact breaks allow us to make reasonable inferences about the Blombos points, using relational analogies as in the case of controlled experiments (Gifford-González, 1991). As we will see, differences can also be enlightening.

Analysis of impact fractures has also been greatly aided by access to the experimental material developed by a group of French technologists, led by Hugues Plisson and Jean-Michel Geneste. The aim of this research group (Geneste and Plisson, 1990; Castel, 2008) was the study of the functional technology of Solutrean points based on replication and use of shouldered and unifacial points, hafted and mounted as darts on spear shafts weighing 202 g and 1.5 m long or as arrowheads on wooden arrows 80 cm long. The flint points were shot in three different ways: with spear throwers similar to the Upper Paleolithic ones, with a calibrated cross-bow with 25 kg of pull or with a long bow made of yew with about 22 kg of force. The bow was a replica of the oldest known bows from Mesolithic and Neolithic European sites. The target of the points shown here was dead adult cows about 450 kg and the weapons were shot from fixed distances (9 m for the bow and 18 m for the cross-bow). The experimental material generated through a number of years includes hundreds of specimens and we have been able to study 55 specimens and document different kinds of impact fractures with microscope photos. Manufacturing breaks were also accidentally produced by one of us (V.M.) in his experimental replication of Still Bay points and testing of local raw materials, using hard and soft (wood) hammers. More experimental replications are needed and are planned to assist in the classification of the whole lithic assemblage.

**Table 2**  
Frequencies of raw materials for Still Bay points and point fragments.

Raw material	n	%
Silcrete	266	71.7
Quartzite	56	15.1
Quartz	48	12.9
Cryptocrystalline silica	1	0.3
Total	371	100

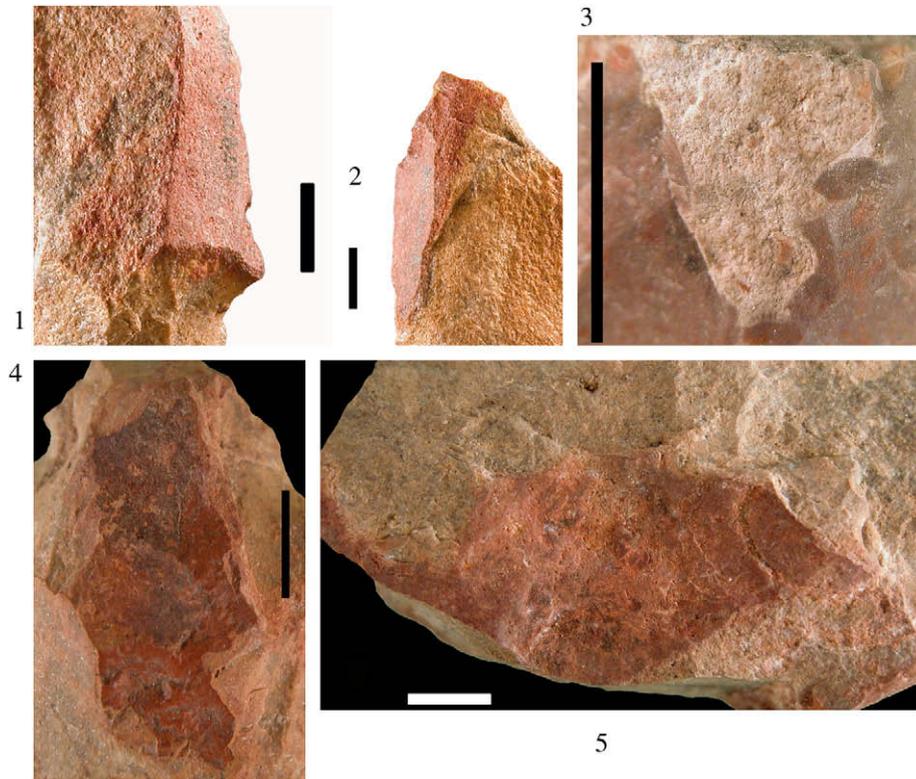


Fig. 3. Different kinds of cortex on silcrete of Still Bay points. (1–2) Rolled cortex. (3) Fresh cortex. (4–5) Weathered, altered cortex on silcrete. Scale bars = 1 cm.

5. Production sequence

The Blombos assemblage contains a large number of points broken and/or abandoned unfinished in various stages of manufacture, allowing us to reconstruct their reduction sequence.

The shaping of the Still Bay points is a progressive process and it is not easy to define clearly distinct, regularly succeeding stages. Some of the characteristics of the finished products are systematically present (bilateral symmetry, regular tip outline and profile), others appear optional (bifacial symmetry, regular base outline and

Table 3

Phases of manufacture. For each attribute the number of observed specimens is less than the total for the phase because specific attributes could not be observed on broken specimens. Seven broken specimens could not be diagnosed at all and the phase is undetermined. A few pieces were diagnosed but not recorded in detail. Bifacial symmetry is in profile view; bilateral symmetry is in outline view. Regular tip or base outline applies to that portion only.

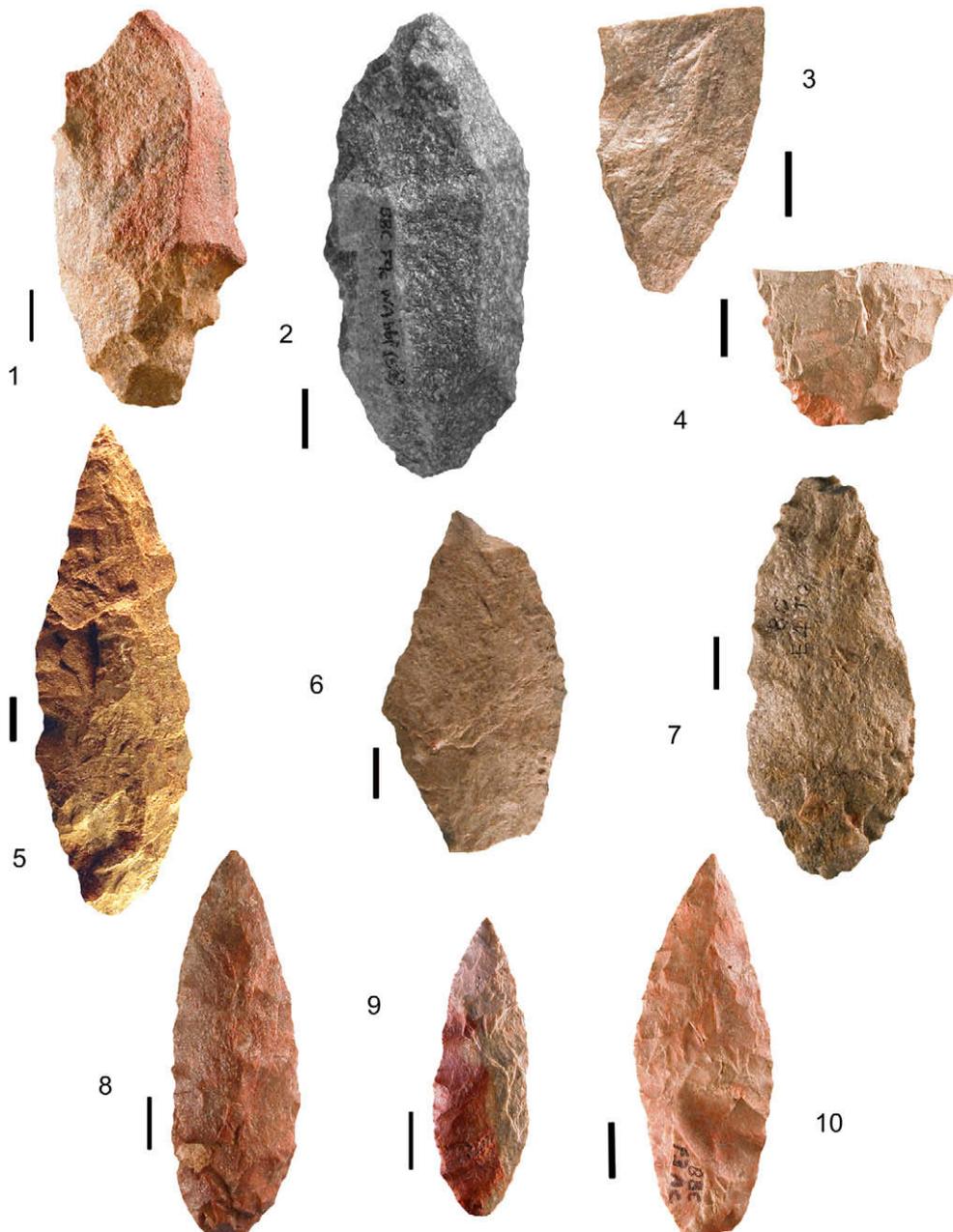
	Phase 1		Phase 2 (N = 57 + 57 + 56 phase 2 indet. = 170)				Phase 3		Phase 4	
	Initial shaping (N = 51)		Phase 2a Advanced shaping (N = 57)		Phase 2b Advanced shaping (N = 57)		Finished product (N = 107)		Recycled, modified (N = 17)	
Product										
Percussion technique	Internal percussion (hard hammer)		Marginal percussion (soft hammer)		Marginal percussion (soft hammer)		Marginal percussion (soft hammer)		Internal percussion (hard hammer)	
	N	%	N	%	N	%	N	%	N	%
1. Cortex on edges	12/39	30.8	3/46	6.5	2/35	5.7	0/42	0	0/14	0
2. Portion of unmodified edge (flake ventral surface or natural surface)	22/39	56.4	11/46	23.9	8/35	22.9	6/42	14.3	3/14	21.4
1 and/or 2 combined	26/39	66.7	13/46	28.3	10/35	28.6	6/42	14.3	3/14	21.4
3. Regular outline of tip	0/25	0	2/23	8.7	1/18	5.6	31/34	91.4	1/12	8.3
4. Regular outline of base	1/28	3.6	1/31	3.2	3/22	13.6	17/20	85.0	5/11	45.5
5. Regular tip profile	1/25	4.0	2/23	8.7	3/18	16.7	30/34	88.2	2/12	16.7
6. Regular base profile	1/28	3.6	1/31	3.2	7/22	31.8	16/20	80.0	7/11	63.6
7. Bifacial symmetry	1/37	2.7	5/46	10.9	10/35	28.6	30/42	71.4	7/14	50.0
8. Bilateral symmetry	3/35	8.6	7/45	15.6	8/35	22.9	41/42	97.6	8/14	57.1

profile; see Table 3 for definitions). They are produced in a mosaic fashion without respecting a clearly established sequence. Thus certain preforms may already show bilateral symmetry while the same may be absent in pieces in an advanced shaping phase. The manufacturing sequence appears to be less regular, less standardized than the reduction stages defined for Folsom and other bifacial Paleoindian points (Frison and Bradley, 1980; Bradley, 1982; Bradley and Frison, 1987). For these reasons we prefer to use the term “phases” which seems less formal than the term “stages”.

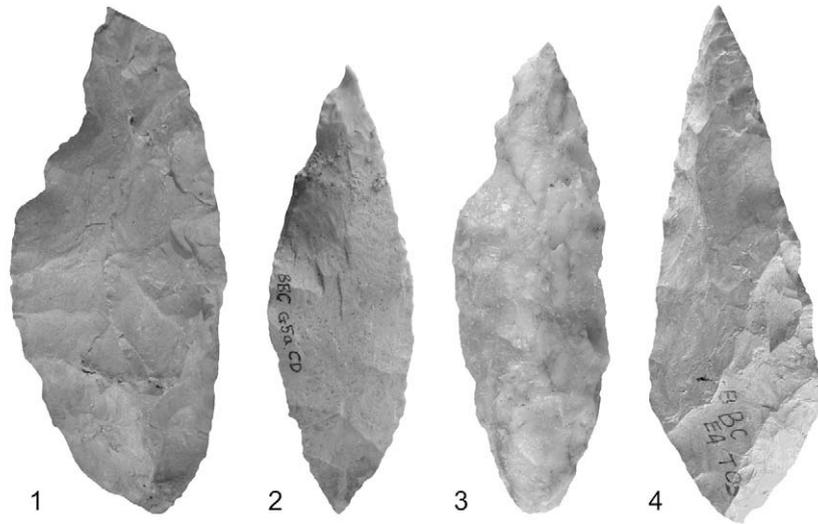
The knapping techniques used by the Blombos artisans can be used to support a basic subdivision of the production sequence. Two kinds of removals can be observed: (1) with concave negative bulbs and a highly localized point of percussion, two features that indicate use of a hard stone hammer striking away from the edge of the piece (internal percussion; for a definition of this term see Soriano et al., 2007); and (2) with shallow negative bulbs and a diffuse contact point indicating a marginal striking motion (marginal percussion)

obtained with a soft (organic or soft stone) hammer in a swinging, tangential motion. Given the absence of cervids and antlers in the African fauna, a soft organic hammer would be made of wood or bone. The second hypothesis is supported by the finds of two bovid long bone shaft fragments with impact scars resulting from knapping. One from a Class III bovid (wildebeest size) in layer CA in the M1 phase bears a few linear impact scars and it may have been used as a retoucher (D’Errico and Henshilwood, 2007). There are, however, very few scars, much fewer than those observed on retouchers of the Lower and Middle Paleolithic in Europe (Villa and d’Errico, 2001). A second metacarpal shaft fragment from a Class IV bovid (eland size) bears many more scars; it comes also from Still Bay layers (Henshilwood et al., 2001b). Experimental work on the local raw materials is needed to check if soft organic (wood or bone) or soft stone hammer was used at Blombos.

Use of pressure flaking for shaping and thinning the points has been suggested in the past (Henshilwood and Sealy, 1997; Deacon



**Fig. 4.** Blombos points in various phases of manufacture, all of silcrete except no.2, of quartzite. (1–2) Phase 1, P 29, rolled cortex on the right side; PVN 95, rolled cortex on the left side. (3–5) Phase 2a, P 45, P 53 and P 70. (6–7) Phase 2b, P 41 and PVN 64. (8–10) Phase 3, PVN 7, P 54 and Museum 3. Scale bars = 1 cm.



**Fig. 5.** Blombos phase 4 points. 1,2 and 4 are of silcrete, 3 is of quartz. 1–3 have notches at the distal end, (PVN 140, P. 71 and PVN 139); 4 has notches on the right side (PVN 68). Scale bars = 1 cm.

and Deacon, 1999). However, we can exclude the use of pressure on the Blombos bifacial points: the scars are too wide, they are not parallel and are delimited by ridges that are too sinuous and irregular to be compatible with this technique (Inizan et al., 1995).

Pieces that retain evidence of the blank from which they were made are few (51 of 352). A portion of the ventral surface of a flake blank is visible in 36 pieces; for 9 other pieces the evidence of a flake blank is less certain while 6 points were made from thin angular blocs. This suggests that often, but not exclusively, large flakes were used as blanks. However, the initial phase of blank manufacture and selection cannot be described solely on the basis of pieces transformed into points, as it needs to be investigated through analysis of the whole lithic assemblage and comparisons with experimental materials. This kind of work is in the planning stages.

We can divide the manufacturing sequence of points in four phases (Table 3, Figs. 4–6):

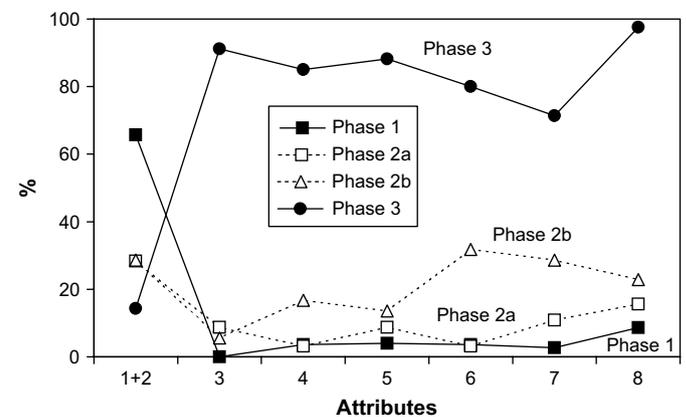
**Phase 1. Initial shaping.** These pieces exhibit deep percussion scars done by hard stone hammer with irregular profiles and irregular margins. They may have some cortex or portion of edges retaining some of the ventral surface of the flake from which they were made. The preliminary flaking sequence is interrupted by knapping breaks or high spots and irregular scars with deep hinge or step termination that cannot be corrected (Fig. 4: 1–2).

**Phase 2. Advanced shaping.** This phase is characterized by the use of the marginal percussion (with a soft or soft stone hammer) which allows the removal of thin, long flakes for thinning the piece over its entire surface. The use of the hard hammer is reserved to removals done for correcting hinge or step terminations, remove protrusions or marginal steep surfaces. We distinguish phase 2a and phase 2b. Phase 2a (Fig. 4: 3–5 and Fig. 1e) has scars produced by hard and soft hammer, some residual cortex on the edges or the base or the center of the piece and mostly irregular outlines and profiles. Phase 2b (Fig. 4: 6–7) has only soft hammer scars. There are fewer cases of residual cortex; bases are more often regular; bilateral and bifacial symmetry are present in about one-fourth of the cases. Accidental breaks are common and 56 pieces were assigned to indeterminate Phase 2.

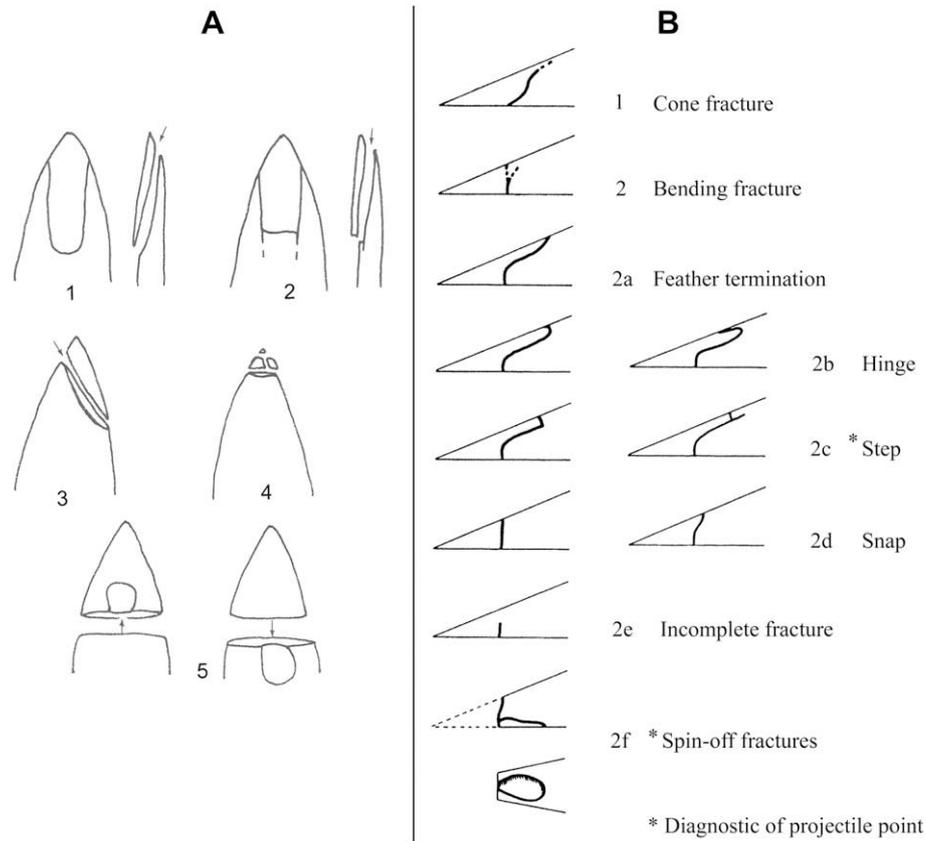
**Phase 3** (Fig. 1b, c, d and f; Fig. 4: 8–10) consists of the finished product with only soft hammer removals. Fine retouch is applied to the edges, especially the tip. The point reaches its final morphology. There is no cortex on the edges and bilateral symmetry is systematic (97.6% of the cases). Bifacial symmetry is slightly less frequent (71.4%) probably due to the use of flakes as blanks.

**Phase 4.** A small number of points show deeper and less carefully spaced hard hammer scars truncating the soft hammer removals, sometimes accompanied by a change in outline form. This reworking, done with a change of technique, is not systematic and there is no unique purpose. Several cases occur. One specimen shows reworking of the distal end and a change in outline suggesting resharpening in the haft (Minichillo, 2005). This is discussed later in the section “Hafting”. Deep notches on the distal end of three points have altered their bifacial and bilateral symmetry (Fig. 1a; Fig. 5: 1–3). Five more specimens seem to belong to this category with notches at the tip and also at the base creating irregular outlines. Two others have notches in the middle section (Fig. 5: 4). In one case the hard hammer may have been an attempt to remove high spots in the center section. In three more cases the purpose is unclear as the piece is broken or no longer pointed.

Fig. 6 shows the frequency distribution of attributes by phase; phase 4 is not included because it includes only a few cases and it represents a change in the purpose of creating a specific morphology. Phases 1 and 3 are at the opposite end of the process; phases 2a and 2b are close to phase 1 and clearly separated from phase 3 when the six major attributes of the points (the regular outline and profile of tip and base, and symmetry of the whole



**Fig. 6.** Frequency distribution of manufacturing phase attributes. The attribute numbers are those of Table 3. 1 + 2 = presence of cortex or portion of unmodified flake ventral surface or natural surface on edges; 3 = regular outline of tip; 4 = regular outline of base; 5 = regular tip profile; 6 = regular base profile; 7 = bifacial symmetry; b = bilateral symmetry.



**Fig. 7.** Classification of macrofractures. (A) Schematic representation of impact scars on Hell Gap points from the Casper site; modified after Frison (1974). (B) Classification of fractures on lithic points, modified after Fischer et al. (1984).

piece in outline and profile view) were achieved by fine percussion flaking; cortex was then completely removed. Morphometric differences between phase 2 and 3 and lack of impact scars on phase 2 points (cf. Sections 8.3 and 8.5 and Table 5) strongly suggest that they cannot be considered functionally equivalent to phase 3 points but were simply a phase in the manufacturing process.

## 6. Breakage and fragment types

About 80% of the Still Bay points are broken. Several types of breakage can be recognized in our sample. Terms used for impact and other kinds of fractures follow work by North American archaeologists (Crabtree, 1972; Frison, 1974; Johnson, 1979; Frison and Bradley, 1980; Bradley, 1982; Bradley and Frison, 1987) and the fracture classification of the Ho Ho Committee (1979); (cf. also Odell and Cowan 1986; Fischer et al., 1984; O'Farrell, 1996). The two main systems of classification of macrofractures, by Frison (1974) and Fischer et al. (1984) are illustrated in Fig. 7. Aside from impact fractures, which will be discussed in a later section, most of the fractures in our sample are snap (bending) fractures and a few cone and perverse fractures. Table 4 shows frequencies of broken pieces by phase of manufacture.

**Cone fractures** occur when force is applied to a limited area and the fractures initiate in the contact area (Fischer et al., 1984). These are most often intentional breaks. Only three cases occur at Blombos on point ends that were deliberately removed during manufacture or for recycling. These are indicated as tip flakes in Table 4.

**Perverse fractures** are spiral or twisting fractures initiated at the point of force along the edge of the piece being flaked (Figs. 1d and 8: 4–5). Perverse fractures indicate manufacturing breaks

(Crabtree, 1972; Johnson, 1979; Frison and Bradley, 1980). On flint the percussion point is visible, although it is often indistinct on quartzite and coarse-grained silcrete. For this reason we have recognized only few perverse fractures at Blombos.

The most common breaks at Blombos are bending fractures. They occur when the force is applied over a rather large area and the break does not initiate at the point of applied force. **Lateral snaps** are transverse bending fractures that can have a straight or curved profile (Fig. 8: 1–3); in cross-section the fracture displays a straight or S-curve face. They are a very common fracture type and

**Table 4**  
Fragment types by phase of manufacture.

Fragment type	Phase 1	Phase 2	Phase 3	Total
Tip	2	40	53	95
Distal	6	11	11	28
Distal-middle	4	10	11	25
Midsection	2	8	3	13
Proximal-middle	1	11	2	14
Base	6	46	8	60
Lateral fragment	2	2	2	6
Tip flake	–	2	1	3
Subtotal	23	130	91	244
Complete or almost complete point	16	18	10	44
Missing the tip only (not by impact)	1	6	4	11
Total	40	154	105	299

Tips are small apical fragments between 0.5 and <3 cm long; distal fragments are  $\geq 3$  cm; midsections are delimited by two fractures proximally and distally; tip flakes are deliberately removed tips with a clear ventral face and a bulb of percussion. Phase 2 includes pieces in Phase 2a, 2b and Phase 2 indeterminate (all broken). Thirty-six fragments could not be attributed to a breakage type or a phase due to incompleteness or limited shaping. Of the 17 pieces of Phase 4, five are broken.

**Table 5**Tip cross-sectional area in mm<sup>2</sup>.

Sites and cultural affiliation	Mean	SD	Min	Max	n	CV
Blombos Still Bay, phase 3 points	99.4	48.5	28.8	190.4	23	48.8
Blombos Still Bay, phase 2b points	148.9	74.9	49.4	344.1	16	50.3
Blombos Still Bay, phase 2a points	195	99.4	99.1	551.9	25	51.0
Blombos Still Bay, phase 1 points	239	84.6	104	410	18	35.4
Sibudu, final MSA (East section, layers Ore to Co), unifacial points.	116.2	41.5	45	200	21	35.7
Sibudu, layers RSP-MOD (North section) unifacial points, late MSA	117.7	57.6	19.5	294	71	48.9
Sibudu, layers below RSP (North section) unifacial points, post-Howiesons Poort	139.4	60	54	320	42	43.0
Murray Springs (Arizona; Clovis)	133.5	36.1	66	179	10	27.0
Folsom type site (New Mexico)	46.9	8.4	35.9	60.5	13	17.9
Casper (Wyoming; Hell Gap)	117	23	68.3	156	36	19.7
Olsen-Chubbuck (Colorado; Cody)	60.6	8.3	51.6	76.5	20	13.7
Jurgens (Colorado; Cody)	61.8	17.3	32.3	97.9	31	28.0
Arrowheads	33	20	8	146	118	60.6
Dart tips	58	18	20	94	40	31.0
Spear tips	168	89	50	392	28	—
Solutrean shouldered points	30.1	—	—	—	931	—

The TCSA is calculated by the formula: 1/2 maximum width x maximum thickness. SD = standard deviation; CV = coefficient of variation. The means of phases 3 and 2b of Blombos Still Bay are significantly different:  $t = 3.67$ ,  $p < 0.001$ ,  $df = 37$ . In all cases the TCSA is calculated on points which are complete or whose break affects only length but not the original width and thickness. For sources of data sets and discussion of previously published TCSA values, see [Supplementary Material](#).

occur often during manufacture but can occur also through use, i.e. impact or by trampling.

Can we distinguish between these different causes? If trampling was the cause of a lateral snap, breakage would be accompanied by other features, such as microfractures of the edges or abrupt pseudoretouches or abraded edges. Their absence on all points suggests that trampling can be excluded in most cases.

Lateral snaps occur also during violent impact. At the Casper site in Wyoming, a single-event Paleoindian bison kill site, many of the projectile points (total = 60) show impact scars on the distal end and transverse breaks on the stem and blade of the tool (Frison, 1974). Frison and Stanford (1982: 80, 106) noted that the base and tip of the Agate Basin projectile points were particularly vulnerable to snap breaks as a consequence of impact and this was confirmed by experiments using thrusting spears. Fig. 8: 1–2 shows three examples of lateral snaps on Agate Basin projectile points from the Frazier site (Colorado), another single-event bison kill site. The fractures are undoubtedly due to impact on the distal end causing breakage in the haft.

Can we separate snaps due to manufacture from snaps due to impact at Blombos? Of 91 broken finished points at Blombos only 10 are bases or proximal plus middle fragments. Most of the broken pieces are tips (Table 4). The Blombos tips could in principle result from impact, rather than manufacture, if we assume that broken tips were brought back to the site inside the killed animal carcass.

However, exactly the same kind of bending fractures occur on finished and unfinished pieces at different phases of manufacture. Tips broken in different phases of production show a majority of lateral snaps, followed by tips with a “languette” (=breaks with a long feather termination; Inizan et al., 1995) and tips with a short feather termination. Thus we believe that most of these tips and base fragments represent production failures and are not the result of violent impact. Intensive retouch is applied to tips during phase 3. Since tips are narrower and thinner than bases, they are more prone to breakage than the thicker and less retouched bases, hence the high frequency of tips compared to bases (Table 4); reshaping of the distal end would often continue after the accident. In a few cases, however, the snap break is accompanied by impact scars at the apex, proving that the point broke on impact.

In sum, the majority of the Blombos points were abandoned because of errors that left them too thick or irregular or because of breaks; this implies that morphometric and macrofracture analyses must distinguish finished from unfinished pieces.

## 7. Production failures

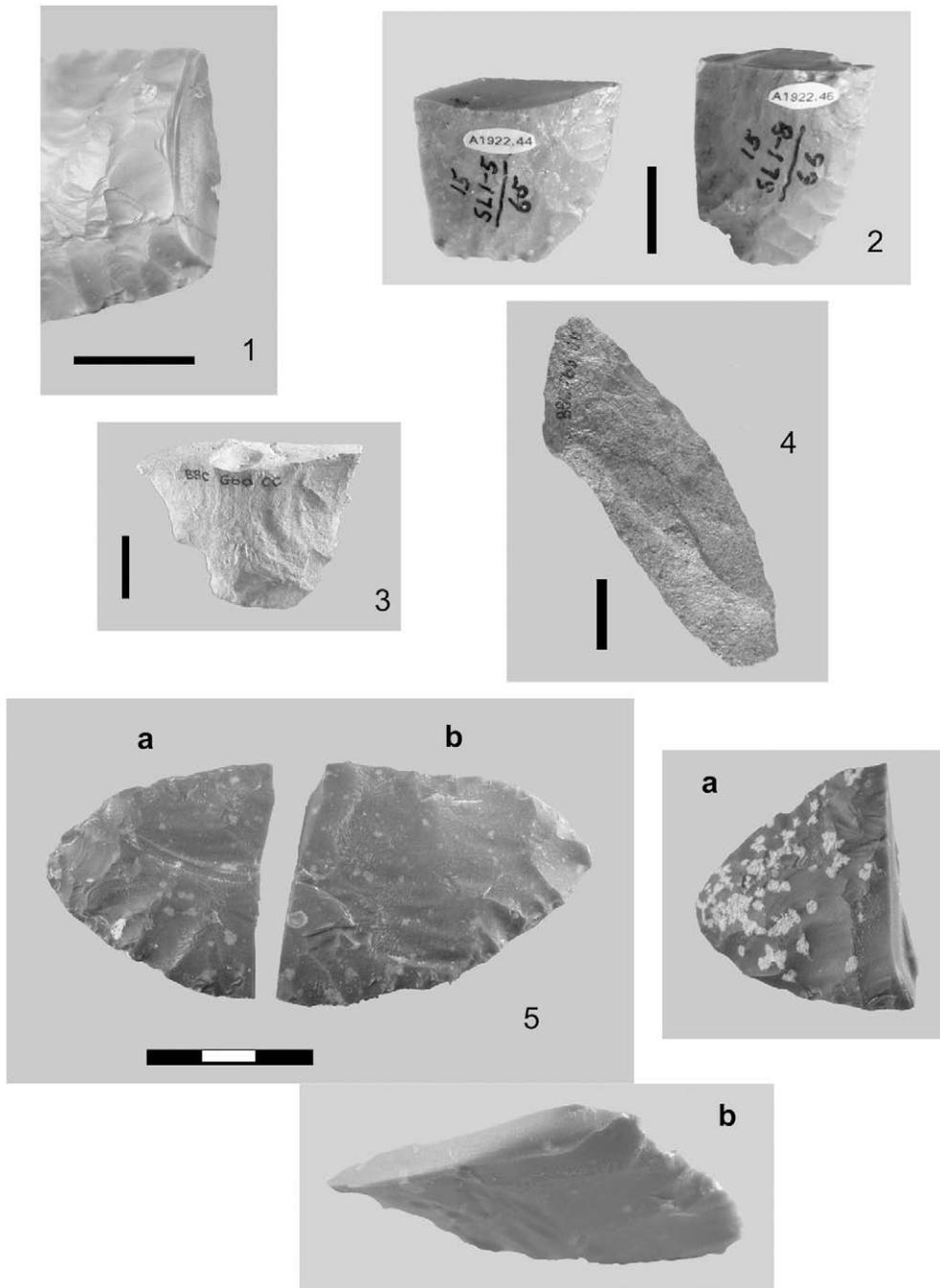
The total number of broken pieces (excluding pieces broken by impact, see below) is 270 of 343, i.e. 79%. Production rejects include all the phase 1 and 2 points whether broken or complete (221 of 345 pieces assigned to a phase). Of the phase 3 and phase 4 points only 23 are complete or have minor damage or breaks (Table 4). Excluding 9 broken points with distal impact or haft fractures due to utilization, most fractures appear to be production failures. The total sum of phase 1, phase 2 and broken specimens of phase 3 and 4 is 308 corresponding to 89.8% of 343 pieces; points broken distally by impact or in the haft are excluded. A high proportion of production failures and broken specimens occur at some bifacial point production sites of later ages (Johnson, 1979; preliminary counts show that of 177 Archaic bifacial stemmed points only 28 were completed). Failure rates of 37% are reported for the final phase of manufacturing of Folsom points (Sellet, 2004). Manufacturing breaks and unfinished pieces are common at the Solutrean site of Maitreaux (Aubry et al., 2008; counts not yet available). The proportion of production rejects and broken specimens at Blombos is higher but still comparable to those occurring at much later sites on easier-to-flake materials used by the skilled Solutrean and Paleoindian stone knappers.

## 8. Hafting, morphometric and impact scar analyses

Analyses of stone points from prehistoric kill sites have shown that the attributes necessary for the proper functioning of a device to kill a large animal are a sharp point to penetrate the hide, and sharp side edges to open a hole for the remainder of the point and shaft (Frison, 1991). Tip design is critical for the penetration of a low velocity weapon (Hughes, 1998). Thus analysis of lithic points, to test the hypothesis that the points were used as parts of hunting weapons, must show three things: (1) there must be some evidence of hafting; (2) the points must have a sharp tip, to penetrate the hide; and (3) some should have impact scars, indicating their use as killing weapons.

### 8.1. Hafting

Evidence of hafting has been found by Lombard (2005, 2006 a,b, 2007) on some of the post-Howiesons Poort unifacial points and Still Bay bifacial points from Sibudu by microwear and residue analysis. Minichillo (2005) suggested hafting based on his observation of resharpening of the distal edges of two Still Bay points



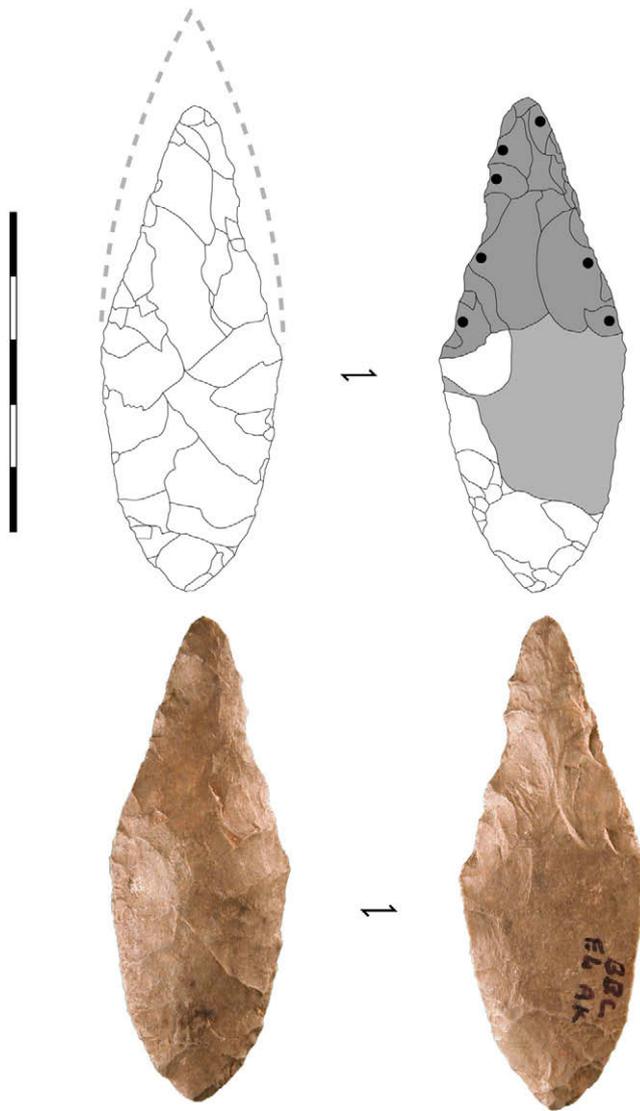
**Fig. 8.** Examples of snap and perverse fractures. (1–2) Agate Basin projectile points from the Frazier site (Colorado). All three specimens have lateral snap fractures, due to impact on the distal end causing breakage in the haft. (1) Distal-middle portion; (2) two bases. All have grinding of the proximal edges, proof that they are finished and used points. (3) Lateral snap on P 53, a phase 2a Blombos point of fine silcrete; the hollow in the stone is an imperfection that may have been the cause of break during manufacture. (4) Perverse fracture on P 67, a phase 3 Blombos point of coarse-grained silcrete. (5a, b) Experimental, unfinished bifacial foliate point broken during manufacture by Jacques Pelegrin (direct percussion with a soft hammer); the twisting surface of the fracture is evident in Fig. 5b. Scale bars = 1 cm.

from Hangklip and from Hollow Rock Shelter. According to him resharpening left the base wider than the distal part of the point and this implied that the point had been resharpened in the haft. He interpreted the Still Bay points as both butchery knives and spear tips. Lombard (2006b) also suggested that some of the Sibudu points were used as weapon tips and others as butchery knives with lateral hafting.

At Blombos we found three kinds of evidence for axial hafting, appropriate for points used as spear-heads. The first case rejoins Minichillo's observation. PVN 65 is a phase 4 point of fine silcrete, made on a large flake. On one face the distal part has been completely reworked with removals by hard hammer, thus the

distal portion has a slightly concave edge (Fig. 9). Either it was easier to use an internal percussion technique on a point still in its haft or resharpening was done by a less experienced knapper. The pattern of resharpening strongly suggests axial hafting.

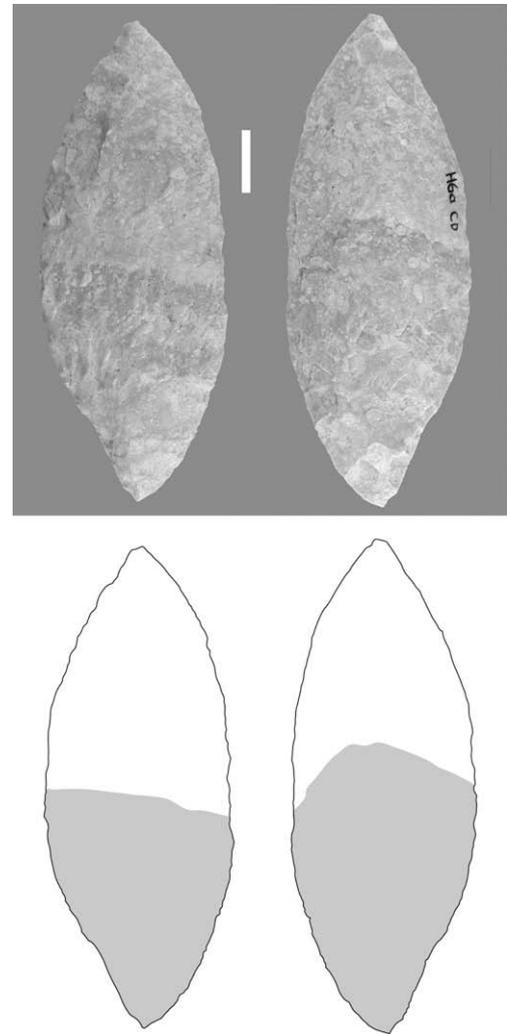
The second case of axial hafting is indicated by a peculiar patination of another point, PVN 66. On both faces the distal part has a whitish patina; the proximal part is unpatinated and darker in color. The contact between the two areas is sharp (Fig. 10). The lack of patination of the proximal part may be due to hafting: the organic material which constituted the haft deteriorated through time while the unhafted area was exposed to direct atmospheric conditions and developed the white patina. This same pattern of



**Fig. 9.** Phase 4 point (PVN 65, E4, AK) showing reshaping in the haft. The hard hammer removals on the distal portion of the point are indicated by black dots; they are later than the soft hammer removals on most of the piece. The original shape of the point is indicated at the top left. The light grey area (top right) is the flake blank surface.

patinated and non-patinated areas on the same implement has been observed on a Mousterian scraper from the site of Quneitra (Israel) dated to 54,000 years ago (Friedman et al., 1994–1995). The pattern was experimentally replicated by hafting two flakes and one Mousterian point of black flint and exposing them to atmospheric conditions for 6 months. The hafted area remained dark in color; the exposed unhafted part developed a white/gray patina. The patina pattern of the Blombos point indicates axial hafting.

The third kind of evidence is provided by impact scars on the proximal part of two phase 3 points: a step-terminating bend break at the base of an almost complete point (Fig. 11a, b) and two burin-like removals originating from a straight snap on the midsection of a second point (Fig. 11c–e). This kind of break, by pressure or counter shock in the haft or above the haft, occurs on Paleoindian bifacial points (Bradley, 1982: 198; Bradley and Frison, 1987: 217; Huckell, 2007: 200) and has been experimentally reproduced on replicas of Paleoindian spear points thrust into an elephant carcass (Huckell, 1982) or shot on bisons with an atlatl by Bruce Bradley (personal communication, December 2007) and on replicas



**Fig. 10.** Phase 3 point (PVN 66, H6a, CD) with patinated and unpatinated areas on both faces. This pattern may have resulted from hafting, the darker, unpatinated color corresponding to the hafted area. Scale bar = 1 cm.

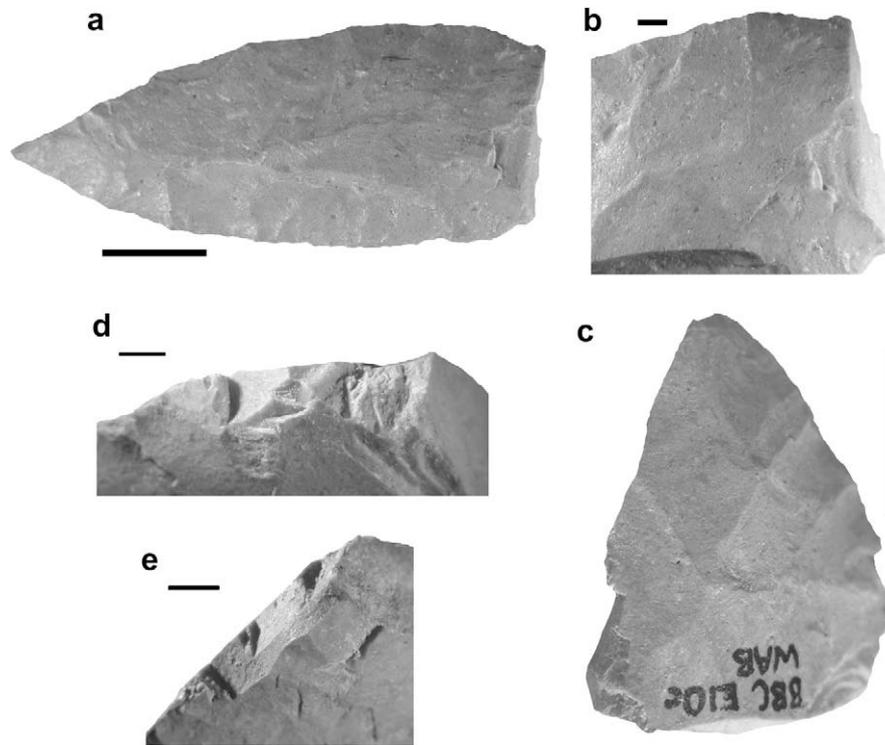
of Solutrean shouldered points (Fig. 12). All these points were hafted axially.

## 8.2. Spear tips or butchery knives?

The two most common interpretations of the Still Bay points are that they were used as spear tips or butchery knives or both (Minichillo, 2005; Lombard, 2006b, 2007). Lombard suggested that some of the Still Bay points from Sibudu and Blombos were used as weapon tips and others as butchery knives.

However, we do not believe that Blombos Still Bay points were designed as both spear-heads and butchery knives. We should distinguish between intended function and occasional use.

If a point is designed for the purpose of killing animals, it has to be properly aligned in the haft to withstand the axial pressure of thrust on impact which is different from the pressure resulting from butchering (Frison, 1991: 315). A butchery tool is subject to stress from the side, i.e. from directions other than that directly toward the V-shaped end of the point. Paleoindian points hafted axially into a main shaft through a foreshaft may have been occasionally used for butchery, especially at kill sites, using the equipment at hand. However, this was possible for Paleoindian points because they were very likely attached to a foreshaft that could easily be removed from the main shaft after its use for a kill (Frison, 1974). Direct physical evidence of foreshafts in North America



**Fig. 11.** Impact fractures on the bases of two phase 3 points, both of silcrete. (a, b) Step fracture on PVN 45 (D2b, CF); (c–e) Two burin-like fractures on the right and left side of PVN 97 (E10c, WAB). The scale of (a) and (c) = 1 cm; the scale of (b), (d), (e) = 2 mm.

occurs only by about 300 AD but there are some possible examples from Paleoindian times (Bradley and Frison, 1996: 67). It is difficult to imagine that foreshafts (documented in the Magdalenian and in Holocene times on South African arrows; Pétilion and Cattelain, 2004; Bosc-Zanardo, 2004) were already in use at Blombos, more than 60,000 years before their physical record. Thus the Still Bay points, if their intended use was butchery, had to be hafted in a way different from that used for insertion on the distal end of a main shaft. In fact, Lombard (2006b) suggested that two asymmetrical Sibudu points may have been mounted on short hafts.

We are not sure that this applies to the Blombos points, none of which show the asymmetry observed by Lombard at Sibudu. It is unclear to us why an artifact to be used as a knife should have a pointed or a very narrow proximal end which is a shape appropriate for insertion into a socket or split haft. The narrow proximal margins of a Still Bay point are adapted to the use of binding materials (sinew or plant fiber) without creating a significant “hilt” effect. If the binding is too bulky it will hinder penetration of the shaft into the hole formed by the stone point to reach a vital spot (Frison, 1991; Knecht, 1997).

It does not seem efficient to design a point and a knife in the same way. The Blombos points with their sequence of manufacturing phases provide evidence that the intended final form of the artifact was clear in the mind of the knappers; a specific mental template was guiding the operation, especially with respect to the apex of the tool. This is why we do not believe that the Blombos points were designed with a dual objective of being used as points **and** as knives, although points may have had a secondary use as a knife.

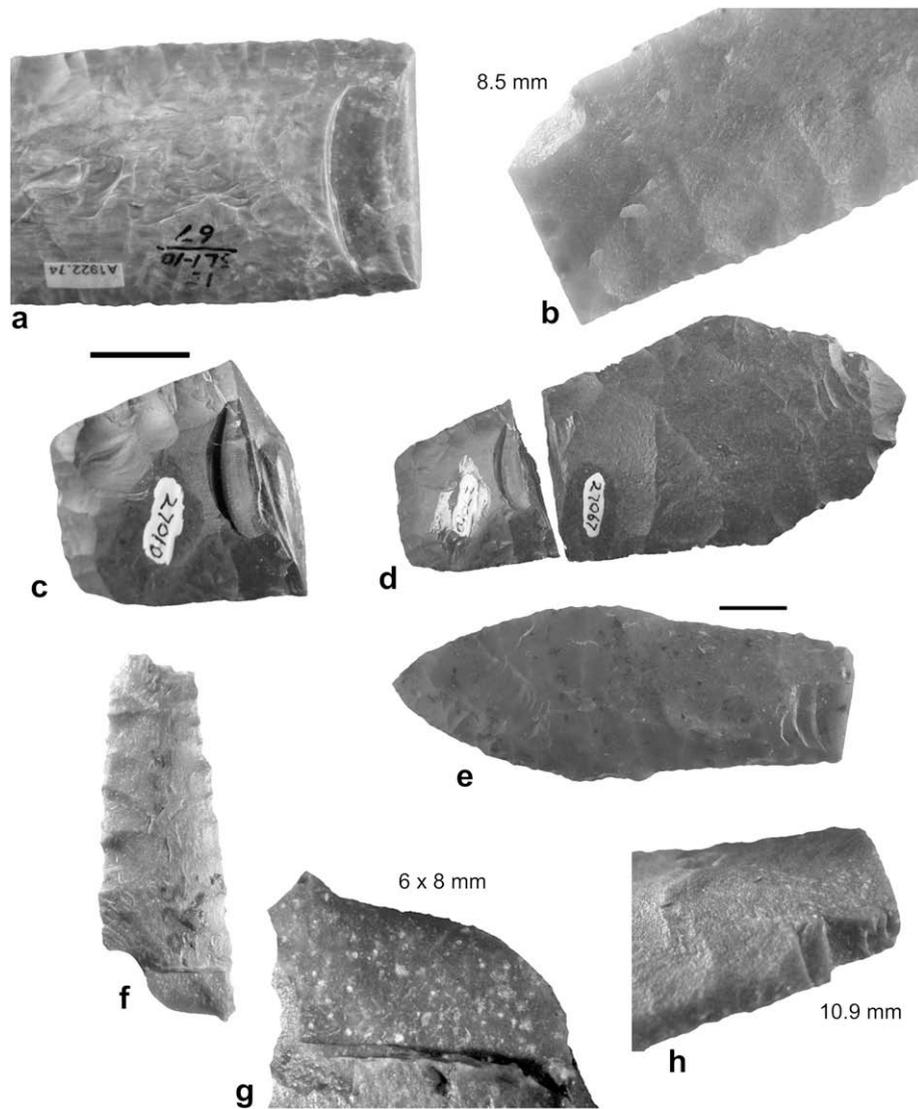
The base of many Still Bay points is not always a narrow, pointed V shape; it is sometimes broad or wide arched or is elliptical but with a straight truncation, either a deliberate fracture surface or a truncation occasionally obtained by retouch or by leaving an area of cortex (Supplementary Materials, Table 1). That particular shape, with a narrow but straight end, may be a way of avoiding damage

that a V-shaped base may cause to the shaft socket by penetration on impact.

### 8.3. Point shape

Morphometric analysis based on comparisons with securely identified spear-heads or arrowheads can show if the artifacts have a potential to be interpreted as killing weapons. The tip cross-sectional area (TCSA; approximated by the formula:  $1/2$  maximum width  $\times$  maximum thickness) is one of the variables that influence penetration of a low velocity weapon, hence its killing power: the smaller the TCSA the better the penetration. Shea (2006) provides descriptive statistics for ethnographic and recent archeological (North American) hafted stone points (spear points, dart tips and arrowheads) based on data provided by Thomas (1978), Shott (1997) and Hughes (1998) and has used them to discriminate between hand-delivered spears (throwing or thrusting spears), dart tips thrown with a spearthrower and arrow-heads. The TCSA value puts the Blombos phase 3 points in the class of hand-delivered spears, together with the unifacial points from Sibudu and the Clovis and Hell Gap points (Table 6; cf. also Shea, 2006).

It has been recently suggested that the coefficient of variation can be a useful measure of standardization (Eerkens and Bettinger, 2001). The TCSA of the Still Bay points is much higher than the coefficient of variation of Paleoindian points. This suggests that differently from the specialized Paleoindian projectile points the MSA points are not fully standardized. The width and thickness of Upper Paleolithic points are often published in condensed statistical form, thus we cannot calculate the TCSA standard deviation and coefficient of variation of the Solutrean points. However, the coefficient of variation of the mean width and thickness is quite low, comparable to values of Paleoindian points but different from the high values of MSA points (Supplementary Materials, Table 2).



**Fig. 12.** Step and burin-like fractures at the base or in the middle portion of Paleoindian points and on an experimental Solutrean shouldered point. (a) Step fracture on a bifacial point from the Frazier site (petrified wood). (b) Burin-like fracture on a point from the Claypool site (chert). (c, d) Step fracture at the base of a refitted point from the Casper site (chert). (e) Step fracture at the base of a Casper point (jasper). (f, g) Step fracture on an experimental shouldered point (flint). (h) Burin-like fracture at the base of a Casper point (quartzite). Scale bar = 1 cm; the size of scars is indicated in millimeter.

#### 8.4. Impact scars and their analytical classification

Based on experimental work and refitting of impact flakes on the Casper points Frison described five kinds of tip damage (Fig. 7A): (1) scars on the face of the point, originating from the apex (called flute scars) and with a feather termination; (2) flute scars with step termination; (3) burin-like scars on the edge of the point; (4) crushing of the tip; the most distinctive and diagnostic is a cluster of small overlapping step scars parallel to the long axis of the point; and (5) small cone fractures (with a negative bulb) starting from a snap. The latter scars have been called spin-offs by Fischer et al. (1984) (Fig. 7B).

Fischer et al. (1984) considered diagnostic only step-terminating fractures and spin-offs. To be diagnostic spin-offs should have a length of 6 mm or greater if they occurred unifacially on large points (like the Brommian points used in their shooting experiments, generally 4 to 6 cm long) or irrespective of length, if they occur bifacially. In the case of small points (like the transverse arrowheads shot with a bow and a length of 1–3 cm) he said that the fractures should be at least 1 mm long. He set no size limits to step-terminating fractures nor does O'Farrell (2004). Step-

terminating fractures have not been obtained in trampling experiments (O'Farrell, 1996) hence are considered diagnostic regardless of size. Burin-like scars were recognized as distinctive by Frison (1974), Bergmann and Newcomer (1983) and Odell and Cowan (1986).

In sum, the general consensus is that step-terminating fractures, burin-like fractures (originating from the tip or from a bend break)

**Table 6**  
Maximum thickness of finished Folsom and Blombos Still Bay points.

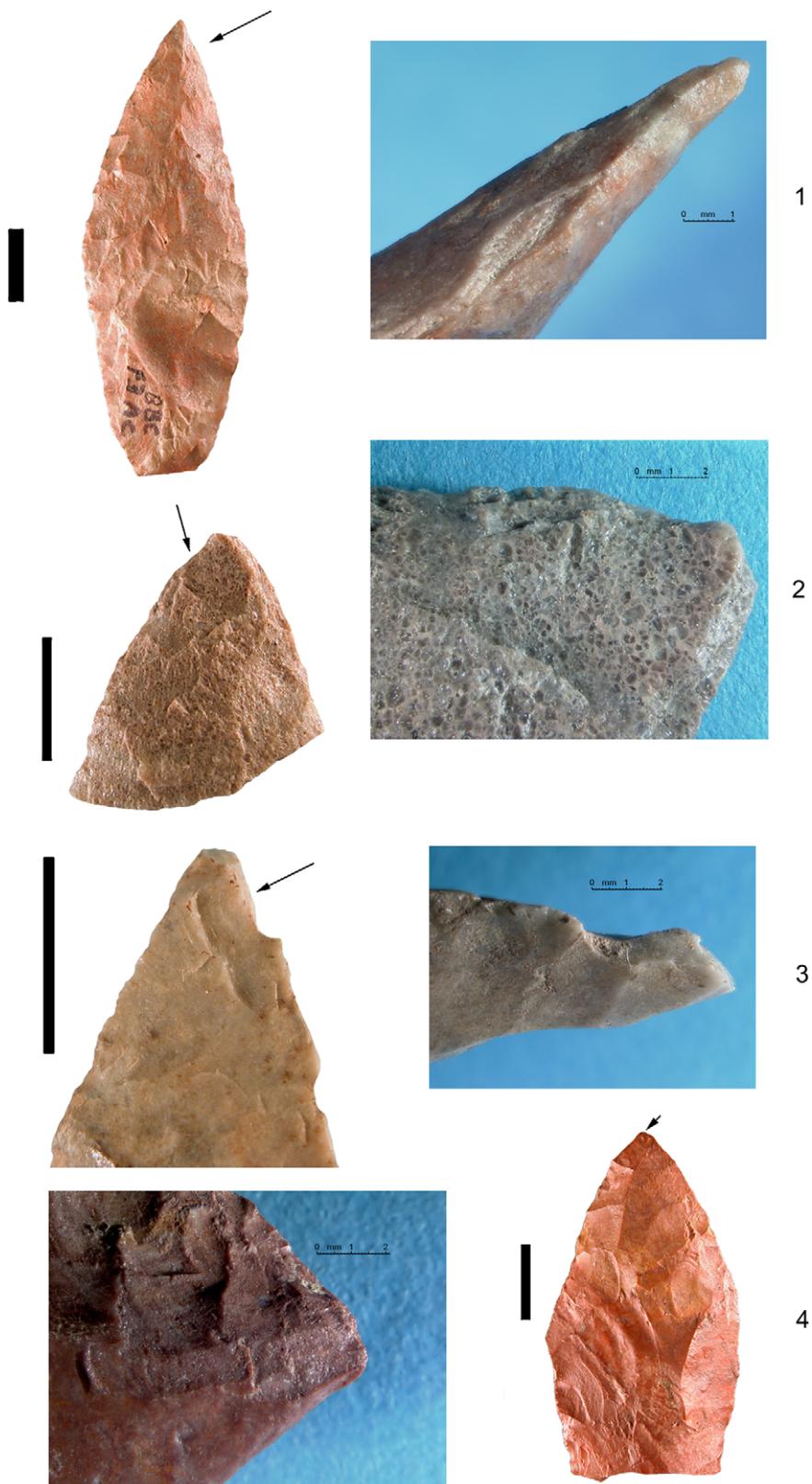
Thickness in mm	Folsom type site	Other Folsom Sites	Blombos
N	15	68	23
Mean	4.1	3.48	8.3
S.d.	0.4	0.84	2.2
Min	3.4	---	4.3
Max	4.8	---	12.9

Measured points are those with complete maximum thickness. At the type site of Folsom 32 bisons were killed and all the points are finished specimens. On the Folsom points the maximum thickness is taken at the thickest point of the blade or base and is not the thickness within flute scars which is always smaller. Data on Folsom from Meltzer (2006): Table 8.4 (casts excluded) and Table 8.9.

and spin-off fractures on the distal end of a point are diagnostic of use as weapon tips. Impact damage occurring on the base or proximal part of a point has been discussed in the section on “Hafting”.

### 8.5. Impact scars at Blombos

At Blombos there are 11 pieces with impact damage on a total of 82 finished phase 3 points that are either complete or observable



**Fig. 13.** Impact scars on Blombos Still Bay points, all silcrete and all phase 3. (1) Burin-like impact scar 4 mm long on the distal edge, Museum 3. (2) Step scar 5.2 mm long; the proximal fracture is an oblique snap with lipped profile, perhaps caused by impact, P 78. (3), burin-like scar 4.9 mm long on the distal edge, P 50. (4) Multiple step fracture, 8.9 mm long; the break in the lower part of the tool is a snap with a curved profile, perhaps caused by impact, PVN 61. Scale bars = 1 cm.

for distal or proximal impact damage. This corresponds to a frequency of 13.4%. Two of these 11 points have proximal damage and have been previously described in the section on “Hafting”. The rest of the points have distal impact damage (Figs. 13 and 14: 1–2). We excluded 6 pieces that have doubtful, very small or irregular damage. One phase 4 point has a step scar 3.5 mm long but later retouch makes the identification doubtful.

There are no impact scars on phase 2b points. One wide step-terminating scar occurs on the distal end of a phase 2b point, also broken in two by a lateral snap in the middle section; this is an example of a manufacturing break that could be potentially confused with an impact scar (Fig. 14: 3–4). It is important to note that step-terminating removals occur during manufacture so one must be careful not to confuse shaping removals with impact scars. In many cases the position is important because the shaping of the point generally involves retouch on the two sides, not on the apex. Experimental replication and observation of the Blombos points show that quartzite and medium to coarse-grained silcrete tend to have step-terminating shaping removals.

### 8.6. Frequency of impact scars

The frequency of impact scars at Blombos (13.4%) is comparable with frequencies from other MSA assemblages that have been completely analyzed. This includes layer RSP from Sibudu with 8.9% of impact scars on unifacial points (9/101) and the post-Howiesons Poort layers with unifacial points at Rose Cottage with 8.3% (4/48) (Villa and Lenoir, *in press*).

Published frequencies of impact scars from several post-Howiesons Poort layers at Sibudu are much higher (42%; Lombard, 2005) but they are based on a sample of 50 points selected from 11 different layers. Since experiments provide high frequencies of impact scars on artifacts used for shooting animals (about 40%; Fischer et al., 1984; Lombard, 2005, 2007) it has been argued that low proportions of diagnostic impact fractures could mean that the points were not used as weapons or were made for that purpose but were never used.

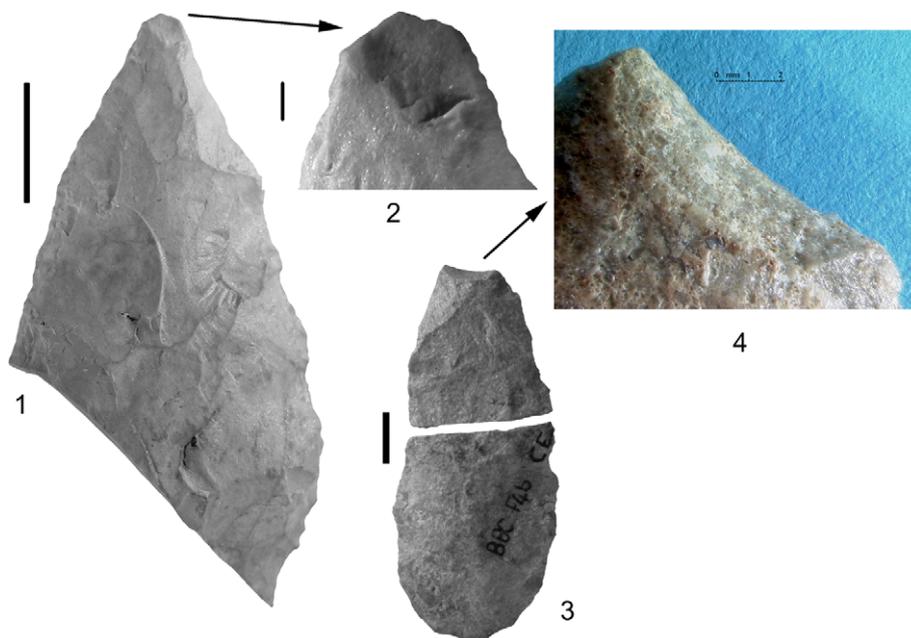
While experiments are very useful for understanding the morphology of impact scars, it does not seem logical to expect them

to provide diagnostic frequencies for archaeological samples of putative hunting weapons. In most experiments points were shot into animals several times or until damage rendered the point useless (e.g. 10 times in the case of thrusting and throwing experiments by Lombard et al. (2004); until breakage in Odell and Cowan (1986) and O’Farrell (1996)). It makes more sense to compare the Blombos case with archaeological sites where the point function is well known.

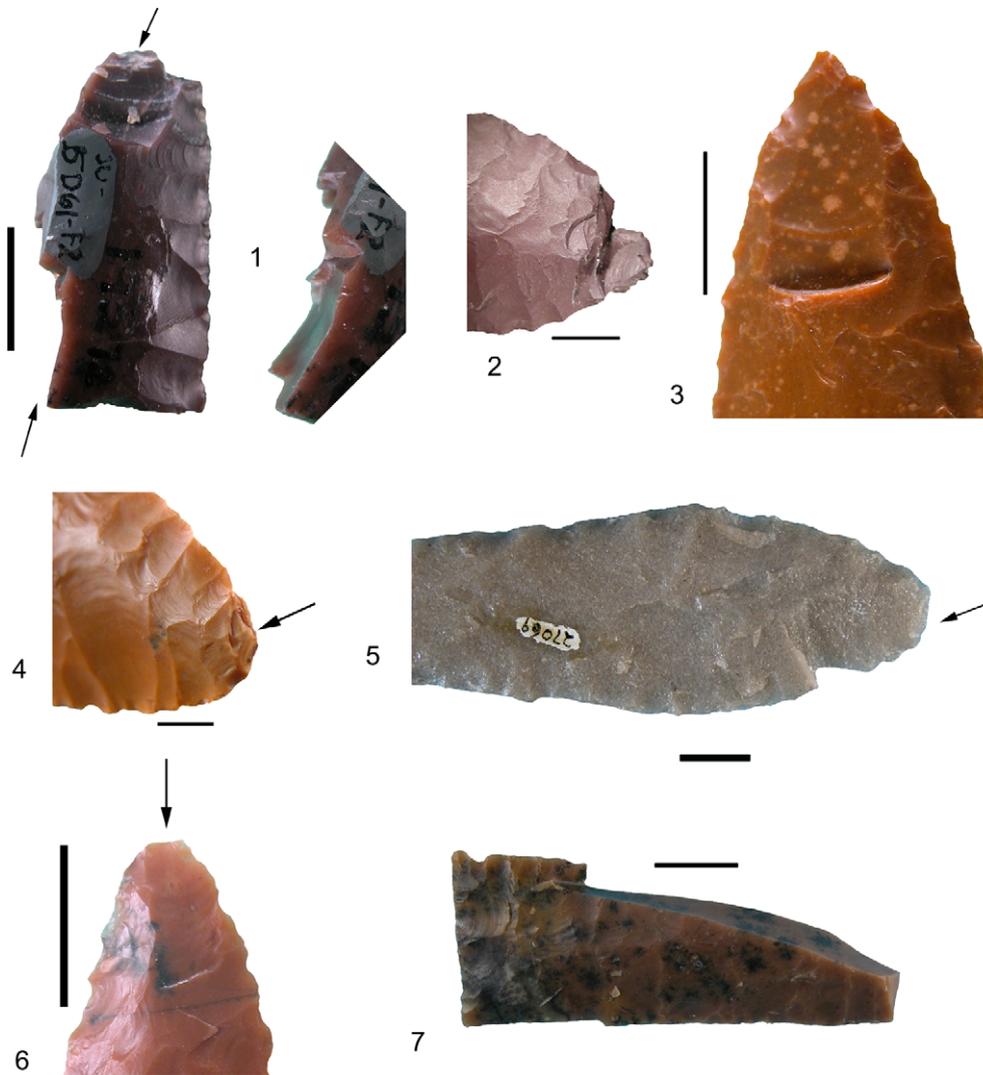
Table 3 in the Supplementary Material (online) shows frequencies of impact scars on tanged and transverse arrowheads at Late Paleolithic to Bronze Age sites in Northern Europe and on Hell Gap bifacial points from the site of Casper. Proportions of impact scars are very variable, from high to quite low. They are very high only at kill sites such as Stellmoor and Casper (42.2 and 43.0%) where the main activity was the killing and butchering of animals. At all other sites there is a clear evidence of a variety of activities which included manufacturing of many domestic (non-weapon) tools, in addition to points and the frequencies of impact scars are much lower. In sum, there is no reason to expect a high percentage of impact scars on points found at a residential or a manufacturing site and this is the case for the Blombos points.

### 8.7. Size of impact scars

Figs. 15 and 16 are examples of impact scars on Paleoindian points and experimental Solutrean points. It can be seen that the size of impact scars can vary widely and can be very small, from just 2 mm or less for crushing damage to very long burin-like scars, like on the Hell Gap point of Fig. 15: 7. Many scars occur in complex varieties, with more than one kind of damage in different parts of the pieces; some are catastrophic breaks, which break the point to an unusable fragment. The impact scars on the Blombos points have the same morphology but their size tends to be smaller and their morphology less well developed. Two factors have to be considered. First, the Paleoindian points were probably thrown with an atlatl. According to experiments by Frison and Bradley (1999) atlatl-propelled darts consistently register an impact more intense than that of hand-thrown spears. The replica Solutrean points were shot either with a calibrated cross-bow with about 25 kg of pull or with



**Fig. 14.** Impact scars (1–2) and accidental breaks (3–4) on Blombos Still Bay points. (1, 2) P 42 (F5c CB), a phase 3 point with a small step scar 3.3 mm long; (3) and (4) Phase 2b point with a wide (8.4 mm) step scar at the tip, very likely an accidental break during manufacture, that could be confused with an impact scar, PVN 6 (the two refitting pieces are from adjacent squares). Scale bar of 1 and 3 = 1 cm; scale bar of 2 = 1 mm.



**Fig. 15.** Impact fractures on Paleoindian bifacial projectile points from bison kill sites: Jurgens, Horner II, Frazier, Casper and Hell Gap. All points are made of cryptocrystalline varieties of silica (jasper, chert, porcellanite, chalcedony) except for the Casper point which is fine-grained quartzite. (1) Midsection fragment of a point with a catastrophic breakage, from Jurgens area 3, a bone bed with the remains of at least 35 bison. The piece has a distal step fracture (7.1 mm long) and a proximal burin-like fracture >1 cm long with stepped termination (detail shown to the right of the piece). (2, 4) Crushing damage, 2–4 mm long on points from Horner II and Frazier. (3) Step scar, partly removed by secondary retouch on a Jurgens point. (5) Step fracture on a Casper point (25.4 mm long). (6) Step fracture on a Jurgens point (8.6 mm long). (7) Burin-like scar 38.1 mm long on a Hell Gap point from the Hell Gap site. Scale bars of 1, 3, 5–7 = 1 cm; scale bar of 2 and 4 = 5 mm.

a bow of similar pull. The smaller size and lesser complexity of the Blombos impact scars may well be due to the fact that the points were likely hafted as hand-thrown or thrusting spears.

The second factor is probably the nature of the raw material. All Solutrean replicas and all Paleoindian points were made of cryptocrystalline silica. Many of the Blombos points are of crystalline varieties of silica, i.e. quartz, coarse-grained quartzite and silcrete. These materials are tough and resistant to shock. Replicative functional experiments are needed to document raw material influence on impact scar size.

### 9. Symbolic function of the Still Bay points

According to Marean (2005: 362) “both the Aterian and the Still Bay include bifaces that are too thin and fragile for the purpose of hunting... though the vast majority are clearly usable as spear/dart tips or knives”. Thus he suggested that the more fragile points might have had not a utilitarian function but a social or religious role. A comparison with the Folsom points shows that this statement does not apply to the Still Bay points from Blombos.

The Folsom points are among the thinnest of all Paleoindian points, yet their use for killing bison is well demonstrated. Table 6 shows that points from the Folsom type site (a bison kill site with an MNI of 32 bison) and other Folsom sites are much thinner than the Blombos points. The thinnest Blombos point is 4.3 mm thick, only five tenths of a millimeter thinner than the thickest Folsom point which is 4.8 mm. The width/thickness ratio of Folsom points is also very high (5.5 versus 2.8 at Blombos; Supplementary Table 4). According to Bradley et al. (1995) the Streletskayan, Solutrean, Clovis and Hell Gap points from Casper also have mean width/thickness ratios of 5 or higher, again significantly thinner than Blombos. We do not imply that no symbolic value was ever attached to the Still Bay points, only that thinness is not significant in this respect.

### 10. Point length

The range of variation of length for the finished Blombos points, from 34.0 to 74.5 mm (mean = 55.0, s.d. = 12.6,  $n = 11$ ) could be seen as suggesting that points of different sizes were used for prey

of different sizes. The sample ( $n = 11$ ) is actually too small to reveal separate modalities. Nevertheless the assumption of equating point size with prey size should be treated with caution. A wide, if not wider, range of variation in length occurs at Paleoindian bison kill sites where the points are associated with only one kind of prey and were not reworked after the hunt. At the bison kill site of Casper (bisons killed = 74) the range of variation is 49.9 to 137.0 mm ( $n = 27$ ). At the Frazier site (bisons killed = 43) the range is 47.2 to

88.2 ( $n = 5$ ); at the type site of Folsom (32 bisons killed) the range is from 32.3 to greater than 56.4 mm.

### 11. Is Blombos a workshop?

The high incidence of Still Bay points at Blombos and their fine flaking have been considered as possible evidence of craft specialization and, by extension, trading (Deacon and Deacon,



**Fig. 16.** Experimental impact fractures on replicated Solutrean shouldered and unifacial points mounted as darts on spear shafts or as arrow-heads. Catalogue numbers in the database of Jean-Pierre Chadelle. (1) No. 452, shouldered point, shot with a bow from a distance of 18 m. It hit a rib and penetrated for 3 cm. The step fracture is 3 mm long and 3.7 mm wide. (2) No. 393, unifacial point with a step fracture and crushing of the tip on the dorsal face (scar length = 4.4 mm), shot with a cross-bow from a distance of 10 m. (3) No. 409, a shouldered point, shot with a cross-bow, broken in two just below the juncture with the shoulder. The distal fracture is irregular; the proximal fracture is a snap with spin-offs about 2.9 mm long. (4) No. 463, a shouldered point shot with a bow, broken distally and proximally just below the shoulder. The distal step fracture is 8.9 mm long; the proximal is an irregular transverse fracture with several spin-offs. (5) No. 405, a shouldered point shot with a cross-bow. The tip has two fractures: a step on the dorsal face (5a) 3.5 mm long, and a burin-like fracture (5b) starting from the ventral face and along the edge, 10.2 mm long. Scale bars of tools = 1 cm; scale bars of microphotos in millimeter.

1999: 100). The implication is that during the M1 phase Blombos was a specialized workshop where points were made to be brought to other sites outside the group range for reciprocal trading.

The term “workshop” has been used in Pleistocene and Holocene prehistory to indicate a site with a high density of lithic remains and few faunal remains. It is applied to sites close to an outcrop of raw material, characterized by an assemblage rich in primary reduction products and blanks (such as cores, tool rejects and debitage) and few formal shaped tools, in other words non-residential sites (e.g. Petraglia et al., 1999; Sampson, 2006).

In fact Blombos was a site where a variety of activities took place and more than just points were made or used at the site, as indicated by formal tools other than points (Table 1). Hundreds of pieces of ochre, including two slabs of engraved ochre, 15 bone tools and 39 beads manufactured from *Nassarius kraussianus* gastropod shells also come from the M1 phase (D’Errico et al., 2005; D’Errico and Henshilwood, 2007). The M1 deposits show numerous small basin-shaped hearths; they have yielded abundant faunal remains including small and large bovinds (Henshilwood et al., 2001a). Three deciduous human premolars (two upper dm1 and one dm2) have been found in the M1 unit; the dm1 could be from a young child (Grine and Henshilwood, 2002). Thus both children and adults lived at the site.

The very large proportion of production rejects (89.8%) shows that point making was a primary activity at the site. It is likely that some of the finished points were taken out of the site and used for hunting elsewhere, as at Paleolithic sites (Sellet, 2004), Solutrean sites (Aubry et al., 2008) and even in earlier times, at some Maastricht–Belvédère localities where Mousterian points and other well-made tools were made in situ and then transported away (De Loecker, 2004; Villa, 2006). This may be an example of long-term planning and of producing hunting weaponry in anticipation of future needs.

In sum, Blombos was a workshop in the sense that the making of points was a primary – though not exclusive – activity at the site. The idea that the Blombos points were “traded”, i.e. exchanged with other groups is unsustainable, as we do not yet have the means to either accept it or reject it.

## 12. Conclusions

Our technological analysis has allowed us: (a) to reconstruct the production sequence of the Blombos Still Bay points; (b) to show that only a minority of the points are finished forms, and that a large proportion of the point assemblage are production rejects; (c) to show that morphometric and impact scar analyses must take into account this process and should distinguish between finished and unfinished forms; (d) to prove that the points were produced by direct percussion by hard hammer, followed by thinning and retouch by soft hammer; (e) to suggest that there were three different kinds of raw material sources and that there is a marked increase in the frequencies of silcrete with respect to the M2 and M3 phases; (f) to find evidence that some of the points were hafted axially and used as weapon tips; (g) to support the view that the making of points was a primary activity at the site but also to stress that the reciprocal trade hypothesis cannot be sustained on the basis of present evidence; (h) to use a preliminary analysis of the lithic assemblage composition and other site data to support a view of the cave as a location of a variety of activities, perhaps a residential location for groups of people that included children; and (i) to suggest that the Still Bay phase initiates a trend to specialized hunting weaponry and that this innovation is congruent with other innovations such as bone tools, shell beads and engraved ochre of the M1 and M2 phases.

By comparisons with Paleolithic and Upper Paleolithic weapon tips, their manufacture stages and their morphology, the design of

the Still Bay hunting weapons appears less standardized and less functionally specialized; nevertheless it is an example of a successful innovation that spread to other parts of South Africa and was adopted by many MSA groups in South Africa.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi: [10.1016/j.jas.2008.09.028](https://doi.org/10.1016/j.jas.2008.09.028).

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