Temporal perspectives on Still Bay point production at Sibudu Cave, KwaZulu-Natal, in the context of southern Africa

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ABSTRACT
Based on optically stimulated luminescence age estimates it has been argued that the Still Bay represents a sudden, short-lived technological innovation dating to about 72–71 kya. Yet, few sites have the stratigraphic integrity and Still Bay point assemblage size to test this assumption. The Wadley deep sounding of Sibudu Cave provides such an opportunity. Here we use fine-grained analyses consisting of technological attributes and morphometric data to explore the retouched point assemblages of Sibudu over a period of more than ten thousand years spanning the Still Bay. Although we found subtle changes through time, we found no evidence of a technological break in retouched point-production strategies since the Wadley early pre-Still Bay at more than 77 kya through to the final Still Bay/early Howiesons Poort dating to 64.7 ± 2.3 kya. We did, however, uncover a potential point-production hiatus at the site and we present testable hypotheses for this phenomenon. We further contextualise the Sibudu assemblages within southern Africa by directly comparing them with those of Hollow Rock Shelter, Umhlatuzana and Apollo 11. Although our results demonstrate both variation and similarities between the different Still Bay assemblages, we could not replicate a previous suggestion regarding technical disconnection between a north-east/south-west axis on the greater landscape.

RÉSUMÉ
Il a été avancé sur la base de datations par luminescence stimulée optiquement que le Still Bay représente une innovation technologique soudaine et de courte durée vers 72-71 kya. Pourtant, peu de sites possèdent l’intégrité stratigraphique et un assemblage de pointes Still Bay adéquats pour vérifier cette hypothèse. Le sondage profond fouillé par l’équipe de Wadley dans la grotte de Sibudu offre une telle opportunité. Nous utilisons ici des analyses détaillées des attributs technologiques et des données morphométriques pour examiner les assemblages de pointes retouchées de Sibudu sur une période de plus de dix mille ans couvrant tout le Still Bay. Bien que nous ayons constaté des
 changements subtils au fil du temps, nous n’avons trouvé aucun signe d’une rupture technologique dans les stratégies de production de pointes retouchées, et ce durant toute la période allant du pré-Still Bay défini par Wadley, à plus de 77 kya, jusqu’au Still Bay final/Howiesons Poort ancien datant de 64,7±2,3 kya. Nous avons toutefois découvert un hiatus potentiel dans la production de pointes sur le site, et nous présentons des hypothèses vérifiables pour expliquer ce phénomène. Nous contextualisons par ailleurs les assemblages de Sibudu plus largement en Afrique australe en les comparant directement avec ceux de Hollow Rock Shelter, Umhlaluzana et Apollo 11. Bien que nos résultats démontrent à la fois des différences et des similarités entre les différents assemblages Still Bay, nous n’avons pas pu reproduire la suggestion qui a été faite antérieurement concernant une déconnexion technique suivant un axe nord-est/sud-ouest dans le paysage.

Introduction

Point production is a key characteristic of the Middle Stone Age in Africa and has served as an impetus for far-ranging interpretative frameworks from early on (e.g. Clark 1988). In many contexts ‘points’ are no more than Levallois-like convergent flakes (e.g. Wurz 2013; Schoville 2014), but retouched points are well-known from numerous contexts in the southern African sequence. Since the dating of Middle Stone Age contexts became possible, and with evidence for flourishing cognitive and behavioural trends in southern Africa from at least 100 kya, no point category has enjoyed more attention than the Still Bay (Wadley 2007; Villa et al. 2009; Lombard et al. 2010; Mourre et al. 2010; Högberg and Larsson 2011; Porraz et al. 2013; Soriano et al. 2015; Archer et al. 2016; Högberg and Lombard 2016a).

Understood as a technocomplex (sensu Lombard et al. 2012), Still Bay assemblages will share a context or class of artefacts, but not all properties will be identical. Each Still Bay assemblage is thus expected to include variations of the same family of artefacts as a response to socio-economic and/or environmental factors (after Clarke 1968). A technocomplex such as the Still Bay can be geographically widespread (Sampson 1974), with regionally subtle shifts in tool frequencies or design, whilst retaining broad similarities (Deacon 1980). The Still Bay type fossil is a thin (≤10 mm), invasively retouched, bifacial, foliate or lanceolate point with semi-circular or wide-angled pointed butt and lenticular cross-section (Goodwin and van Riet Lowe 1929). The points often appear in assemblages together with flakes and cores, but with few other formal tools (Evans 1994). Perhaps of note here is the fact that all Still Bay assemblages contain some unifacial points as part of their composition, yet these are seldom discussed as part of recent ‘Still Bay’ lithic research (though see Högberg and Lombard 2016b; Lombard and Högberg 2018). We suggest that this omission hampers detailed understanding of techno-behaviours associated with point production during this technocomplex and consequently we include both bifacial and unifacial points in our analysis.

It has been speculated (based on age estimates) that the Still Bay was a short-lived, discontinuous technological innovation (Jacobs et al. 2013), which some argue had little to do with climatic events (e.g. Jacobs et al. 2008a), while others align its occurrence strongly with climatic disruption (e.g. Ziegler et al. 2013). Yet few sites have the necessary dated stratigraphic integrity to assess the assumption that the Still Bay technocomplex was
indeed an abrupt innovation, whether climatically determined or not (but see Archer et al. 2015). The Sibudu Cave site (Sibudu), located in KwaZulu-Natal province, South Africa (Figure 1), with its long Middle Stone Age habitation sequence and relatively secure stratigraphy is a site where such work is possible. Since 1998 it has first been excavated and researched by a team led by one of us (Wadley) generating a series of papers (e.g. Schiegl et al. 2004; Villa et al. 2005; Wadley 2005, 2007; Wadley and Jacobs 2006; d’Errico et al. 2008, 2012; Jacobs et al. 2008b; Lombard 2008, 2011; Wadley and Mohapi 2008; Soriano et al. 2009, 2015; Wadley et al. 2011; Bruch et al. 2012; de la Peña and Wadley 2014; de la Peña 2015), while currently a second team led by Prof. Nicholas Conard of the University of Tübingen, Germany, is working at the site (e.g. Conard and Will 2015; Rots et al. 2017; Will and Conard 2018).

Here we apply an approach developed for analysing intra- and inter-site variability of retouched point-production strategies (Högberg and Lombard 2016b; Lombard and Högberg 2018), building on previous methods used to analyse and interpret Still Bay assemblages (Villa et al. 2009; Högberg and Larsson 2011). We use the points (N = 108) excavated by the Wadley team, dating from ≥77.3 ± 2.7 kya to ≥64.7 ± 2.3 kya, to explore temporal changes in how knappers produced retouched points. This period at

Figure 1. Map of southern Africa showing the location of the sites mentioned in the text (modified from Lombard and Högberg 2018).
Sibudu starts with the informally designated pre-Still Bay, moves through the Still Bay and terminates in a layer that incorporates both Still Bay and Howiesons Poort lithic artefacts. Typical Still Bay points (see definition above) are no longer found in layers younger than \( \sim 64.7 \) kya. However, different forms of bifacial point production have been recorded at various stages during the site’s occupations, including many fine, long ones in the final Middle Stone Age (Wadley 2005; Mohapi 2012; de la Peña et al. 2013; de la Peña and Wadley 2014) and stubbier ones at the base of the post-Howiesons Poort ‘Sibudan’ Industry (Conard et al. 2012; Bader and Will 2017).

Together with the points presented by Rots and colleagues (2017), the Sibudu material currently represents one of the largest stratigraphically constrained retouched point (and point fragment) assemblages in southern Africa. Only the Blombos assemblage surpasses that from Sibudu in terms of numbers for complete or almost complete points (Archer et al. 2015). The approach we employ is, however, not reliant on complete pieces only, so that the Sibudu phases separated out for this study represent the most numerous retouched point assemblages used up until now to develop hypotheses about diachronic change in point production spanning the Still Bay technocomplex. Our approach is easily replicable, generating detailed qualitative and quantitative data, with interpretations that can be strengthened and/or constrained through future work.

**Background information on Sibudu pertaining to this study**

The site stratigraphy at Sibudu is complex in layers younger than 60 kya: here millimetre-thick layers are brightly coloured and hearths and burnt bedding layers are tightly stacked. There is a marked visual change in layers older than 60 kya; they are shades of brown or grey and may have been heavily trampled to create relatively uniform matrix colours. Notwithstanding this visual homogeneity in the older layers, there are black and white lenses within, and occasionally rubefied strata under, combustion features that include hearths and ash lenses. Excavations into the deep Middle Stone Age occupations encompass 6 m\(^2\) in squares B4, B5, B6, C4, C5 and C6. Below, we describe the stratigraphy of layers from these squares, in a way appropriate to this paper (Table 1, Figure 2), beginning at the base of the 2011 Wadley excavation.

Layers BS15 to BS: Layer BS (Brown Sand) is a loose, brown sand (7.5YR 4/3 brown) with rock spalls. This deep, fairly uniform layer was subdivided artificially using ‘platforms’ of lithics as markers for each subdivision. The youngest of the BS layers dates to \( \sim 77.3 \) kya. For the volume of deposit excavated and the frequency of points/point fragments for each division see Table 1.

**Table 1.** Sibudu Layers BS, LBG, RGS and PGS: OSL ages, volume of sediments by litre, number of points and point fragments and number of points per litre (l) of sediment.

| Layer      | OSL age kya (Jacobs et al. 2008a) | Litres of deposit | Number of points/point fragments | Points per litre of deposit |
|------------|-----------------------------------|-------------------|---------------------------------|----------------------------|
| BS15–BS11  | No age estimate available         | 136.75            | 14                              | 0.1                        |
| BS10–BS    | 77.3 ± 2.7 (BS)                    | 543.35            | 14                              | 0.03                       |
| LBG4–LBG2  | 73.2 ± 2.7 (LBG 2)                | 230.8             | 0                               | 0                          |
| LBG        | 72.5 ± 2.5 (LBG)                   | 171.7             | 6                               | 0.02                       |
| RGS2       | No age estimate available         | 75                | 22                              | 0.3                        |
| RGS        | 70.5 ± 2.4                        | 242.7             | 32                              | 0.13                       |
| PGS3–PGS   | 64.7 ± 2.3 (PGS)                   | 570.8             | 21                              | 0.04                       |
Layers LBG4 to LBG: Layer LBG (Light, Brownish-Grey) comprises a light, brownish-grey (10 YR 6/2) soft, ashy silt with a few small rock spalls and large rocks encroaching into all squares, but to a lesser extent in B4 and C4. Extensive rock falls occurred before the ∼73.2 kya settlement of the site and the rocks were not completely covered by sediment until about ∼64.7 kya. LBG4, LBG3 and LBG2 are arbitrary divisions of LBG where the layer was thick. LBG was not subdivided in squares C5 and C6. An OSL age of 73.2 ± 2.7 kya was obtained from LBG2 and an age of 72.5 ± 2.5 kya is from LBG (Table 1; Jacobs et al. 2008a, 2008b). Points and point fragments were excavated only from squares B4, B5 and C4 in Layer LBG (see discussion below).

Layers RGS2 and RGS: Layer RGS (Reddish-Grey Sand) is a loose, reddish-grey sand (5 YR 5/2 reddish-grey) that is thin in the C line of squares and thicker in the B line. RGS2 artificially splits the thick RGS into squares B4, B5 and B6, but is not used in the C squares where RGS is seldom more than 5 cm thick. The OSL age of 70.5 ± 2.4 kya comes from RGS (Table 1; Jacobs et al. 2008b). From a sedimentary point of view (colour and textural similarities), there is no reason to split RGS into an upper layer and a deeper one (RGS2) and it must be borne in mind that the separation of the stone artefacts from squares B4, B5 and B6 into an upper RGS and a lower RGS2 is an artificial construct, all the more so because no such division was possible in squares C4, C5 and C6 where the thin RGS layer was undivided during excavation. Notwithstanding this caveat, the separation of the artefacts from RGS2 from those in RGS in squares B4, B5 and B6 has been made and is of interest because of their higher density in RGS2 compared with RGS, as well as for technological reasons that we explain later.

Layers PGS3 to PGS: Layer PGS (Pinkish-Grey Sand) is a loose, pinkish-grey sand (5 YR 5/2 pinkish-grey) that has a few small rock spalls and many large rocks encroaching
into all squares from Layer PGS3 to PGS2. The OSL age of 64.7 ± 2.3 kya comes from PGS. Squares C5 and C6 have considerable roof-rock fall in Layer PGS2. Rocks were repeatedly removed from all squares (below PGS2) while excavating and fallen rocks are an important consideration when analysing material from layers between LGB3 and PGS2. Rock fall is likely to have caused some mixing at the boundaries between strata. The most serious mixing occurred at the interface of Layers RGS and PGS3/2 where the rocks are large and RGS is relatively ephemeral (see also Soriano et al. 2015).

The stone artefacts from Layers BS15 to LBG have previously been described briefly by Wadley (2012) as pre-Still Bay and as belonging to a flake, not a blade, industry. Some rare unifacial points and dolerite denticulates were recorded here. In BS6 where fossilised bedding was recovered (Wadley et al. 2011) a few backed tools, including a wide segment, were found together with a unifacial point. Layers RGS2 and RGS contain assemblages previously described as Still Bay (Wadley 2007; Soriano et al. 2015) because both layers contain relatively thin, bifacial, lanceolate points, although most are in the form of distal and proximal point fragments. Layers PGS3 to PGS have previously been described as the early part of the Howiesons Poort at Sibudu (Wadley and Mohapi 2008; Kempson 2016). The PGS blade-rich assemblage with many backed tools, especially segments, is presently under study (Paloma de la Peña, pers. comm., July 2018), and a small study of stone artefacts from one square (C4) was previously carried out by Kempson (2016) who found that of the ~1000 by-products examined nearly half were blades or broken blades. Backed tools are the fossiles directeurs of the Howiesons Poort, but tiny quartz bifacial points, dated to ~63.8–61.7 kya, are now recognised as part of a potentially local late Howiesons Poort tradition at Sibudu (de la Peña et al. 2013; de la Peña and Wadley 2014; de la Peña 2015).

Our approach

Our analytical approach is the same as that published in Lombard and Högberg (2018), only slightly adapted from Högberg and Lombard (2016b). Instead of repeating the details of this here, we direct the reader to the ‘our approach’ section in these two open access publications. For detailed cross-referring to figures and tables to our approach see also our Appendix 1 online. In short, we record a series of attributes including raw material, the fragment type/completeness of the piece, length-width-thickness measurements, the base shape, cross-section and centredness of the dorsal ridge at the bilateral equilibrium, the placement of the bilateral equilibrium plane, whether the pieces were worked on one or both sides and blank type, as well as the use of pressure flaking as defined by Crabtree (1973), Patten (1978) and Patterson (1998) (see also Mourre et al. 2010; Högberg and Lombard 2016a). To make sure that fragments do not belong to the same points, all the points were laid out on a table and examined for possible refits. Based on the above criteria, we interpret (where possible) the point-production strategy for each piece. Thus far, we discriminate between five point-production strategies for retouched points associated with the Still Bay, which include: a) the bifacial nodule point-production strategy version 1; b) the bifacial nodule point-production strategy version 2; c) the bifacial blade point-production strategy; d) the bifacial flake point-production strategy; and e) the unifacial point-production strategy (Högberg and Lombard 2016b; Lombard and Högberg 2018).
The raw data for this study are available in Appendix 1. Our samples for each phase comprise all retouched points and point fragments, both unifacial and bifacial. Although the numbers of points for each point-bearing phase are relatively small, ranging from 14 to 32 in number, they are the largest samples available for temporally constrained work on point production straddling the Still Bay (apart from the Blombos sequence, which is currently not available for study). Our approach here is thus to formulate hypotheses and discussion based on the Sibudu material that can be assessed and extrapolated upon as larger samples become available for study in future.

Based on the site’s stratigraphy (see above) and impressions gained during assessment of the volumes excavated in which points occur (Table 1), as well as a preliminary impression of all the attributes (such as broad trends in raw material use, and point-production strategies) recorded during our study, we sub-divided the assemblage into the following phases, arranged chronologically from earlier to later:

- Wadley’s earlier pre-Still Bay (Layers BS15–BS11; thus far undated);
- Wadley’s later pre-Still Bay (Layers BS10–BS; uppermost layer BS dated to 77.3 ± 2.7 kya);
- Potential hiatus in point production (Layers LBG4-LBG2 excavated by Wadley; LBG2 dated to 73.2 ± 2.7 kya);
- Earlier Still Bay (Layers LBG–RGS2 excavated by Wadley; LBG dated to 72.5 ± 2.5 kya);
- Later Still Bay (Layer RGS excavated by Wadley; dated to 70.5 ± 2.4 kya);
- Terminal Still Bay/Wadley’s early Howiesons Poort (PGS layers excavated by Wadley; PGS2 undated; PGS dated to 64.7 ± 2.3 kya).

To extend our understanding of point production at the site through time, we also include in our morphometric analyses data for the pre-Still Bay serrated point assemblage excavated by the Conard team (Rots et al. 2017; Lombard and Höberg 2018), which underlies Wadley’s earlier pre-Still Bay, and data from the younger Howiesons Poort bifacial points, dated to ~63.8–61.7 kya (de la Peña et al. 2013; de la Peña and Wadley 2014; de la Peña 2015). To elaborate on inter-site variation, we compare the results from Sibudu with those already obtained from the Still Bay assemblages of Hollow Rock Shelter and Umhlatuzana in South Africa and Apollo 11 Cave in Namibia (Högberg and Lombard 2016b; Lombard and Höberg 2018).

**Sibudu point-production strategies, raw material use and morphometric attributes through time**

**Wadley’s earlier pre-Still Bay**

At this time, the unifacial point-production strategy dominates the manner in which knappers made their retouched points (N = 11, 79%). They used hornfels (N = 4, 29%), quartzite (N = 3, 21%) and dolerite (N = 3, 21%) to make these pieces, with a single point attempted in sandstone (Table 2, Figures 3 and 4). A few points were also produced using the bifacial nodule point-production strategy version 1 (N = 3, 21%). All those produced in this way were made in quartzite (N = 6, 43%). Quartzite was the material most often used for producing points during this phase at Sibudu.
Table 2. Summary of point-production strategies, material use, cross-sections, base shapes and morphometric data for the basal layers of Wadley’s earlier pre-Still Bay, Layers BS15–BS11. Number of points analysed = 14, see Figure 4 and Appendix A for details of each point. (Note: we rounded off percentages, so that totals may differ by up to 1% from those of subdivisions).

### Summary of materials used for point production

| Material     | Quartzite | | Dolerite | | Hornfels | | Quartz | | Sandstone |
|--------------|-----------|---|----------|---|------------|---|----------|---|----------|
| N% N% N% N% | 6 43 | | 3 21 | | 4 29 | | 0 - | | 1 7 |

### Point-production strategies in relation to material use

| Material     | Bifacial nodule pps 1 | | Bifacial nodule pps 2 | | Bifacial flake pps | | Unifacial pps | | Pps not known |
|--------------|----------------------|--|----------------------|--|-------------------|---|----------------|---|
| Quartzite    | 3 21 | | 0 - | | 0 - | | 3 21 | | 0 - |
| Hornfels     | 0 - | | 0 - | | 0 - | | 4 29 | | 0 - |
| Dolerite     | 0 - | | 0 - | | 0 - | | 3 21 | | 0 - |
| Sandstone    | 0 - | | 0 - | | 0 - | | 1 7 | | 0 - |
| Total = 14   | 3 21 | | 0 - | | 6 43 | | 14 100 |

### Cross-sections, base shapes and pressure flaking in relation to material use

| Cross-sections | Base shapes | Pressure flaking |
|----------------|-------------|------------------|
| Lenticular     | Semi-circular | Yes |
| Rhombic        | Triangle    | No |
| Wedge          |              |                 |
| Semi-circular  |              |                 |
| Triangular     |              |                 |
| N% N% N% N%   | N% N% N% N% | N% N% |
| Quartzite      | 2 14 - - - - | 4 29 - - | 0 - - - - | 0 - - - - | 6 43 - - |
| Hornfels       | 0 - - - - 1 7 | 0 - 3 21 | 0 - - - - | 0 - - - - | 4 29 - - |
| Dolerite       | 0 - - - - 1 7 | 1 7 1 7 | 0 - - - - | 0 - - - - | 1 7 - - |
| Sandstone      | 0 - - - - - - | 1 7 - - | 0 - - - - | 0 - - - - | 1 7 - - |
| Total = 14     | 2 14 0 - 2 14 | 6 43 4 29 | 0 - 1 7 6 43 | 0 - 14 100 |

### Summary of morphometric data

| Length | Width | Thickness | Length:Width | Length:Thickness | Width:Thickness |
|--------|-------|-----------|--------------|------------------|-----------------|
| Average | 47 | 20.7 | 7.9 | 2.2 | 6.3 | 2.7 |
| SD      | 18.4 | 5.2 | 1.8 | 0.5 | 1.9 | 0.6 |
| CV      | 39.1 | 24.9 | 22.2 | 23.6 | 29.8 | 20.8 |
Figure 3. Summary of point-production strategy and physical attribute frequencies (%) in relation to the materials used for knapping points at Sibudu during occupation by the makers of Wadley’s earlier pre-Still Bay. (Note: rounded off percentages were used in the graph, so that total percentages may differ by up to 1% from those of subdivisions. Key: BS base shape; CS cross-section; PPS point production strategy).

Figure 4. Retouched points, fragments and preforms from Wadley’s earlier pre-Still Bay (Layers BS15–BS11; thus far undated). Numbers correlate with the raw data provided in Appendix A.
Cross-sections are predominantly semi-circular (N = 6, 43%), represented on all the rock types — apart from hornfels — but mostly on quartzite (N = 4, 29%). Triangular cross-sections, on the other hand, dominate the hornfels assemblage with three out of the four hornfels pieces displaying this cross-section shape (Table 2, Figure 3). The characteristic Still Bay lenticular cross-section is only present on two of the pieces, both produced on quartzite. One hornfels and one dolerite piece each have a wedge-shaped cross-section. Not all pieces retained their butts (50% not known), but where it was possible to discern base shape all of the pieces had straight bases (N = 6, 43%), apart from the single point made on sandstone that has a semi-circular base often associated with the Still Bay (Table 2, Figures 3 and 4).

During this phase, we found no evidence that knappers attempted to use pressure flaking to shape their points. A summary of the morphometric traits of the Wadley’s earlier pre-Still Bay from stratigraphic layers BS15–BS11 points is presented at the bottom of Table 2, with the data for each point available in Appendix 1. In general, the point assemblage from these layers is not typical of Still Bay assemblages (cf. Wadley 2007; Villa et al. 2009; Högberg and Larsson 2011; Högberg and Lombard 2016b; Lombard and Högberg 2018), yet we do see some of the traits, such as bifacial shaping, lenticular cross-sections and points with semi-circular bases, appearing in small numbers.

Wadley’s later pre-Still Bay

This point assemblage directly overlies those described above and a date of 77.3 ± 2.7 kya was obtained for the uppermost layer of this phase. Compared to the previous phase, we recorded an increase in bifacial points produced with the bifacial nodule point-production strategy version 1 (N = 7, 50%). There is also a marked increase in the use of dolerite to produce these pieces (N = 4, 29%), as well as the introduction of bifacial points made on quartz (N = 2, 14%), and hornfels (N = 1, 7%), the latter having previously been used only to manufacture unifacial points (Tables 2 and 3, Figures 5 and 6). Although the emphasis now seems to have been placed on producing bifacial points, the knappers at Sibudu were still relying on the unifacial point-production strategy to manufacture 43% (N = 6) of their points during this phase. Quartzite is now mostly used (N = 3, 21%), as well as dolerite (N = 2, 14%) and hornfels (N = 1, 7%) for the unifacial point-production strategy. A single quartz point was made using the bifacial flake point-production strategy.

As opposed to the previous phase (Layers BS15-BS10), a shift is now evident toward points with lenticular cross-sections (N = 6, 43%), with fewer points displaying semi-circular cross-sections (N = 3, 21%). This trend seems to follow the move in material use towards dolerite, as most pieces with lenticular cross-sections were also produced from this material (N = 4, 29%). Single quartz and hornfels pieces also display this kind of cross-section (Table 3, Figure 5). The frequency of points with triangular cross-sections is the same as that during the previous phase (N = 4, 29%), but this form of cross-section was not used for dolerite (the material used most frequently during this phase for point production). We recorded only three points with semi-circular cross-sections (the shape that dominated during the previous phase), one each on dolerite, quartzite and quartz. Where it was possible for us to record them, semi-circular and straight base shapes are equally represented (N = 4, 29% each), with equal use of dolerite (N = 2, 14% each) and quartz (N = 1, 7% each). One quartzite piece has a straight base, whereas a single hornfels point has a semi-circular butt (Table 3, Figures 5 and 6).
Table 3. Summary of point-production strategies, material use, cross-sections, base shapes and morphometric data for Wadley’s later pre-Still Bay, Layers BS10–BS. Number of points analysed = 14, see Figure 6 and Appendix A for details of each point. (Note: we rounded off percentages, so totals may differ up to 1% from those of subdivisions).

| Summary of materials used for point production |
|-----------------------------------------------|
| Material          | Quartzite | Dolerite | Hornfels | Quartz | Sandstone |
|-------------------|-----------|----------|----------|--------|-----------|
| Material          | N %       | N %      | N %      | N %    | N %       |
| Total = 14        | 3 21      | 6 43     | 2 14     | 3 21   | 0         |

| Point-production strategies in relation to material use |
|--------------------------------------------------------|
| Material      | Bifacial nodule pps 1 | Bifacial nodule pps 2 | Bifacial flake pps | Unifacial pps | Pps not known |
|---------------|------------------------|------------------------|--------------------|---------------|---------------|
| Dolerite      | 4 29                   | 0 -                    | 0 -                | 2 14          | 0 -           |
| Quartzite     | 0 -                    | 0 -                    | 0 -                | 3 21          | 0 -           |
| Quartz        | 2 14                   | 0 -                    | 1 7                | 0 -           | 0 -           |
| Hornfels      | 1 7                    | 0 -                    | 0 -                | 1 7           | 0 -           |
| Total = 14    | 7 50                   | 0 -                    | 1 7                | 6 43          | 0 -           |

| Cross-sections, base shapes and pressure flaking in relation to material use |
|-------------------------------------------------------------------------------|
| Cross-sections | Base shapes | Pressure flaking |
|-----------------|-------------|------------------|
| Material        | Lenticular  | Rhombic          | Wedge | Semi-circular | Triangular | Pointed | Semi-circular | Straight | Yes | No |
| Dolerite        | 4 29        | 0 -              | 1 7   | 1 7           | 0 -        | 0 -     | 2 14          | 2 14     | 2   | 14 |
| Quartzite       | 0 -         | 0 -              | 0 -   | 1 7           | 2 14       | 0 -     | 0 -           | 1 7      | 1   | 7  |
| Quartz          | 1 7         | 0 -              | 0 -   | 1 7           | 1 7        | 0 -     | 1 7           | 1 7      | 0   | 3  |
| Hornfels        | 1 7         | 0 -              | 0 -   | 0 -           | 1 7        | 0 -     | 1 7           | 0 -      | 1   | 7  |
| Total = 14      | 6 43        | 0 -              | 1 7   | 21            | 4 29       | 0 -     | 4 29          | 4 29     | 4   | 29 |

| Summary of morphometric data |
|------------------------------|
| Length | Width | Thickness | Length:Width | Length:Thickness | Width:Thickness |
|--------|-------|-----------|--------------|------------------|-----------------|
| Average| 45.0  | 27.5      | 8.8          | 1.6              | 5.2             | 3.4             |
| Standard Deviation| 25.3 | 13.4 | 3.8 | 0.3 | 1.8 | 1.5 |
| CV     | 56.3  | 48.6      | 42.6         | 16.7             | 34.1            | 44.0            |
Figure 5. Summary of point-production strategy and physical attribute frequencies (%) in relation to the materials used for knapping points at Sibudu during Wadley’s later pre-Still Bay. (Note: rounded off percentages were used in the graph, so that total percentages may differ by up to 1% from those of subdivisions. Key: BS base shape; CS cross-section; PPS point production strategy).

Figure 6. Retouched points, fragments and preforms from Wadley’s later pre-Still Bay (Layers BS10–BS; uppermost layer BS dated to 77.3 ± 2.7 kya). Numbers correlate with the raw data provided in Appendix A.
We recorded evidence for pressure flaking on four pieces, two made of dolerite and one each from quartzite and hornfels. This method of shaping was not recorded for any of the pieces shaped during the previous phase, but has been suggested for serrated points found in older ‘pre-Still Bay’ contexts at Sibudu (Rots et al. 2017). Where the length dimension was available, points during Wadley’s later pre-Still Bay phase in layers BS10-BS were on average 45.0 mm long, 27.5 mm wide and 8.8 mm thick (Table 3).

What stands out during this phase is the increase in point traits traditionally associated with the Still Bay, such as the use of the bifacial nodule point-production strategy version 1 to produce points with lenticular cross-sections and semi-circular bases (e.g. Villa et al. 2009), whilst continuing with the unifacial point-production strategy.

**Potential hiatus in point production**

Although 230.8 litres of deposit were excavated, Layers LBG4-LBG2 of the Wadley excavation (the top of which is dated to 73.2 ± 2.7 kya; Table 1) contain no retouched points or point fragments and no points were recorded for the upper LBG layer in squares C5 and C6 where the layers have not been subdivided. Instead, all the recorded points in LBG (N = 6) originate from squares B4, B5 and C4 (Figure 2). Our interpretation of a potential disruption in point production during LGB4–LGB2 is therefore as feasible as the excavated material allows. Layers LBG4–LBG2 are otherwise relatively rich in informal stone artefacts, negating any idea of a total occupational hiatus. Four of the six points (67%) from LBG are bifacial and have lenticular cross-sections. Out of the three base shapes preserved, all are semi-circular (50%). The point sample for LBG is too small to be statistically meaningful, but it seems to be separate from the pre-Still Bay phases and have broad Still Bay-like traits. We therefore interpret these points as being most closely associated with the directly overlaying earlier Still Bay and include their data as part of that phase for the purposes of this study.

**Earlier Still Bay**

In the layers representing this phase emphasis is on bifacial production (54%, N = 15). Knappers now used three different strategies to make bifacial points. The bifacial nodule point-production strategy version 1 was used for 43% (N = 12) of the points, most of which were made on dolerite (N = 7, 25%), but also making use of hornfels (N = 3, 11%) and quartzite (N = 2, 7%). Additionally, the bifacial flake point-production strategy was used to produce two hornfels points, while a single dolerite point was made with the bifacial nodule point-production strategy version 2, previously not used for point production at Sibudu (Table 4, Figure 7).

The unifacial point-production strategy is, however, a noticeable part of point manufacture at the site during this phase with 29% (N = 8) of all the points being made this way, four on hornfels, three on dolerite and one on quartzite. We were unable to determine point-production strategies for five pieces in this assemblage. Material use for point production shows a marked difference in the importance of hornfels (N = 11, 39%) compared to the later pre-Still Bay phase (N = 2, 14%).

Points with lenticular cross-sections (N = 15, 54%) dominate the assemblage, produced equally frequently on both dolerite (N = 6, 21%) and hornfels (N = 6, 21%), with some on
Table 4. Summary of point-production strategies, material use, cross-sections, base shapes and morphometric data for the earlier Still Bay, Layers LBG–RGS2. Number of points analysed = 28, see Figure 8 and Appendix A for details of each point. (Note: we rounded off percentages, so totals may differ by up to 1% from those of subdivisions).

| Material  | Quartzite |  | Dolerite |  | Hornfels |  | Quartz |  | Sandstone |  |
|-----------|-----------|----------------|----------|----------------|----------|----------|----------|----------|-----------|----------|
| Total = 28 | 3  | 11 |  | 13  | 46 |  | 11  | 39 | 1  | 4  | 0  | -  |

**Summary of materials used for point production**

| Material  | Quartzite |  | Dolerite |  | Hornfels |  | Quartz |  | Sandstone |  |
|-----------|-----------|----------------|----------|----------------|----------|----------|----------|----------|-----------|----------|
| Total = 28 | 12  | 43 |  | 1  | 4  |  | 2  | 7  | 8  | 29  | 5  | 20  |

**Point-production strategies in relation to material use**

| Material  | Bifacial nodule pps 1 |  | Bifacial nodule pps 2 |  | Bifacial flake pps |  | Unifacial pps |  | Pps not known |  |
|-----------|------------------------|----------|------------------------|----------|-------------------|----------|-------------|----------|---------------|----------|
| Dolerite  | 7  | 25 | 1  | 4  | 0  | -  | 3  | 11 | 2  | 7  |
| Hornfels  | 3  | 11 | 0  | -  | 2  | 11 | 4  | 14 | 2  | 7  |
| Quartzite | 2  | 7  | 0  | -  | 0  | -  | 0  | -  | 1  | 4  |
| Quartz    | 0  | -  | 0  | -  | 0  | -  | 1  | 4  | 0  | -  |
| Total = 28 | 15  | 54 | 1  | 4  | 2  | 7  | 8  | 29 | 5  | 20  |

**Cross-sections, base shapes and pressure flaking in relation to material use**

(Note: N = 21, 75 % of base shapes not known)

| Cross-sections | Lenticular | Rhombic | Wedge | Semi-circular | Triangular | Pointed | Semi-circular | Straight | Pressure flaking | Yes | No |
|----------------|------------|---------|-------|---------------|------------|---------|---------------|----------|-----------------|-----|----|
| Material  | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % | N % |
| Dolerite  | 6  | 21  | 1  | 4  | 0  | -  | 5  | 18 | 1  | 4  | 1  | 4  | 2  | 7  | 1  | 4  | 1  | 4  | 12  | 43 |
| Hornfels  | 6  | 21  | 0  | -  | 2  | 7  | 3  | 11 | 0  | -  | 2  | 7  | 0  | -  | 0  | -  | 11  | 39 |
| Quartzite | 3  | 11  | 0  | -  | 0  | -  | 0  | -  | 0  | -  | 0  | -  | 0  | -  | 0  | -  | 3  | 11 |
| Quartz    | 0  | -  | 0  | -  | 0  | -  | 1  | 4  | 1  | 4  | 1  | 4  | 5  | 20 | 1  | 4  | 1  | 4  | 26  | 93 |
| Total = 28 | 15  | 54 | 1  | 4  | 0  | -  | 7  | 25 | 5  | 19 | 1  | 4  | 5  | 20 | 1  | 4  | 1  | 4  | 26  | 93 |

**Summary of morphometric data**

(Note: all length data include only complete and almost complete pieces; other data include complete pieces and those for which maximum width and thickness could be measured)

| Length | Width | Thickness | Length:Width | Length:Thickness | Width:Thickness |
|--------|-------|-----------|--------------|------------------|-----------------|
| Average | 52.8  | 28.0  | 9.3  | 1.9  | 5.8  | 3.2  |
| Standard Deviation | 22.0  | 13.4  | 4.5  | 0.5  | 1.3  | 0.9  |
| CV     | 41.7  | 47.9  | 48.5 | 25.0 | 21.9 | 29.0 |
quartzite (N = 3, 11%), representing all the quartzite pieces in this assemblage (Table 4, Figures 7 and 8). The semi-circular cross-section shape is the second most frequently recorded (N = 7, 25%); it is mostly present on dolerite pieces (N = 5, 18%), but is also found on hornfels (N = 2, 7%) (Table 4, Figure 7). Only 19% (N = 5) of the pieces have triangular cross-sections as opposed to 29% in both pre-Still Bay phases (Table 4, Figure 7). Materials used to make points with triangular cross-sections include hornfels (N = 3, 11%), dolerite and quartz (N = 1 and 4% for each). For the first time we see a dolerite point with a pointed base, which is a well recognised characteristic of Still Bay points (Goodwin and van Riet Lowe 1929). Apart from another dolerite point with a straight base, all the other points for which we could determine this attribute (N = 5, 18%) have semi-circular bases made on dolerite (N = 2, 7%), hornfels (N = 2, 7%) and quartz (N = 1, 4%) (Table 4, Figures 7 and 8).

A single dolerite piece displayed traces of pressure flaking. Points of this phase have mean dimensions of 52.8 mm in length, 28 mm in width and 9.3 mm in thickness (Table 4, Figure 7). Traits strongly associated with Still Bay points such as bifacial retouch, lenticular cross-sections and retouched bases (semi-circular or pointed) clearly dominate the assemblage compared to the pre-Still Bay phases.

**Later Still Bay**

Whereas unifacial point production was a substantial part of point production during all the previous phases excavated by Wadley, we recorded a solitary unifacial point made of dolerite for the ∼70.5 kya occupation (Table 5, Figures 9 and 10). The bifacial nodule point-production strategy version 1 dominates (N = 12, 39%), with some points knapped using the bifacial flake point-production strategy (N = 4, 13%). Dolerite is by far the preferred material for point knapping (N = 18, 58%), used for the bifacial nodule point-production strategy version 1 (N = 8, 26), the bifacial flake point-production strategy version 1 and the unifacial strategy (Table 5). This marked shift in material usage is linked to the transition from unifacial to bifacial production observed by Wadley (1983) and is recorded in the Sibudu Cave assemblages for the first time.

![Figure 7](image_url)

**Figure 7.** Summary of point-production strategy and physical attribute frequencies (%) in relation to the materials used for knapping points at Sibudu during the earlier Still Bay phase. (Note: rounded off percentages were used in the graph, so that total percentages may differ by up to 1% from those of subdivisions. Key: BS base shape; CS cross-section; PPS point production strategy).
Figure 8. Retouched points, fragments and preforms from the earlier Still Bay (Layers LBG–RGS2 excavated by Wadley; LBG dated to 72.5 ± 2.5 kya). Numbers correlate with the raw data provided in Appendix A.
Table 5. Summary of point-production strategies, material use, cross sections, base shapes and morphometric data for the later Still Bay, Layer RGS. Number of points analysed = 31, see Figure 10 and Appendix A for details of each point. (Note: we rounded off percentages, so totals may differ by up to 1% from those of subdivisions).

### Summary of materials used for point production

| Material    | Quartzite | Dolerite | Hornfels | Quartz | Sandstone |
|-------------|-----------|----------|----------|--------|-----------|
| N           | 14        | 6        | 7        | 5      | 2         |
| N%          | 51        | 18       | 23       | 16     | 0         |

### Point-production strategies in relation to material use

| Material    | Bifacial nodule pps 1 | Bifacial nodule pps 2 | Bifacial flake pps | Unifacial pps | Pps not known |
|-------------|-----------------------|-----------------------|--------------------|---------------|---------------|
| Dolerite    | 8                     | 6                     | 1                  | 3             | 7             |
| Hornfels    | 2                     | 6                     | 1                  | 3             | 4             |
| Quartzite   | 1                     | 3                     | 1                  | 3             | 3             |
| Quartz      | 1                     | 3                     | 0                  | 0             | 0             |
| Total       | 12                    | 39                    | 2                  | 6             | 14            |

### Cross-sections, base shapes and pressure flaking in relation to material use

| Cross-sections | Base shapes | Pressure flaking |
|----------------|-------------|------------------|
| Lenticular     | Semi-circular | Pointed | Semi-circular | Straight | Yes | No |
| N %            | N %          | N %              | N %            | N %       | N % |
| Dolerite       | 12           | 39               | 0              | 0         | -   | 0   |
| Hornfels       | 3            | 10               | 0              | 0         | -   | 0   |
| Quartzite      | 3            | 10               | 0              | 0         | -   | 0   |
| Quartz         | 1            | 3                | 0              | 0         | -   | 0   |
| Total          | 19           | 61               | 0              | 0         | -   | 0   |

### Summary of morphometric data

| Length | Width | Thickness | Length:Width | Length:Thickness | Width:Thickness |
|--------|-------|-----------|--------------|------------------|-----------------|
| Average| 52.6  | 30.3      | 8.7          | 1.9              | 5.6             |
| Standard Deviation| 12.5  | 5.8       | 2.2          | 0.3              | 1.5             |
| CV     | 23.7  | 19.0      | 25.5         | 18.1             | 25.9            |
|        |       |           |              |                  | 21.2            |
strategy (N = 2, 6%) and the single unifacial point. Hornfels is the second most popular point-making material, with seven points made of this material, two using the bifacial nodule point-production strategy version 1 and one for a piece made with the bifacial flake point-production strategy (Table 5, Figures 9 and 10). Quartzite was used for five points, one made using the bifacial nodule point-production strategy version 1, one using the bifacial flake point-production strategy and three with unknown point-production strategies. The single quartz point was produced with the bifacial nodule point-production strategy version 1. For a relatively large portion of the assemblage (N = 14, 45%), we were unable to determine a point-production strategy with confidence as a result of fragmentation and/or the production phase (Table 5, Figures 9 and 10) (see discussion in Högberg and Lombard 2016b).

Bar the single unifacial dolerite point, all the pieces now have mostly lenticular (N = 19, 61%) and, to a lesser extent, semi-circular (N = 11, 35%) cross-sections, mostly made on dolerite, but with some on hornfels and quartzite (Table 5, Figure 8). The single quartz point also has a lenticular cross-section. All three base shapes are represented, even though we were not able to record this attribute for most of this assemblage (N = 16, 65%). One dolerite and one hornfels point each have a pointed base, while three dolerite pieces together with the one quartz piece have semi-circular butts. Although straight bases were strongly associated with unifacial point production in the basal layers of the Wadley excavation (Wadley’s earlier pre-Still Bay, Layers BS15–BS11), we see their return here in the context of bifacial point production with five pieces displaying this trait, only one of which is a unifacial point (Table 5, Figures 9 and 10).

Three pieces show evidence of pressure flaking, two of which are in quartzite and one in hornfels (sensu Soriano et al. 2015). The points present during this ~70.5 kya phase measure on average 52.6 mm long, 30.3 mm wide and 8.7 mm thick (Table 5). Compared to the previous phases, the knapping of unifacial points and triangular cross-sections have...
Figure 10. Retouched points, fragments and preforms from the later Still Bay (Layer RGS excavated by Wadley; dated to 70.5 ± 2.4 kya). Numbers correlate with the raw data provided in Appendix A.
both now almost disappeared. Bifacial points with lenticular and semi-circular cross-sections dominate the assemblage, yet where we were able to record the trait it seems as if straight butts now make a comeback.

**Terminal Still Bay/Wadley’s Early Howiesons Poort**

If the point component is not the result of sediment disturbance caused by the rock fall, these layers may represent a terminal Still Bay expression at Sibudu although they are heavily dominated by backed tools associated with the Howiesons Poort. Bifacial point production is still the most used strategy, with five of the dolerite and two of the quartzite pieces made with the bifacial nodule point-production strategy version 1 (Table 6, Figures 11 and 12). A further four quartzite points were produced with the bifacial flake point-production strategy. Two unifacial points were produced, one on dolerite and one on hornfels. At 62% (N = 13), dolerite is the dominant material for point production during this phase, with 33% (N = 7) of the pieces made on quartzite and only one on hornfels (Table 6, Figures 11 and 12).

Whereas lenticular cross-sections dominated in the two preceding phases, at 48% (N = 10) they are now only marginally more frequent than pieces with semi-circular cross-sections (N = 9, 43%). Most dolerite pieces have a lenticular cross-section shape (N = 8, 38%), while the semi-circular cross-section shape is well-represented on both quartzite (N = 5, 24%) and dolerite (N = 4, 19%). The single hornfels piece is also the only one with a triangular cross-section (Table 6, Figure 11). One dolerite point and one quartzite point each have a pointed base, but most of the pieces for which we could identify base shapes had semi-circular bases (N = 4, 19%). Two of the quartzite pieces have straight bases (Table 6, Figures 11 and 12). We recorded evidence of pressure flaking on two (10%) of the quartzite pieces and one dolerite point. A summary of the morphometric data is presented in Table 6, with all of the recorded detail for each piece given in Appendix 1.

**Comparative analyses**

Above we presented our results for the six phases created for our study. Here, we directly compare some aspects of our analysis regarding temporal trends in retouched point production at the site from >77.3 ± 2.7 kya to 64.7 ± 2.3 kya. We also compare the combined pre-Still Bay and combined Still Bay point assemblages of Sibudu with similar sets of data obtained from those excavated at Hollow Rock Shelter, Umhlatuzana and Apollo 11 (for which data were published in Högberg and Lombard 2016b; Lombard and Högberg 2018). First, however, we present intra-site comparative data that assess the pre-Still Bay and Still Bay phases at Sibudu against some of the criteria originally used to define the Still Bay technocomplex, i.e., bifacial retouch, semi-circular or pointed butts, and lenticular cross-sections (Goodwin and van Riet Lowe 1929) (Figure 13).

**Still Bay characteristics and morphometric analysis of the Sibudu sequence**

Our comparative analysis of the key Still Bay point characteristics demonstrates that, notwithstanding a potential hiatus in point production at about ≥ 73.2 kya, some
Table 6. Summary of point-production strategies, material use, cross sections, base shapes and morphometric data for the PGS layers. Number of points analysed = 21, see Figure 12 and Appendix A for details of each point. (Note: we rounded off percentages, so totals may differ by up to 1% from those of subdivisions).

| Summary of materials used for point production |
|-----------------------------------------------|
| **Material** | **Quartzite** | **Dolerite** | **Hornfels** | **Quartz** | **Sandstone** |
| **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| **Total = 21** | 7 | 33 | 13 | 62 | 1 | 5 | 0 | - | 0 | - |

| Point-production strategies in relation to material use |
|-------------------------------------------------------|
| **Material** | **Bifacial nodule pps 1** | **Bifacial nodule pps 2** | **Bifacial flake pps** | **Unifacial pps** | **Pps not known** |
| **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| **Dolerite** | 5 | 24 | 0 | - | 0 | - | 1 | 5 | 1 | 5 |
| **Quartzite** | 2 | 10 | 0 | - | 4 | 19 | 0 | - | 1 | 5 |
| **Hornfels** | 0 | - | 0 | - | 0 | - | 1 | 5 | 0 | - |
| **Total = 21** | 7 | 33 | 0 | - | 4 | 19 | 2 | 10 | 8 | 38 |

| Cross-sections, base shapes and pressure flaking in relation to material use |
|--------------------------------------------------------------------------|
| **Material** | **Cross-sections** | **Base shapes** | **Pressure flaking** |
| **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| **Lenticular** | 8 | 38 | 1 | 5 | 0 | - | 4 | 19 | 0 | - | 1 | 5 |
| **Rhombic** | 2 | 10 | 0 | - | 2 | 10 | 0 | - | 1 | 5 |
| **Wedge** | 0 | - | 0 | - | 0 | - | 1 | 5 | 0 | - | 0 | - |
| **Semi-circular** | 43 | 19 | 1 | 5 | 0 | - | 2 | 10 | 4 | 19 |
| **Triangular** | 1 | 5 | 3 | 14 | 0 | - | 1 | 5 | 1 | 5 |
| **Pointed** | 2 | 10 | 2 | 10 | 2 | 10 | 3 | 14 | 18 | 86 |
| **Yes** | 1 | 5 | 12 | 57 | 1 | 5 | 12 | 57 | 1 | 5 |
| **No** | 7 | 33 | 4 | 19 | 0 | - | 0 | - | 1 | 5 |

| Summary of morphometric data |
|-----------------------------|
| **Material** | **Length** | **Width** | **Thickness** | **Length:Width** | **Length:Thickness** | **Width:Thickness** |
| **Average** | 48 | 26.8 | 8.4 | 1.7 | 5.1 | 3.2 |
| **Standard Deviation** | 14.1 | 4.0 | 1.1 | 0.6 | 1.8 | 0.4 |
| **CV** | 29.5 | 14.8 | 13.6 | 33.3 | 36.0 | 12.7 |
technological traits of Still Bay point production (for example, bifacial nodule point-production strategy version 1, lenticular cross-sections and semi-circular bases) already appear in the ≥77.3 kya assemblages. After the interruption in point production somewhere between ∼73.2 and ∼72.5 kya in Layers LBG4-LBG2, Still Bay point production intensified at Sibudu between ∼72.5 and ∼70.5 kya. Invasive bifacial retouch reaches its climax during the later Still Bay (Figure 12). Cumulatively, 43% (N = 12 out of 28) of all the pre-Still Bay points and point fragments were bifacially retouched, as opposed to the 63% (N = 50 out of 80) of the combined Still Bay ones. Lenticular cross-section shapes follow a similar tendency, also reaching their peak by ∼70.5 kya.

During the combined pre-Still Bay phases 29% (N = 8) of the pieces were produced in a manner that resulted in a lenticular cross-section, whereas this frequency rises to 55% (N = 44) during the Still Bay. Many of the pieces were fragmentary so we could not determine their base shapes. However, working with what is present in the assemblages, it appears that the characteristic Still Bay semi-circular butt already makes its appearance during the pre-Still Bay at Sibudu. Of all the pre-Still Bay pieces, 18% (N = 5) have Still Bay-typical bases, whilst these semi-circular or pointed bases are present on 21% (N = 17) of the Still Bay pieces (Figure 13). Based on the original definition provided for Still Bay points, these data indicate that some point-production traditions such as butt shape, often associated with the Still Bay, spanned about ten millennia at Sibudu. The Still Bay technocomplex therefore does not seem to represent a technological revolution.

Teased apart, as we have done for the production strategy and material analyses above, the individual sample sizes for complete points in each of our sub-phases at Sibudu are too small to provide meaningful morphometric comparisons. Moreover, our interpretation of the data presented thus far justifies the grouping of Wadley’s pre-Still Bay phases and the combined Still Bay phases into two separate units for comparative purposes. To extend our understanding of point production at the site through time, we further include in our morphometric analysis published data for the pre-Still Bay serrated point assemblage

**Figure 11.** Summary of point-production strategy and physical attribute frequencies (%) in relation to the materials used for knapping points at Sibudu during the terminal Still Bay/Wadley’s Early Howiesons Poort. (Note: rounded off percentages were used in the graph, so that total percentages may differ by up to 1% from those of subdivisions. Key: BS base shape; CS cross-section; PPS point production strategy).
excavated by the Conard team underlying Wadley’s pre-Still Bay (Rots et al. 2017), as well as data from the younger Howiesons Poort bifacial points. These small quartz points are from the GS and GR stratigraphic layers in the Sibudu sequence dated to ~63.8–61.7 kya (see de la Peña et al. 2013; de la Peña and Wadley 2014; de la Peña 2015).

Box-and-whisker plots for the Sibudu sequence show some degree of overlap and no obvious outliers in any of the dimensions measured or amongst the shape ratios (Figure 14). The distributions for length and thickness during the early pre-Still Bay occupation from the Conard excavation display a higher degree of standardisation compared to the same dimensions during the two subsequent phases. In general, the dimensions of the Conard pre-Still Bay serrated point assemblage are more standardised than those of Wadley’s younger pre-Still Bay and the Still Bay phases. This could be an artefact of selective sampling because we do not have information about points other than the serrated ones.

Figure 12. Retouched points, fragments and preforms from the terminal Still Bay/Wadley’s early Howiesons Poort (PGS layers excavated by Wadley; PGS undated; PGS dated to 64.7 ± 2.3 kya). Numbers correlate with the raw data provided in Appendix A.
excavated from this context by the Conard team. However, the large number of bifacial tool pieces (N = 170) from this Conard pre-Still Bay collection (Rots et al. 2017) is on its own a departure from the components of the younger pre-Still Bay layers described here. The Howiesons Poort point assemblage is the most standardised in its length and width dimensions, but the least so in thickness. There are no significant differences in any of the dimensions on record for the Sibudu pre-Still Bay vs Still Bay assemblages (see p-values in the table of Figure 14). On the other hand, comparing actual length, width and thickness dimensions (diagram to the left in Figure 14), there are significant differences in length between the Howiesons Poort points and those of the combined pre-Still Bay and Still Bay phases, as well as between the widths of the Howiesons Poort points compared to those of the Still Bay.

Comparing ratios (diagram to the right in Figure 14) we see that during the Wadley pre-Still Bay phase the length:width shape ratio is the most standardised. The length:thickness ratio displays the most variation throughout the sequence. Regardless of a possible hiatus in point production, there seems to be an increasing measure of standardisation in the width:thickness ratio throughout the Sibudu sequence (Figure 14). There are no differences in the length:width ratio, but there are differences in both the length:thickness and width:thickness ratios of the Howiesons Poort points compared to those of the pre-Still Bay and Still Bay. In sum, the Howiesons Poort points are significantly shorter and fatter than the preceding point assemblages from Sibudu.

Our morphometric analysis demonstrates a relatively high degree of similarity in all dimensions and ratios spanning the Sibudu pre-Still Bay and Still Bay, with no significant
Intra- and inter-site point-production strategies

Our graph (Figure 15) representing all the points and point fragments from Sibudu for which we were able to identify their point-production strategies demonstrates the following:

- the bifacial nodule point-production strategy version 1 was already in practice during the earlier pre-Still Bay, increasing markedly during the later pre-Still Bay to a level not much different from that which was used some millennia later during the early Still Bay and then climaxing at ∼70.5 kya during the later Still Bay phase;
a distinct decrease is apparent in the use of the unifacial point-production strategy through time (between >77 and 65 kya), with most unifacial points recorded for Wadley’s earlier pre-Still Bay and the least number for the terminal Still Bay/early Howiesons Poort at ≥64.7 kya;

initial use of the bifacial flake point-production strategy occurred during Wadley’s later pre-Still Bay before being picked up on again during the early Still Bay and culminating in the terminal Still Bay/early Howiesons Poort;

a brief experimentation with the bifacial nodule point-production strategy version 2 took place during the earlier Still Bay phase that was abandoned during subsequent Still Bay phases.

In sum, the pre-Still Bay at Sibudu is clearly distinct from the Still Bay phases in terms of the frequency with which unifacial points were produced. However, our analysis does not demonstrate that the Still Bay represents a dramatic innovation regarding how knappers went about making their retouched points. Instead, trends observed during the pre-Still Bay phases were picked up on and continued and/or intensified during the Still Bay phases.

Compared to the point-production strategies applied at other Still Bay sites (Figure 15), the Sibudu pre-Still Bay is distinct and conservative in the sense that only two strategies were used to manufacture retouched points, with the unifacial point-production strategy dominant. This is most similar to the Apollo 11 Still Bay assemblage, where knappers also used the unifacial point-production strategy most frequently, sometimes also applying the bifacial nodule point-production strategy version 1 (cf. Lombard and Högberg 2018). During the Still Bay at Sibudu, Umhlatuzana and Hollow Rock Shelter a total of five different point-production strategies were applied with relatively little reliance on the unifacial point-production strategy compared to the Sibudu pre-Still Bay and the Apollo 11 Still Bay.

In terms of configuration in point-production strategies used during the Still Bay, the Sibudu assemblage is most similar to that of Hollow Rock Shelter, with the same four strategies applied at both sites, the most prevalent being the bifacial nodule point-production strategy version 1, the least often used strategy the bifacial nodule point-production strategy version 2. However, compared to what happened at Sibudu, Hollow Rock Shelter knappers used the bifacial flake point-production strategy more frequently than the

Figure 15. Intra- and inter-site variation in the use of point-production strategies (percentages calculated from all points with known point-production strategies in each assemblage).
unifacial point-production strategy, while these two strategies were applied with almost equal frequency at Sibudu (Figure 15). Umhlatuzana stands out in terms of the use of the bifacial blade point-production strategy, which has thus far only been recorded at this site, potentially representing a local innovation during its Still Bay phase (Högberg and Lombard 2016b). However, here, as well as at Sibudu and Hollow Rock Shelter, the bifacial nodule point-production strategy version 1 was used most frequently. This is thus far also the only production strategy reported for the relatively large Still Bay point assemblage from Blombos (Villa et al. 2009).

**Intra and inter-site material use for retouched point production**

At Sibudu, the use of dolerite to manufacture retouched points displays a clear increase through time (Figure 16). Quartzite was most often used during the early pre-Still Bay, but became less important during the later pre-Still Bay. It was used for only a few points during the early Still Bay, but became gradually more popular again during the subsequent phases. The use of hornfels seems to indicate a break in material-use tradition. This rock was less often used for point production during the later pre-Still Bay than its earlier phase, but was used frequently during the earlier Still Bay phase, with a decrease in its importance in the subsequent Still Bay phases. Sandstone was used only for a single point during the earlier pre-Still Bay phase. Quartz was introduced during the later pre-Still Bay and was then used infrequently thereafter, until the Howiesons Poort where it became an important raw material for the production of small, stubby points (de la Peña et al. 2013; de la Peña and Wadley 2014; de la Peña 2015). Rots and colleagues (2017), however, reported quartz being dominant again during the Conard pre-Still Bay layers that underlie the Wadley pre-SB layers. The material analysis validates variability between the pre-Still Bay and Still Bay assemblages at Sibudu. Nevertheless, the recorded trends in point frequencies produced on rocks such as dolerite and quartzite, and to a lesser extent on quartz, support an interpretation of long-standing developments in techno-behaviours associated with point production as opposed to a radical transformation with the introduction of the Still Bay phase at Sibudu.

![Figure 16](image-url)
Comparing the pre-Still Bay material use patterns at Sibudu with the combined Still Bay assemblages from the same site, Apollo 11, Umhlutuzana and Hollow Rock Shelter (Figure 16), Sibudu’s overall reliance on local dolerite as opposed to quartzite becomes apparent, with minimal use recorded of either quartz or sandstone. Dolerite was used in equal proportions during the combined Still Bay occupation at Sibudu, but was never used at the relatively nearby site of Umhlutuzana. Here, similar to Hollow Rock Shelter and Apollo 11, knappers preferred to make their points on quartzite and in all four of the Still Bay assemblages quartz was used to a greater or lesser extent, but markedly more frequently compared to the pre-Still Bay at Sibudu. As far as we are aware, all the materials at all the sites were locally available to knappers or available at a short distance from the site. Thus, although a possible ‘tradition’ could have existed for making Still Bay points on quartzite and quartz, the point knappers clearly also used materials unique to their own environments. These included dolerite at Sibudu, silcrete at Hollow Rock Shelter and crypto-crystalline minerals at Apollo 11 (Lombard and Högb erg 2018).

**Inter-site comparative morphometric analysis**

Multivariate patterns in bifacial point shape and size, gained from 3D scans, have previously been used to demonstrate temporal morphological variation within the Still Bay of Blombos (Archer et al. 2015) and across South Africa (Archer et al. 2016). Here, we use straightforward measurements for each dimension (length, width, thickness) to assess whether there are marked differences between the Still Bay assemblages from Sibudu, Umhlutuzana, Hollow Rock Shelter and Apollo 11. Our box-and-whisker plots show some overlap for all three dimensions measured for all four Still Bay assemblages (Figure 17, diagram to the left). Generally, the Still Bay points from Umhlutuzana seem to be the most uniform, apart from the thickness of the Apollo 11 points. For all the Still Bay assemblages, thickness is the most similar dimension. The dimensions of the Still Bay points from Sibudu are most similar to those from Apollo 11, the latter of which also display no significant differences in length, width and thickness compared with Still Bay points from Hollow Rock Shelter (Figure 17). The least similar with regards to variation in all dimensions are the point assemblages from Hollow Rock Shelter and Umhlutuzana. Sibudu Still Bay points are further noticeably longer than those from Hollow Rock Shelter and wider than those from Umhlutuzana, whereas the Umhlutuzana points are significantly narrower than those from Apollo 11 (Figure 17).

Looking at the shape ratios, there is general overlap in the length:thickness ratio, with no significant differences between any of the sites (see the table in Figure 17). This is, however, also the ratio that is least standardised, so that data sets are relatively widely spread. Even though the sites are the closest to each other, the shapes of the Sibudu Still Bay points are the most different from those found at Umhlutuzana, with significant differences in both their length:width and width:thickness ratios. Other marked differences include the length:width ratio between points from Sibudu and Hollow Rock Shelter, and between the latter and Apollo 11. In terms of width:thickness, there is a distinct difference between the Umhlutuzana and Apollo 11 Still Bay point assemblages. In general, and apart from the similarity between the Sibudu and Apollo 11 Still Bay assemblages, there are more significant differences among Still Bay assemblages than among the Sibudu pre-Still Bay and Still Bay assemblages.
Discussion and conclusion

**Sibudu point production in context**

The Wadley team’s excavations at Sibudu Cave have uncovered one of the most complete and stratigraphically intact Middle Stone Age sequences in southern Africa. Building on this effort, the Conard team’s work continues to demonstrate the stratigraphic complexity of the site and is excavating ever older occupations. Based on material generated from these excavations, we are able to demonstrate variation in point production, material use and morphometric attributes throughout a sequence spanning more than ten thousand years at the site.

Juxtaposing detailed point-production analyses of the localised Sibudu phases with regional (KwaZulu-Natal) and supra-regional (KwaZulu-Natal, Western Cape and southern Namibia) assemblages enables us to move away from mere descriptive macro-scale studies toward explaining intra- as well as inter-regional techno-behavioural trends regarding point production. Our results demonstrate intra-site similarities and differences through time, with subtle shifts in point-production strategies, material use and morphometric attributes. They also suggest that some traditions bridge both the pre-Still Bay and Still Bay phases at Sibudu.

**Figure 17.** Inter-site comparative morphometric data distribution. Within the boxes ‘x’ indicates the mean and ‘−’ the median for each distribution. Sample sizes: Sibudu pre-Still Bay Conard N = 8; Sibudu pre-Still Bay Wadley N = 10; Sibudu Still Bay N = 15; Umhlatuzana Still Bay N = 16; Hollow Rock Shelter Still Bay N = 20; Apollo 11 Still Bay N = 11. Table shows t-test result p values (two-tail), significant differences (p = ≤0.05) are in bold.

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| Data sets compared               | Length | Width | Thickness | L:W | L:T | W:T | p-values |
|---------------------------------|--------|-------|-----------|-----|-----|-----|----------|
| Sibudu combined SB vs Umhlatuzana SB | 0.388  | 0.006 | 0.466     | 0.003 | 0.838 | 0.000 |          |
| Sibudu combined SB vs Hollow Rock Shelter SB | 0.039  | 0.070 | 0.258     | 0.000 | 0.187 | 0.176 |          |
| Sibudu combined SB vs Apollo 11 SB | 0.438  | 0.433 | 0.487     | 0.114 | 0.072 | 0.567 |          |
| Umhlatuzana SB vs Hollow Rock Shelter SB | 0.001  | 0.014 | 0.057     | 0.070 | 0.187 | 0.176 |          |
| Umhlatuzana SB vs Apollo 11 SB | 0.077  | 0.012 | 0.405     | 0.114 | 0.151 | 0.000 |          |
| Hollow Rock Shelter SB vs Apollo 11 SB | 0.282  | 0.664 | 0.096     | 0.045 | 0.548 | 0.318 |          |
A general comparison of points from the oldest and the youngest layers included in our analysis shows differences similar to those reported for Blombos Cave (Archer et al. 2015). However, looking in more detail at how point production played out temporally, we see that Still Bay point production is explicit and that it has its origin at Sibudu already during Wadley’s pre-Still Bay (≥77.3 ± 2.7 kya), when some technological and morphometric attributes emerge, climaxing during the later Still Bay at ~70.5 kya.

The current absence of points in Layers LBG4–LBG2 at Sibudu requires some thought and further investigation. These layers are rich in lithic flakes and chips, combustion features, worked ochre and smashed, burnt bone, so the absence of points cannot be explained by people not using the shelter during this phase. Several scenarios are possible: a) the people of Sibudu did not make or use retouched points during this phase; b) there was a shift in spatial organisation during this time with point production/use happening elsewhere at the site or off site; or c) there was a regional or supra-regional break in point production during this time.

During the terminal Still Bay/Wadley’s early Howiesons Poort layers (≥64.7 kya) we see the advent of intense production of a Howiesons Poort technology in the form of backed tools and blades. The presence of some Still Bay points in the PGS layers at Sibudu could represent the final expression of this technocomplex and it is not impossible that the early Howiesons Poort may have incorporated aspects of the Still Bay. On the other hand, some Still Bay points in this layer (and some backed tools in Layer RGS) may represent admixing between Still Bay and Howiesons Poort layers as a result of the extensive rock fall that we mentioned above. These hypotheses can all be tested with ongoing work at the site.

In sum, variation in point production at Sibudu for the >77.3 to ≥64.7 kya period is not radical, but nuanced. We do, however, see a technological rearrangement starting with the production of the small bifacial quartz points dated between ~63.8 and 61.7 kya. These points are morphometrically significantly different, compared to the preceding Still Bay and pre-Still Bay points, and constrained to the use of a single material, namely quartz. Consequently, our results support previous interpretations of technological rearrangement between the Still Bay and Howiesons Poort at Sibudu (e.g. de la Peña and Wadley 2017).

We also compared the Still Bay points from Sibudu with those from three additional southern African sites with dated Still Bay assemblages. The results presented here support conclusions from our previous studies in which we have shown inter-regional similarities and differences in point-production strategies between sites (Högberg and Lombard 2016b; Lombard and Högberg 2018). Here, we have also shown that similarities between layers within the Sibudu Still Bay sequence are more pronounced than similarities between the sites compared. Cumulatively, our results imply intra- and inter-regional Still Bay point-production conventions over the extended landscape. They also highlight variability in inter-regional point production strategies.

To us, a surprising result is the difference revealed in point production and shape between the two Still Bay sites analysed from KwaZulu-Natal. First, almost one third (29%) of Umhlatuza’s points were produced from blades, a strategy never used at Sibudu during the phases presented in this study (Figure 15). Second, acknowledging differences in the raw materials used, the Still Bay points from Umhlatuza and Sibudu are most different from each other in shape, whereas the points from Umhlatuza are more similar to those from Hollow Rock Shelter in the Western Cape Province and those from Sibudu more similar to those from Apollo 11 in southern Namibia (Figure 17). However, the
lithic raw material close to Umhlatuzana is of a better quality than that near Sibudu (Wadley, personal observation) and this may account for some of the differences between the stone artefacts at the two sites. This is a result that contrasts with the finding of Archer and colleagues (2016), who saw a spatial separation between site clusters in the northeast as opposed to those in the southwest of southern Africa (see also Soriano et al. 2015).

**Material culture, climate and environmental change**

There has been wide discussion about climate and environmental change as drivers for innovation in the late Middle Stone Age (Wadley 2015; Wilkins et al. 2017). Several studies have elaborated on human adaptation to radical changes as an explanation for the variation in material culture expressed in the archaeological record (e.g. Chase 2010; McCall and Thomas 2012; Mackay et al. 2014). Our analysed sequence of point production at Sibudu spans a period of substantial changes in sea levels, temperature and humidity (Wadley 2013; Ziegler et al. 2013).

Our research reveals an absence of point production at Sibudu in Layers LBG4–LBG2. An OSL age estimate of 73.2 ± 2.7 kya for Layer LBG2 indicates that this hiatus centres around this age and/or somewhat older occupations. An OSL age of 77.3 ± 2.7 kya for the underlying BS layer suggests that the hiatus in point manufacture is unlikely to have been longer than about 4000 years. As there are no direct age determinations available for Layers LBG4 and LBG3 (where no points occur), a more accurate start date for this change in techno-behaviour cannot be presented at this stage. The age range for the hiatus, however, roughly coincides with the onset of MIS 4 glacial conditions and the recorded 76–72 kya change in vegetation at Blombos (Hillestad Nel and Henshilwood 2016). At Sibudu, tooth enamel from pre-Still Bay ungulates has lower δ¹³C and δ¹⁸O values than those later in the sequence. This implies a more closed, likely heavily forested, and wetter habitats than subsequent phases (Robinson and Wadley 2018), supported by anthracological studies (Lennox and Wadley 2019) and remains of forest-dwelling mammals such as blue duiker (*Philantomba monticola*) and bushpig (*Potamochoerus larvatus*) (Jamie Clark, pers. comm., August, 2018).

Hence, fluctuations in local environment possibly had consequences for the people of Sibudu through shifts in the flora, and consequently the fauna, of the site’s surroundings. If so, local hunting opportunities and food collecting possibilities would have changed. This assumption can be tested in future when environmental reconstructions are completed. Looking at possible scenarios for a hiatus in point production at Sibudu, we present the following testable scenarios:

- if the people of Sibudu did not make or use retouched points for some time between ≤77 and ≥73 kya, it could reflect a local technological disruption as a result of change in flora and fauna, resulting in a change in site function and organisation;
- if, instead of climate-caused change in techno-behaviour, there was a shift in spatial organisation during this time with point production/use happening elsewhere at the site, this will be revealed by the Conard team’s expansion into new excavation areas;
- if there was a regional or supra-regional break in point production during this time, it needs to be demonstrated by more extensive dating and comparative work on the stone artefacts from stratified sequences that span the Still Bay. Only once this has been
accomplished, can the notion of the Still Bay as an abrupt techno-behavioural phenomenon be discussed effectively because here we have demonstrated that, notwithstanding a potential break, long-lasting Still Bay point-making traditions survived for several thousands of years before and after the onset of MIS 4.

Another possibility, of course, is that social and demographic changes that are not yet properly understood (Conard and Will 2015; Högberg and Lombard 2016b; de la Peña and Wadley 2017) were responsible for the technological choices made at Sibudu.

We argue that if spatial re-organisation has been eliminated as an explanation for the perceived point-production hiatus at Sibudu, and if a synchronised regional supra-regional break cannot be demonstrated explicitly, then the people making use of Sibudu were technologically disrupted or isolated for a period of time. When social and/or climatic circumstances on the landscape opened up again for contact with groups, who continued to make retouched points according to previously established traditions, they picked up on these again.

Alternatively, if climatic changes caused shifts in the size or shape of local floral and faunal communities (a temporary change viewed in long-term perspective, but perhaps lasting over generations), then perhaps Sibudu was not a good place for spear hunting for a while, but was better suited for other meat-getting strategies. This might explain the continuity in point-making traditions as well as the change in hornfels use. Moving away from the site for hunting and butchery activities with retouched points might have introduced point makers to readily available hornfels resources on the wider landscape, a tradition that they then continued at the site based on knowledge gained during the point production hiatus there.

In conclusion

Humans function and interact within a multi-dimensional cognitive and social landscape, with long-lasting social trends and ideologies developing over time. Variations in techno-behaviours resonate with ways to interact with multifaceted socio-economic landscapes (Lombard 2012, 2016). The highly developed flexibility in human capacity enables diversity in knowledge-transfer across groups and generations (Gärdenfors and Högberg 2017; Riede et al. 2018), facilitating technological variability and plastic responses to new situations and often building on established traditions. This is reflected in the outcome of our study.

Our results demonstrate that changes in climate over time did not lead to innovation or radical changes in retouched point production during the period spanning the Still Bay expression at Sibudu (≥77.3–64.7 kya). Consequently, we do not see the Still Bay expression as a short-lived and discontinuous technological innovation diametrically aligned with climatic disruption (contra Henshilwood 2012; Ziegler et al. 2013). Instead, continuity in traditions seem to have resulted in small technological changes through time. This is in line with Kandel and colleagues (2016: 644), who state that ‘contrary to the idea that the MSA [Middle Stone Age] represents a time of sudden increases in complex behaviour, on the macro-scale we just see slow and steady change’.

At the same time, we recorded a possible disruption in point production at the site, indicating (in a long-term perspective) the temporal effect of environmental change on a local scale. Currently, we are only able to present hypothetical explanations for this
observation. However, comparing point data from before and after this possible interruption, we can conclude that traditions in retouched point production were continuous. Although humans were affected by, and reacted to, environmental changes (see the discussion in Wilkins et al. 2017), at Sibudu this did not result in lasting change in their technology. Technological traditions associated with the Still Bay at the site were of relatively long duration. Knowledge of particular knapping techniques was obviously passed down through generations over thousands of years.

Comparing sites on a regional and supra-regional scale, we see that variation is not specifically related to biotopes. There are both similarities and differences in technological traditions between sites located in the same, as well as in different, current rainfall zones. This is different from the outcome reached by Archer and colleagues (2016), who suggested that there is a geographically separated variation in points between northeastern and southwestern sites in South Africa with little evidence of cultural interconnectedness. We do not rule out cultural exchange over long distances in southern Africa spanning the Still Bay. Instead, we contend that until such time as similarly high-resolution data to those we were able to generate here for Sibudu become available for several sites across the landscape, it is premature to venture broad explanations for the regional and supra-regional variation in Still Bay point production.

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