



HAL
open science

Variability in Middle Stone Age symbolic traditions: The marine shell beads from Sibudu Cave, South Africa

Marian Vanhaeren, Lyn Wadley, Francesco D'errico

► To cite this version:

Marian Vanhaeren, Lyn Wadley, Francesco D'errico. Variability in Middle Stone Age symbolic traditions: The marine shell beads from Sibudu Cave, South Africa. *Journal of Archaeological Science: Reports*, 2019, 27, pp.101893. 10.1016/j.jasrep.2019.101893 . hal-02998635

HAL Id: hal-02998635

<https://hal.science/hal-02998635v1>

Submitted on 11 Nov 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Manuscript Details

Manuscript number	JASREP_2017_485_R1
Title	Variability in Middle Stone Age symbolic traditions: the marine shell beads from Sibudu Cave, South Africa
Short title	Marine shell beads from Sibudu
Article type	Research Paper

Abstract

Located in the KwaZulu-Natal, 15 km from the coast, Sibudu has yielded twenty-three marine gastropods, nine of which perforated. At 70.5 ± 2.0 ka, in a Still Bay Industry, there is a cluster of perforated *Afrolittorina africana* shells, one of which has red ochre stains. There is also a perforated *Mancinella capensis* and some unperforated shells of both *A. africana* and *M. capensis*. The cluster may represent an area where the shells were processed or where apparel to which shells were attached was lost. In a Howiesons Poort layer, 64.7 ± 1.9 ka, there is a single perforated *Afrolittorina africana* shell. This shell may be from the Still Bay and may have been dislodged by rock fall. Two *Nassarius kraussianus* shells, one of them perforated and bearing traces of utilisation as a bead, were found in a late Middle Stone Age layer with an OSL age of 46.6 ± 2.3 ka. *N. kraussianus* was not found in older layers, even though this taxon occurs in southern Cape sites during the Middle Stone Age. Where the perforations are undamaged and suitable for microscopy, they appear to have been made by punching the shells with a pointed tool made of bone or hard wood. Such perforations have been replicated experimentally. Unlike the Blombos beads, the Sibudu shells from the Still Bay and Howiesons Poort layers bear no compelling evidence of use wear in their perforations. We therefore cannot be certain that they were suspended. However, if the Sibudu shells were beads, the changing use of taxa through time suggests variability in symbolic traditions.

Keywords	Middle Stone Age; marine shell ornaments; microscopy; taphonomy
Corresponding Author	Marian Vanhaeren
Corresponding Author's Institution	CNRS
Order of Authors	Marian Vanhaeren, Lyn Wadley, Francesco d'Errico
Suggested reviewers	Antonietta Jerardino, Karen van Niekerk, Susan Pfeiffer, Chris Stringer, Alison S Brooks, Christopher Henshilwood

Submission Files Included in this PDF

File Name [File Type]

Sibudu_DearEditor_June2019.docx [Cover Letter]

Sibudu marine shell beads Revised June 2019.doc [Response to Reviewers]

Sibudu_Highlights_June2019.docx [Highlights]

Sibudu_ResonseToReviewers_June2019.docx [Manuscript File]

To view all the submission files, including those not included in the PDF, click on the manuscript title on your EVISE Homepage, then click 'Download zip file'.

Journal of Archaeological Science: Reports

Dear Editor,

Please find here attached our manuscript on the “*Variability in Middle Stone Age symbolic traditions: the marine shell beads from Sibudu Cave, South Africa*”.

This manuscript corresponds to a revised and updated version of the one we submitted in August 2017 (JASREP_2017_485) and for which we got two positive reviews (see “Comments from the editors and reviewers” here below). The present manuscript addresses all these comments (see “Response to Reviewers 1 and 2” here below) and integrates relevant new literature published since then.

Hoping JASR will consider the manuscript for publication, we remain,
Yours Sincerely,

Marian Vanhaeren,
Corresponding author on the behalf of the other author

Comments from the editors and reviewers

-Reviewer 1

- Dear Colleagues

I like this paper a lot, and think it makes an important contribution to the study of marine shell beads in Southern Africa.

All of the things to correct are simple things: there are some abbreviations that just 'appear' in the text that should be clarified, and some small things that could be adjusted on some figures. As a general point, I feel that some of the paragraphs and sentences within them, particularly in the introductory section (but also in the discussion) would benefit with being shortened or split up to make them easier for the reader to follow. This also holds true for the discussion section, where you make some very important and interesting points that are sometimes a little lost in the longer sentences!. Also, some of your reference strings in the Introduction and background sections e.g. lines 51-55 and 123-130, break up the flow somewhat.

Use of Thanatocoenoses throughout - absolutely proper, but consider noting somewhere really early on that this is 'Death assemblage'?

Diagram, Figure 1, has the Portuguese spelling of Mozambique (Mocambique), is this intentional? while the rest of the spelling on the map is in conventional English.

Line 208 - here you use the abbreviation post-HP, presumably for post Howiesons Poort, but do not actually introduce the abbreviation previously.

Line 213 - OMOD, which is a reference to one of your stratigraphic contexts is not mentioned in its long form in the text.

Line 218 - SB, again presumably Still Bay, discussion shifts straight to the abbreviation without directly noting that this is Still Bay.

Lines 256-266 - The sentences in this paragraph could benefit from being split up. additionally the discussion, back and forth about issues surrounding the OSL ages at Diepkloof, if relevant to the wider picture being presented in this paper here is not immediately obvious? and the paragraph feels like it needs one further sentence to close it out.

*Lines 255-257 - this sentence could be reworded slightly? e.g.: 'The chronostratigraphy of of pre-Still bay, Still Bay and Howiesons Poort layers, determined through OSL and TL dating, has, for some years, situated...'
the confusion here (for me anyway) comes from the late placement of Chronostratigraphy in the middle of the sentence...*

Lines 344-345 - single sentence paragraph, consider merging it into 4.6?

Figure 5 - the base axis on your ternary taphogram is very difficult to read properly, it is not at all clear which species name relates to which data point. you could consider different symbols for each species? and/or put the names of species at an angle to allow them to be more closely related to their relevant data points.

*line 425 - *Nassarius kraussianus* should be italicized*

section 7- conclusions. you again use OMOD here, having not set up its abbreviated meaning earlier.

-Reviewer 2

- Important paper. I think one figure needs modification and you could clarify the captions of others. I'm slightly concerned by your rather definite conclusions of cultural difference given the extremely slight evidence. May need a little tidying otherwise but requiring only minor revisions (below).

Line Issue

57 et seq. omit 'ago' after 'ka' - the abbreviation 'ka' implies the 'ago' so it doesn't need stating

65 italicise 'Conus'

NB It might be clearer if the stratigraphic overview in Section 2 were condensed into a table summarising stratigraphy, dates and key characteristics of layers so that the salient points only were highlighted in the text.

Fig. 3. Very nice to see the shells in these plans (I guess they are plans?) but it would be helpful if a key to the taxa was contained in the caption. It is irritating to have to scroll to the table to see which is which.

209 'bedding strata' - not clear what this means - had people burnt bedding in these strata? or were there abundant signs of burning in these layers? or what? Rephrase please!

213 What is OMOD?

219 If you are going to give Latin binomials for the blue duiker and other antelope, please give them also for red duiker and steenbok.

224 binomial for vervet monkey?

235 'tend' should be 'tended'. It all happened some time ago.

238 remove 'the'. NB it is unclear whether the argument about heat-treatment of lithic raw material relates to Blombos or Sibudu. If at Blombos, I'm not sure it is needed here.

255 Incomplete sentence. or does it continue into 256? - if so 'Chronostratigraphy' does not need an initial capital. And is the Tribolo et al. argument needed here?

284 If you have 4 sites, you have four assemblages, not one. And are they truly thanatocoenoses? Is it possible that they were modified by your collection methods? I think you need to state your criteria and methods for collection during the two hours and where on the shoreline you were collecting, as dead shells are strongly sorted by wave and current action so that strandline assemblages will differ from assemblages cast on upper beaches by storm waves, for instance.

Fig. 4. Please add names of taxa and which numbers relate to them to the caption

368 This heading is the first mention of sampled biocoenoses - you need to add something about the acquisition of these to your materials and methods! You talk earlier of a thanatocoenosis. In this heading it has suddenly become plural and below you seem to be talking of four assemblages. Again, please clarify!

374-6 Is this part of the table caption? It doesn't seem to be. These localities should be documented in the Materials and Methods.

Fig. 5. You need to use colours or symbols to differentiate taxa in your ternary diagram. It is not always clear which name goes with which dot

417 is 'one' necessary

513 and elsewhere: space SI units and notation e.g. 2 kcal for 0.4 g

539 start sentence with 'Transport in the stomach...

596 OESB is an unnecessary abbreviation. If ostrich doesn't and didn't occur locally the absence of ostrich eggshell beads points to (a) a lack of long-distance travel and/or long-distance exchange networks for the Sibudu people at this point and (b) that beads were culturally necessary but the choice of taxon used was relatively expedient.

620-625 You are really dealing with the statistics of small numbers here and I think over-interpreting! The excavated area is tiny and the number of shells minute. This patterning could equally well be random. I suggest you phrase this as a suggestion to be tested by further work, rather than as a solid difference between people generating the different lithic industries

Response to Reviewers 1 and 2

Response to Reviewer 1

We have clarified the abbreviations post-HP (post-Howiesons Poort), OMOD (Orange Mottled Deposit) and SB (Still Bay) and rephrased or split-up the longish paragraphs, sentences and reference strings in the introductory and discussion sections. The meaning of the word “thanatocoenoses” is now explained in the introduction. Here below the details of the modifications:

- Reference strings in lines 51-55 and 123-130 were split up.
- The meaning of “Thanatocoenoses” was explained early on in the introduction
- Mozambique was spelled in conventional English in Figure 1
- Line 208 it is now explained here that the abbreviation “post-HP” means “post-Howiesons Poort”
- Line 213 the long form of the OMOD abbreviation is now explained (i.e. Orange Mottled Deposit).
- Line 218 the abbreviation SB is explained in the Introduction.
- Lines 256-266 – This paragraph has been modified to explain the relevance of the OSL ages at Diepkloof for the discussion on the dating of the Still Bay and Howiesons Poort at Sibudu: If contemporaneity is suggested for Diepkloof and the Western Cape, there is, for the time being, no evidence suggesting that this would be the case for Sibudu and the KwaZulu-Natal region.
- Lines 255-257 – This sentence indeed had a problem and has been reworked in order to start with “Chronostratigraphy”
- Lines 344-345 As suggested, the single sentence paragraph has been merged into the previous one.
- Figure 5 - Species names and data points are now connected with arrows.
- Line 425 - *Nassarius kraussianus* is now italicized
- Section 7- conclusions. The meaning of the OMOD abbreviated has been explained earlier on.

Response to Reviewer 2

We modified Figures 3-5 and rephrased the conclusion to be more cautious and refer to necessary further excavations to test our interpretation of cultural differences. Also the other issues raised by reviewer 2 were addressed:

- Line 57 et seq. We omitted 'ago' after 'ka'

- Line 65 'Conus' is now in italic

- Detailed studies of the stratigraphy, cultural remains, and dates of Sibudu have been published elsewhere and we provide only an overview in Section 2. Without complete re-writing of this section, it is difficult to summarise it in a table as suggested by Reviewer 1 as we combine data from different studies. We think section 2 gives an as condensed overview as possible and would like to keep this section as it is.

- Figure 3 Taxa identification are (and were) given within the figure. The caption now explains the presence of symbols, colors and plan views of the shells.

- Line 209 The phrase about 'bedding strata' was rephrased in order to make clear it refers to strata wherein the inhabitants burnt beddings made of plant material

- Line 213 the meaning of the abbreviation of stratigraphic layer "OMOD" is now explained (i.e. Orange Mottled Deposit).

-Line 219 we give the Latin binomials for red duiker and steenbok.

-Line 224 the Latin binomial for vervet monkey has been given

-Line 235 'tend' was corrected by 'tended'.

-Line 238 'the' was removed and it has been made clear that the argument about heat-treatment refers to Sibudu

-Line 255 This sentence has been rephrased and the relevance of the Tribolo et al. argument has been clarified.

- Line 284 The collecting methods have been clarified as follows: "Dead shells were sampled at each location for two hours during low tide between the upper beach and the strandline" and that the "Fragmentation properties were also described independently of their location".

-Figure 4. Taxa identification is now given within the caption.

-Line 368 The acquisition of the biocoenoses is explained in the method section under point 4.2.

-Line 374-6 The coordinates of the sampled beaches and the malacological reference

collections are now documented in the Materials and Methods instead of in the caption of Table 2 and Figure 6

-Fig. 5. Arrows make clear now which name goes with which dot.

-Line 417 'one' has been eliminated from the sentence

-Line 513 and elsewhere: a space has been added between SI units and notation

-Line 539 The sentence now starts with 'Transport in the stomach...'

-Line 596 The abbreviation OESB has been eliminated.

-Line 620-625 The conclusion has been phrased more cautiously.

1 **Variability in Middle Stone Age symbolic traditions: the marine shell beads from Sibudu**
2 **Cave, South Africa**

3

4 Marian Vanhaeren^{a,*}, Lyn Wadley^b, Francesco d'Errico^{a,c}

5

6 ^a Unité Mixte de Recherche 5199, De la préhistoire à l'actuel: culture, environnement,
7 anthropologie, Centre National de la Recherche Scientifique, Université de Bordeaux, Bâtiment
8 B2, Allée Geoffroy Saint Hilaire, CS 50023, F-33615 Pessac Cedex, France.

9 marian.vanhaeren@u-bordeaux.fr, francesco.derrico@u-bordeaux.fr

10 ^b Evolutionary Studies Institute, University of the Witwatersrand, 1 Jan Smuts Avenue,
11 Braamfontein 2000, Johannesburg, South Africa Johannesburg, South Africa.

12 Lyn.Wadley@wits.ac.za

13 ^c SFF Centre for Early Sapiens Behaviour (SapienCE), University of Bergen, Bergen, Norway.

14 * Corresponding author

15

16 **Highlights**

17

- 18 • We analyse marine gastropods from Sibudu dated to between 70 ka and 46 ka
- 19 • We study present day gastropod biocoenoses and thanatocoenoses along the KwaZulu Natal
20 coast
- 21 • *Nassarius kraussianus* shells were used as beads at Sibudu 46 ka
- 22 • *Mancinella capensis* and *Afrolittorina africana* may have been used as beads 70 ka
- 23 • Observed differences in perforated taxa over time suggests variability in symbolic traditions

25 **Abstract**

26 Located in the KwaZulu-Natal, 15 km from the coast, Sibudu has yielded twenty-three marine
27 gastropods, nine of which perforated. At 70.5 ± 2.0 ka, in a Still Bay Industry, there is a cluster
28 of perforated *Afrolittorina africana* shells, one of which has red ochre stains. There is also a
29 perforated *Mancinella capensis* and some unperforated shells of both *A. africana* and *M.*
30 *capensis*. The cluster may represent an area where the shells were processed or where apparel to
31 which shells were attached was lost. In a Howiesons Poort layer, 64.7 ± 1.9 ka, there is a single
32 perforated *Afrolittorina africana* shell. This shell may be from the Still Bay and may have been
33 dislodged by rock fall. Two *Nassarius kraussianus* shells, one of them perforated and bearing
34 traces of utilisation as a bead, were found in a late Middle Stone Age layer with an OSL age of
35 46.6 ± 2.3 ka. *N. kraussianus* was not found in older layers, even though this taxon occurs in
36 southern Cape sites during the Middle Stone Age. Where the perforations are undamaged and
37 suitable for microscopy, they appear to have been made by punching the shells with a pointed
38 tool made of bone or hard wood. Such perforations have been replicated experimentally. Unlike
39 the Blombos beads, the Sibudu shells from the Still Bay and Howiesons Poort layers bear no
40 compelling evidence of use wear in their perforations. We therefore cannot be certain that they
41 were suspended. However, if the Sibudu shells were beads, the changing use of taxa through
42 time suggests variability in symbolic traditions.

43

44 **Keywords**

45 Middle Stone Age, marine shell ornaments, microscopy, taphonomy

46

48 1. Introduction

49 Early instances of personal decoration (e.g. Deacon, 1995; Ambrose, 1998; Kuhn et al., 2001;
50 Henshilwood et al., 2004; Vanhaeren et al. 2006; Bouzouggar et al., 2007; Bar-Yosef Mayer et
51 al., 2009; d’Errico et al. 2009; Conard, 2010; d’Errico and Backwell, 2016; Bicho et al., 2018;
52 see Steele et al. 2019 for a review) have attracted the attention of archaeologists interested in the
53 emergence of modern cultural traits because they are generally considered a convincing hallmark
54 of symbolically mediated behaviour and, by extension, a reflection of cultures comparable to
55 those known today (e.g. McBrearty and Brooks, 2000; Wadley, 2003; Kuhn and Stiner, 2007;
56 Henshilwood and Dubreuil, 2011; d’Errico et al., 2003; d’Errico and Stringer, 2011; Shipton et
57 al., 2018). The discovery, more than a decade ago, of marine shells used as beads at the southern
58 African Middle Stone Age (MSA) site of Blombos Cave, in layers dated to ca 72 ka
59 (Henshilwood et al., 2004; d’Errico et al., 2005; Vanhaeren et al., 2013) has challenged the
60 longstanding paradigm according to which personal decoration did not occur before 40 ka.
61 Additional marine shell beads dated to between ca 100 ka and 70 ka were identified in
62 subsequent years at seven Aterian and Levantine Mousterian sites of North Africa and Western
63 Asia (Vanhaeren et al., 2006; Bouzouggar et al., 2007; d’Errico et al., 2009; Bar-Yosef et al.,
64 2009) and in the Howiesons Poort of Border Cave in South Africa (d’Errico and Backwell,
65 2016). At each of these sites personal ornaments consist of perforated shells belonging almost
66 exclusively to a single species: *Nassarius gibbosulus* in Morocco and Algeria, this species and
67 *Glycymeris* sp. in Israel, and *Nassarius kraussianus* and *Conus ebraeus* shells in South Africa.
68 Taphonomic analysis and experimental reproduction of the modifications recorded on the shells
69 have shown that *N. kraussianus* were collected alive, whereas *N. gibbosulus* and *Glycymeris* sp.
70 were gathered dead on the shores. Some of these beads bear traces of pigment and intense use-
71 wear. Experimental reproduction of use-wear recorded on *Nassarius kraussianus* shell beads
72 from Blombos Cave has recently shown that a clear change in the way of stringing beads and the
73 visual appearance of the resulting beadwork occurred at Blombos Cave between lower and upper
74 Still Bay layers (Vanhaeren et al., 2013). It has also been shown that these changes were
75 coincident with environmental change and the way in which the habitation space was used.
76 When recovered at sites excavated with modern standards these shell beads often bear traces of
77 red pigment. Some of them are blackened by heating either accidentally or for the purpose of
78 changing their colour (d’Errico et al., 2015).

79 While confirming the existence of early bead-using traditions these discoveries have also raised
80 questions about the mechanisms that have led to the emergence and maintenance of such
81 innovation. On the one hand, no personal ornaments have been so far reported from sites

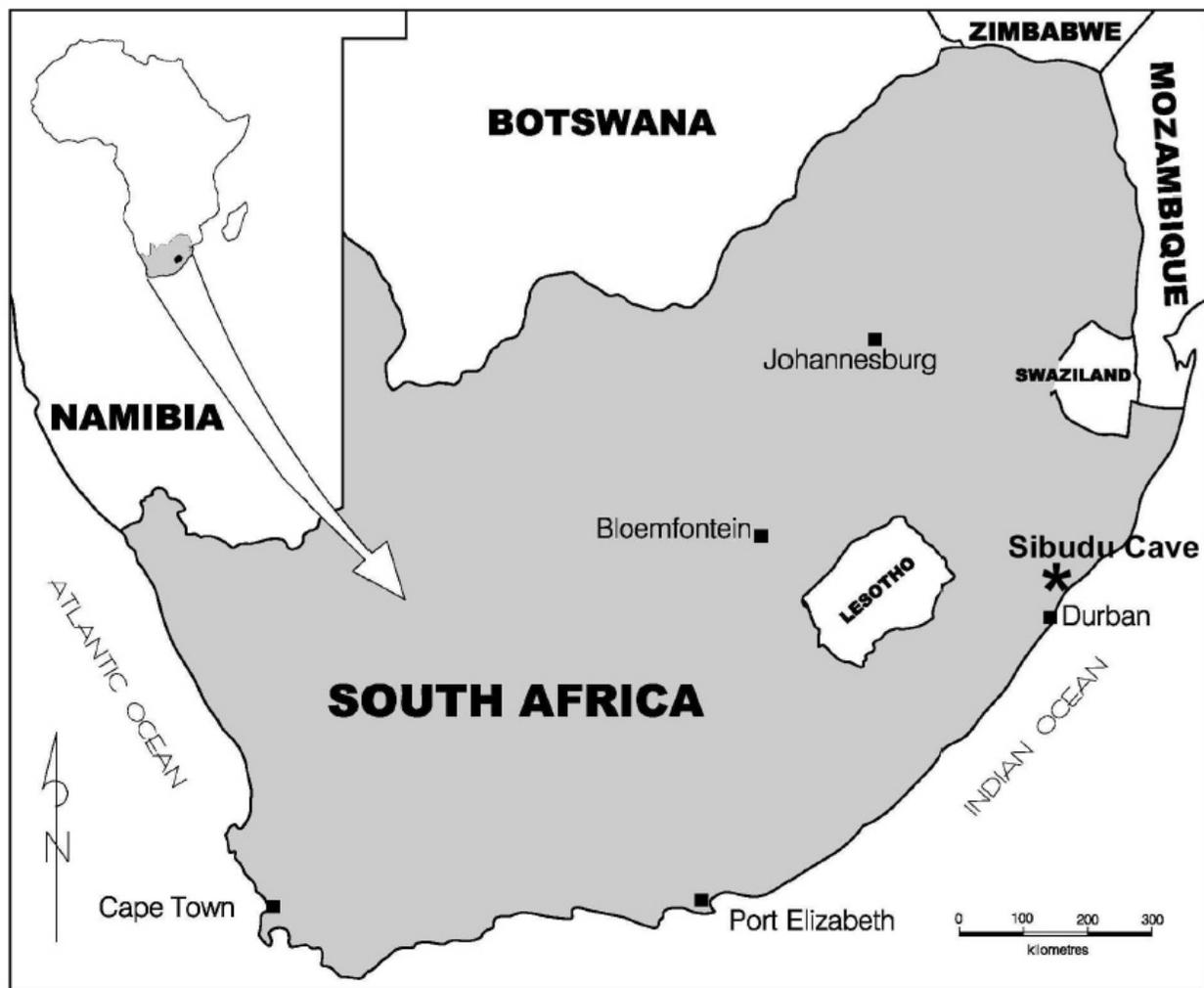
82 securely dated to between 70 ka and 50 ka and the ornaments attested in Africa at ca. 45 ka
83 (Ambrose, 1998; d’Errico et al., 2012; Gliganic et al., 2012; Miller and Willoughby, 2014),
84 almost exclusively consisting of ostrich egg shell and stone beads, suggests cultural discontinuity
85 with previous traditions. This contradicts (d’Errico and Stringer, 2011) the scenario according to
86 which the emergence of cultural complexity would be reflected by a process of continuous
87 accretion and implementation of cultural innovations. On the other hand, although convincing
88 and associated with other striking evidence of cultural complexity, the Blombos and Border Cave
89 shell beads were, until now, the only reliable instance of personal ornamentation prior to 70 ka
90 for the southern African continent.

91 In a previous paper we reported the presence of possible shell beads in the Still Bay layers at
92 Sibudu Cave, KwaZulu-Natal, South Africa (d’Errico et al., 2008). They consist of six
93 *Afrolittorina africana*, five of which were recovered in the Still Bay and one in the lowermost
94 Howiesons Poort layer of this site. Three of these shells bear perforations, one has residues of red
95 pigment, and three are blackened by heating. One shell bears a complete and a broken
96 perforation that can correspond to a repair after a first break. Taphonomic analysis of the
97 archaeological specimens based on present day *Afrolittorina africana* biocoenoses, microscopic
98 examination, experimental perforation of modern shells, and a review of the natural agents that
99 may accumulate marine shells at inland sites such as Sibudu has suggested to us probable human
100 involvement in the collection, transport, modification, and abandonment of Sibudu’s
101 *Afrolittorina africana*. Here we report on the discovery of an extended collection of marine
102 shells from the late Middle Stone Age (MSA), Howiesons Poort (HP), Still Bay (SB), and pre-
103 Still Bay (pre-SB) layers of this site. These shells belong to three species (*Afrolittorina africana*,
104 *Mancinella capensis* and *Nassarius kraussianus*); some are perforated, heated, and bear red
105 pigment residues. Study of archaeological and experimentally perforated shells, and comparison
106 with shells from modern biocoenoses (*i.e.* living assemblages) and thanatocoenoses (*i.e.* dead
107 assemblages) of the Ballito Bay shores, allows us to reinforce the argument for their being
108 purposely collected, modified and used as beads. A detailed description of this material and
109 related behavioural correlates is key to assessing recent claims according to which the production
110 of personal ornaments would have little implication for the emergence of complex human
111 cognition (Haidle et al., 2015; Garofoli, 2014).

112

114 **2. Background to Sibudu**

115 Sibudu is a large rock shelter above the uThongathi River, about 40 km north of Durban in
116 KwaZulu-Natal, South Africa (Fig. 1). At present the shelter is about 15 km inland of the coast
117 and the maximum distance from the coast during the last glacial episode is likely to have been
118 about 20 km.



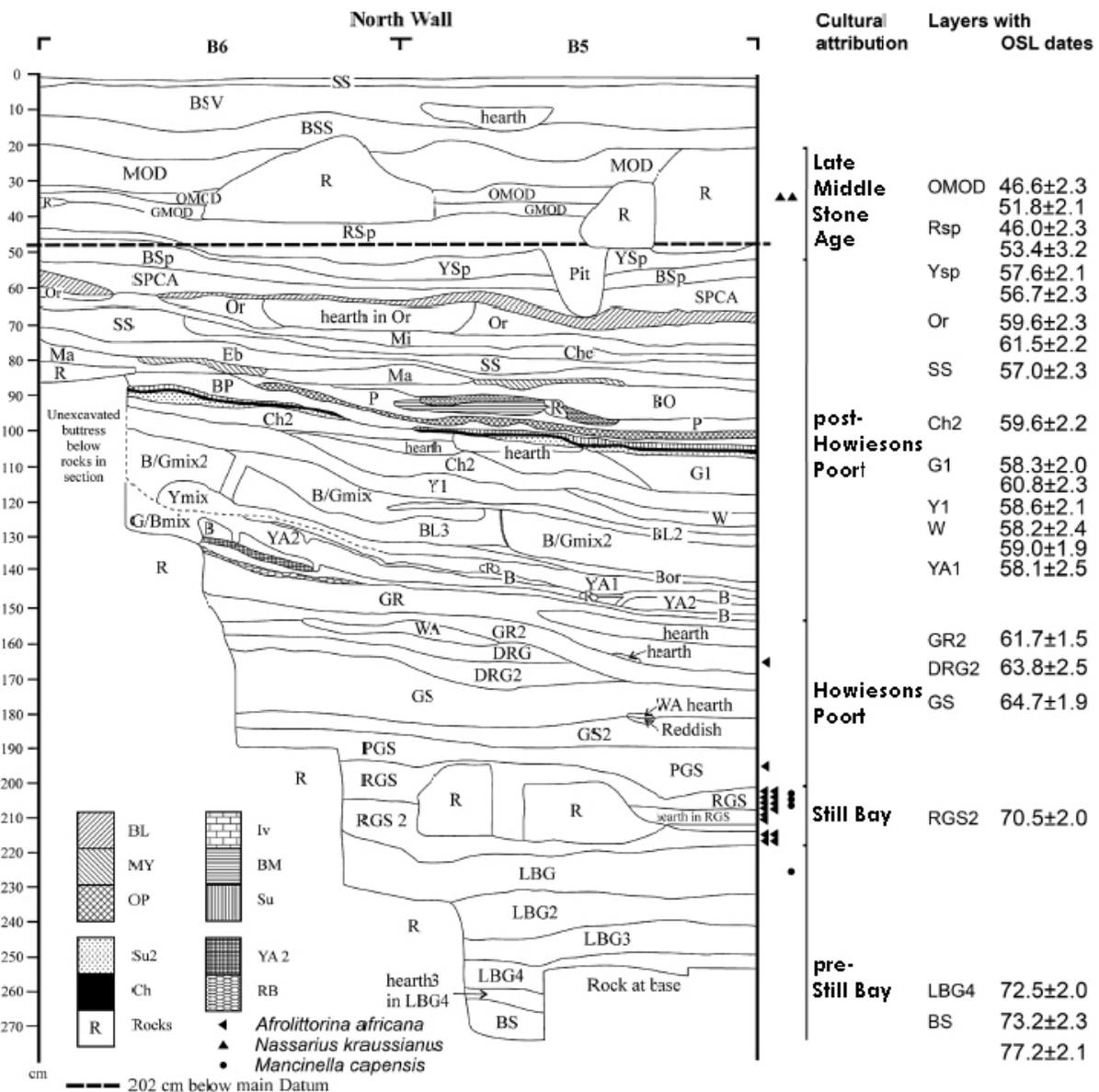
119
120 Figure 1. Location of Sibudu Cave.

121
122 The site was excavated under the directorship of Lyn Wadley between 1998 and 2011. Since
123 2011 the site has been excavated by Nicholas Conard, University of Tübingen. A long and
124 detailed Middle Stone Age (MSA) sequence with good organic preservation occurs within its
125 three metre deep sediments. The site's cultural succession (Lombard 2004, 2005, 2006a, 2006b,
126 2007, 2011; Wadley, 2004, 2005, 2006, 2007, 2010a,b; Villa et al., 2005; Cochrane, 2006, 2008;
127 Delagnes et al., 2006; Villa and Lenoir, 2006; Backwell et al., 2008; d'Errico et al., 2008;
128 Wadley and Mohapi, 2008; Wadley et al., 2009, 2011; Wadley and Kempson, 2011; d'Errico et

129 al., 2012b; de la Peña et al. 2013; de la Peña and Wadley, 2014a, b, 2017; de la Peña, 2015;
130 Soriano et al. 2015; Wozcieszak and Wadley, 2018), chronology and micromorphology ((Schiegl
131 et al., 2004; Pickering, 2006; Schiegl and Conard, 2006; Wadley and Jacobs 2006; Jacobs et al.,
132 2008a, b; Goldberg et al., 2009) and environmental context (Cain, 2004, 2006; Plug, 2004, 2006;
133 Allott, 2006; Glenny, 2006; Herries, 2006; Renaut and Bamford, 2006; Reynolds, 2006; Sievers,
134 2006; Wells, 2006; Clark and Plug, 2008; Wadley et al., 2008; Robinson and Wadley, 2018;
135 Clark 2019) are already published extensively elsewhere.

136

137 The Wadley excavation method is described in detail in Wadley and Jacobs (2006). In brief, the
138 sediment was excavated in 50 cm quadrants (*a-d*) within each metre square. Quadrant *a* is the
139 north-east quadrant in each metre square and B4a, for example, describes quadrant *a* in square
140 B4. Twenty-one square metres of deposit were excavated into the ~58 ka occupations and six
141 square metres were excavated as a deep sounding into older occupations with ages between 77.2
142 ± 2.1 and 61.7 ± 1.5 ka (Fig. 2). The ages are derived from single-grain optically stimulated
143 luminescence (OSL) analysis of sedimentary quartz grains (Jacobs et al., 2008a, b). The deepest
144 layers contain assemblages that are informally called pre-Still Bay, while Still Bay, Howiesons
145 Poort and late MSA Industries occur more recently. Occupations at Sibudu were discontinuous,
146 with hiatuses that, in layers more recent than 58 ka, were sometimes as long as 10,000 years. The
147 final Wadley excavations of 2011 reached a layer called BS16 (Brown Sand 16), which is
148 undated, but older than 77 ka. Characteristic finds, constituent stratigraphic units, date intervals
149 of the different cultural assemblages and OSL ages for the stratigraphic units are summarised in
150 Figure 2.



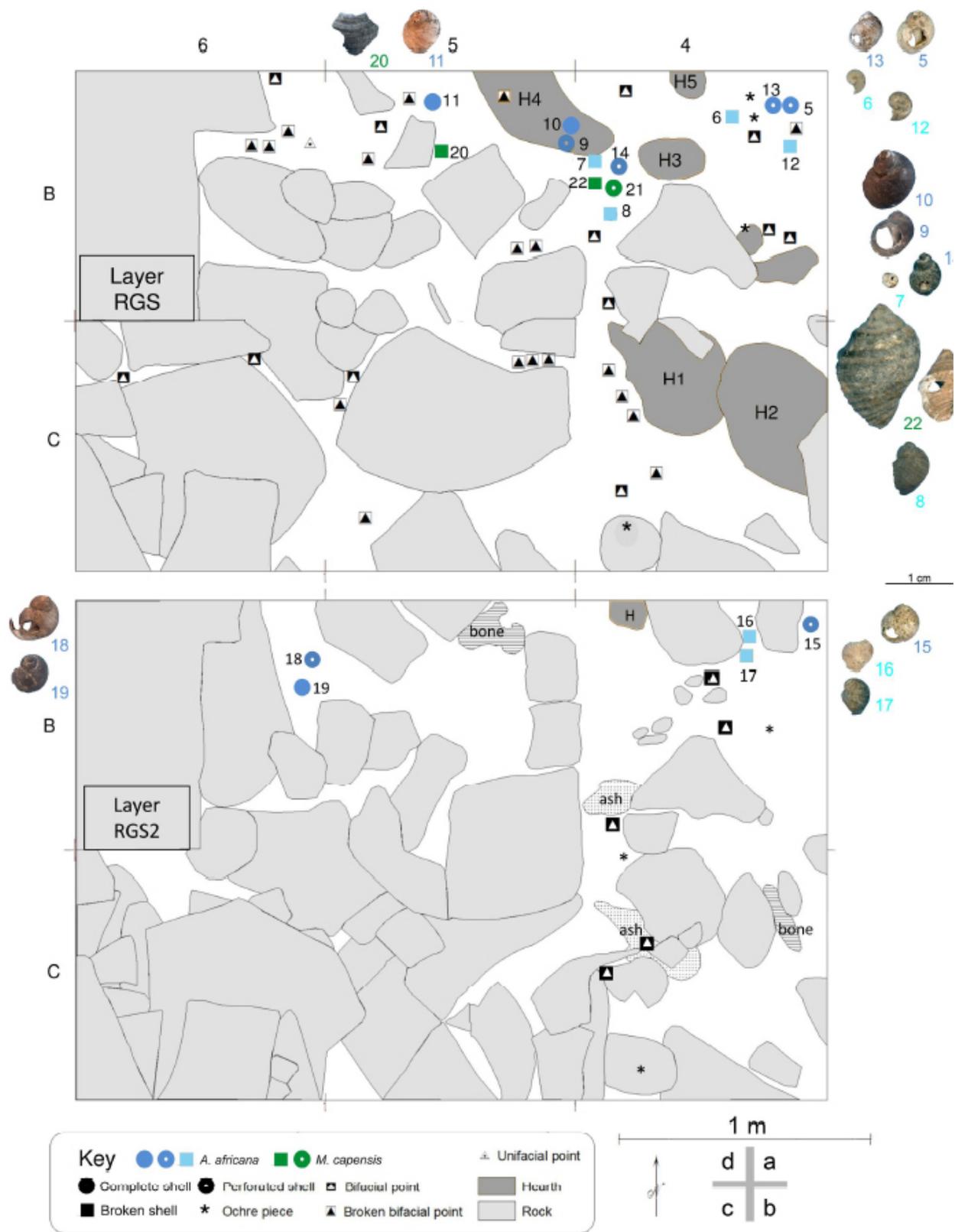
151
 152 Figure 2. Stratigraphy of Sibudu Cave along the North section with indication of the stratigraphic
 153 layers, their cultural attribution, and optically stimulated luminescence (OSL) dates after Wadley
 154 and Jacobs, 2006 and Jacobs et al., 2008a,b.

155
 156 In the lower most stratigraphic unit BS16 BS16 of the Wadley excavation, a long bifacial point
 157 was recovered (Wadley, 2012). It is narrow and thin, but has a rounded base, not a pointed one
 158 like a ‘classic’ Still Bay point. The Conard excavations below BS16 recovered more bifacial
 159 points, some serrate (Rots et al. 2017). The uppermost BS layer has an OSL age of 77.2 ± 2.1 ka.
 160 The BS member varies between 30 and 40 cm in thickness and, apart from the basal layer BS16,
 161 contains an informal assemblage with only rare retouched pieces. The LBG (Light Brownish
 162 Sand) member above this is about 50 cm thick and it comprises four layers with two available

163 OSL ages, 73.2 ± 2.3 and 72.5 ± 2.0 ka (Jacobs et al., 2008b). The informal lithic assemblage in
164 these layers has only rare examples of retouched pieces and has been designated pre-Still Bay.
165 Bone tools with double bevel working ends come from the pre-Still Bay layers.-Some ochre
166 pieces with groups of lines forming fan-shaped motifs that may have been deliberately scored
167 come from the pre-Still Bay layers (Hodgskiss, 2012, 2013).

168
169 The Still Bay Industry at the site is therefore immediately preceded by a deep sequence that
170 extends about 80 cm in the Wadley excavation and even farther in the recent Conard one. The
171 Still Bay occurs in the member Reddish Grey Sand (RGS), a loose, sandy sediment named after
172 the Munsell colour reading 5YR 5/2 Reddish-Grey. Two layers, RGS2 and RGS have been
173 named although the division between the two is not distinct, and the entire member is seldom
174 more than 20 cm thick (Fig. 2). Several separate lenses have been distinguished by subtle colour
175 changes within RGS2 and RGS. RGS, at the top of the sequence, has an OSL age of 70.5 ± 2.0
176 ka, and the entire Still Bay seems to represent a short pulse of occupation at Sibudu. Since the
177 RGS layer is directly below a Howiesons Poort layer (PGS) with an OSL age of 64.7 ± 1.9 ka, an
178 occupation hiatus of about five thousand years seems to occur at Sibudu between the Still Bay
179 and the Howiesons Poort. Excavation of the Still Bay layers was hampered by extensive rock fall
180 that began in the BS member and continued, perhaps intermittently, until about 65 ka. The rock
181 fall has encroached on the six square metres of the deep sounding and this has resulted in
182 restricted areas of occupation within the SB and HP Industries. Perhaps because of the extensive
183 rockfall, the combustion features in Layer RGS are concentrated in squares B4 and C4 and in a
184 single quadrant in square B5 where fewer rocks occur (Fig. 3). At least three of the ashy features
185 appear to be hearths. All lithics and bone fragments larger than 20 mm were piece-plotted during
186 the excavation of the Still Bay layers, as well as shells, bifacial tools and worked ochre. The Still
187 Bay Industry at Sibudu, like that occurring in MSA sites along the South African Cape coast, is
188 marked by the presence of bifacial tools with invasive retouch, including some rare lanceolate
189 points. Whole bifacial points are relatively uncommon at the site, but bifacial point fragments are
190 abundant, as is also the case at other Still Bay sites, such as Blombos (Henshilwood et al., 2001)
191 and Hollow Rock (Evans, 1994). This pattern is probably due to the vulnerability of the long,
192 thin bifacial points. In a preliminary study, bifacially worked tools comprised 44% of all the
193 retouched pieces in the RGS member (Wadley, 2007). A more detailed analysis (Soriano et al.,
194 2015) showed that stone knapping in RGS and RGS2 was mostly intended for the production of
195 bifacial foliate points and that most were broken during utilization, sharpening or resharpening,
196 so that many discarded tips and tip flakes were found. Dolerite, quartzite and hornfels were used

197 for the manufacture of the points. Residue and use-trace analysis of a few Sibudu Still Bay
198 bifacial points and point fragments suggests that they were mostly pointed hunting weapons, but
199 at least one of the points was a cutting tool (Lombard, 2006a) and the majority of points studied
200 by Soriano and colleagues seem to have been cutting tools. Raman Spectroscopy and Scanning
201 Electron Microscopy (Wozcieszak and Wadley, 2018) support the original interpretation that the
202 tools were hafted with an adhesive containing ochre powder. Other lithics in the Still Bay
203 assemblage include splintered pieces, a few segments and unifacial points, and scrapers of
204 various types (Wadley, 2007). Worked ochre is less common in the Still Bay than elsewhere in
205 the site (Hodgskiss, 2013). No worked bone has yet been found in the Still Bay layers at Sibudu.
206 In contrast, worked bone is extremely common in the younger Howiesons Poort Industry,
207 including pointed forms, awls, smoothers, *pièces esquillées* and pressure flakers (d'Errico et al.,
208 2012b). The use of bone pressure flakers during the Howiesons Poort at Sibudu has been recently
209 supported by analysis of quartz bifacial points (de la Peña et al., 2013). The layers associated
210 with the Howiesons Poort are (from the base to the top): Pinkish Grey Sand (PGS), Grey Sand
211 (GS, GS2 and GS3), Dark Reddish Grey (DRG) and Grey Rocky (GR and GR2) (Wadley and
212 Jacobs, 2006). The stratigraphy is clear, but the rock fall mentioned earlier has caused some
213 disturbance to the oldest Howiesons Poort layer, PGS, as well as to the Still Bay layers. PGS has
214 an OSL age of 64.7 ± 1.9 ka, while the younger Howiesons Poort layer, GR2, has an OSL age of
215 61.7 ± 2 ka (Jacobs et al., 2008b). GR2 is an artificial spit to divide the light, brownish-grey silt
216 of GR. There are several hearths in GR. The Howiesons Poort layers have rich lithic assemblages
217 with many backed tools and small bladelets (Wadley and Mohapi, 2008; de la Peña and Wadley,
218 2014). Worked ochre is more common in the Howiesons Poort than in the Still Bay (Hodgskiss,
219 2013).



220

221 Figure 3. Spatial distribution of selected archaeological finds, rocks and ash lenses in squares B-

222 C/4-6 within layer RGS (top) and RGS 2 (bottom). Colors and symbols identify find category,

223 shell taxa and state of completeness. See Table 1 for descriptive information on the illustrated

224 and numbered marine shell finds.

225 A long sequence of post-Howiesons Poort (post-HP) layers occurs after the HP; these are about
226 100 cm in depth and they contain many strata wherein the inhabitants burnt bedding layers made
227 of plant material (Goldberg et al., 2009; Wadley et al., 2011). The weighted mean age of the
228 post-HP is 58.5 ± 1.4 ka (Jacobs et al., 2008a). Some post-HP lithics have been described
229 (Cochrane, 2006; Villa et al., 2005; Conard et al., 2012; de la Peña and Wadley, 2017), as has the
230 rich fauna (Clark and Plug, 2008). Layer BSp is the youngest of the post-HP layers and the late
231 MSA succeeds the post-HP. The Late MSA layer OMOD (Orange Mottled Deposit) has an age
232 estimate of 46.6 ± 2.3 ka. Lithics in OMOD include bifacial and unifacial points, scrapers and
233 convergent flakes.

234 The GIS-based Coexistence Approach (CA_{GIS}) analysis demonstrates that the late MSA was
235 warmer in winter than was previously the case, summer precipitation increased and vegetation
236 became more closed (Bruch et al., 2012). *Podocarpus* sp. was consequently present in layer
237 OMOD (Hall et al., 2014). Furthermore, as was the case in the earlier SB and HP occupations
238 where vegetation was closed, small bovids like *Philantomba monticola* (blue duiker),
239 *Cephalophus natalensis* (red duiker) and *Raphicerus campestris* (steenbok) occurred (Wadley et
240 al., 2008). Nonetheless, large animals like *Tragelaphus oryx* (eland), *Equus quagga* (zebra) and
241 *Syncerus caffer* (buffalo) were still present. Stable carbon and oxygen isotope data were retrieved
242 from faunal tooth enamel throughout the sequence (Robinson and Wadley, 2018). The pre-SB
243 seems to have been dominated by more closed environments than at other times, and was likely
244 forested and mesic. More open and perhaps drier conditions occurred between ~48–38 ka ago,
245 but the remaining periods were not dissimilar from today (Robinson and Wadley, 2018).

246 Throughout the Sibudu sequence there is bone preservation, though it is often burnt. People
247 collected many suids and a diverse assemblage of small game in the pre-SB (Clark, 2019). High
248 frequencies of blue duiker (*Philantomba monticola*) in the SB and before suggest the early use of
249 remote capture technology (Clark 2019). In HP layers, and even earlier, there are remains of
250 large bovids and bushpig, and small creatures are well-represented (Clark and Plug, 2008; Plug
251 personal communication 2009), including *Philantomba monticola* (blue duiker) and *Chlorocebus*
252 *pygerythrus* (vervet monkey). In the upper part of the post-HP, there is an increase in plains
253 game such as zebra and small bovids become rare (Clark and Plug, 2008). Birds, reptiles, rodents
254 and fish occur throughout the sequence, as well as fresh water and marine molluscs (Plug, 2006).
255 Marine species include turtles, fish, crustaceans and molluscs (Plug, 2006).

256 Since most of the shells that we describe here come from the SB layers of Sibudu, we provide
257 more detail on the broad context of this Industry.

258 3. The Still Bay

259 The southern African Still Bay (Goodwin and van Riet Lowe, 1929; Sampson, 1974) has the
260 lanceolate, bifacially shaped, point as its *fossile directeur*, but it also contains thin, long bifacial
261 points of other shapes. The thin Still Bay points tended to break easily both during manufacture
262 and use. The Industry at Blombos Cave on the coast in the Cape, more than 1000 km from
263 Sibudu, has a well-known and remarkable Still Bay sequence with many bifacial points. Heat
264 treatment of silcrete was used at this site to improve its quality for production, sometimes
265 through pressure flaking, of the fine points (Brown et al., 2009; Mourre et al., 2010; Villa et al.,
266 2009; Soriano et al., 2015). Bone tools in the form of fully shaped points and awls produced by
267 scraping were found in Still Bay layers at Blombos and Peers Caves (d’Errico and Henshilwood,
268 2007). Modified red ochre is common at Still Bay sites (Henshilwood et al., 2009; Dayet et al.,
269 2013) and, at Blombos, fragments of hematite are engraved with abstract motifs (Henshilwood et
270 al., 2009). Perforated *Nassarius kraussianus* shells were used as beads by the Still Bay
271 inhabitants of Blombos Cave during the M1 archaeological phase (Henshilwood et al., 2004;
272 d’Errico et al., 2005; Vanhaeren et al., 2013).

273 Little is known about the origin of the Still Bay. At Sibudu and Blombos archaeological layers
274 immediately below the Still Bay contain relatively simple flake-based assemblages with few
275 retouched tools. In contrast, pre-Still Bay layers at Diepkloof and Klasies River contain unifacial
276 and bifacial pieces shaped with invasive retouch that appear to announce the technical
277 complexity of the Still Bay (Porráz et al., 2013).

278 To date, four sites – Sibudu (Wadley, 2007) and Umhlatuzana in KwaZulu-Natal Province
279 (Lombard et al., 2010; Mohapi, 2013), Diepkloof in the Western Cape Province (Rigaud et al.,
280 2006; Porráz et al., 2013), and Apollo 11 in the South of Namibia (Wendt, 1974; Vogelsang et
281 al., 2010; Lombard and Högberg, 2018) have stratigraphic sequences in which Still Bay
282 assemblages precede Howiesons Poort ones. Chronostratigraphy, Optically stimulated
283 luminescence (OSL) and Thermoluminescence (TL) dating of pre-Still Bay, Still Bay, and
284 Howiesons Poort layers have, for some years, situated the Still Bay between 72 and 71 ka and,
285 after a possible archaeological hiatus, the younger Howiesons Poort between 65 and 60 ka
286 (Jacobs et al., 2008b, 2013; Jacobs and Roberts, 2008). This view, i.e. that the Howiesons Poort
287 would be younger than the Still Bay, has been recently challenged by the OSL and TL dating of
288 the Diepkloof sequence (Tribolo et al., 2009; 2013) and fired the controversy surrounding
289 calculation of internal dose rate in OSL dating (Guérin et al., 2013, but see responses by
290 Galbraith, 2015; Jacobs and Roberts, 2015). Tribolo and colleagues propose a mean age of $109 \pm$
291 10 ka for the Still Bay of Diepkloof, i.e. almost 40 ka older than the age estimated by Jacobs et

292 al. (2008b) for the same site, and a duration of 50 ka (from 105 ± 10 to 65 ± 8 ka) for the
293 Howiesons Poort. They use these age estimates to support the hypothesis that both the Still Bay
294 and the Howiesons Poort emerged during the last interglacial and coexisted during OIS 5 and 4
295 in southern Africa. So far, there is no evidence in the KwaZulu-Natal region suggesting that the
296 Howiesons Poort was contemporaneous with the Still Bay.

297

298 **4. Material and Methods**

299 *4.1. Taxonomic identification*

300 Modern and archaeological marine gastropods were identified at genus and, where possible,
301 species level using criteria proposed by Kilburn and Rippey (1982), Branch and Branch (1981),
302 Richards (1981), Branch et al. (1994), Marais and Seccombe (2010). Archaeological specimens
303 were compared to modern shell reference collections hosted at the KwaZulu-Natali Museum,
304 Pietermaritzburg. The taxonomic status of each species was checked and, where needed,
305 corrected using the WoRMS Editorial Board (2014).

306

307 *4.2. Survey of the biocoenoses*

308 Present day availability of marine gastropod species in the intertidal zone was checked at Ballito
309 Bay ($29^{\circ}32'23.52''S$, $31^{\circ}13'13.22''E$) and Shaka's Rock ($29^{\circ}30'49.92''S$, $31^{\circ}13'57.03''E$) by
310 shore bound surveying and snorkelling at rocky outcrops in February 2012. This led to the
311 creation of a list of identified species and determination of their relative abundance.

312

313 *4.3. Survey of the thanatocoenoses*

314 A marine shell thanatocoenoses composed of 522 remains of marine gastropods was collected by
315 the authors of this study in February 2012 at four locations: Shaka's Rock ($29^{\circ}30'49.92''S$,
316 $31^{\circ}13'57.03''E$), Ballito Bay ($29^{\circ}32'23.52''S$, $31^{\circ}13'13.22''E$), Emerald Cove ($30^{\circ}47'00.80''S$,
317 $30^{\circ}25'48.92''E$) and Umdloti Beach ($29^{\circ}38'56.67''S$, $31^{\circ}08'00.86''E$). These four locations are
318 found along the sandy beaches and rocky outcrops of the KwaZulu-Natal coast. Dead shells were
319 sampled at each location for two hours during low tide between the upper beach and the
320 strandline. Shell fragmentation was described using five grades: 1) complete, 2) 99-75%, 3) 74-
321 50%, 4) 49-25%, 5) <24% preserved. Fragmentation properties were also described
322 independently of their location, according to genus by using a ternary taphogram (Kowalewski et
323 al., 1995) in which the three states are represented by complete or almost complete specimens
324 (grades 1 and 2), damaged specimens (grades 3 and 4), and fragments (grade 5). The Software
325 PAST was used to produce the ternary taphogram.

326 4.4. Malacological reference collection

327 Our reference collection also comprises 470 *Afrolittorina africana* collected alive in September
328 2006 at two locations - uThongathi River mouth (29°34'22.93''S, 31°11'07.17''E) and Ballito
329 Bay (29°32'23.52''S, 31°13'13.22''E) - on the coast of Kwa-Zulu-Natal (d'Errico et al., 2008),
330 and four *Nassarius kraussianus* collected dead at the same time inside the river mouth and on the
331 oceanic beach close to the uThongathi River (Fig. 4). An additional five and nine dead *N.*
332 *kraussianus* were collected respectively in February 2012 and November 2013 on the oceanic
333 beaches of Ballito Bay (Kwa-Zulu-Natal) and Die Hoop (34°29'6.76''S, 20°29'28.16''E) in the
334 Western Cape). The surface of five *N. kraussianus* from Goukou (Western Cape) were also
335 analysed: one from the biocoenosis, one from the thanatocoenosis (d'Errico et al., 2005), as well
336 as two experimentally burned specimens and one burned and etched specimen; d'Errico et al.,
337 2015). 3D scanning of a 877 x 660 µm representative surface of these shells was performed with
338 a Sensofar S neox Confocal Imaging Profiler (Sensofar, Barcelone) after optical examination of
339 the piece. Surfaces were scanned with a 20x objective allowing a lateral sampling interval of
340 0,645 µm and a vertical resolution of 0.02 µm.



341
342 Figure 4. Marine shells from the Pleistocene layers of Sibudu Cave. See Table 1 for contextual
343 and descriptive information. 1-2: *Nassarius kraussianus*, 3-19: *Afrolittorina africana*; 20-23:
344 *Mancinella capensis*. Scale bar = 1 cm.

345

346 4.5. *Experimental reference collections*

347 Experimental criteria to identify techniques used to perforate *A. africana* are known in the
348 literature (d'Errico et al., 2008). We have applied a similar approach to the other perforated
349 gastropod species found at Sibudu, *Mancinella capensis*. Seven types of tools were used to
350 perforate modern specimens of this species: a retouched lithic point, a small crab claw, a small
351 pebble, and bone and wooden awls of two sizes. Shells were perforated by punching the body
352 whorl through the aperture and from the outer dorsal side. The pebble was only used on the outer
353 dorsal side. For all experimentally perforated shells we recorded the location, morphology, size,
354 maximum diameter, and orientation of the perforations, the location of micro-chipping, and the
355 height of the shell aperture.

356 Three fresh and two dead *Mancinella* shells were experimentally heated in a fire made from a
357 large sheaf of *Cyperus involucratus* culms. The fire combusted the culms rapidly; the maximum
358 temperate was in excess of 800°C for five minutes, then the fire died immediately.

359

360 4.6. *Archaeological shells*

361 Both sides of the Sibudu shells were digitised at a resolution of 1200 dpi with an Epson
362 Perfection 1660 Photo scanner. The resulting images served as a base to produce drawings of the
363 two aspects of each shell with Adobe Illustrator. The archaeological specimens were also
364 examined and photographed with a motorised Leica Z6 APOA equipped with a DFC420 digital
365 camera and a Leica Application Suite (LAS) equipped with the Multifocus module. The
366 Multifocus module is designed to acquire extended depth of field images from the microscope.
367 Once digital images have been collected at different Z-positions, adapted algorithms combine
368 them into one single sharp composite image that massively extends the depth of focus.

369 Measurements were taken with a digital calliper. The location of spots of red pigment on shells
370 was systematically recorded and selected spots were analysed with a Jobin-Yvon T64000 Raman
371 spectrometer operated in triple subtractive mode. The 514.5 nm line of an argon ion laser was
372 used as the excitation source. Backscattered spectra were collected via an Olympus BX40
373 microscope Raman attachment, and the light dispersed via 1800 lines/mm gratings onto a liquid-
374 nitrogen cooled CCD detector. Power for the sample was kept fairly low (1.2mW) to minimize
375 localised heating effects. A narrow bandpass filter was used to remove laser plasma lines from
376 the spectra. 3D scanning with a Confocal Imaging Profiler of a surface of a *N. kraussianus* from
377 Sibudu was performed as described above.

379 **5. Results**

380 *5.1. Taxonomic identification*

381 Twenty-three marine gastropods were recovered in the Pleistocene layers of Sibudu Cave (Table
 382 1, Fig. 4). They belong to three species (*Afrolittorina africana*, *Mancinella capensis* and
 383 *Nassarius kraussianus*) living in different habitats and having a different diet. *Afrolittorina*
 384 *africana* (Krauss in Philippi, 1847) lives on exposed rocks located at the top of the intertidal
 385 shore along the coast or in the mouth of estuaries; they shelter in little pools and moist crevices,
 386 where they can be found in vast numbers (Branch and Branch, 1981; McQuaid, 1981). Juvenile
 387 *A. africana* feed on bacteria and diatoms, adults mainly on lichens and blue-green algae.
 388 *Mancinella capensis* (Petit de la Saussaye, 1852; Claremont et al., 2013), previously called
 389 *Reishia capensis* (Petit de la Saussaye, 1852), can be found living under rocks and in rock
 390 crevices in high energy wave action shores from low neap-tide downward. It feeds on large
 391 ascidians and gastropods such as *Burnupena* spp. (Marais and Seccombe, 2010). *Nassarius*
 392 *kraussianus* (Dunker, 1846) is a scavenging gastropod adapted to estuarine environments
 393 (Palmer, 1980; Branch et al., 1994). Present day distribution of *A. africana* and *M. capensis*
 394 ranges from Cape Aghulas to Northern Natal. *N. kraussianus* can be found all along the South
 395 African coast, except the North-West coast.

Table 1. Taxonomic, contextual and descriptive data on the gastropod shells found in the Middle Stone Age layers of Sibudu Cave.

Layer	Cultural attribution	Square	Number	Date	Species	Perforation	Pigment	Heating	Length (mm)	Perforation max. diam. (mm)	Perforation min. diam. (mm)	Number in Fig. 5
OMOD	Late MSA	A5a Hearth	2404	30/08/2005	<i>N. kraussianus</i>	no	no	no	6,67	na	na	1
OMOD	Late MSA	C3c	na	26/08/1999	<i>N. kraussianus</i>	yes	no	yes	8.30	6.26*	3.78*	2
GR2	HP	C4b	na	14/02/2009	<i>A. africana</i>	no	no	no	6.20	na	na	3
PGS	HP	B5d	2057	10/11/2004	<i>A. africana</i>	yes	no	no	5	2.4*	2.27*	4
RGS	SB	B4a	na	17/11/2009	<i>A. africana</i>	yes	no	no	5.55	1.28**	1.18**	5
RGS	SB	B4a	na	13/11/2009	<i>A. africana</i>	na	no	no	na	na	na	6
RGS	SB	B4c	na	15/11/2009	<i>A. africana</i>	na	yes	no	na	na	na	7
RGS	SB	B4d	na	15/11/2009	<i>A. africana</i>	na	no	yes	8,5	na	na	8
RGS	SB	B5a Hearth	1989	11/11/2004	<i>A. africana</i>	yes	yes	yes	5.79	2.8*	2.46*	9
RGS	SB	B5a Hearth	1989	11/11/2004	<i>A. africana</i>	no	no	yes	7.97	na	na	10
RGS	SB	B5c	1991	11/11/2004	<i>A. africana</i>	no	no	no	5.33	na	na	11
RGS	SB	B5c	1988	11/11/2004	<i>M. capensis</i>	na	no	yes	na	na	na	20
RGS true 2	SB	B4a	na	17/11/2009	<i>A. africana</i>	na	yes	no	na	na	na	12
RGS true 2	SB	B4c	na	17/11/2009	<i>M. capensis</i>	yes	no	no	10,5	2.8	1.8	21
RGS brown	SB	B4c	na	23/11/2009	<i>M. capensis</i>	na	yes	yes	18.60	na	na	22
RGS brown 2	SB	B4a	na	24/11/2009	<i>A. africana</i>	yes	no	no	6.20	2.91	2.40	13
RGS brown 2	SB	B4c	na	25/11/2009	<i>A. africana</i>	yes	no	yes	6.15	1.75	1.22	14
RGS2	SB	B4a	na	27/11/2009	<i>A. africana</i>	yes	no	no	6.11	2.23	1.52	15
RGS2	SB	B4a	na	27/11/2009	<i>A. africana</i>	no	yes	no	na	na	na	16
RGS2	SB	B4a	na	27/11/2009	<i>A. africana</i>	na	no	yes	na	na	na	17
RGS2	SB	B6a	na	16/11/2004	<i>A. africana</i>	yes	no	yes	6.14	2.27	1.67	18
RGS2	SB	B6a	na	16/11/2004	<i>A. africana</i>	no	no	yes	na	na	na	19
LBG	pre-SB	B5a	2062	14-18/11/2004	<i>M. capensis</i>	na	yes	no	na	na	na	23

N.: *Nassarius*; *A.*: *Afrolittorina*; *M.*: *Mancinella*; *na*: not applicable; *perforation with post-depositional damage; **perforation produced by chemical alteration; MSA: Middle Stone Age, HP: Howiesons Poorts, SB: Still Bay, figure numbers in *italics* indicate shells published in d'Errico et al. 2008.

397 Table 1. Taxonomic, contextual and descriptive data on the gastropod shells found in the Middle
 398 Stone Age layers of Sibudu Cave.

399

400 *5.2. Analysis of the biocoenoses and thanatocoenoses*

401 The survey of two marine shell biocoenoses along the Dolphin coast allowed for the
 402 identification of marine gastropods belonging to 18 genera, among which *Afrolittorina*, *Cypraea*,
 403 *Littorina*, *Nerita*, *Nodilittorina* and *Turbo* are the most represented (Table 2).

404

Table 2. Marine gastropods collected in modern bio- and thanatocoenoses on the Dolphin coast of Kwa-Zulu-Natal

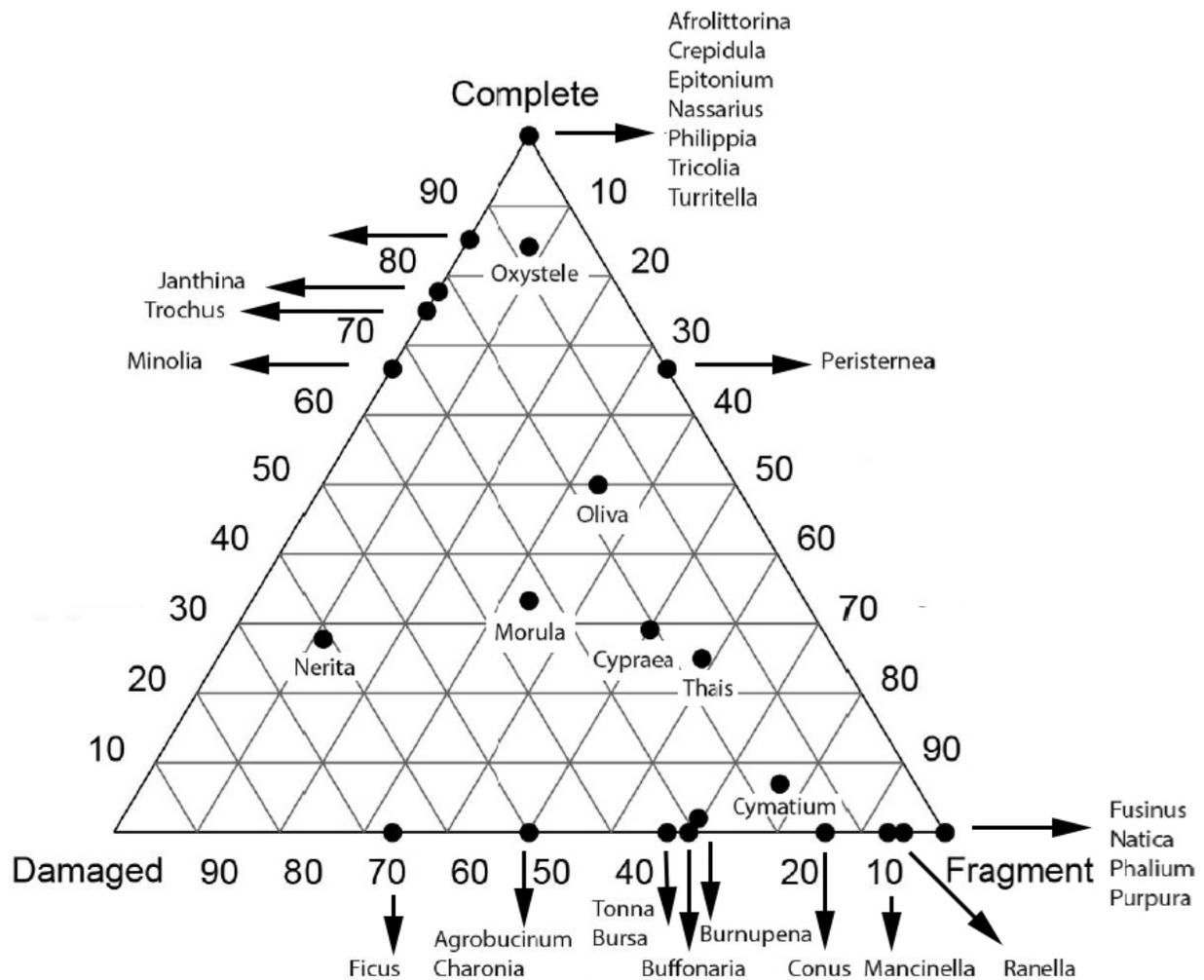
Genus	Biocoenosis		Thanatocoenosis						Fragmentation					Sibudu				
	Ballito	Shaka	Ballito	Shaka	Emerald	Umdloti	N	%	1	2	3	4	5	R	PHP	HP	SB	PSB
<i>Afrolittorina</i> *	•••	•••	-	-	5	-	5	1,1	5	-	-	-	-	-	-	-	2	-
<i>Agrobuccinum</i>	-	-	1	2	-	1	4	0,9	-	-	-	2	2	-	-	-	-	-
<i>Buffonaria</i>	-	-	4	4	-	5	13	2,9	-	-	1	3	9	-	-	-	-	-
<i>Bullia</i>	-	-	52	-	-	9****	61	13,4	38	14	6	3	-	-	-	-	-	-
<i>Burnupena</i>	••	-	13	26	-	10	49	10,8	-	1	6	8	34	-	-	-	-	-
<i>Bursa</i>	•	•	-	-	-	3	3	0,7	-	-	-	1	2	-	-	-	-	-
<i>Charonia</i>	-	-	-	-	2	4	6	1,3	-	-	-	3	3	-	-	-	-	-
<i>Conus</i>	-	•	2	1	14	4	21	4,6	-	-	-	3	18	-	-	-	-	-
<i>Crepidula</i>	-	-	1	-	-	1	2	0,4	1	1	-	-	-	-	-	-	-	-
<i>Cronia</i>	••	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cymatium</i>	-	-	15	8	14	6	43	9,5	1	2	2	5	33	-	-	-	-	-
<i>Cypraea</i>	-	•••	2	5	7	10	24	5,3	7	-	-	5	12	-	-	-	-	-
<i>Epitonium</i>	-	-	1	-	-	1	2	0,4	-	2	-	-	-	-	-	-	-	-
<i>Ficus</i>	-	-	2	1	-	-	3	0,7	-	-	1	1	1	-	-	-	-	-
<i>Fusinus</i>	-	-	-	-	-	1	1	0,2	-	-	-	-	1	-	-	-	-	-
<i>Hydatina</i>	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Janthina</i>	-	-	2	-	3	4	9	2,0	-	7	2	-	-	-	-	-	-	-
<i>Littorina</i>	••	••	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mancinella</i> ***	••	-	8	44	6	-	58	12,7	-	-	-	4	54	-	-	-	3	1?
<i>Minolia</i>	-	-	3	-	-	-	3	0,7	1	1	1	-	-	-	-	-	-	-
<i>Morula</i>	•••	-	-	2	1	-	3	0,7	1	-	-	1	1	-	-	-	-	-
<i>Natica</i>	-	-	-	1	-	-	1	0,2	-	-	-	-	1	-	-	-	-	-
<i>Nassarius</i> **	-	-	5	-	-	-	5	1,1	3	2	-	-	-	-	2	-	-	-
<i>Nerita</i>	•••	•••	6	12	-	-	18	4,0	3	2	7	4	2	-	-	-	-	-
<i>Nodilittorina</i>	••	••	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Oliva</i>	-	-	-	2	1	3	6	1,3	-	3	-	1	2	-	-	-	-	-
<i>Oxysteles</i>	-	-	17	13	-	8	38	8,4	24	8	2	1	3	-	-	-	2	-
<i>Peristernea</i>	•••	-	-	1	1	1	3	0,7	2	-	-	-	1	-	-	-	-	-
<i>Phalium</i>	-	-	-	3	1	-	4	0,9	-	-	-	-	4	-	-	-	-	-
<i>Philippia</i>	-	-	-	-	1	-	1	0,2	-	1	-	-	-	-	-	-	-	-
<i>Purpura</i>	-	-	-	2	-	-	2	0,4	-	-	-	-	2	-	-	-	-	-
<i>Ranella</i>	-	•	4	-	8	8	20	4,4	-	-	1	-	19	-	-	-	-	-
<i>Strombus</i>	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Thais</i>	•	-	2	5	4	1	12	2,6	1	2	-	2	7	-	-	7	-	-
<i>Throchus</i>	•	•	2	-	1	1	4	0,9	1	2	1	-	-	-	-	-	-	-
<i>Tonna</i>	-	-	1	2	4	5	12	2,6	-	-	-	4	8	-	-	-	1	-
<i>Tricolia</i>	-	-	12	-	3	2	17	3,7	16	1	-	-	-	-	-	2	3	1
<i>Turbo</i>	•••	•••	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Turritella</i>	-	-	-	-	-	2	2	0,4	-	2	-	-	-	-	-	-	-	-
Total	-	-	155	134	76	81	455		104	51	30	51	219	-	2	9	11	1
Indetermined	-	-	11	37	10	13	70	13,4	-	-	-	2	67	1	4	36	1	7

*: present, ••: abundant, •••: very abundant, R: recent, HP: Howiesons Poort, SB: Still Bay, PHP: Post Howiesons Poort, PSB: Pre-Still Bay
 *: *Afrolittorina africana*, **: *Nassarius kraussianus*, ***: *Mancinella capensis*, ****: one specimen bears a perforation on the body whorl

405
 406 Table 2. Marin gastropods collected in modern bio- and thanatocoenoses on the Dolphin coast of
 407 KwaZulu Natal.

408

409 Analysis of four thanatocoenoses along the same coast identified between 17 and 22 genera
410 (Table 2). *Conus*, *Cymathium*, *Cypraea*, *Thais* and *Tonna* are found in all samples. Of the three
411 shell species found at Sibudu, only two, *A. africana* and *M. capensis*, are found alive on present
412 day shores of the Ballito Bay area (Table 2, Fig. 4). Although the biocoenosis of this species was
413 not surveyed by us, *N. kraussianus* is likely living in local estuaries and reported from the
414 Mzingazi in Richards Bay, 120 km up north (Teske et al., 2007). The scarcity of dead *A. africana*
415 and the fragmentary state of *M. capensis* are probably due to the strong wave action, which
416 crushes or breaks them as soon as they are dislodged by waves. *N. kraussianus* is apparently
417 more resistant to wave action as we found it on the Ballito Bay shores, 5 km away from the
418 closest estuary. The degree of fragmentation varies according to genera (Table 2, Fig. 5).



419

420 Figure 5. Ternary taphogram showing the state of fragmentation of identified marine shells
421 genera found on the Dolphine's coast beaches. See methods and Table 2 for information on how
422 the taphogram was made and on which malacological reference collections were included.

423

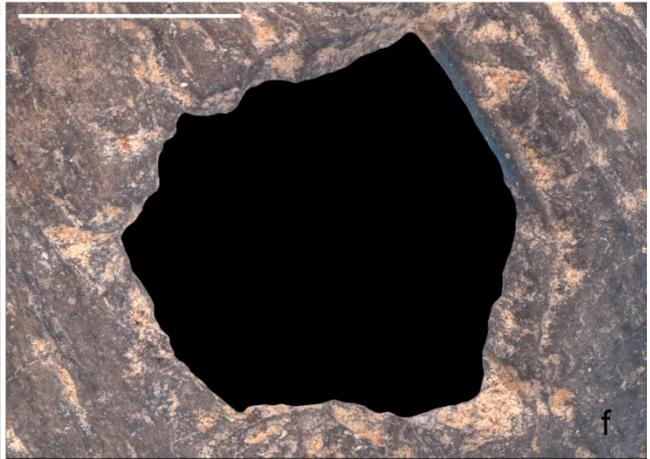
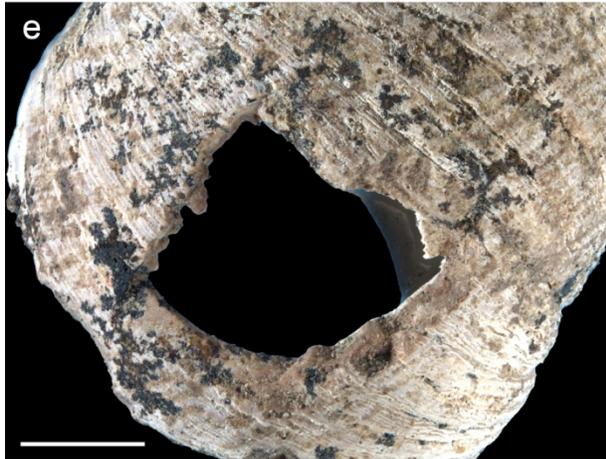
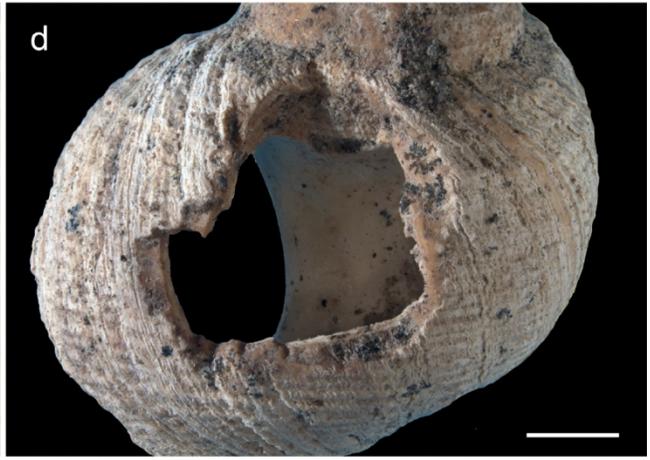
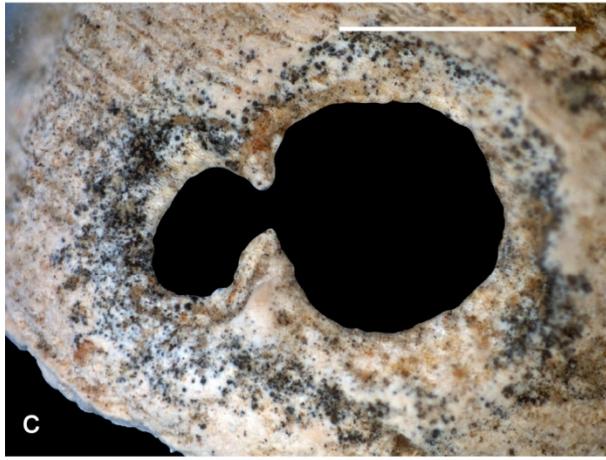
424 *Afrolittorina, Bullia, Crepidula, Epitonium, Nassarius, Oxysteles, Peristernia, Philippia, Tricolia*
425 and *Turritella* are most often complete, while *Agrobuccinum, Buffonaria, Burnupena, Bursa,*
426 *Charonia, Conus, Ficus, Fusinus, Mancinella, Natica, Phalium, Purpura, Ranella,* and *Tonna,*
427 are only found as damaged specimens or fragments. The remainder of the genera are represented
428 by at least one complete or almost complete specimen.

429 Natural perforations only occur on two species, *Nassarius* and *Burnupena*. Nine out of ten
430 *Nassarius* found on Ballito Bay and Thongathi beaches bear perforations, three on the ventral
431 and seven on the dorsal side. Perforations on the ventral aspect of the recovered *Nassarius*
432 consist of worn holes bored into the shell by *Natica* (Palmer, 1980), those on the dorsal aspect
433 result from mechanical abrasion by sand and wave action on the beach (Fig. 6).



434
 435 Figure 6. Top: *Nassarius kraussianus* collected dead on the sandy beaches of Die Hoop in the
 436 top row, Ballito Bay in the middle row and close to the uThongathi River in the bottom row.
 437 Bottom: *Mancinella capensis* and *Burnupena burnupena* with natural perforations (top row) and
 438 experimental perforations made with a stone (middle row) and a bone tool (bottom row) exerting
 439 pressure on the inside of the shell through its aperture.
 440

441 All perforated beached *Nassarius* display granules firmly stuck within the shell's interior.
442 Alterations on *Nassarius* from Ballito and Thongathi thanatocoenoses differ from those recorded
443 on dead *Nassarius* from estuarine environments (d'Errico et al., 2005: 12, fig.4) where gradual
444 decalcification in calm waters is the main taphonomic agent. The latter are porous and display
445 perforations with thin, crenulated edges resulting from the gradual weakening of the shell wall
446 whereas Ballito and Thongathi *Nassarius* are not etched, have smooth hole-edges and a shiny
447 appearance (Fig. 6). At microscopic scale, micro-pits due to impacts are observed (Fig. 7b).
448 Abrasion first produces sub-millimetric perforations on the spire, then causes an enlargement of
449 that perforation, the opening of a second millimetric perforation on the spire, the removal of the
450 apex and the opening of a wide perforation on the body whorl that increases its size until partial
451 removal of the shell's lip. The surviving segment of the lip takes a typical pointed morphology
452 characteristic of beach worn *Nassarius* (Fig. 6). Only one fragment of *Burnupena* over the 49
453 collected bears a sub-circular worn perforation of unknown origin (Fig. 7h).
454



456

457 Figure 7. Macro photos of a) the perforated *Nassarius kraussianus* from Sibudu (Fig. 4 n°2), b) a
458 beach worn *Nassarius kraussianus*, c) two very small juxtaposed perforations interpreted as
459 resulting from a chemical alteration on *Afrolittorina africana* (Fig. 4 n°5), d-e) perforations on
460 *Afrolittorina africana* (Fig. 4 n°15 and 14) that must result from pressure on the inside of the
461 shell, g) perforation on *Mancinella capensis* (Fig. 4 n°21), and h) natural perforation on
462 Burnupena from Umdloti.

463

464 5.3. Stratigraphic and spatial distribution.

465 Marine gastropods were recovered in the pre-Still Bay, Still Bay, Howiesons Poort and late MSA
466 layers (Table 1). *N. kraussianus* is only found in the late MSA, *A. africana* in different
467 Howiesons Poort and Still Bay layers, *M. capensis* in the Still Bay and possibly in the pre-Still
468 Bay. The discovery of a single *A. africana* in the lowermost Howiesons Poort layer PGS and the
469 nature and thickness of this layer has suggested (d'Errico et al., 2008) that this specimen may
470 have derived from the underlying Still Bay layer RGS, where most of the other shells were
471 found. The enlarged collection of marine gastropods described here includes another *A. africana*
472 from Howiesons Poort layer GR2, which confirms the presence of marine gastropods in Sibudu
473 Howiesons Poort layers.

474 In Still Bay layers two clusters of five and four perforated *A. africana* shells were found in the
475 same lens subdivided in three sub-units of different colour (RGS, RGS brown, RGS true). The
476 first cluster is associated with two hearths (H3-4); the other is located East of hearths H3 and H5
477 (Fig. 3). Two lumps of ochre occur together with the second cluster in B4a (Fig. 3). Two other
478 clusters of three and two shells were found in the underlying lens RGS2: one in the same
479 location as the second cluster of the overlying lens RGS; the other in sub-square B6a (Fig. 3).
480 Another piece of ochre is found nearby and a fourth one at one meter in square C4 (Fig. 3). The
481 three Still Bay *M. capensis* were found within the first cluster of lens RGS (Fig. 3). This
482 clustering of the perforated shells contrasts with the dispersed distribution of bifacial points and
483 point fragments in the same layer (Fig. 3).

484

485 5.4. Taphonomic and technological analysis

486 The absence of features diagnostic of estuarine (d'Errico et al., 2005) or beach induced
487 alterations (Fig. 6, 7) suggests that the two *N. kraussianus* from the late MSA layer OMOD were
488 either collected alive or within an estuarine thanatocoenosis soon after their death. One is
489 complete (Fig. 4 n°1), the other (Fig. 4 n°2) bears a perforation on the dorsal aspect and traces of

490 heating that caused blackening and weakening of the shell (d'Errico et al., 2015). The latter has
491 probably favoured the micro breakage of most of the perforation edge (Fig. 7a). A portion of the
492 original perforation edge is nevertheless preserved and reveals a smooth appearance comparable
493 to that produced on experimentally worn *N. kraussianus* (Vanhaeren et al. 2013). Although the
494 smoothing visible on the preserved portion of the original perforation edge is comparable to that
495 observed on highly abraded beach worn *N. kraussianus*, such a taphonomic process can be
496 discarded for this archaeological specimen since it would entail advanced damage, not observed
497 here, on the spire.

498 Of the 17 *A. africana*, four are complete or only slightly damaged (Fig. 4 n°3,10,11 and 19),
499 seven have a perforation on the body whorl (Fig. 4 n°4,5,9,13-15 and 18), two have their body
500 whorl partially removed by breakage (Fig. 4 n° 8 and 17), three are apical fragments (Fig. 4 n°6-
501 7 and 12), and one consists of a portion of the body whorl (Fig. 4 n°16). Seven are blackened by
502 heating and four bear micro-residues of red material (Table 1). Among the seven perforated
503 shells, one displays two conical contiguous perforations with evidence of etching suggesting
504 chemical dissolution (Fig. n°7c). The perforations on the other *A. africana* (Fig. 7d-f) are similar
505 to those produced experimentally by punching the inner aspect of the body whorl, i.e. through
506 the aperture, with a pointed tool (d'Errico et al., 2008, Fig. 7-8). This is suggested by their
507 location and the presence of micro-chipping around the perforation edge on the outer surface of
508 the shell. In one case (Fig. 4 n°18) this action was performed twice (d'Errico et al., 2008),
509 probably to re-use the shell after breakage of the first perforation. In two cases, post-depositional
510 damage of the original perforation (fig. 4 n°4 et 9) prevents identifying the morphology of the
511 tool-tip used to produce the holes. The hole morphology and location on the other specimens
512 support the use of a thin point made of bone or hard wood. Microscopic analysis of these
513 perforations reveals no obvious traces of use-wear (Fig. 7).

514 Of the three (Fig. 4 n°20-22), possibly four (Fig. 4 n°23), *M. capensis*, one (Fig. 4 n°22) is well
515 preserved, blackened by heating, and misses its outer lip and a part of the adjacent body whorl. A
516 second (Fig. 4 n°21) exhibits a perforation on the body whorl, a broken outer lip with post
517 depositional damage, and misses its apex. A third (Fig.4 n°20) is only represented by a small
518 portion of a body whorl which is blackened by heating and displays crenulated edges identical to
519 those observed on specimens of the same species experimentally broken by intense heating. The
520 fourth specimen, possibly *M. capensis* (Fig. 4 n°23), consists of a fragment which displays, on
521 one side, a crenulated edge similar to the one described for the third specimen. On the other
522 sides, it has smoothed edges as well as an orange stain on the dorsal and the ventral aspect which
523 contrasts with the light brownish grey colour of the sediment of layer LGB.

524 Experimental attempts to perforate *M. capensis* shells reveal that punching the shell from the
525 outer surface is ineffective whatever tool-type (bone or lithic point) used. Pressure through the
526 aperture with a bone or lithic point resulted in sub-rectangular perforations with edges exposing
527 the inner prismatic layer and occasional micro-chipping (Fig. 6). These features are also found
528 on the single perforated *M. capensis* from Sibudu (Fig. 4 n°21). As with the *A. africana*, the
529 perforation on the *M. capensis* shows no compelling evidence of usewear.

530

531 **6. Discussion**

532 In previous papers we reviewed the potential causes for the accumulation of marine gastropods at
533 inland southern African sites (d'Errico et al., 2005, 2008) and concluded that humans were to be
534 considered the more likely agent responsible for the accumulation and modification of six *A.*
535 *africana* found at Sibudu (d'Errico et al., 2008). Analyses of 17 supplementary gastropods (*A.*
536 *africana*, *N. kraussianus* and *M. capensis*) from Sibudu MSA layers, local bio- and
537 thanatocoenoses, and additional perforation experiments allow us to assess this diagnosis anew.
538 The distance of Sibudu from the sea during its Pleistocene occupation rules out the possibility
539 that these marine shells were accumulated by natural processes. The survey and fragmentation
540 analysis of natural gastropod assemblages confirm that the Sibudu gastropod collection is not
541 representative of present day biocoenoses or thanatocoenoses of the Dolphin Coast. Taxa well
542 represented in the biocoenoses such as *Burnupena*, *Littorina*, *Morula*, *Nerita*, *Nodilittorina*, and
543 *Peristerna*, are absent at Sibudu. Similarly, *Bullia*, *Burnupena*, *Cymatium*, *Oxysteles*, and *Ranella*,
544 representing 50% of present day thanatocoenoses, are absent at Sibudu. It is unlikely that the
545 Sibudu gastropods were collected for consumption or to be used as tools. Almost all of them are
546 tiny gastropods with low caloric value (2 kcal for 0.4 g of dry soft tissue extracted from 100 *A.*
547 *africana* and 4 kcal for 0.8 g extracted from 100 *N. kraussianus*; d'Errico et al., 2005, 2008)
548 which makes a subsistence strategy based on transporting them for 15 km ineffective. Although
549 the bivalves, like *Perna perna*, which is present at the site, and a few gastropods found at Sibudu
550 could have been transported for food, their low numbers suggest that the consumption of
551 seafood, if it did occur, was only occasional at the site (Plug, 2006). The small size of the
552 gastropods is also in contradiction with their use as tools (e.g. containers).

553 Sibudu *N. kraussianus* shells bear surface features that are incompatible with a gathering of dead
554 specimens on beaches and rather point to a collection of living specimens or a thanatocoenosis
555 soon after the death of the organisms in their estuarine habitat. *N. kraussianus* is listed among the
556 64 species of marine shells found in the stomach of a loggerhead sea turtle (*Caretta caretta*)
557 (Hughes, 1974). The identification of remains of this species in the MSA layers of Sibudu (Plug,

2006) opens the possibility that *N. kraussianus* reached the site accidentally in the stomach of prey. *Caretta caretta* crushes large gastropod shells before ingurgitating them as they are only found in the form of fragments in the turtle's stomach (Hughes, pers. com.). Small gastropods, such as *N. kraussianus*, are probably swallowed whole. However, it is unlikely that *Caretta caretta* made the keyhole perforation on one of the two Sibudu *N. kraussianus*. This perforation type is rarely found in estuarine thanatocoenoses and when it does it only occurs on decalcified shells (d'Errico et al., 2005), which is not the case for the Sibudu specimen. The state of preservation of this archaeological specimen is also incompatible with the use-wear observed on beach worn *Nassarius*. In contrast, even if damaged, the use wear on a well preserved portion of the perforation edge is comparable to that observed on archaeological and experimental *N. kraussianus* shells used as beads (Vanhaeren et al., 2013). The use of *N. kraussianus* as beads is documented in the Still Bay of Blombos Cave, dated to ca. 72 ka (Henshilwood et al., 2004) and in the Early Later Stone Age of Border Cave, dated to between 42-44 ka cal BP (d'Errico et al., 2012). The perforated Sibudu *N. kraussianus* comes from a layer dated 46.6 ± 2.3 ka (Jacobs 2008a). Transport in the stomach of a turtle cannot be discarded for the complete *N. kraussianus*. Its occurrence in the same late MSA layer as the perforated specimen makes it however equally possible that it corresponds to a shell lost or discarded before being perforated to be used as bead. No natural agents are known to bring *A. africana* or *M. capensis* to inland sites and neither of these two species is reported as being found in the stomach of identified prey at Sibudu. Littorinidae are present in the Still Bay layers of Blombos Cave (d'Errico et al., 2005) and the MSA layers of Klasies River (Thackeray, 1988). Due to lack of clear human induced modifications, they have been interpreted as "incidental shells" which came to the site accidentally with seafood (e.g. attached to the byssus of mussels). This is unlikely for the *A. africana* from Sibudu considering the scarcity of shellfish consumption at this site. Also, none of these Littorinidae from Blombos or Klasies River are perforated, while a third of those from Sibudu are, and another third may have been perforated before post-depositional damage. The spatial distribution of *A. africana* and *M. capensis* provides clues for discussing the reasons for their presence at the site. Contrary to the lithic bifacial points, found all over the excavated area, perforated and clearly unperforated gastropods are found in clusters associated with some hearths and are absent around other hearths (Fig. 3). This indicates that different spatial use and patterns of discard applied to the shells and the points. It also suggests that the loss or disposal of the shells is the consequence of an activity conducted close to hearths but that this activity did not systematically occur every time a hearth was created and maintained. This pattern also contradicts the hypothesis according to which the shells found at the site correspond to accidental

592 losses of individual beads during a variety of everyday activities. If this was the case, one would
593 expect to find a more widespread if not random distribution of exclusively perforated or broken
594 shells. The observed spatial distribution is compatible with an occasional subsistence activity or
595 the manufacture or maintenance of beadwork.

596 The perforations observed on the Sibudu *A. africana* are of three types: 1) natural perforation
597 either made by a scavenger or by post-depositional chemical dissolution (Fig. 4 n°5), 2)
598 perforations produced and/or enlarged by post-depositional processes for which an
599 anthropogenic intervention is difficult to prove (Fig. 4 n°4 and 9) and 3) small perforations with
600 features implying that they have been produced by punching the shell through its aperture (Fig. 4
601 n°13-15 and 18). The only perforated *M. capensis* (Fig. 4 n°21) falls in this last category.

602 Considering the small caloric value of *A. africana*, shells belonging to this last category could
603 well have been intended for beads. Microscopic analysis of their perforation edges identifies no
604 or undiagnostic use-wear that would unambiguously demonstrate their use as beads. The absence
605 of use-wear could be explained by the fact that 1) they have been lost or disposed before use-
606 wear could develop, 2) they were attached in such a way that use-wear could not develop, 3)
607 their use as beads produced breakage of the perforation edges rather than identifiable wear, 4)
608 they have been perforated by humans for an unknown reason, and 5) the perforations were made
609 by an unknown natural agent. The first two hypotheses are consistent with the spatial distribution
610 of archaeological finds within layer RGS and RGS2. The third hypothesis is contradicted by the
611 presence, among the perforated specimens, of small perforations that can hardly result from
612 enlargement of previously even tinier holes (Fig.4 n°14). The fourth and fifth hypotheses are
613 difficult to test at present as they would require a larger assemblage and, probably, the creation
614 of an experimental protocol seeking to explore the impact of post-depositional damage on shells
615 incorporated in Southern Africa multi-layered MSA sequences in shelters and cave.

616

618 7. Conclusions

619 Three species of perforated marine shell were found in MSA layers of Sibudu: *Nassarius*
620 *kraussianus*, *Afrolittorina africana* and *Mancinella capensis*. *Nassarius kraussianus* was found
621 only in the late MSA in OMOD layer dated to ca 47 ka; it did not occur in Howiesons Poort or
622 earlier industries. A *N. kraussianus* shell bead and an unperforated shell belonging to the same
623 species were recovered from OMOD. The perforated shell had been heated. *N. kraussianus* was
624 found at Border Cave, north of Sibudu, in early LSA contexts. It was first used as a personal
625 ornament in the Western Cape Still Bay. Sibudu confirms what has been recently highlighted at
626 Border Cave (d'Errico et al., 2012): after an early introduction, for example at Blombos, this
627 species was subsequently used to produce beads at late MSA/early LSA sites located along the
628 eastern flank of South Africa. The absence, at Sibudu, of ostrich eggshell beads, found at Border
629 Cave in association with the *N. kraussianus*, may indicate that ostrich eggshell beads are an
630 intrusive phenomenon in this part of southern Africa and that in the earliest phases of their
631 spread their distribution may have been restricted to north-east KwaZulu-Natal. Ostrich did not,
632 and does not, occur in the Sibudu area, and no ostrich bones or eggshell occur in the MSA layers
633 of the site.

634 Seven perforated *A. africana* shells were found in Sibudu, as well as ten unperforated *A. africana*
635 shells. Six perforated *A. africana* shells were from the Still Bay and one from the Howiesons
636 Poort, though the Howiesons Poort one may be misplaced from the Still Bay as the result of rock
637 fall disturbance. Three of the unperforated and one perforated shell showed traces of pigment,
638 while three perforated and four unperforated shells had been heated. The only perforated *M.*
639 *capensis* shell was found in the Still Bay and this shell's small perforation has features implying
640 that it was produced by punching the shell through its aperture. Three unperforated *M. capensis*
641 shells were found in the Still Bay; two had traces of pigment in them and two had been heated.
642 The interpretation of Sibudu's *A. africana* shells as beads used for a short time only, together
643 with unused shells, or shells intended for perforation represents, at present, the most
644 parsimonious explanation for this evidence. However, we are still far from the degree of
645 certainty attained at other MSA sites from northern and southern Africa where the larger number
646 of specimens found, and the consistency in traces of manufacture and utilisation make the
647 diagnosis more robust. If formally demonstrated, the use of shell beads at Sibudu during the late
648 MSA, Howiesons Poort and Still Bay occupations would represent supporting evidence for shell
649 bead use in the Howiesons Poort and early LSA, already suggested for Border Cave (d'Errico et
650 al. 2012; Beaumont and Bednarik, 2013). Furthermore, it would corroborate the evidence for
651 comparable behaviour by Still Bay populations, attested at Blombos Cave (Henshilwood et al.,

652 2004). The use of different shell species for making beads at Sibudu suggests that the Howiesons
653 Poort and the Still Bay are not a homogeneous cultural phenomenon. Instead, these entities are
654 associated, in different regions of southern Africa, with distinct bone tool technologies (d’Errico
655 et al. 2012) as well as personal ornament traditions (d’Errico and Backwell, 2016). Moreover, the
656 presence of *N. kraussianus* beads in Sibudu’s final MSA and Border Cave’s early LSA points to
657 dynamically changing traditions through time.

658

659 **Acknowledgements**

660 Our primary thanks go to Ina Plug, who first recognised that there might be worked shell at
661 Sibudu. We thank Phil Hockey, Georges Hughes, Markus Lussi, Christopher McQuaid, Kim
662 Prochazka, David Reid, Dai Herbert and Christine Sievers for valuable information and
663 discussions on shell ecology and taphonomy. Christine Sievers generously passed to us her
664 marine shell collection. FD was funded by the European Research Council (FP7/2007/2013,
665 TRACSYMBOLS 249587) and the Research Council of Norway through its Centre’s of
666 Excellence funding scheme (SFF Centre for Early Sapiens Behaviour –SapienC– project number
667 262618), MV and FD by the *Agence Nationale de la Recherche – LaScArBx* Cluster of
668 Excellence (ANR-10-LABX-52). LW and MV by the South African National Research
669 Foundation. The funding agencies do not necessarily support the opinions expressed in this
670 paper.

671

672 **References**

- 673 Allott, L.F., 2006. Archaeological charcoal as a window on palaeovegetation and wood use
674 during the Middle Stone Age at Sibudu Cave. *Southern African Humanities* 18 (1), 173–201.
- 675 Ambrose, S., 1998. Chronology of the later Stone Age and food production in East Africa.
676 *Journal of Archaeological Science* 25, 377–392.
- 677 Backwell, L., d’Errico, F., Wadley, L., 2008. Middle Stone Age bone tools from the Howiesons
678 Poort layers, Sibudu Cave, South Africa. *Journal of Archaeological Science* 35, 1566–1580.
- 679 Bar-Yosef Mayer, D.E, Vandermeersch, B., Bar-Yosef, O., 2009. Shells and ochre in Middle
680 Paleolithic Qafzeh Cave, Israel: indications for modern behaviour. *Journal of Human*
681 *Evolution* 56, 307–314.
- 682 Beaumont, P.B., Bednarik, R.G., 2013. Tracing the emergence of palaeoart in Sub-Saharan
683 Africa. *Rock Art Research* 30 (1), 1–22.
- 684 Bicho, N., Cascalheira, J., André, L., Haws, J., Gomes, A., Gonçalves, C., Raja, M., Benedetti,
685 M., 2018. Portable art and personal ornaments from Txina-Txina: a new Later Stone Age site

686 in the Limpopo River Valley, southern Mozambique. *Antiquity* 92(363): e2.

687 Bouzouggar, A., Barton, N., Vanhaeren, M., d'Errico, F., Collcutt, S., Higham, T., Hodge, E.,
688 Parfitt, S., Rhodes, E., Schwenninger, J.-L., Stringer, C., Turner, E., Ward, S., Moutmir, A.,
689 Stambouli, A., 2007. 82,000-year-old shell beads from North Africa and implications for the
690 origins of modern human behaviour. *Proceedings of the National Academy of Science USA*
691 104, 9964–9969.

692 Branch, M., Branch, G., 1981. *The Living Shores of Southern Africa*. C. Struik (Pty) Ltd, Cape
693 Town.

694 Branch, G.M., Griffiths, C.L., Branch M.L., Beckley, L.E., 1994. *Two Oceans. A Guide to the*
695 *Marine Life of Southern Africa*. David Philip Publishers (Pty) Ltd, Claremont.

696 Brown, K.S., Marean, C.W., Herries, A.I.R., Jacobs, Z., Tribolo, C., Braun, D., Roberts, D.L.,
697 Meyer, M.C., Bernatchez, J., 2009. Fire as an engineering tool of early modern humans.
698 *Science* 325, 859–862.

699 Bruch, A.A., Sievers, C., Wadley, L., 2012. Quantification of climate and vegetation from
700 southern African Middle Stone Age sites - an application using Late Pleistocene plant
701 material from Sibudu, South Africa. *Quaternary Science Reviews* 45, 7–17.

702 Cain, C.R. 2004. Notched, flaked and ground bone artefacts from Middle Stone Age and Iron
703 Age layers of Sibudu Cave, KwaZulu-Natal, South Africa. *South African Journal of Science*
704 100,195–197.

705 Cain, C.R., 2006. Human activity suggested by the taphonomy of 60 ka and 50 ka faunal remains
706 from Sibudu Cave. *Southern African Humanities* 18 (1), 241–260.

707 Claremont M., Vermeij G.J., Williams S.T., Reid D.G., 2013. Global phylogeny and new
708 classification of the Rapaninae (Gastropoda: Muricidae), dominant molluscan predators on
709 tropical rocky seashores. *Molecular Phylogenetics and Evolution* 66, 91–102.

710 Clark, J.L. 2019. The Still Bay and pre-Still Bay fauna from Sibudu Cave: Taphonomic and
711 taxonomic analysis of the macromammal remains from the Wadley excavations. *Journal of*
712 *Paleolithic Archaeology* 2(1), 26-73.

713 Clark, J.L., Plug, I., 2008. Animal exploitation strategies during the South African Middle Stone
714 Age: Howiesons Poort and post-Howiesons Poort fauna from Sibudu Cave. *Journal of Human*
715 *Evolution* 54, 886–898.

716 Cochrane, G.W.G., 2006. An analysis of lithic artefacts from the ~58 ka layers of Sibudu Cave.
717 *Southern African Humanities* 18 (1), 69–88.

718 Cochrane, G.W.G., 2008. The transition from Howieson's Poort to post-Howieson's Poort
719 Industries in southern Africa. *South African Archaeological Society Goodwin Series* 10,157–

720 167.

721 Conard, N. 2010. Cultural modernity: Consensus or conundrum? *Proceedings of the National*
722 *Academy of Science USA* 107(17), 7621-7622.

723 Conard, N., Porraz, G., Wadley, L., 2012. What is in a name? Characterising the ‘post-
724 Howieson’s Poort’ at Sibudu. *South African Archaeological Bulletin* 67, 180–199.

725 Dayet, L., Texier, P.-J., Daniel, F., Porraz, G., 2013. Ochre resources from the Middle Stone Age
726 sequence of Diepkloof Rock Shelter, Western Cape, South Africa. *Journal of Archaeological*
727 *Science* 40, 3492–3505.

728 Deacon, H.J., 1995. Two late Pleistocene-Holocene archaeological depositories from the
729 Southern Cape, South Africa. *South African Archaeological Bulletin* 50, 121–131.

730 d’Errico, F., Backwell, L., 2016. Earliest evidence of personal ornaments associated with burial:
731 The Conus shells from Border Cave. *Journal of Archaeological Science* 93, 91-108.

732 d’Errico, F., Henshilwood, C.S., 2007. Additional evidence for bone technology in the southern
733 African Middle Stone Age. *Journal of Human Evolution* 52, 142–163.

734 d’Errico, F., Stringer, C.B., 2011. Evolution, revolution or saltation scenario for the emergence
735 of modern cultures? *Philosophical Transactions of the Royal Society London B Biological*
736 *Science* 366(1567), 1060–1069.

737 d’Errico, F., Henshilwood, C., Lawson, G., Vanhaeren, M., Soressi, M., Bresson, F., Tillier, A.-
738 M., Maureille, B., Nowell, A., Backwell, L., Lakarra, J.A., Julien, M., 2003. The search for
739 the origin of symbolism, music and language: a multidisciplinary endeavour. *Journal of*
740 *World Prehistory* 17, 1–70.

741 d’Errico, F., Henshilwood, C.S., Vanhaeren, M., Van Niekerk, K., 2005. *Nassarius kraussianus*
742 shell beads from Blombos Cave: evidence for symbolic behaviour in the Middle Stone Age.
743 *Journal of Human Evolution* 48, 2–14.

744 d’Errico, F., Vanhaeren, M., Wadley, L., 2008. Possible shell beads from the Middle Stone Age
745 layers of Sibudu Cave, South Africa. *Journal of Archaeological Science* 35, 2675–2685.

746 d’Errico, F., Vanhaeren, M., Barton, N., Bouzouggar, A., Mienis, H., Richter, D., Hublin, J.-J.,
747 Mcpherron, S.P., Lozouet, P., 2009. Additional evidence on the use of personal ornaments in
748 the Middle Paleolithic of North Africa. *Proceedings of the National Academy of Science USA*
749 106, 16051–16056.

750 d’Errico, F., Backwell, L., Villa, P., Degano, I., Lucejko, J.J., Bamford, M.K., Higham, T.F.G.,
751 Perla Colombini, M., Beaumont, P.B., 2012a. Early evidence of San material culture
752 represented by organic artifacts from Border Cave, South Africa. *Proceedings of the National*
753 *Academy of Sciences USA* 109, 13214–13219.

754 d'Errico, F., Backwell, L., Wadley, L., 2012b. Identifying regional variability in Middle Stone
755 Age bone technology: The case of Sibudu Cave. *Journal of Archaeological Science* 39,
756 2479–2495.

757 d'Errico, F., Vanhaeren, M., van Niekerk, K., Henshilwood, C.S., Erasmus, R.M., 2015.
758 Assessing the accidental versus deliberate colour modification of shell beads: a case study on
759 perforated *Nassarius kraussianus* from Blombos Cave Middle Stone Age levels.
760 *Archaeometry* 57, 51–76.

761 de la Peña, P., 2015. Refining our understanding of the Howiesons Poort lithic technology: the
762 evidence from grey rocky layer in Sibudu Cave (KwaZulu-Natal, South Africa). *PloS One* 10
763 (12), e0143451.

764 de la Peña, P., Wadley, L., 2014. Quartz knapping strategies in the Howiesons Poort at Sibudu
765 (KwaZulu-Natal, South Africa). *PLoS ONE* 9(7) e101534.

766 de la Peña, P., Wadley, L., 2014b. New knapping methods in the Howiesons Poort at Sibudu
767 (KwaZulu-Natal, South Africa). *Quaternary International* 350, 26–42.

768 de la Peña, P., Wadley, L., 2017. Technological variability at Sibudu Cave: the end of
769 Howiesons Poort and reduced mobility strategies after 62,000 years ago. *PloS One* 12 (10),
770 e0185845.

771 de la Peña, P., Wadley, L., Lombard, M., 2013. Quartz bifacial points in the Howiesons Poort of
772 Sibudu. *South African Archaeological Bulletin* 68, 119–136.

773 Delagnes, A., Wadley, L., Villa, P., Lombard, M., 2006. Crystal quartz backed tools from the
774 Howiesons Poort at Sibudu Cave. *Southern African Humanities* 18 (1), 43–56.

775 Evans, U., 1994. Hollow Rock Shelter, a Middle Stone Age site in the Cederberg. *Southern*
776 *African Field Archaeology* 3, 63–73.

777 Galbraith, R.F., 2015. On the mis-use of mathematics: A comment on “How confident are we
778 about the chronology of the transition between Howieson's Poort and Still Bay?” by Guérin et
779 al. (2013). *Journal of Human Evolution* 80, 184–186.

780 Garofoli, D., 2014. Do early body ornaments prove cognitive modernity? A critical analysis from
781 situated cognition. *Phenomenology and the Cognitive Sciences*, 1–23.

782 Glenny, W., 2006. Report on the micromammal assemblage analysis from Sibudu Cave.
783 *Southern African Humanities* 18(1), 270–288.

784 Gliganic, L.A., Jacobs, Z., Roberts, R.G., Dominguez-Rodrigo, M., Mabulla, A.Z.P., 2012. New
785 ages for Middle and Later Stone Age deposits at Mumba rockshelter, Tanzania: Optically
786 stimulated luminescence dating of quartz and feldspar grains. *Journal of Human Evolution* 62,
787 533–547.

788 Goldberg, P., Miller, C.E., Schiegl, S., Ligouis, B., Berna, F., Conard, N.J., Wadley, L., 2009.
789 Bedding, hearths, and site maintenance in the Middle Stone Age of Sibudu Cave, KwaZulu-
790 Natal, South Africa. *Archaeological and Anthropological Sciences* 1(2), 95–122.

791 Goodwin, A.J.H., van Riet Lowe, C., 1929. The Stone Age cultures of South Africa. *Annals of*
792 *the South African Museum* 27, 1–289.

793 Guérin, G., Murray, A.S., Jain, M., Thomsen, K.J., Mercier, N. 2013. How confident are we in
794 the chronology of the transition between Howiesons Poort and Still Bay? *Journal of Human*
795 *Evolution* 64, 314–317.

796 Haidle, M.N., Bolus, M., Collard, M., Conard, N.J., Garofoli, D., Lombard, M., Nowell, A.,
797 Tennie, C., Whiten, A., 2015. The nature of culture: an eight-grade model for the evolution
798 and expansion of cultural capacities in hominins and other animals. *Journal of*
799 *Anthropological Sciences* 93, 43–70.

800 Hall, G., Wadley, L., Woodborne, S., 2014. Past environmental proxies from the Middle Stone
801 Age at Sibudu, KwaZulu-Natal, South Africa. *Journal of African Archaeology* 12, 7–24.

802 Henshilwood, C.S., Dubreuil, B., 2009. Reading the artifacts: gleanings language skills from the
803 Middle Stone Age in southern Africa. In: Botha, R., Knight, C. (Eds), *The Cradle of*
804 *Language, Volume 2: African perspectives*. Oxford University Press, Oxford, pp. 61–92.

805 Henshilwood, C.S., Dubreuil, B., 2011. The Still Bay and Howiesons Poort, 77 - 59 ka:
806 Perspective-taking and the evolution of the modern human mind during the African Middle
807 Stone Age. *Current Anthropology* 52(3), 361–400.

808 Henshilwood, C.S., Sealy, J.C., Yates, R.J., Cruz-Uribe, K., Goldberg, P., Grine, F.E., Klein,
809 R.G., Poggenpoel, C., van Niekerk, K.L., Watts, I., 2001. Blombos Cave, southern Cape,
810 South Africa: preliminary report on the 1992-1999 excavations of the Middle Stone Age
811 levels. *Journal of Archaeological Science* 285, 421–448.

812 Henshilwood, C.S., d’Errico, F., Vanhaeren, M., 2004. Middle Stone Age shell beads from South
813 Africa. *Science* 304, 404.

814 Henshilwood, C.S., d’Errico, F., Watts, I., 2009. Engraved ochres from the Middle Stone Age
815 levels at Blombos Cave, South Africa. *Journal of Human Evolution* 57, 27–47.

816 Herries, A.I.R., 2006. Archaeomagnetic evidence for climate change at Sibudu Cave. *Southern*
817 *African Humanities* 18(1), 131–147.

818 Hodgskiss, T., 2012. Attribute analysis of the Sibudu Middle Stone Age ochre assemblage.
819 *Southern African Humanities* 24, 99–120.

820 Hodgskiss, T., 2013. Ochre use in the Middle Stone Age at Sibudu, South Africa: Grinding,
821 rubbing, scoring and engraving. *Journal of African Archaeology* 11, 75–95.

822 Hughes, G.R., 1974. The sea turtles of south-east Africa, II, The biology of the Tongaland
823 loggerhead turtle *Caretta caretta* L., with comments on the leatherback turtle *Dermochelys*
824 *coriacia* L., and the green turtle *Chelonia mydas* L. in the study region. Oceanographic
825 Research Institute, South Africa Investigational Report 36.

826 Jacobs, Z., Wintle, A.G., Duller, G.A.T., Roberts, R.G., Wadley, L., 2008a. New ages for the
827 post-Howiesons Poort, late and final Middle Stone Age at Sibudu Cave, South Africa. *Journal*
828 *of Archaeological Science* 35, 1790–1807.

829 Jacobs, Z., Roberts, R.G., Galbraith, R. F., Deacon, H. J., Grün, R., Mackay, A., Mitchell, P.J.,
830 Parkington, J., Wadley, L., 2008b. Ages for the Middle Stone Age of southern Africa:
831 implications for human behaviour and dispersal. *Science* 322, 733–735.

832 Jacobs, Z., Hayes, E.H., Roberts, R.G., Galbraith, R.F., Henshilwood, C.S., 2013. An improved
833 OSL chronology for the Still Bay layers at Blombos Cave, South Africa: further tests of
834 single-grain dating procedures and a re-evaluation of the timing of the Still Bay industry
835 across southern Africa. *Journal of Archaeological Science* 40(1), 579–594.

836 Jacobs, Z., Roberts, R.G., 2008. Testing times: old and new chronologies for the Howieson’s
837 Poort and Still Bay industries in environmental context. *South African Archaeological Society*
838 *Goodwin Series* 10, 9–34.

839 Jacobs, Z., Roberts, R.G., 2015. An improved single grain OSL chronology for the sedimentary
840 deposits from Diepkloof Rockshelter, Western Cape, South Africa. *Journal of Archaeological*
841 *Science* 63, 175-192.

842 Kilburn, R., Rippey, E., 1982. *Sea Shells of Southern Africa*. Macmillan South Africa
843 (Publishers) (Pty) Ltd, Johannesburg.

844 Kowalewski, M., Flessa, K.W., Hallman, D.P., 1995. Ternary taphograms: triangular diagrams
845 applied to taphonomic analysis. *Palaios* 10, 478– 483.

846 Kuhn S.L., Stiner, M.C., Reese, D.S., Güleç, E., 2001. Ornaments of the earliest Upper
847 Paleolithic: new insights from the Levant. *Proceeding of the National Academy of Science*
848 *USA* 98 (13), 7641–7646.

849 Kuhn, S.L., Stiner, M.C., 2006. Les parures au Paléolithique: enjeux cognitifs, démographiques
850 et identitaires. *Diogenes* 214, 47–58.

851 Kuhn, S., Stiner, M. 2007. Body ornamentation as information technology: towards an
852 understanding of the significance of early beads. In: Mellars, P., Boyle, K., Bar-Yosef, O.,
853 Stringer, C. (Eds.), *Rethinking the Human Revolution: New Behavioural and Biological and*
854 *Perspectives on the Origins and Dispersal of Modern Humans*. MacDonald Institute of
855 Archaeology, Cambridge, pp. 45–54.

- 856 Lombard, M., 2004. Distribution patterns of organic residues on Middle Stone Age points from
857 Sibudu Cave, KwaZulu-Natal, South Africa. *South African Archaeological Bulletin* 59, 37–
858 44.
- 859 Lombard, M., 2005. Evidence of hunting and hafting during the Middle Stone Age at Sibudu
860 Cave, KwaZulu-Natal, South Africa: a multi-analytical approach. *Journal of Human*
861 *Evolution* 48, 279–300.
- 862 Lombard, M., 2006a. First impressions on the functions and hafting technology of Still Bay
863 pointed artefacts from Sibudu Cave. *Southern African Humanities* 18 (1), 27–41.
- 864 Lombard, M., 2006b. Direct evidence for the use of ochre in the hafting technology of Middle
865 Stone Age tools from Sibudu Cave, KwaZulu-Natal. *Southern African Humanities* 18 (1), 57–
866 67.
- 867 Lombard, M. 2007. The gripping nature of ochre: the association of ochre with Howiesons Poort
868 adhesives and Later Stone Age mastics from South Africa. *Journal of Human Evolution* 53,
869 406–419.
- 870 Lombard, M., 2011. Quartz-tipped arrows older than 60 ka: further use-trace evidence from
871 Sibudu, KwaZulu-Natal, South Africa. *Journal of Archaeological Science* 38, 1918–1930.
- 872 Lombard, M., Högberg, A. 2018. The Still Bay points of Apollo 11 Rock Shelter, Namibia: an
873 inter-regional perspective. *Azania: Archaeological Research in Africa* 53(3), 312-340.
- 874 Lombard, M., Wadley, L., Jacobs, Z., Mohapi, M., Roberts, R.G., 2010. Still Bay and serrated
875 points from Umhlatuzana Rock Shelter, KwaZulu-Natal, South Africa. *Journal of*
876 *Archaeological Science* 37, 1773–1784.
- 877 Marais, A.P., Seccombe, A.D. (Eds.), 2010. Identification guide to the seashells of South Africa,
878 Volume 1, Centre for Molluscan Studies, Groenkloof.
- 879 McBrearty, S, Brooks, A.S., 2000. The revolution that wasn't: a new interpretation of the origin
880 of modern human behaviour. *Journal of Human Evolution* 39, 453–563.
- 881 McQuaid, C.D., 1981. The establishment and maintenance of vertical size gradients in
882 populations of *Littorina africana knysnaensis* (Philippi) on an exposed rocky shore. *Journal of*
883 *Experimental Marine Biology and Ecology* 54(1), 77–89.
- 884 Miller, J.M., Willoughby, P.R., 2014. Radiometrically dated ostrich eggshell beads from the
885 Middle and Later Stone Age of Magubike Rockshelter, southern Tanzania, *Journal of Human*
886 *Evolution* 74, 118–122.
- 887 Mohapi, M., 2013. The Middle Stone Age point assemblage from Umhlatuzana Rock Shelter: a
888 morphometric study. *Southern African Humanities* 25, 25–51.
- 889 Mourre, V., Villa, P., Henshilwood, C.S., 2010. Early use of pressure flaking on lithic artifacts at

890 Blombos Cave, South Africa. *Science* 330, 659–662.

891 Palmer, C.G., 1980. *Some aspects of the biology of Nassarius kraussianus (Dunker), in the*
892 *Bushmans river estuary, with particular reference to recolonisation after floods.* M.A.
893 Dissertation, Rhodes University (SA).

894 Pickering, R., 2006. Regional geology, setting and sedimentology of Sibudu Cave. *Southern*
895 *African Humanities* 18(1), 123–129.

896 Plug, I., 2004. Resource exploitation: animal use during the Middle Stone Age at Sibudu Cave,
897 KwaZulu-Natal. *South African Journal of Science* 100, 151–158.

898 Plug, I., 2006. Aquatic animals and their associates from the Middle Stone Age levels at Sibudu
899 Cave. *Southern African Humanities* 18(1), 289–299.

900 Porraz, G., Texier, P.-J., Archer, W., Piboule, M., Rigaud, J.-P., Tribolo, C., 2013. Technological
901 successions in the Middle Stone Age sequence of Diepkloof Rock Shelter, Western Cape,
902 South Africa. *Journal of Archaeological Science* 40, 3376–4300.

903 Renaut, R., Bamford, M., 2006. Results of preliminary palynological analysis of samples from
904 Sibudu Cave. *Southern African Humanities* 18(1), 235–240.

905 Reynolds, S.C., 2006. Temporal changes in vegetation and mammalian communities during
906 Oxygen Isotope Stage 3 at Sibudu Cave, KwaZulu-Natal. *Southern African Humanities* 18(1),
907 301–314.

908 Richards, D., 1981. *South African Shells. A collector's guide.* C. Struik (Pty) Ltd, Cape Town.

909 Rigaud, J.-P., Texier, P.-J., Parkington, J., Poggenpoel, C., 2006. Le mobilier Stillbay et
910 Howiesons Poort de l'abri Diepkloof. La chronologie du Middle Stone Age sud-africain et ses
911 implications. *Comptes Rendus de l'Académie des Sciences Palevol* 5, 839–849.

912 Robinson, J.R., Wadley, L. 2018. Stable isotope evidence for (mostly) stable local environments
913 during the South African Middle Stone Age from Sibudu, KwaZulu-Natal. *Journal of*
914 *Archaeological Science* 100: 32-44.

915 Rots, V., Lentfer, C., Schmid, V.C., Porraz, G., Conard, N.J., 2017. Pressure to serrate points for
916 the hunt: serrated points used as hafted projectiles at Sibudu Cave, South Africa. *PLoS One* 12
917 (4), e0175151.

918 Sampson, G.S., 1974. *The Stone Age Archaeology of Southern Africa.* Academic Press, New
919 York.

920 Schiegl, S., Conard, N.J., 2006. The Middle Stone Age sediments at Sibudu: results from FTIR
921 spectroscopy and microscopic analyses. *Southern African Humanities* 18(1), 149–172.

922 Schiegl, S., Stockhammer, P., Sievers, C., Wadley, L., 2004. A mineralogical and phytolith study
923 of the Middle Stone Age hearths in Sibudu Cave, KwaZulu-Natal, South Africa. *South*

924 *African Journal of Science* 100, 185–194.

925 Shipton, Ceri, Patrick Roberts, Will Archer, Simon J. Armitage, Caesar Bitu, James Blinkhorn,
 926 Colin Courtney-Mustaphi et al. 78,000-year-old record of Middle and Later stone age
 927 innovation in an East African tropical forest. *Nature communications* 9, 1832.

928 Sievers, C., 2006. Seeds from the Middle Stone Age layers at Sibudu Cave. *Southern African*
 929 *Humanities* 18 (1), 203–222.

930 Steele, T.E., Álvarez-Fernández, E.S., Hallett-Desguez, E.M., 2019. Personal Ornaments in
 931 Early Prehistory A Review of Shells as Personal Ornamentation during the African Middle
 932 Stone Age. *PaleoAnthropology* 2019, 24-51.

933 Soriano, S., Villa, P., Delagnes, A., Degano, I., Pollarolo, L., Lucejko, J.J., Henshilwood, C.,
 934 Wadley, L. 2015. The Still Bay and Howiesons Poort at Sibudu and Blombos: Understanding
 935 Middle Stone Age technologies. *PLoS One* 10, e0131127.

936 Teske, P.R., Papadopoulos, I., McQuaid, C.D., Newman, B.K., Barker, N., 2007. Climate
 937 change, genetics or human choice: why were the shells of mankind’s earliest ornament larger
 938 in the Pleistocene than in the Holocene? *Plos One* 7, e614.

939 Thackeray, J.F., 1988. Molluscan fauna from Klasies River, South Africa, *South African*
 940 *Archaeological Bulletin* 43, 27–32.

941 Tribolo, C., Mercier, N., Valladas, H., Joron, J.-L., Guibert, P., Lefrais, Y., Selo, M., Texier, P.-
 942 J., Rigaud, J.-P., Porraz, G., Poggenpoel, C., Parkington, J.E., Texier, J.-P., Lenoble, A., 2009.
 943 Thermoluminescence dating of a Still Bay – Howiesons Poort sequence at Diepkloof Rock
 944 Shelter (Western Cape, South Africa). *Journal of Archaeological Science* 36, 730–739.

945 Tribolo, C., Mercier, N., Douville, E., Joron, J.-L., Reyss, J.-L., Rufer, D., Cantin, N., Lefrais,
 946 Y., Miller, C.E., Porraz, G., Parkington, J.E., Rigaud, J.-P., Texier, P.-J., 2013. OSL and TL
 947 dating of the Middle Stone Age sequence at Diepkloof Rock Shelter (South Africa): a
 948 clarification. *Journal of Archaeological Science* 40, 3401–3411.

949 Vanhaeren, M., d’Errico, F., Stringer, C., James, S.L., Todd, J., Mienis, H.K., 2006. Middle
 950 Palaeolithic shell beads in Israel and Algeria. *Science* 312, 1785–1788.

951 Vanhaeren, M., d’Errico, F., van Niekerk, K.L., Henshilwood, C.S., Erasmus, R.M., 2013.
 952 Thinking strings: additional evidence for personal ornament use in the Middle Stone Age at
 953 Blombos Cave, South Africa. *Journal of Human Evolution* 64, 500–517.

954 Villa, P., Delagnes, A., Wadley, L., 2005. A late Middle Stone Age artefact assemblage from
 955 Sibudu (KwaZulu-Natal): comparisons with the European Middle Palaeolithic. *Journal of*
 956 *Archaeological Science* 32, 399–422.

957 Villa, P., Soressi, M., Henshilwood, C.S., Mourre, V., 2009. The Still Bay points of Blombos

- 958 Cave (South Africa). *Journal of Archaeological Science* 36, 441–460.
- 959 Villa, P., Lenoir, M., 2006. Hunting weapons of the Middle Stone Age and the Middle
960 Palaeolithic: spear points from Sibudu, Rose Cottage and Bouheben. *Southern African*
961 *Humanities* 18(1), 89–122.
- 962 Vogelsang, R., Richter, J., Jacobs, Z., Eichhorn, B., Linseele, V., Roberts, R.G., 2010. New
963 excavations of Middle Stone Age deposits at Apollo 11 Rock Shelter, Namibia: Stratigraphy,
964 archaeology, chronology and past environments. *Journal of African Archaeology* 8, 185–218.
- 965 Wadley, L., 2001. What is cultural modernity? A general view and a South African perspective
966 from Rose Cottage. *Cambridge Archaeological Journal* 11(2), 201–221.
- 967 Wadley, L., 2003. How some archaeologists recognize culturally modern behaviour. *South*
968 *African Journal of Science* 99, 247–250.
- 969 Wadley, L., 2004. Vegetation changes between 61 500 and 26 000 years ago: the evidence from
970 seeds in Sibudu Cave, KwaZulu-Natal. *South African Journal of Science* 100, 167–173.
- 971 Wadley, L., 2005. A typological study of the final Middle Stone Age stone tools from Sibudu
972 Cave, KwaZulu-Natal. *South African Archaeological Bulletin* 60, 51–63.
- 973 Wadley, L., 2006. Partners in grime: results of multi-disciplinary archaeology at Sibudu Cave.
974 *Southern African Humanities* 18 (1), 315–341.
- 975 Wadley, L., 2007. Announcing a Still Bay Industry at Sibudu Cave. *Journal of Human Evolution*
976 52, 681–689.
- 977 Wadley, L., 2010a. Were snares and traps used in the Middle Stone Age and does it matter? A
978 review and a case study from Sibudu, South Africa. *Journal of Human Evolution* 58, 179–
979 192.
- 980 Wadley, L., 2010b. Cemented ash as a receptacle or work surface for ochre powder production at
981 Sibudu, South Africa, 58,000 years ago. *Journal of Archaeological Science* 37, 2397–2406.
- 982 Wadley, L., 2012. Two ‘moments in time’ during Middle Stone Age occupations of Sibudu,
983 South Africa. *Southern African Humanities* 24, 79–97.
- 984 Wadley, L., Jacobs, Z., 2006. Sibudu Cave: background to the excavations, stratigraphy and
985 dating. *Southern African Humanities* 18(1), 1–26.
- 986 Wadley, L., Mohapi, M., 2008. A segment is not a monolith: evidence from the Howiesons Poort
987 of Sibudu, South Africa. *Journal of Archaeological Science* 35, 594–2605.
- 988 Wadley, L., Kempson, H., 2011. A review of rock studies for archaeologists, and an analysis of
989 dolerite and hornfels from the Sibudu area, KwaZulu-Natal. *Southern African Humanities* 23,
990 87–107.
- 991 Wadley, L., Plug, I., Clark, J., 2008. The contribution of Sibudu fauna to an understanding of

- 992 KwaZulu-Natal environments at ~60 ka, ~50 ka and ~37 ka. In: Badenhorst, S., Mitchell, P.,
993 Driver, J.C. (Eds.), *People, Places and Animals of Africa: Papers in Honour of Ina Plug*.
994 BAR International Series 1849, Oxford pp. 34–45.
- 995 Wadley, L., Hodgskiss, T., Grant, M., 2009. Implications for complex cognition from the hafting
996 of tools with compound adhesives in the Middle Stone Age, South Africa. *Proceedings of the*
997 *National Academy of Science USA* 106 (24), 9590–9594.
- 998 Wadley, L., Sievers, C., Bamford, M., Goldberg, P., Berna, F., Miller, C., 2011. Middle Stone
999 Age bedding construction and settlement patterns at Sibudu, South Africa. *Science* 334,
1000 1388–1391.
- 1001 Wells, C.R., 2006. A sample integrity analysis of faunal remains from the RSp layer at Sibudu
1002 Cave. *Southern African Humanities* 18(1), 261–277.
- 1003 Wendt, W.E., 1974. 'Art mobilier' aus der Apollo 11- Grotte in Siidwest-Afrika. Die altesten
1004 datierten Kunstwerke Afrikas. *Acta Praehist. Arch.* 5, 1–42.
- 1005 WoRMS Editorial Board, 2014. World Register of Marine Species. Available from
1006 <http://www.marinespecies.org> at VLIZ.
- 1007 Wojcieszak, M.A., Wadley, L. 2018. Raman Spectroscopy and Scanning Electron Microscopy
1008 confirm ochre residues on 71 000-year-old bifacial tools from Sibudu, South Africa.
1009 *Archaeometry* 60(5), 1062-1076.

Highlights

- We analyse marine gastropods from Sibudu dated to between 70 ka and 46 ka
- We study present day gastropod biocoenoses and thanatocoenoses along the KwaZulu Natal coast
- *Nassarius kraussianus* shells were used as beads at Sibudu 46 ka
- *Mancinella capensis* and *Afrolittorina africana* may have been used as beads 70 ka
- Observed differences in perforated taxa over time suggests variability in symbolic traditions

Response to Reviewers

Response to Reviewer 1

We have clarified the abbreviations post-HP (post-Howiesons Poort), OMOD (Orange Mottled Deposit) and SB (Still Bay) and rephrased or split-up the longish paragraphs, sentences and reference strings in the introductory and discussion sections. The meaning of the word “thanatocoenoses” is now explained in the introduction. Here below the details of the modifications:

- Reference strings in lines 51-55 and 123-130 were split up.
- The meaning of “Thanatocoenoses” was explained early on in the introduction
- Mozambique was spelled in conventional English in Figure 1
- Line 208 it is now explained here that the abbreviation “post-HP” means “post-Howiesons Poort”
- Line 213 the long form of the OMOD abbreviation is now explained (i.e. Orange Mottled Deposit).
- Line 218 the abbreviation SB is explained in the Introduction.
- Lines 256-266 – This paragraph has been modified to explain the relevance of the OSL ages at Diepkloof for the discussion on the dating of the Still Bay and Howiesons Poort at Sibudu: If contemporaneity is suggested for Diepkloof and the Western Cape, there is, for the time being, no evidence suggesting that this would be the case for Sibudu and the KwaZulu-Natal region.
- Lines 255-257 – This sentence indeed had a problem and has been reworked in order to start with “Chronostratigraphy”
- Lines 344-345 As suggested, the single sentence paragraph has been merged into the previous one.
- Figure 5 - Species names and data points are now connected with arrows.
- Line 425 - *Nassarius kraussianus* is now italicized
- Section 7- conclusions. The meaning of the OMOD abbreviated has been explained earlier on.

Response to Reviewer 2

We modified Figures 3-5 and rephrased the conclusion to be more cautious and refer to necessary further excavations to test our interpretation of cultural differences. Also the other issues raised by reviewer 2 were addressed:

- Line 57 et seq. We omitted 'ago' after 'ka'

- Line 65 'Conus' is now in italic

- Detailed studies of the stratigraphy, cultural remains, and dates of Sibudu have been published elsewhere and we provide only an overview in Section 2. Without complete re-writing of this section, it is difficult to summarise it in a table as suggested by Reviewer 1 as we combine data from different studies. We think section 2 gives an as condensed overview as possible and would like to keep this section as it is.

- Figure 3 Taxa identification are (and were) given within the figure. The caption now explains the presence of symbols, colors and plan views of the shells.

- Line 209 The phrase about 'bedding strata' was rephrased in order to make clear it refers to strata wherein the inhabitants burnt beddings made of plant material

- Line 213 the meaning of the abbreviation of stratigraphic layer "OMOD" is now explained (i.e. Orange Mottled Deposit).

-Line 219 we give the Latin binomials for red duiker and steenbok.

-Line 224 the Latin binomial for vervet monkey has been given

-Line 235 'tend' was corrected by 'tended'.

-Line 238 'the' was removed and it has been made clear that the argument about heat-treatment refers to Sibudu

-Line 255 This sentence has been rephrased and the relevance of the Tribolo et al. argument has been clarified.

- Line 284 The collecting methods have been clarified as follows: "Dead shells were sampled at each location for two hours during low tide between the upper beach and the strandline" and that the "Fragmentation properties were also described independently of their location".

-Figure 4. Taxa identification is now given within the caption.

-Line 368 The acquisition of the biocoenoses is explained in the method section under point 4.2.

-Line 374-6 The coordinates of the sampled beaches and the malacological reference

collections are now documented in the Materials and Methods instead of in the caption of Table 2 and Figure 6

-Fig. 5. Arrows make clear now which name goes with which dot.

-Line 417 'one' has been eliminated from the sentence

-Line 513 and elsewhere: a space has been added between SI units and notation

-Line 539 The sentence now starts with 'Transport in the stomach...'

-Line 596 The abbreviation OESB has been eliminated.

-Line 620-625 The conclusion has been phrased more cautiously.