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Technical expressions and societies in Southern Africa at the Pleistocene-Holocene transition: the example of the Bushman Rock Shelter Oakhurst lithic industries (Limpopo, South Africa)

Expressions techniques et sociétés en Afrique australe à la charnière Pléistocène-Holocène : exemple des industries lithiques Oakhurst de l'abri Bushman (Limpopo, Afrique du Sud)

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ABSTRACT / RESUME

In this article we present the preliminary results of the technological study of the lithic industries from the top of the Bushman Shelter sequence (BRS). This shelter and its lithic collections are located at many interfaces. First, the shelter is located on the edge of the Highvelds in the north of the country, a few kilometres from the canyon formed by the Blyde River, which marks a clear boundary with the low plains of eastern southern Africa (Lowvelds). It is also a cultural interface, since, at the transition between the Pleistocene and the Holocene, the lithic industries described by N. Walker in the chrono-cultural sequence of the Matopos mountain range (Zimbabwe) are expressed to the north, while to the south the lamellar lithic industries of the Robberg have given way to an original technical tradition focused on the knapping of flakes and the use of scrapers: the Oakhurst lithic complex.
The technological analysis of the BRS top sequence lithic material clearly assimilates the latter to the Oakhurst technical traditions (as often proposed but never formally demonstrated). This makes BRS the most northerly Oakhurst occurrence.

Nous proposons dans cet article les premiers résultats de l'étude technologique des industries lithiques du sommet de la séquence de l'abri Bushman (BRS). Cet abri et ses collections lithiques se situent à l'endroit de nombreuses interfaces. Interface climatique et écologique d'abord, puisque l'abri est localisé aux confins des Highvelds (hauts plateaux) au nord du pays à quelques kilomètres du canyon formé par la rivière Blyde qui marque une frontière géographique et écologique nette avec les basses plaines de l'est de l'Afrique austral (Lowvelds). Interface culturelle aussi, parce qu'à la transition entre le Pléistocène et l'Holocène, vers le nord s'expriment les industries lithiques décrites par N. Walker dans la séquence chrono-culturelle de la chaîne de montagne des Matopos (Zimababwe) alors qu'au sud les industries lithiques lamellaires du Robberg ont laissé place à une tradition technique originale tournée vers le débitage d'éclats et la fabrication de nombreux grattoirs : l'Oakhurst.

L'analyse technologique du matériel lithique du sommet de la séquence de BRS assimile très clairement ces dernières aux traditions techniques Oakhurst, comme cela a souvent été proposé mais sans que cela ne soit formellement démontré. Cela fait de BRS l'occurrence Oakhurst la plus septentrionale.

KEYWORDS / MOTS-CLEFS

Abri Bushman , Industries lithiques , Later Stone Age_ , Oakhurst_ , Technologie

Bushman Rock Shelter , Later Stone Age , Lithic industries , Oakhurst , Technology

TEXTE INTEGRAL

Introduction

The Later Stone Age (LSA, 23,000 to 2,000 BP) is often perceived as a phase of the full advent of modern behaviour [1,2]. This period, at the junction of the Pleistocene and the Holocene, is even more interesting as it is contemporary with profound environmental changes. The Last Glacial Maximum is characterised by a peak of aridity in Africa 20,000 years ago, followed by a warmer and humid climatic phase, punctuated by several cold and dry oscillations: the Dryas climatic events [3].

In response to these climatic changes, two main trajectories were adopted by African hunter-gatherer societies contemporary with the Last Glacial Maximum: on the one hand, lamino-lamellar lithic industries and microlithism are the adaptive choices favoured by hunter-gatherer societies on a continental scale, and thus characterise the LSA, while on the other hand, rarer societies retain their technical traditions, which are all straight out of the cultural heritage of the MSA [1,2].

In southern Africa, two LSA traditions are well identified: the Robberg at the end of the Pleistocene (23,000 to 12,000 BP) and the Wilton (9,000 to 2,000 BP) in the Holocene [1, 2, 4, 5, 6, 7]. Between them, a complex phase of behavioural diversification remains largely unknown [1]. On a continental scale, it is characterised by the appearance of multiple regional facies within which transformations in the technical spheres (lithic and bone industries), hunting practices and symbolic activities can be perceived. However, while at the dawn of the Holocene such a phenomenon of regionalisation seems to be taking place everywhere on the African continent [1], the hunter-gatherer societies of South Africa are taking a completely original path, abandoning microlithic instruments to return to lithic industries made of flakes and macrolithic tools: the Oakhurst [7, 8, 9].

Based on the typological study and the degree of patina of material collected from surface sites in the Orange Free State near the town of Smithfield, they decided to periodize the Later Stone Age in three phases: including Smithfield 'A', the oldest (nowadays named as Okahurst lithic complex). Following the invention and early descriptions of the Smithfield [10, 11], many prehistorians recognized these industries throughout southern Africa. In the 1970s, when G. Sampson [12] concentrated his work in the Seacow Valley in South Africa, N. Walker excavated several sites in the Matopos. He opted for a local classification of industries using the name of the site where the industry was first recognised as a lithic complex [13]. He distinguishes the Maleme, Pomongwe (already identified and named as such by C. K. Cooke), Nswatugi and Amadzimba. The author again compares the Pomongwe of the Matopos to the South African Oakhurst [13].

In addition to the Albany (Southern Cape Smithfield variant) recognised at several sites in the Southern Cape by the Deacon couples, J. Deacon [8] includes the macrolithic industries of Apollo 11 and Pochenbank excavated by Wendt in Namibia within the Oakhurst complex.

P. Mitchell, L. Barham and L. Wadley, among others, are involved in establishing the first South African-wide syntheses on Later Stone Age which includes Oakhurst lithic industries through their own excavations and their recognition of these lithic complexes in Lesotho, Swaziland, the Orange Free State and Limpopo respectively [1, 2, 6, 14, 15].

Despite all this work, most of it carried out in the 1980s and 1990s, the Oakhurst lithic industries remain poorly documented, particularly from the point of view of its lithic industries that have escaped the advent of the Technological approach [16]. Its conditions of emergence, disappearance, and geographical extension remain also unclear.

The Oakhurst lithic industries are often described as 'macrolithic'. They include numerous scrapers made from coarse-grained materials whose knapping ability is often described as poor (quartz, hornfels, quartzites) and a large component of quartz remains knapped by axial bipolar percussion on anvil [1, 2, 6, 9, 14, 15, 17]. Oakhurst has been recognised throughout South Africa (including Swaziland and Lesotho) except in the far north of the country where its presence is not clearly attested. Several regions such as the Limpopo in northern South Africa have been little studied since the end of the 1980s and fuel both this apparent documentary disparity and the questions raised by the original trajectories of South African LSA societies.

The Bushman Rock Shelter (BRS) site in Limpopo, in the north of the country, is situated at the interface of different cultural areas, between the Oakhurst, recognised in the south, and the Matopos sequence described by N. Walker [13] in Zimbabwe **(fig. 1a and b)**. BRS has a relatively powerful stratigraphic sequence containing lithic industries contemporary with environmental changes at the Pleistocene-Holocene transition [18]. In a 1981 article, I. Plug [19] does not clearly attribute these industries to a specific techno-complex, pointing out differences with the South African Oakhurst. To discuss the characteristics of the LSA occurrences at the interface between the Oakhurst-dominated territories in the south and the archaeological sequence described in Zimbabwe, we propose here a study of the BRS lithic industries as it seems legitimate to question its chrono-cultural attribution.

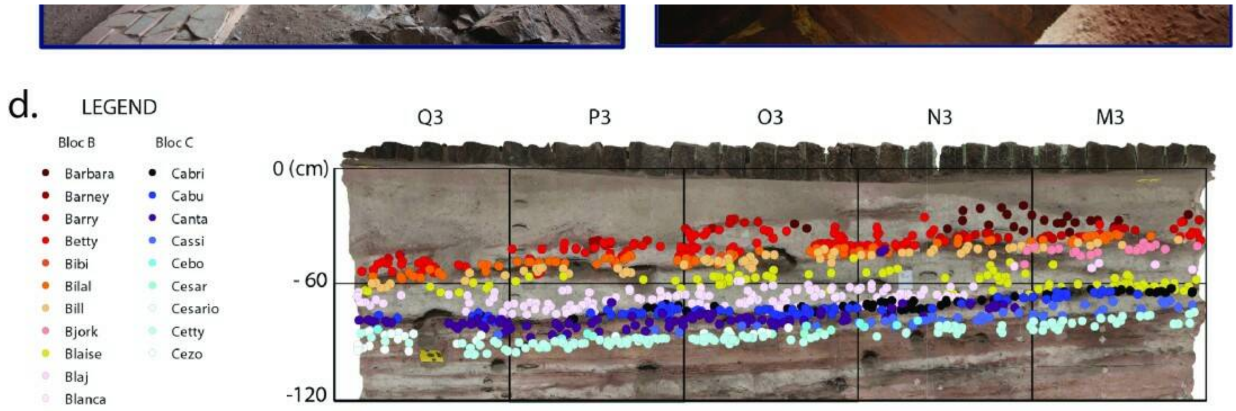

Fig.1: a Chrono-cultural map of Southern Africa at the Pleistocene to Holocene change. **b** Photo of BRS (L. Feyfant). **c** Photo of the LSA layers. **d** Frontal scatterplot of the lithic remains plotted per field US (Photogrammetry M. Haaland)

1. Bushman Rock Shelter

BRS is in the Limpopo administrative region of South Africa at the northern margin of the Drakensberg Range, on the edge of the Great Escarpment [18]. The Great Escarpment forms a natural boundary between the grasslands to the west and the lowland plains to the east. The site lies at an altitude of approximately 1,500 metres above sea level, the shelter opens into a dolomitic cliff, it overlooks a small valley dug by a small tributary of the Orighstad river.

The site was first excavated by A. W. Louw in the 1960s [18]. These first known excavations of the shelter were limited to a test pit in the upper part of the deposits. In the 1960s and 1970s Professor H. Eloff undertook more extensive excavations. He opened a large excavation in the upper part of the deposit and carried out a deep test pit. Over a stratigraphic depth of seven metres, he described 105 sedimentary units, 18 of which are attributed to the Later Stone Age. Professor Eloff uncovered levels rich in organic remains which constitute a significant proportion of the deposits (combustion structures, ash levels, botanical remains). Within the stratigraphic units associated with the LSA (US 2 to 18), a child's burial was uncovered, as well as numerous objects of adornment and rich collections of faunal remains and lithic remains [18]. Despite the quality of Professor H. Eloff's excavations, few publications have emerged from this work, and the LSA in the Limpopo region remains largely unknown.

Since 2014, the MSA and LSA levels of BRS are again being excavated by a team led by G. Porraz and A. Val [18]. Today, the excavation of the LSA levels has been completed (area of approximately 4.5 metres by 0.5 **fig. 1c**), involving nearly 1.60 metres of deposits. In the field, the LSA sequence was divided into three blocks (B, C and D). Blocks B, C and the top of block D can be correlated with the collections from Professor Eloff's excavations studied by I. Plug (layers 2-18). Within these latter collections, two phases can be distinguished on either side of the 'Charly' US. One corresponds to block B and the top of block C, which is mainly composed of quartz remains. The second, underlying the 'Charly' US, is made up of remains mainly knapped from hornfels.

In this article we focus on that last phase recorded in the Block B and top of C (Sedimentary units “Barbara” to “Cezo”, approximately 0,80 meters thick, **fig. 1d**) corresponding to the layers 2 to 7 of H. Eloff’s excavations. Three Radiocarbon dates have been made on these layers (Eloff’s excavations) by Abell and Plug [20]. Layers 2 have been dated to 9570 +/- 55 5 (calibrated [11 083 – 10585] cal BP with 2 sigma, using intcal 20 calibration curve), layer 5 to 9510 +/- 55 5 ([11148 – 10712] cal BP with 2 sigma) while layer 8 is dated back to 9940 +/- 80 ([11 728 – 11 212] cal BP with 2 sigma).

The repeated occupations of the shelter documented within US 2 to 7 (excavations H. Eloff or Block B and top of

Block C for the Porraz and Val excavations) thus occurred over a short period of time around 11 000 cal BP. Based on isotope analyses of land snail (*Achatina immaculata*) shells and the presence of specific botanical remains (including hundreds of marula seeds, [21]), Abell and Plug [20] propose that these occupations correspond to a warm climatic phase occurring after the Younger Dryas.

2. Material and method

2.1 Assemblage composition

Within the sample units, the remains localised in three dimensions (long axis > 2 cm = 667 quartz and 333 hornfels and other raw material pieces) and all the lithic remains from the sieve rejects (3 mm mesh) were described systematically in different databases (total of 7425 pieces < 2 cm).

The techno-economic study of lithic material presented here is based on the principles of Technology as developed in the 1980s by numerous authors [16, 22, 23]. Its aim is to describe the knowledge and techniques used during knapping, to describe the economies (spatio-temporal location of the knapping activities in a theorical chain involving knowledges and know-how) developed and the choices made by placing each lithic remain in its production '*chaîne opératoire*'. The chrono-cultural attribution of the material is carried out thanks to bibliographic comparisons.

The material was studied during missions to South Africa at the University of the Witwatersrand in Johannesburg. To obtain consistent data and to be as efficient as possible, databases adapted to each raw material were set up. Each database was developed following initial observations of the series. These two databases ("Quartz" and "Hornfels") have enabled us to systematically record technological and typological criteria for each vestige. It is mainly a question of describing the methods of production of the remains to arrive at the knowledge involved in the act of knapping [16] and to reconstruct the economies linked to the use and circulation of these objects.

The choice of variables selected for the technological description of the remains was made following an initial exhaustive observation of the material. The main aim was to objectify and quantify these initial observations. To optimise data recording, a tactile database was set up using Filemaker Pro software. The nuclei were described thanks to diacritical sketches.

2.2 Hornfels and other raw materials

The aim of this database is to describe the methods and techniques used to knapp hornfels. Preliminary observations have shown that all the blanks are flakes. Most of them are wider than long, this could be explained by the fact that a lot of them are hinged.

To quantify these first observations and to describe the technical modalities and methods involved in the knapping of hornfels, an adapted database has been developed.

To test this hypothesis and to quantify these observations, the variables and modalities used to describe the hornfels blanks are as follows:

- Raw material: Schist, Quartzite, Hornfels, Chert, Dolomite, indeterminate
- Raw material grain size: fine, medium, coarse
- Natural surface description: absent, neocortical, diaclase, cortical, flat cortical (slab)
- Technical category: nucleus, flake, block, slab, fragment, debris, casson, geofact
- A 'fragment' is any piece broken during the knapping process that can be repositioned on a blank (proximal, mesial, distal parts). A 'débris' is a broken piece that cannot be repositioned on a blank. A 'casson' does not bear any technic stigmata of knapping (no identifiable ventral face).
- Completion: position on flake (complete, proximal, mesial, distal, lateral, multiple)
- Hinged: yes, no
- Accident: fracture, intentional fracture, plunging, right, left, central Siret
- Striking platform: plains, neocortical, cortical, diaclase, exploded, faceted, punctiform, linear
- Bulb: absent, marked conchoid, low conchoid
- Lip: absent, present

- Number of scars on dorsal face: 0, 1, 2, 3, 4, 5, more than 5
- Percentage of hinged scars on dorsal face: 0%, < 50%, > 50%, 100%
- Scar organisation on dorsal face: unidirectional, bidirectional, unidirectional, and orthogonal, bidirectional, and orthogonal, orthogonal, convergent, opposite convergent, centripetal, indeterminate
- Number of retouch rows on proximal part = 1, 2, 3, 4, 5, more than 5
- Back description: absent, previous removal, removal with counter-bulb, natural, mixed
- A. Tavoso's [24] list of distribution of natural surfaces: E1 to E18
- Double patina between different knapping phases: yes, no
- Retouch: presence, absence
- Technological length (measured with a calliper in mm)
- Technological width (measured with a calliper in mm)
- Maximum thickness (measured with a calliper in mm)
- Butt length (measured with a calliper in mm)
- Maximal butt thickness (measured with a calliper in mm)
- Flaking angle (angle between the butt and the ventral face, measured with a goniometer in degrees)
- Angle de chasse (angle between the butt and the dorsal face, measured with a goniometer in degrees)

2.3. Quartz

The aim of this database is to describe the methods and techniques used for quartz blanks knapping of quartz. Bipolar on anvil is very often used for quartz knapping [25, 26, 27]. The presence of edge battering and splintering on the distal part of the blanks is often diagnostic of this latter technique. The main objective here is to quantify and distinguish between blanks knapped by bipolar on anvil percussion and blanks knapped by direct hard percussion. When bipolar on anvil percussion is used, the issue is also to determine whether the percussion gesture is axial or non-axial. The proximal and the distal part of the complete blanks was systematically observed under a binocular with a x10 (at least) magnification.

To answer these questions, the variables and methods used to describe the hornfels are as follows:

- Raw material: Xenomorphic, Automorphic
- Structure: planes without grain, planes with grain, without plane without grain, without plane with grain
- Natural surface description: absent, neocortical, diaclase, cortical, crystal plane, indeterminate
- Natural surface quantification: 0%, > 50%, > 50%, 100%
- Technical category: nucleus, blank, block, slab, fragment, débris, casson, geofact
- Completion (i.e., position on flake): complete, proximal, mesial, distal, lateral, multiple
- Accident 1: absence, hinged, plunging
- Accident 2: fracture, intentional fracturing, right, left, or central Siret
- Butt description: absent, punctiform, linear, plain, neocortical, cortical, exploded
- Edge battering and splintering on proximal part: presence, absence
- Bulb: absent, conchoid, shapeless
- Number of scars on dorsal face: 0, 1, 2, 3, 4, 5, more than 5
- Scar organisation on dorsal face: unidirectional, bidirectional, unidirectional, and orthogonal, bidirectional, and orthogonal, orthogonal, convergent, opposite convergent, centripetal, indeterminate
- Back description: absent, previous removal, removal with counter-bulb, natural, mixed
- Distal part description: punctiform, linear, neocortical, cortical, peripheral sharpness, exploded
- Ventral face profile: straight, convex, concave
- Edge battering and splintering on proximal part: presence, absence
- Distal bulb: absent, present
- Scales on distal part (i.e., small scars in "stairs-like" morphology): present, absent
- Retouch: absence, presence

- Technological length (measured with a calliper in mm)
- Technological width (measured with a calliper in mm)
- Maximum thickness (measured with a calliper in mm)
- Butt length (measured with a calliper in mm)
- Maximal butt thickness (measured with a calliper in mm)
- Flaking angle (angle between the butt and the ventral face, measured with a goniometer in degrees)
- Angle de chasse (angle between the butt and the dorsal face, measured with a goniometer in degrees)

2.4. Sieving rejects (from 3 mm sieves)

Within the quartz and hornfels sieve rejects, the objective was to document the reduction strategies involved in the knapping, and to describe the stages of blank reduction of the scrapers. To do this, the remains in the 3 mm sieve rejects were systematically sorted into broad technical categories and then counted in both quartz and hornfels sieve rejects.

3. Results

3.1. Hornfels (and other raw material) "*chaîne opératoire*" description

A very large majority of this assemblage (n= 333 pieces **fig. 2a**) is made of hornfels (91% against 6% of quartzite pieces and 3% of indeterminate raw material). Among these hornfels pieces, 60% are fine grain, 37% are composed of medium size grain and 3% are coarse grain. Sixty six percent of the hornfels pieces bear a natural surface, among which 44% bear a slab flat surface, 31% a weathering alteration surface (cortical), 23% a neocortical surface (pebble) and 2% an indeterminate natural surface.

At first instance, the most striking criterion are on one hand the presence of a very large number of hinged pieces (92/ 157 i.e., 58%) among the complete blanks and on the second hand the large amount of unidirectional scars direction of removals on the dorsal face on the hornfels flakes (68% *contra* 21% indeterminate and 11% others **fig. 2b**). These scars show a high number of hinged removals and their size decreases as they go along, the latter being only a few millimetres long. The hornfels blanks are generally wider than they are long and bear for 60% of them a plain butt and for 30% a natural surface as a striking platform (10% others). Very often, a well-developed bulb is present on the ventral face and attests for a hard direct percussion.

In the hornfels assemblage, what was initially identified as two cores or macro-tools raise the question of their actual status. Both are made out from thick slabs and are circular in shape. They bear unidirectional scars all around. The scars size decrease as the piece reduces. A large amount of these scars shows a hinged termination.

From the above descriptions, there is no doubt that the hornfels are involve in the shaping of the edge of the macro-tools. The hornfels flakes show the same technique stigmata and, according to the diacritic schemes made on the flakes themselves and on the macro-tools, they fit into the same *chaîne opératoire* **fig. 2c**).

At this stage of the *chaîne opératoire*, percussion is carried out with a hard stone striker, as evidenced by the thick butts and the strong conchoidal bulbs. As the cutting edge of the macro-tool becomes more regular, the size of the flakes decreases and the angle between the butt and the dorsal (i.e., *angle de chasse*) face increase as shown when comparing the number of previous unidirectional flake scars on the dorsal face (number of retouch ranks) to the flake size or to the *angle de chasse*. This latter angle of the third flake generation (3 ranks of retouch, mean of 71°) reflects the edge angle of the macro-tools **(fig. 2d and e)**.

The macro-tools have a double status, they are *a priori* tools and cores, they are in fact providers of numerous flakes which can in turn be transformed into scrapers, this pattern concerns five pieces in the collection. These scrapers are circular or sub-circular in shape. Most of them bear only one rank of retouch on their edge **(fig. 4c and d)**.

a.

Core/macro tool ?	Flakes	Fragments	Débris	Cassons	Slab fragments	Total
2	157	78	68	23	5	333

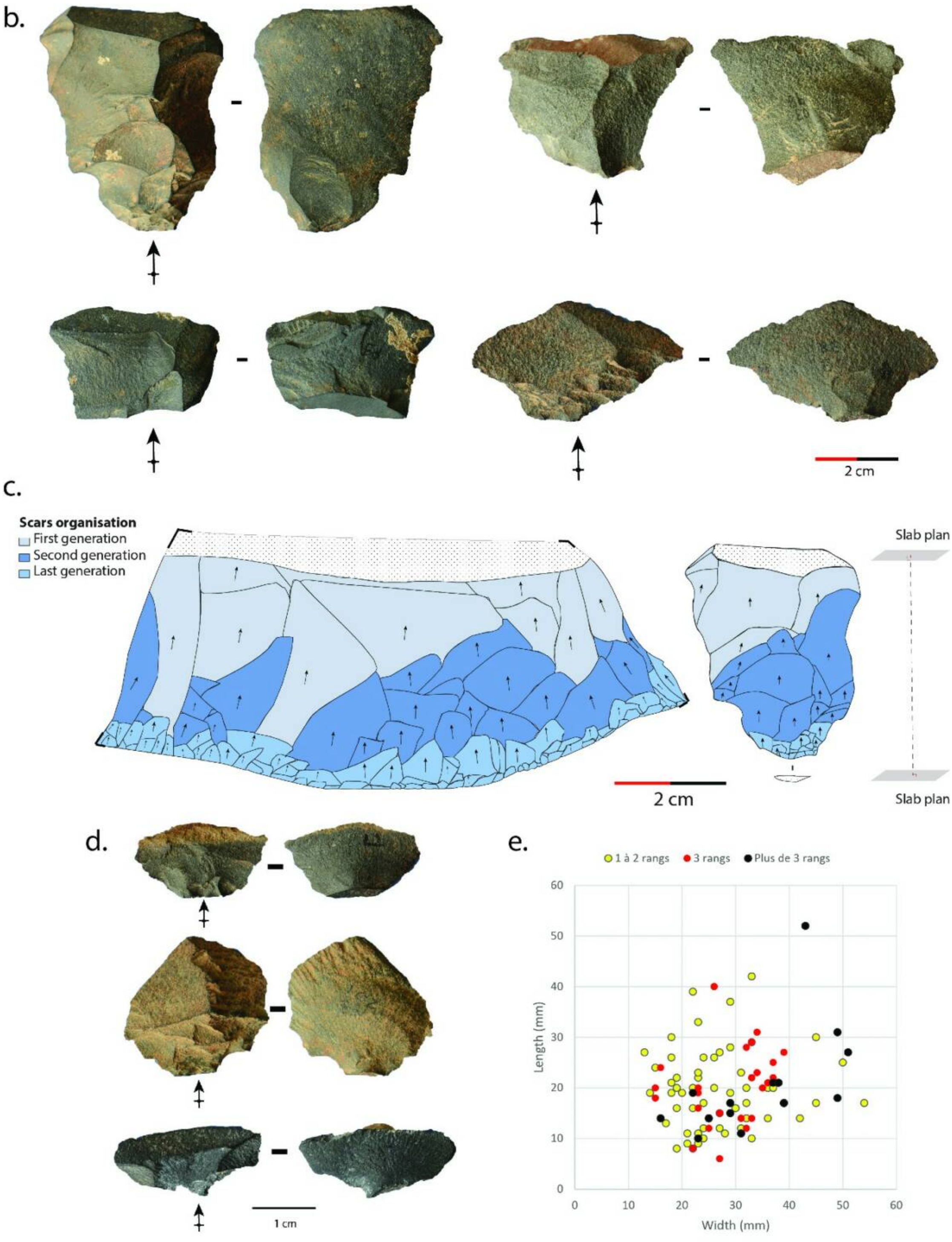

Figure 2: a Hornfels (and other raw material composition. **b** Hornfels flakes. **c** Diacritic schemes of a core/macro-tool and of a hornfels flake. **d** Retouch and resharpening flakes. **e** Width per length scatterplot with number of retouch ranks on hornfels complete flakes

3.2. Quartz “chaîne opératoire” description

Ninety nine percent of the quartz remains (< 2 cm) of the studied assemblage (335/667 **fig. 3b**) has a xenomorphic structure (absence of grains and presence of plans) according to the classification of Lombera-Hermida 2009). The presence of plans often involves a high degree of fragmentation during the knapping process (almost half of the quartz assemblage is composed of fragments, débris and cassons). Half of the quartz blanks bear a natural surface, 31% of which is cortical (surface alteration), 56% is a cristal plan, 2% is neocortical (pebble) and 11% is indeterminate. Quartz is present in the immediate environment of the site in large quantities and under different forms, our results show that all of them could have been exploited for knapping.

To quantify the proportion of debitage by bipolar percussion on anvils and to describe its modalities among the quartz complete blanks (n= 319), a multiple correspondence analysis (MCA) and a hierarchical classification (HC) were carried out **(fig. 3d)**. The aim being to search for variability within the quartz assemblage **(fig. 3a)** and for variables and modalities associations when describing quartz blanks. Seven variables were selected in the ACM and HC: butt description (plain, neocortical, cortical, linear, shattered, punctiform), bulb (presence, absence), the scar organisation (unidirectional, bidirectional opposed, unidirectional-orthogonal, bidirectional opposed-orthogonal, multidirectional, indeterminate), splintering and edge battering on the proximal part (presence, absence), splintering and edge battering on the distal part (presence, absence) **(fig. 3c)**, scales on the distal part (presence, absence), description of the distal termination (regular cutting-edge, neocortical, cortical, linear, shattered, punctiform).

Three clusters are highlighted by the HC **(fig. 3d)**.

- The cluster 1 is composed of 48% of the blanks and is described as follow:

- Edge battering/splintering on the distal part (presence)

- Distal termination (linear, punctiform)

- Scales distal (presence)

- Bulb (absence)

- Edge battering/splintering on the proximal part (presence)

- Butt description (shattered, linear)

- The cluster 2 is composed of 29% of the blanks and is described as follow:

- Edge battering/splintering on the distal part (absence)

- Edge battering/splintering on the proximal part (presence)

- Distal termination (shattered)

- Scales distal (absence)

- Distal termination (regular cutting edge)

- Butt (linear, punctiform)

- Bulb (absence)

- Scar organisation (indeterminate)

- The cluster 3 is composed of 23% of the blanks and is described as follow:

- Edge battering/splintering on the proximal part (absence)

- Edge battering/splintering on the distal part (absence)

- Bulb (presence)

- Distal termination (regular cutting edge, neocortical)

- Scales distal (absence)

Nearly half of the blanks bear edge battering and splintering on their distal part. We interpret these as resulting from debitage by bipolar percussion on an anvil using an axial modality. Two other groups are formed. One (29% of the supports) contains remains whose proximal part of the supports is like that of the supports included in the previous group (axial percussion) and only the nature of the distal part differs (absence of crushing). These blanks are probably the result of bipolar percussion on an anvil in a non-axial mode. Finally, the last statistical group describes (23%) blanks whose proximal and distal parts are completely different. This last group is more difficult to interpret and could contain blanks from either produced through a bipolar on anvil percussion with a non-axial gesture or by direct hard percussion (i.e., without the use of an anvil).

In terms of method (scar organisation), no differences appear in the MCA and the HC analysis. In fact, most of the scars when readable show unidirectional directions of removals (56% of unidirectional scars against 37%

indeterminate and 7% others) whatever the technique employed (*i.e.*, belonging to one of the three clusters). There seems to be no significant difference in terms of size between the three clusters. The quartz blanks are only slightly elongated, the blanks of group 3 being slightly wider relative to the length **(fig. 3e)**. The lack of elongation and the largely irregular morphology of the quartz blanks does not allow to include them in the lamino-lamellar knapping methods.

In line with the observation of the scars present on the dorsal face of the quartz blanks, the cores reveal a unidirectional debitage method with a single debitage surface and a single percussion surface. The cores are very rarely rotated 180 degrees (inversion of the percussion and resting surfaces on the anvil). They are very often fragmented and reduced to sizes sometimes smaller than a centimetre.

Nine quartz blanks are transformed into small size scrapers. These scrapers are rather circular in shape and bear only one or two ranks of retouch on their edge **(fig. 4c and d)**.

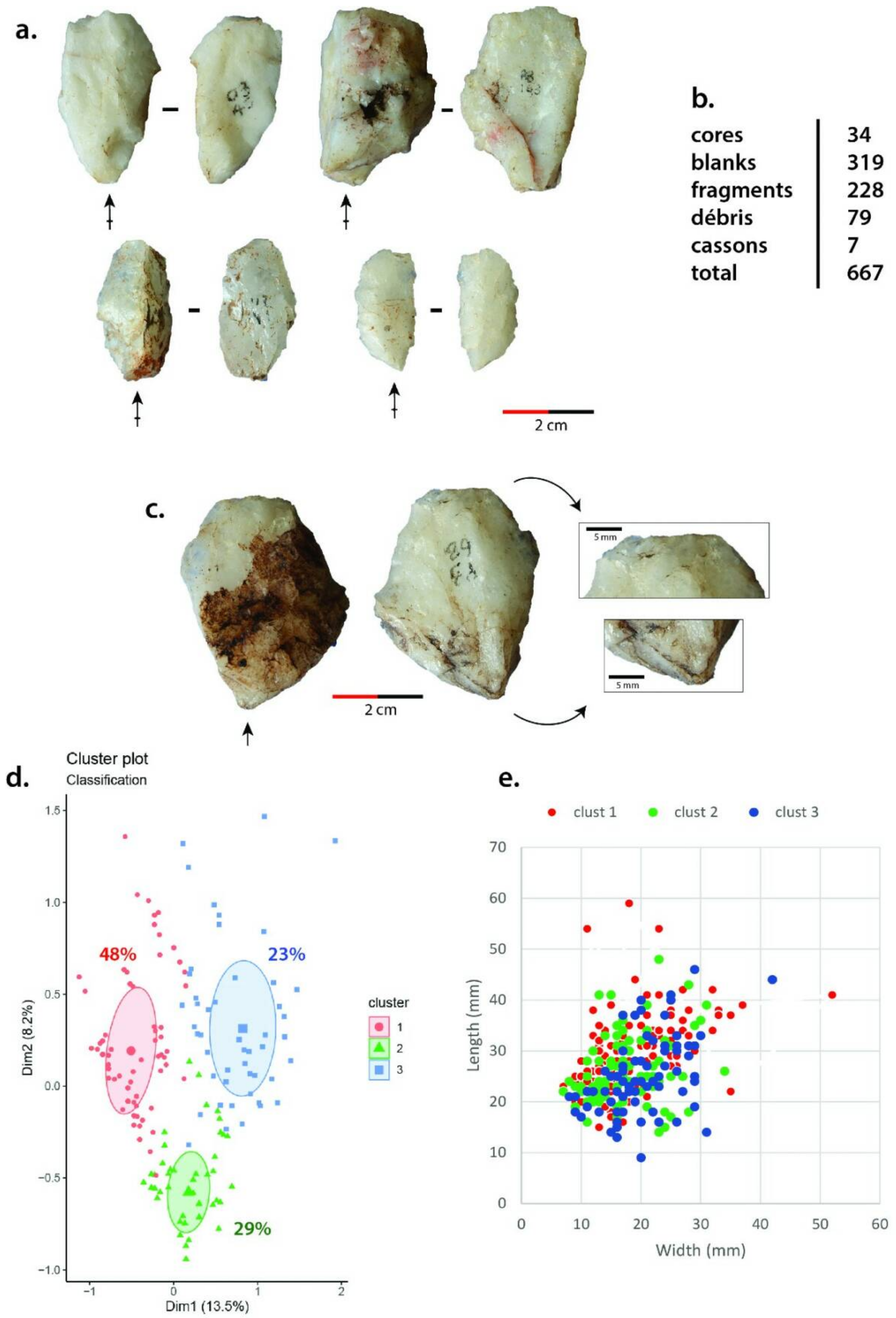

Figure 3: a. Quartz blanks. **b.** Quartz assemblage composition. **c.** Splintering and edge battering on the proximal and distal parts of a quartz blank. **d.** PCA involving the quartz blanks. **e.** Length per width scatterplot of the quartz complete blanks with the cluster belonging (PCA and HC)

3.3. Sieving rejects (block B only)

3.3.1. Hornfels and other raw materials

The hornfels (and other raw materials) sieves rejects (pieces between 3 mm and 20 mm) are mainly composed of retouch and resharpening flakes involved in the making of the scrapers (along numerous fragments, débris, cassons and chips). We used L. Bourguignon [28] method of classification to describe the techno-functional impact of the retouch and resharpening flakes on the macro-tools' edges. They are classified among four categories **(fig. 4a)**:

- Type 0: of low thickness, it induces a convex removal on the cutting edge.

- Type I: hinged, it induces a concave removal on the cutting edge

- Type II: hinged, it induces a concave removal on the cutting edge and bear several scars on its dorsal proximal part

- Type III: of low thickness, it induces a convex removal on the cutting edge and bear several scars on its dorsal proximal part.

After the removal of bigger retouch or resharpening flakes described in section 4.1. Type 0 and III are the first applied to the macro-tools edge. The thin concave cutting edge of the macro-tools is related with the Type I and Type III retouch flakes that make the cutting edge more regular and sharper.

The observation of a lip at the interface between the butt and the ventral face of the flakes could attest to a soft direct impact at the end of the regularisation of the macro-tools' edges. The presence of bone retouchers in the BRS Oakhurst tends to confirm this hypothesis which should be investigated in more details.

3.3.2. Quartz

Quartz sieve rejects (n = 4893) are composed of a very large amount of chips and fragments, debris and casson (91% of the pieces) which is in accordance with the high number of fragments produced during the quartz knapping on anvil **(fig. 4b)**. The presence of small size blanks with crushing on their distal termination and of reduced cored sometimes smaller than a centimetre shows a high degree of reduction of the bipolar on anvil cores and the presence of a microlithic productions on quartz.

a.

us	blanks	cores	Frag.-débris-cassons	retouch flakes ?	resharpening flakes ?	"batonnets"	chips	Total
Barbara	60	3	163	1	0	3	251	481
Barney	10	0	15	0	0	0	48	73
Barry	51	1	137	3	10	19	450	671
Betty	100	3	594	0	0	9	905	1611
Bev	13	0	149	0	0	3	229	394
Beyon	1	0	24	4	0	0	28	57
Bibi	4	0	24	0	0	0	20	48
Bilal	59	1	308	48	2	9	704	1131
Bill	13	0	151	0	0	3	191	358
Billy	7	0	30	0	0	0	32	69
Total	318	8	1595	56	12	46	2858	4893

b.

us	Type 0	Type I	Type II	Type III	Thin flakes	Frag.-Débris-Cassons	chips	Total
Barbara	23	7	1	5	49	78	67	230
Barney	3	0	0	0	1	2	0	6
Barry	33	4	2	5	18	76	38	176
Betty	37	86	20	7	51	150	98	449
Bev	1	0	0	1	0	0	0	2
Beyon	3	3	0	0	1	9	0	16
Bibi	0	3	2	1	0	8	2	16
Bilal	64	90	15	22	5	99	53	348
Bill	26	51	22	11	10	74	18	212
Billy	5	3	2	1	0	5	0	16
Total	206	255	69	57	147	549	326	1609

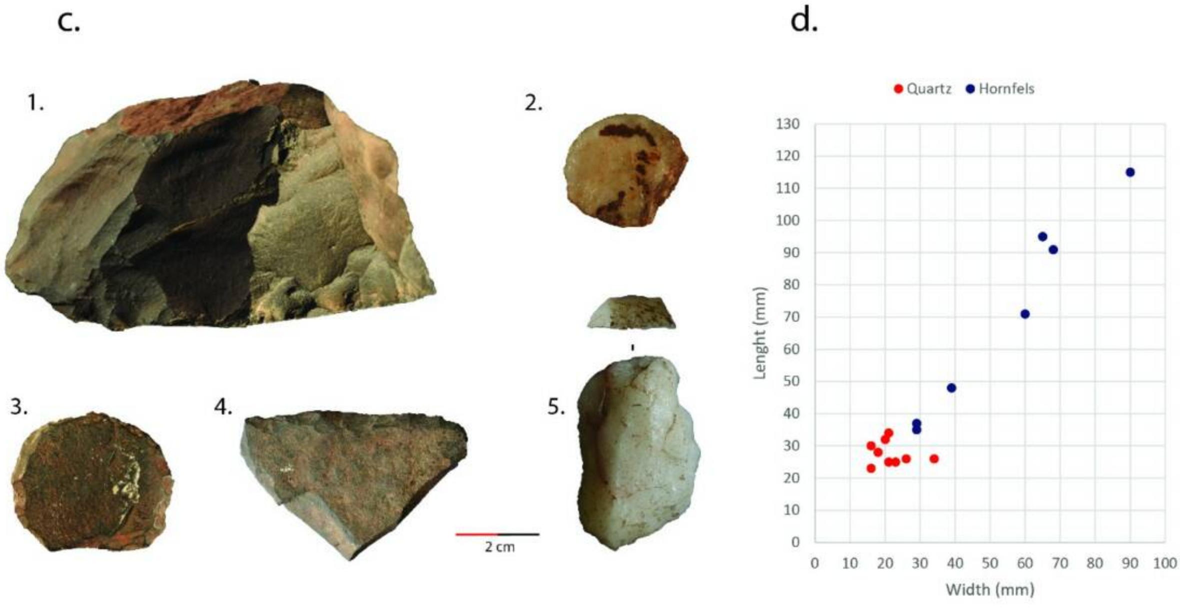

Figure 4: a. Quartz sieve rejects composition. **b.** Hornfels sieve rejects composition. **c.** 1. Macro-tool made on hornfels (Photo S. Solanas), 3. And 4. Circular scrapers made on hornfels. 2. and 5. scrapers made on quartz. **d.** Width per length scatterplot of the quartz and hornfels macro-tools and scrapers.

4. Discussion

Two main *chaînes opératoires* have been identified. The first concerns quartz and consists of the knapping of intermediate to small size blanks mostly using a bipolar on anvil technique of percussion through a unidirectional reduction strategy. It is difficult to know the function of the quartz blanks. Only, few of them are retouched as scrapers. The knapping of quartz by bipolar percussion on anvil is often described as expedient, responding to immediate needs. Many authors (see for example [29] have highlighted that bipolar debitage on anvil is the most cost-effective débitage to produce cutting-edges. As quartz is abundantly available in the immediate vicinity of the site in abundance, its knapping technique/method could meet immediate sharp cutting edge needs at the site.

The second concerns hornfels and is geared towards the shaping of the macro-tools. These latter macro-tools have a double status: they are both tools and raw material stocks that provide flakes (i.e., cores) that can in turn be transformed into circular scrapers.

A clear "raw material economy" in the sense of C. Perlès ([23], i.e., *chaînes opératoires* restricted to specific raw materials) distinguishes between a one reserved for quartz and that used for the shaping of macro-tools and hornfels scrapers. Both were made entirely on the site from local materials but differ in their production objectives.

The *chaîne opératoire* associated with the knapping of hornfels (so-called 'coarse raw material') is the characteristic and discriminating aspect of the Oahkurst. The lithic industries from the top of the BRS sequence do not share any common features with the Matopos Pomongwan [13], which is not present in the Oakhurst (bipolar debitage on quartz anvils or presence of small circular scrapers).

From a methodological point of view, it could be interesting to compare the results of the PCA composed of complete quartz blanks with an experimental quartz knapping model composed of bipolar on anvil (axial and non-axial variants) and direct percussion within a discriminant analysis.

Conclusions and perspectives

The lithic industries of Block B and the top of Block "C" at Bushman Rock Shelter fit neatly into the 'Oakhurst' complex as described in South Africa, Lesotho, and Swaziland [1, 2, 4, 5, 6, 7, 8, 9, 12, 14, 15, 17]. To date, BRS is the most northerly occurrence of the Oakhurst industries and opens interesting research prospects towards the until now understudied Zimbabwean territories and the Mozambican corridor.

Because of its macrolithic aspect and a return to flake industries, the Oakhurst marks a clear break with the micro-lamellar industries of the Robberg that preceded it. The Oakhurst constitutes one of the most original and singular technical trajectories of the African Later Stone Age. It is likely that the specificities of the BRS Oakhurst, like those observed at other sites in South Africa, Lesotho, and Swaziland, are attributable to local adaptations to a wide range of raw materials within the subcontinent.

This macrolithic technical trajectory contrasts very clearly with the previous microlithic industries of Robberg.

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