Journal of Archaeological Science: Reports 49 (2023) 104034

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

Macro use-wear identifiers on lithic scrapers and behavioural shifts at Little Muck Shelter, SLCA

Nicole Leoni Sherwood [a,*], Tim Forssman [a,b]

[a] Department of Anthropology and Archaeology, University of Pretoria, Private Bag X20 Hatfield, Tshwane 0028, South Africa
[b] Cultural and Heritage Studies, School of Social Science, University of Mpumalanga, Mbombela 1200, South Africa

ARTICLE INFO

Keywords:
Later Stone Age
Forager-farmer interactions
Stone scrapers
Use-wear
Shashe-Limpopo confluence area
Southern Africa

ABSTRACT

The arrival of farmer groups in southern Africa, from the early first millennium CE, is thought to have influenced forager behavioural patterns. Understanding these behavioural shifts are important not only to examine how foragers adjusted their ways of living to accommodate new opportunities, but also their contributions to local economies. In the Shashe-Limpopo confluence area this is of particular interest because it was here that southern Africa's earliest state-level society appeared, based at Mapungubwe c. 1220 CE. Forager participation is known through trade wealth that appears in their camps during this period, but little more is known. At Little Muck Shelter, a forager site occupied from before contact until the end of the Mapungubwe phase, increases in lithic scrapers has been associated with trade with farmer groups and while it is clear what foragers received, it is not known what they used to obtain these goods. To assess this, experimentation was used to identify macro-use wear on cryptocrystalline scrapers and in turn to determine scraper use at Little Muck. The experimental results and their comparison with the archaeological remains show that scrapers were used on a variety of materials throughout the site's occupation, however, two general phases of activity were observed. In the pre-contact levels wood and animal hide was worked more often than bone that dominate scraper-related activities after the arrival of farmer groups. There is also an increase in bone points and shafts during this time, which could indicate that Little Muck was a manufacturing site for hunting implements used to obtain wild game that could be traded with farmers. This research shows that forger and farmer interactions were complex and included shifts in behavioural activities as a response to the appearance of new social and economic opportunities. Moreover, our findings demonstrate that foragers were active within the local economy during the rise of state-level society in southern Africa.

1. Introduction

The Shashe-Limpopo confluence area (SLCA) is well known because it was here that southern Africa's first state level society, Mapungubwe, appeared at c. 1220 CE (Huffman 2015a). The developmental stages leading to the rise of this state began at least 300 years prior, with the arrival of Zhizo farmers, but the roots of this change extend back to the arrival of the first farmer groups in the valley from the early first millennium AD. The Iron Age or farmer sequence in the region has been extensively documented (Hanisch 1980, 1981a, b; Huffman 2000, 2002, 2007, 2008, 2009a, b, 2010, 2014; 2015a, b; Schoeman 2006; Meyer 2000; Smith et al. 2010; Huffman and du Piesanie 2011; Antonites 2016; Antonites et al. 2016), largely as result of interest in urbanism. However, from well before this, stone tool-producing hunting and gathering groups, or foragers, ancestral to modern San communities, lived in the valley occupying several rock shelter sites and open-air camps (Forssman 2020). The appearance of farmers severely disrupted forager lifeways, including their settlement patterns, access to resources and new technologies, and mobility patterns. However, specific behavioural shifts are mostly assumed and not clearly shown. As such, other than in a few contexts, the influence farmers had on forager society has not been well established. This is of particular importance because foragers interacted with resident farmers as they were undergoing state-formation and were able to contribute to complex socio-political and economic systems. Changes are seen at Little Muck Shelter (LMS) as an increase in activity just after farmers entered the region and a marked increase in the frequency of scraper tools. To determine if this change was linked to farmer occupation of the region, gaining insight into what

* Corresponding author.
E-mail address: niccisherwood@gmail.com (N. Leoni Sherwood).

https://doi.org/10.1016/j.jasrep.2023.104034
Received 2 September 2022; Received in revised form 22 December 2022; Accepted 29 April 2023
Available online 12 May 2023

these scraper tools were used for will be invaluable. This study thus aims to determine scraper use at LMS with the use of experimentation to establish macro use-wear patterns.

Use-wear studies are important as many materials that were likely worked by stone age people often don't preserve due to their organic nature. One way to determine what organic tools and technologies people exploited is to conduct use-wear studies on lithics left behind, which can be used to infer what implements were made and what materials were exploited, based on unique damage signatures found on lithics. Hurcombe (1992) notes that the most important attributes to look for is how a tool was used and on what material to help determine behaviours.

Use-wear and residue analysis can answer both questions and has provided archaeologists with considerable insight into tool function and human behaviour (Binneman & Deacon 1986; Hardy & Garufi 1998; Kealhofer et al. 1999; Rots & Williamson 2004; Rots 2005; Rots et al. 2006; Morales and Vergès 2014; Lemorini et al. 2016) alongside studies done on the contemporary use of stone scrapers (Webley 1990; Sahle et al. 2012; Sahle 2019). These analyses are particularly important to investigate tool use as tool type and specialised shapes do not always corelate with function (Bisson 2000), even though sometimes they do (Binneman & Deacon 1986; Lemorini et al. 2016), but can instead be a result of many complex factors, such as stages of reduction (Dibble 1984; Dibble 1987; Dibble 1995; Dibble et al 2017), raw material constraints (Rolland and Dibble 1990), blank morphology and user preference (Brumm and McLaren 2011; Guillemard and Porraz 2019), or simply because a specific tool morphology is effective for a large variety of tasks (Latorre et al. 2017). This is also reflected in work done by Viala et al. (2020), who determined that a large variety of tools can be used for woodworking and that tools can be used interchangeably with other materials and is not dependant on specific morphology. This is also seen at the site of San Quirce (Spain) where wood-working and plant matter is seen alongside butchery on the same tools (Clemente-Conte et al. 2014), and in Norway where stone axes were shown to be multi-purpose tools (Solheim et al. 2018). A study conducted by Clemente-Conte et al. (2020) on pointed scrapers is a clear indicator that form-and-function is complex as these tools were used to process meat, hides, wood, and fish and not used as projectiles, which could be an easy assumption to make based on their form. This holds true for most tool types, as Robertson et al. (2009) pointed out with use-wear and residue analyses for backed microliths and bladelets in Australia, showing that these tools were often used on a range of materials. Useful working edges were often what was sought after rather than the formal shape of a tool as determined by Knutsson et al. (2015) for quartz flakes and fragments from Mesolithic and Neolithic sites in Sweden and Finland.

Use-wear and residue studies have been conducted on scrapers and related tools for LSA sites in southern Africa with the aid of experimentation (Binneman & Deacon 1986; Lombard 2005a, b, 2008; Rots 2005; Rots et al. 2006; Lombard and Wadley 2007), but few use-wear studies have been conducted on sites in the SLCA to confirm the use of various tools, with the exception of Forssman et al. (2015) and Forssman et al. (2018). Forssman et al. (2018) argued that rigid materials were the preferred material worked at the Little Muck based on the formation of certain polishes, fracture types, and damage patterns on scrapers from excavations done by Hall and Smith (2000), who attributed these to hide working activities as ethnographic evidence often indicates scraper use in hide-working activities (Deacon and Deacon 1980; Walker 1994; Hall and Smith 2000). Forssman et al.'s (2018) study did not perform its own replication experiments and relied on previous use-wear studies to determine use-wear. This study aims to provide further evidence for scraper use at LMS by means of extensive experimentation tailored to the materials in the region. A variety of methods have been employed to determine use-wear on lithic tools, most with experimentation and the use of either macro use-wear, (Beyin 2010; Forssman et al. 2018; Groman-Yaroslavski et al. 2022), micro use-wear (Clemente-Conte et al. 2020; Gassin et al. 2020; Bello-Alonso et al. 2021), Scanning Electron Microscopy (Martín-Viveros and Ollé 2020; Pedergnana and Olle 2020), and even Laser Scanning Confocal Microscopy (Álvarez-Fernández et al. 2020).

This study will make use of experimentation and provide macro use-wear traces for cryptocrystalline materials. Macro use-wear was chosen due to the time constraints and the bulk of artefacts that would need to be analysed. These macro use-wear identifiers will provide a means to help identify scraper use in future studies and for other sites in southern Africa making use of cryptocrystalline materials. We also intend to shed some insight into the complexity of forager behaviours by using the experimental results to determine scraper use at Little Muck Shelter before contact with farmer communities and for the duration after. In doing so, we develop a better understanding of activity patterns at the site and assess whether change was related to forager-farmer interactions. We hypothesise that foragers in the SLCA shifted their behaviour as a response to the arrival of farmer communities in the region and played an active role in the local economy.

2. Archaeological background

2.1. Little Muck Shelter

Little Muck is a north-facing shelter set in an east–west running sandstone ridge on the northern bank of the Kolope River in the SCLA (Fig. 1). The shelter has an opening of approximately 12 m, a depth that varies between two and four metres, and a steeply rising ceiling (Fig. 2). In the western portion of the shelter there is a deeper recess that reaches about 5 m into the rock face but has a low ceiling. Rock art can be found on the eastern back wall stretching across the site and ending after a central column, and it includes giraffe, kudu, elephant, feline forms, impala, and humans, as well as non-representational lines and comb-shapes. In the extreme western area, where the shelter ends, there is a small painted panel of humans. In front of the shelter is a large open-air space with a gentle eastward gradient. This slope meets what appears to be a dried-up spring channel that originates from outside the eastern edge of the shelter. Along the stream bed, which heads in a northwards direction from the shelter into the outlying, flatter bedrock, are a series of gaming boards, hollows and cupules in a high density about 40 m away from the shelter. The shelter itself is in proximity to other sites in the area, such as Leokwe Hill, a large Iron Age settlement 1.5 km south (Calabrese 2005), the Mbere Complex (Kuman et al. 2005) and Kaoxa Shelter, an impressive rock art site (Eastwood and Eastwood 2006).

Little Muck was first excavated by Simon Hall and Benjamin Smith (2000) in 1998. Their interest in the site stemmed from its close proximity to Leokwe Hill. In particular, they hoped to examine social relations between resident foragers and nearby farmers on a landscape that lacked direct ethnography and was in a sense unencumbered by the Kalahari Debate. Their work included excavating two 1 × 1 m squares alongside one another inside the shelter and four 1 × 1 m squares in a single trench in the open-air portion of the site. The only publication to come from this study, however, presented preliminary analysis from Square L42, inside the shelter. Renewed excavations at Little Muck began in 2020 to obtain secure chronology from the site and expand on the areas excavated inside and outside of the shelter, under the Hunter-Gatherer Archaeological Research Project (HARP). This work has excavated a trench across most of the internal area with numerous excavated squares at both ends, and additional open-air areas have been investigated for features such as platforms, floors, or middens (Fig. 2).

Both excavations have provided complimentary evidence regarding the site's relative chronology. Fortunately, the ceramic and bead sequence for the valley is well established and using these indices to determine chronological phases, if they are in situ and present, is highly viable (Fig. 3). Based on the combination of results, Little Muck's basal layer (VDB1, 1+ & 2; we use HARP's stratigraphic profile) predates the arrival of farmer communities around 350 CE, followed by an early contact period (350–900 CE; DRG1/DRG1 +). Between 900 and 1000

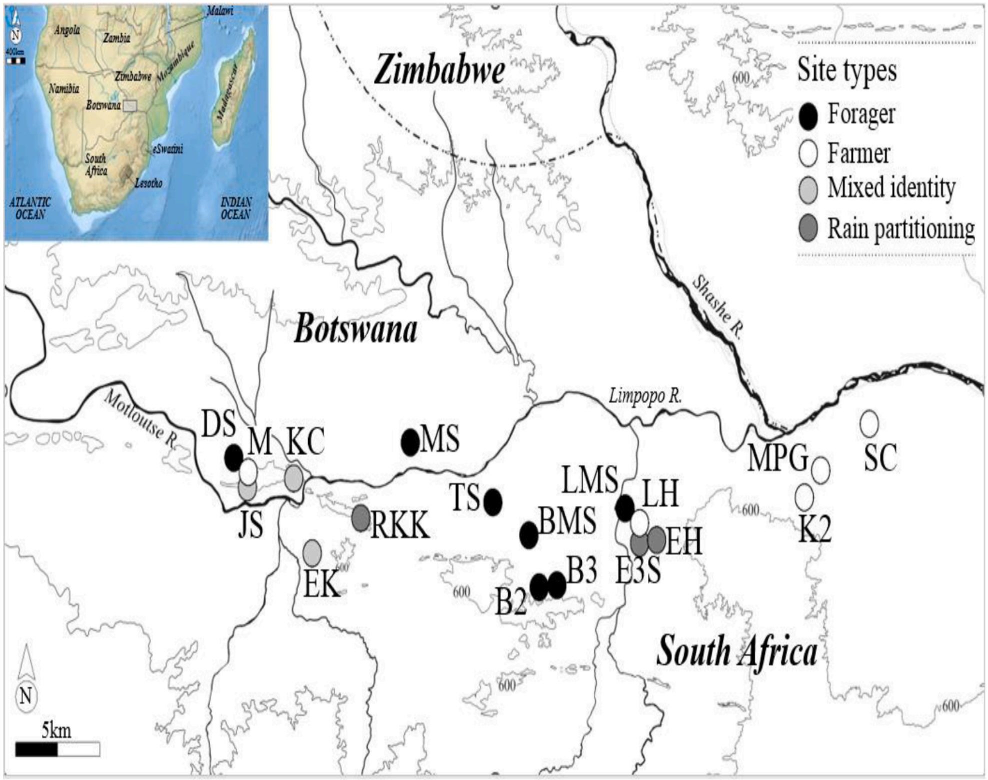

Fig. 1. The Shashe-Limpopo confluence area. From left to right: DS: Dzombo Shelter, JS: João Shelter, M: Mmamagwa, KC: Kambaku Camp, EK: Euphorbia Kop, RKK: Ratho Kroon Kop, MS: Mafunyane Shelter, TS: Tshisiku Shelter, BMS: Balerno Main, B2: Balerno 2, B3: Balerno 3, LMS: Little Muck Shelter, LH: Leokwe Hill, EH: EH Hill or Mbere Complex, M3S: M3S Hill, MPG: Mapungubwe, K2: Bambandyanalo, and SC: Schroda.

CE, the most intensive occupation occurred before the sequence shows a decline in artefacts (PBG1/PBG1 +). The site was possibly appropriated by farmer communities around 1000 – 1300 CE (GB2 & 3) interpreted from an increase in farmer items and rock markings thought to date to this period and produced during boys' initiation (Hall and Smith 2000). However, results from HARP's excavations are showing a continued presence of foragers at the site, producing Later Stone Age materials, after 1000 CE and into the Mapungubwe phase (GB2). Scrapers increase from the basal level until 1000 CE when they decline rapidly along with all other forager items. Since morphology alone cannot assist in interpreting this change (Forssman et al. 2018), further experimentation is required to assess scraper function and how this may link to local social relations.

3. Materials and methods

3.1. Experimental design

The methodology was designed by N.S specific for the needs of this study and takes an experimental approach to determine macro-wear left on scrapers made from cryptocrystalline (fine-grained silica based) materials used to scrape materials most likely to be worked by Later Stone Age forager communities. The experimental scrapers were knapped, shaped, and hafted by N.S and these tools were used to gather actualistic data on the scraping process, as well as use-wear indicators that were used to determine what the artefactual scrapers were used for at Little Muck.

Walker (1994) identifies scrapers as a lithic piece that has one or more retouched edge at an acute angle between 35° and 75°. Guilemard and Poraz (2019) classified scrapers as a retouched tool with one convex end framed by two straight edges (also known as thumbnail scrapers), where the retouched edge angles ranged from 30° to 100°. Observations of scrapers from Little Muck revealed the presence of pieces with angles between 30° to 100° and a large majority were end scrapers. Thus, our experimental scrapers were knapped to resemble end scrapers with edge angles ranging between 30° to 100°.

Flake blanks were knapped in bulk using hard hammer free percussion from cryptocrystalline (CCS) rocks that included types of jasper, agate, chert and flint. All the scrapers analysed from LMS were made from a variety of agates, jaspers, and chert, all which are made up of fine-grained silica material, albeit their geological formations differ, their composition and structures are similar in nature and use-damage is expressed similarly. However, see (Lerner 2014) where use-wear accrual rates could differ between siliceous materials. The flakes most suitable for shaping into scrapers were shaped along the end and the sides to resemble an end scraper. The thinner end of the flake blank, normally the platform, was left unshaped initially and only altered for hafting purposes where necessary.

The experimental sample included a total of 47 scrapers. Ten scrapers were selected that were most suitable for hand-held scraping and the rest (37) were hafted into wooden handles. Since the handles were not being examined, it was considered more efficient to shape them using modern tools that provided greater control of the handles' shape. A slit was cut in the proximal part of the handle just wide enough to squeeze the base of a particular scraper into (Fig. 4). The width of these slits was specifically measured for each scraper to ensure a tight fit, thus other materials such as strips of sinew or leather was not necessary to secure the tool as the friction against the wood was enough to hold it in place and provide stability during scraping activities. Forty of the 47 tools, including the ten handheld scrapers, were used on the different material categories.

Seven different material types were selected for the experiment as they were the most likely materials that foragers living at LMS worked and most of which occur in the local archaeological record, including at Little Muck. This included bone, wood, ochre, ostrich eggshell (OES), tortoise shell, hide and plant material. Each of these material categories

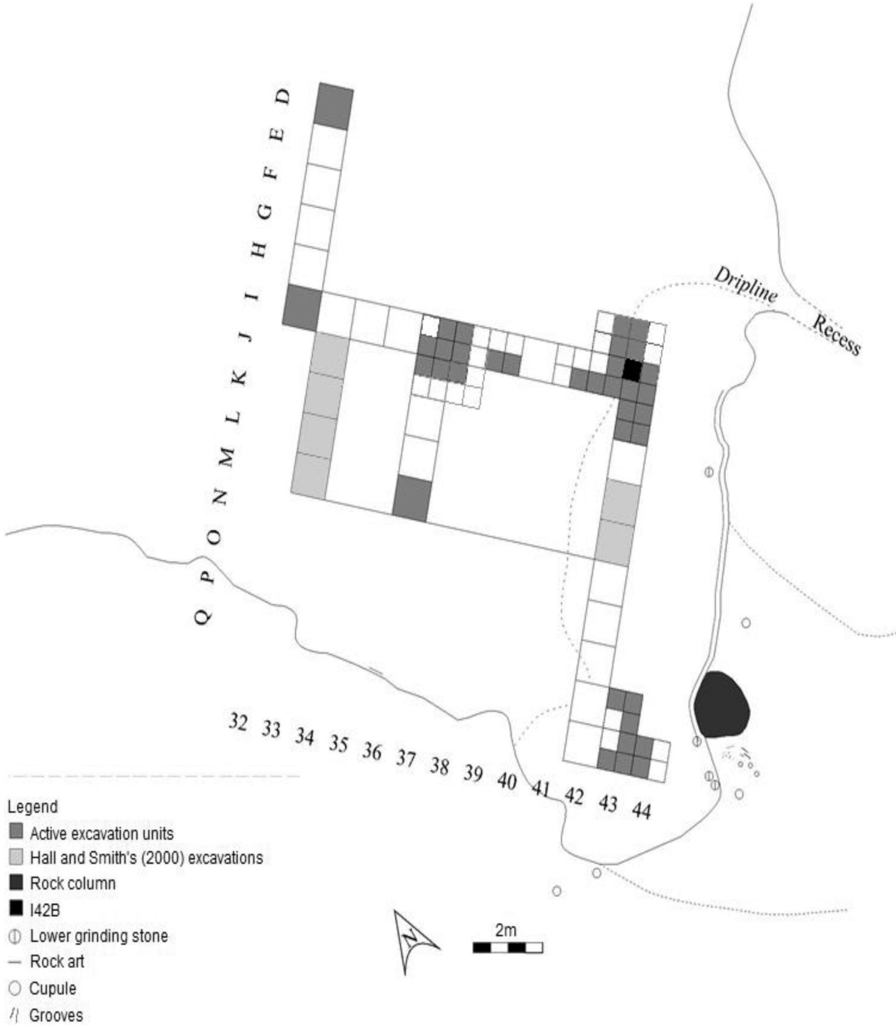

Fig. 2. Map and excavation units. Light grey indicate Hall and Smith's (2000) excavations and dark grey indicate renewed excavations from October 2020 to April 2022 by the Hunter-Gatherer Archaeological Research Project.

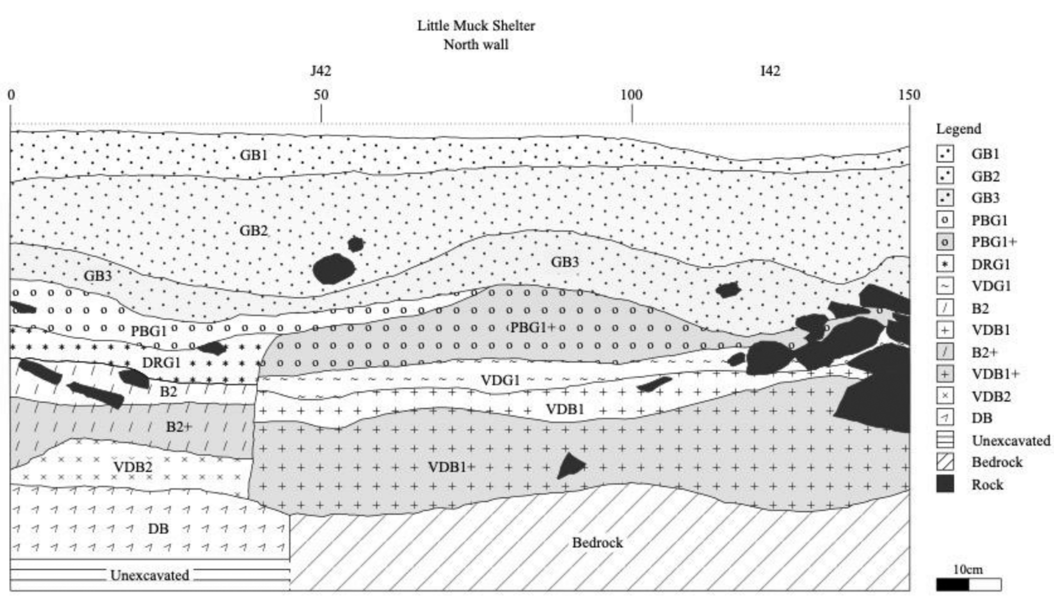

Fig. 3. The stratigraphic profile from J42 and I42 showing distinct stratigraphic changes throughout the sequences and a clear disconnect within J42 from PBG1. Layers with a '+' are consistent with their namesake but contained a notable increase in artefact densities.

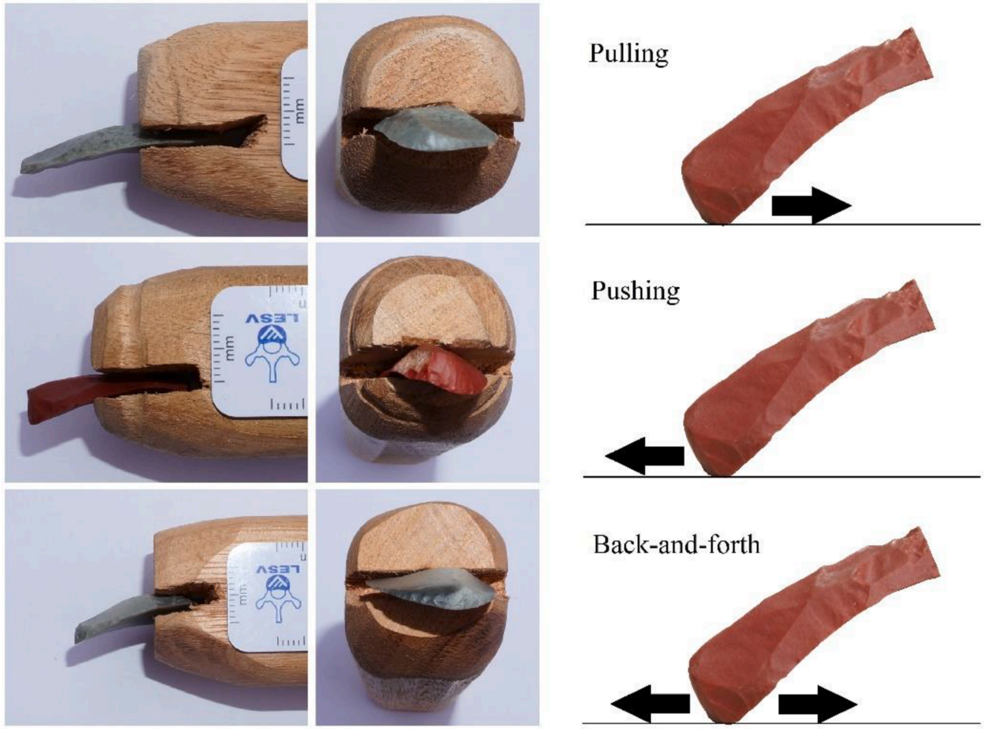

Fig. 4. Experimental scrapers and how they were hafted into a handle as well as the different motions used in the experiments.

had four scrapers performing the actions slightly differently (see Table 1) to see if use-wear differs with motion, such as pushing, pulling or back-and-forth (Fig. 4), or when a tool is hafted or handheld. With each motion the scraper is held with its ventral side down at a 45° angle. The pulling action entails that the scraper's edge is being pulled across the material being worked with the fashioned edge moving backwards and not into the material. The pushing motion on the other hand moves the scraper's fashioned edge into the material and forward. The back-and-forth motion is a combination of the pulling and pushing action in an alternating fashion. For the preliminary experimentation, hide was divided into four categories to determine if use-wear differs when the hide is wet or dry, hairless or not. The seven remaining tools were used extensively on the different materials using any motion that made the task as effective and comfortable as possible to represent use-wear that is actualist and not specifically motion based for comparative reasons. Hide was not dived up into different categories for this experiment and a piece of slightly damp hide with hair was used, as it had less risk of tearing when scraping clean, which was determined from the initial experimentation with the first 40 tools. There were at least 200 S performed by each tool for these experiments, but most were worked for much longer (estimated to be close to 1000) to complete a particular task or to use a tool until the edge showed signs of becoming blunt, but stroke counting desisted after 200.

Table 1
Experimental sample categories and sample numbers of the individual tools.

Category	Hafted, pulling action	Hafted, pulling, retouched	Hafted, pushing action	Handheld
Dry hide with hair	1	2	3	4
Wet hide with hair	5	6	7	8
Dry hide without hair	9	10	11	12
Wet hide without hair	13	14	15	16
Wood	17	18	19	20
Bone	21	22	23	24
Ochre	25	26	27	28
Plant	29	30	31	32
Tortoise shell	33	34	35	36
OES	37	38	39	40
Extra	**Hafted, extensive use, any motion**			
Bone	41			
Wood	42			
Ochre	43			
Tortoise shell	44			
OES	45			
Hide	46			
Plant	47			

Determination of macro use-wear traces and analysis of artefacts:

Macro use-wear traces were identified from the experimental scrapers via the use of a stereoscope (Nikon SMZ 745 T, with magnification of 10 Å~ and 300 Å~ and a Nikon camera with accompanying software). The findings from each of the seven materials were then used as a reference to identify wear on scrapers from Little Muck, which were any tool that had at least one edge with steep retouch (between 30° to 100°), irrespective of shape or whether the edge was convex, concave or flat. This is because despite the large majority being Wilton style (end) scrapers there was the occasional irregular chunk with a deliberately retouched edge and analysis showed that some of these were used for scraping materials. The artefacts from Little Muck were analysed using the same stereoscope as for the experimental tools for consistency.

There was a total of 206 scrapers from Square I42B (Figs. 2 and 3) that were analysed for use-wear. The shape and size of each scraper was not recorded as this was not necessary for the scope of this study.

4. Results

4.1. Scraping methods and use-wear

Eight scrapers were used as controls to determine what the average scraper edge would look like when unused. Fig. 5 shows the average representation of scrapers shaped via pressure flaking(A) and via a stone hammer(B). The edges are unpolished, with no rounding present and exhibits mostly elongated rounded flake scars with smaller flake scars overlapping previous removals. Few step-fractures are present and those that are, are randomly placed. It is possible that these signatures might differ depending on a knapper's skill and style, which is something that would need to be tested in future. Fig. 5C shows edges of LMS scrapers that were determined to not have any use-wear present, for comparison.

The first set of experiments indicated that use-wear does not differ substantially when different motions are used, except for where a forward motion or a back-and-forth motion was used, the occasional pressure flake removals were formed on the ventral surface of the scraper. Wear also did not differ between handheld use and hafted use.

4.1.1. Bone

The forelimb of a domestic cow (*Bos taurus*) was used for these experiments. It still contained some fresh tissue remnants attached to the bone, which was mostly connective tissue. The experimental scrapers were used to clean off most of this tissue and to shape a part of the humerus. Macro use-wear from bone scraping presents itself as multiple large squarish flake removals ending in step fractures on top of one another (Fig. 6A) with a crushed edge, where multiple small flakes and step fractures occur (Fig. 6B). Rounding and polish on the edge are not always present but start to appear where the edge has receded to or past a 90-degree angle (Fig. 6C). This occurs due to the hardness of bone resulting in the working edge being broken away over time resulting in a steeper platform, which can sometimes be seen in earlier stages as deepening of existing flake scars, before the extended edges also get worked away (Fig. 6D). A forward pushing motion, or a back-and-forth motion, also results in flakes being removed from the ventral surface of

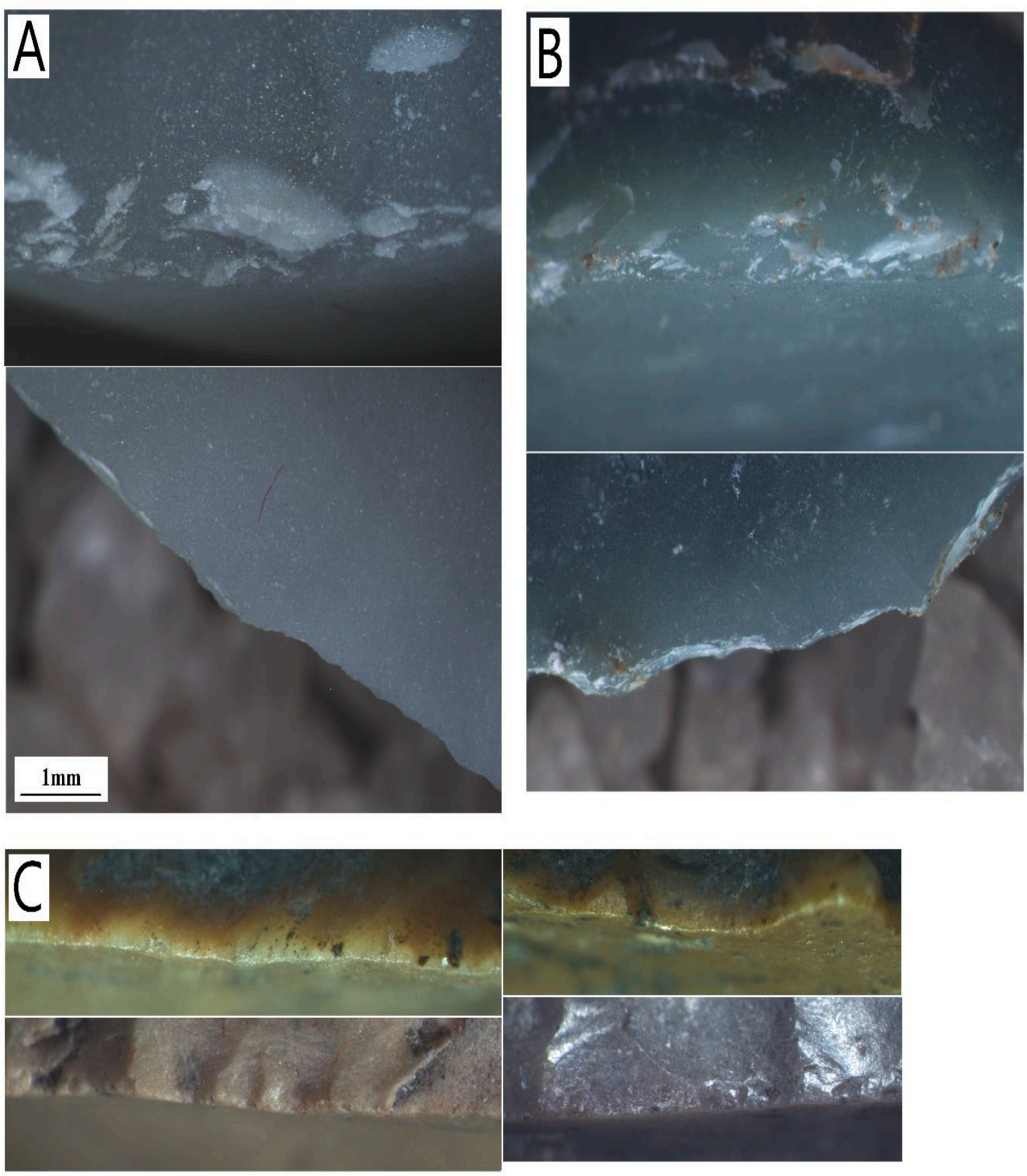

Fig. 5. Scrapers used as control to represent the edge prior to use and artefacts classed as none/no distinguishable use-wear visible. A: Edge pressure flaked with bone. B: Edge shaped with stone hammer. C: LMS scrapers with no use-wear present.

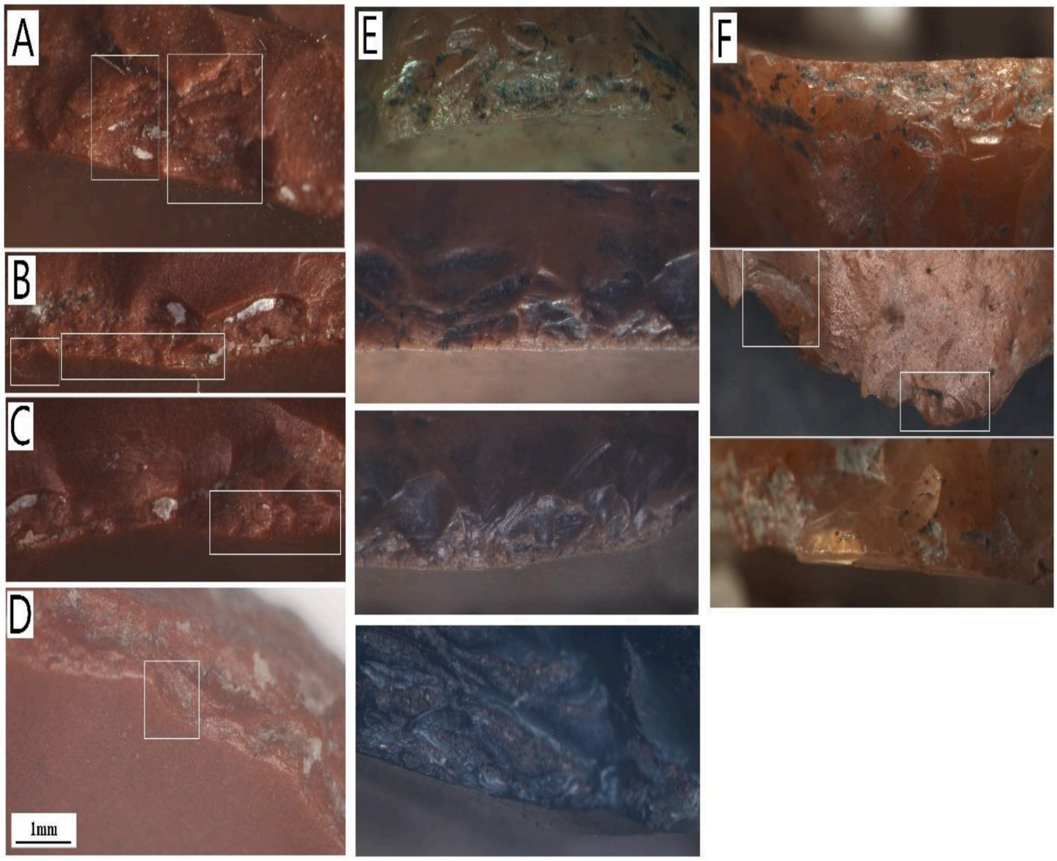

Fig. 6. A-D are experimental scrapers and E-F are artefacts. Common macro use-wear traces from scraping bone. A: Multiple large squarish flake removals ending in step fractures on top of one another. B: The occasional flake removal on the ventral side and crushing where multiple small flakes and step fractures occur along the working edge. C: Rounding and polish of some ridges, normally where the edge has receded to or past a 90-degree angle. D: Deepening of existing flake scars. E: Artefacts from LMS showing bone use. F: Artefact initially used for hide-work and later heavy-duty bone use.

the scraper (Fig. 6F middle). This artefact was initially used to scrape hide and later bone, which was determined because a small fraction of the previous edge was not fully removed from the later use on bone (Fig. 6F bottom).

4.1.2. Wood

Various pieces of acacia (*Vachellia)* wood were used to strip bark from and to shape the underlying woody material. The use-wear presented itself as the occasional large semi-circular flake scars (Fig. 7A & F) and smaller semi-circular flake scars in succession (seen in Fig. 7D, where the flakes have not been entirely removed) often creating a serrated edge (Fig. 7 A, B & G). Rounding and polish are present, but this alone is not an indicator of use on wood and only determined if accompanied by the above-mentioned use-wear patterns. Like with bone use the occasional flake removal is seen on the ventral side of the scraper, which occur when the tool is used in a forward or back-and-forth motion (Fig. 7G, H bottom & I middle). Fig. 7I shows an artefact that has both wood (top) and bone (bottom) wear patterns on different edges showcasing the use-wear for both on one tool for comparison.

4.1.3. Ochre

Scrapers were used on two pieces of ochre, one yellow (hardened clay in transition to slate) and one red (shale). The working edge exhibits extensive rounding with a lack of polish and is coarse with fine parallel streaks due to the individual grains in the rocks abrading against one another. No artefacts exhibited use-wear related to working ochre so images in Fig. 8 are from experimental scrapers.

4.1.4. Shell (ostrich eggshell and tortoise shell)

A couple of OES piece roughly 10 × 10 cm each were used and scraped on the inside surface, and for the tortoise shell the inside of the individual plates (keratinous substance) that make up the shell were scraped, as the fused bone itself is covered by this substance on the inside and scraping the bone directly would likely yield use-wear like scrapers used on bone. The use-wear is similar for both substances, even though they comprise of different materials. The parts of the working edge that contacted the shell shows intense polish and a flattening of the surface, rather than rounding (Fig. 9). Tortoise shell shows the same use-wear as with OES; however it took ten times more strokes (over 1000 S) to show on the tool (Fig. 9B).

4.1.5. Hide

Two pieces of kudu (*Tragelaphus strepsiceros*) hide, 50 × 50 cm each, were used for these experiments. One piece of hide was soaked in a bucket of water for four days before scraping and the other was left dried. Each piece was strung up and tensioned on a wooden frame with strips of leather through the edges of the hide that had holes poked into them with a sharpened bone. Both the side with hair (dorsal) and the side without (ventral) were scraped with different tools to see if any differences in wear appear. Macro-wear did not differ. Wear also did not differ between the wet and dry pieces, but the wet hides resulted in less tearing due to increased elasticity. The extra scraper (Tool 46 in Table 1) was used with any-and-all motions to scrape a patch of 30 × 30 cm clean on a third piece of damp kudu hide. The hide was not strung up this time but was used on the lap and kept tight on the thigh. The use-wear did not differ from the other tools. Use-wear presented itself as rounding and smoothing of the contact edge with moderate polish (Fig. 10) and polish

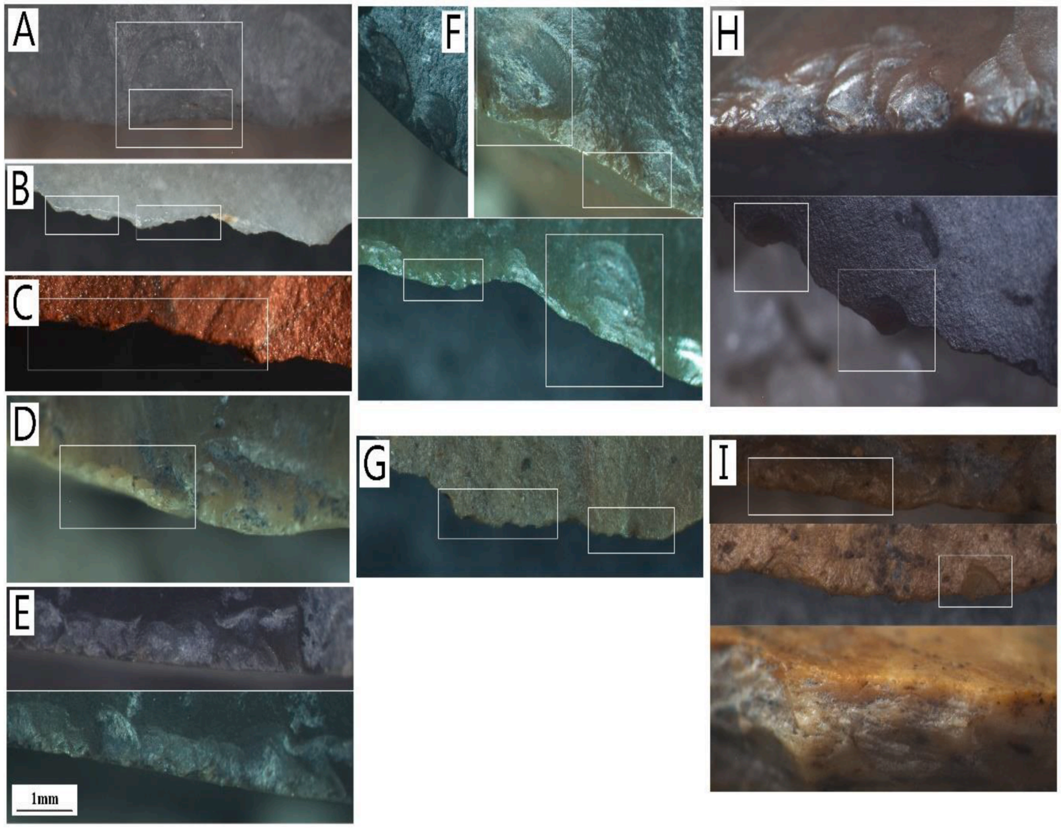

Fig. 7. A-C are experimental scrapers and D-I are artefacts. A: Large semi-circular flake scar with smaller consecutive semi-circular flake scars. B: Ventral side of A. C: Polish and rounding on edge, viewed from ventral side. D: Semi-circular flakes formation in succession, due to the pressure on the wood, but these were not fully removed by the process. E: Artefacts showcasing the successive semi-circular flakes. F: Artefacts showcasing both large and small semi-circular flake scars. G: Artefact showing the serrated appearance of the flake scars from a ventral view. H: Artefact front and ventral view showing ventral flake removals. I: Artefact with both wood (top) and bone(bottom) use-wear, with the middle being the ventral view of the top.

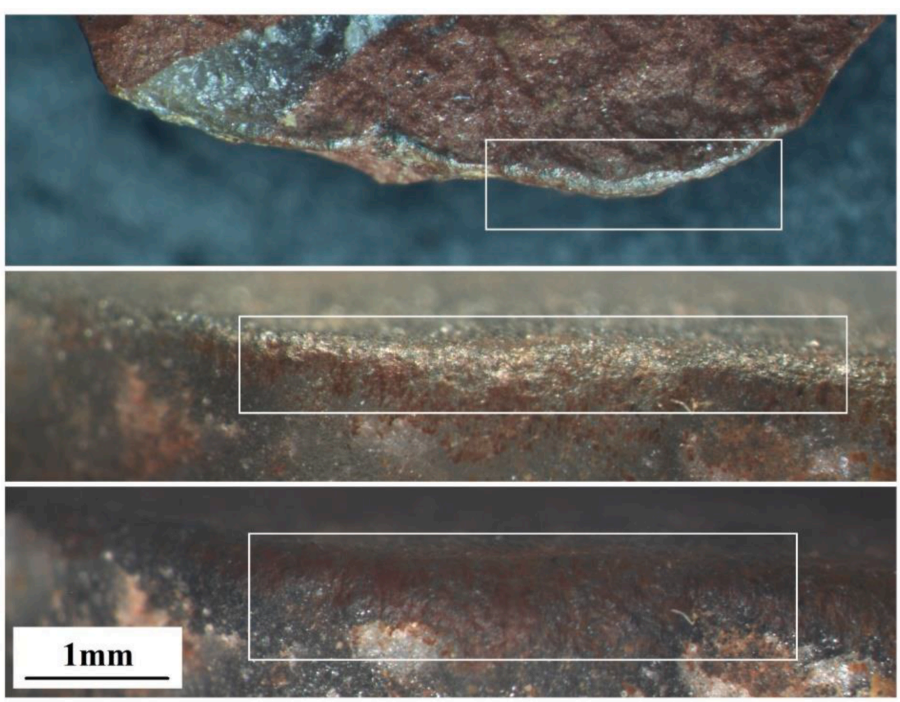

Fig. 8. A: Extensive rounding of surface. B: Surface coarse rather than polished. C: Fine parallel streaks are present on the abraded surface.

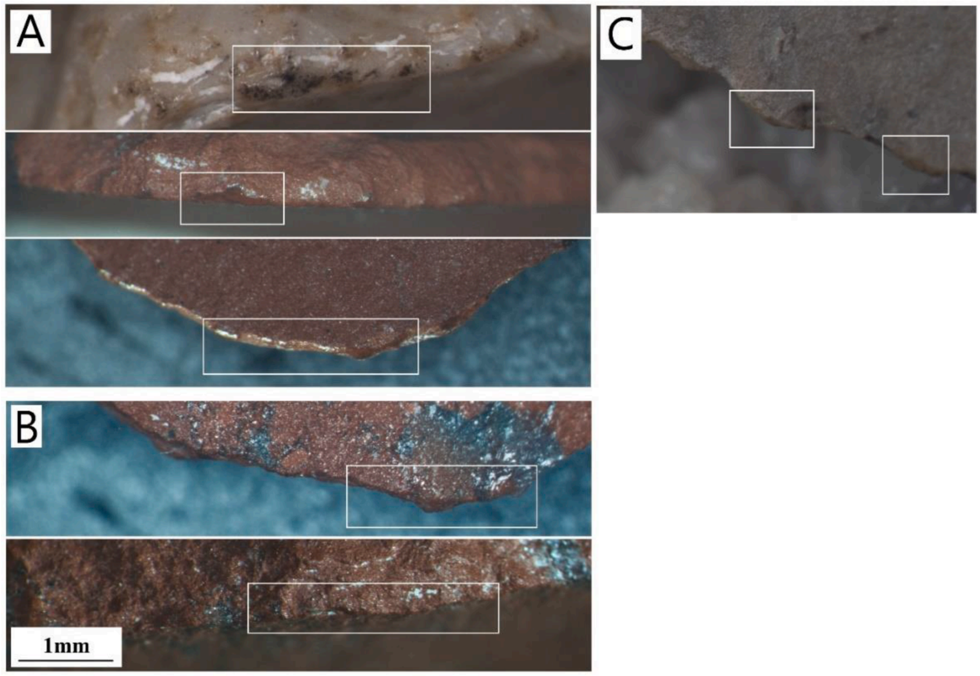

Fig. 9. A- B are experimental scrapers and C an artefact. A: Use-wear from working OES showing intense polish and flattening of contact edges. B: Use-wear from work tortoise shell also showing intense polish and some flattening of the surface. C: Artefact showcasing use on shell.

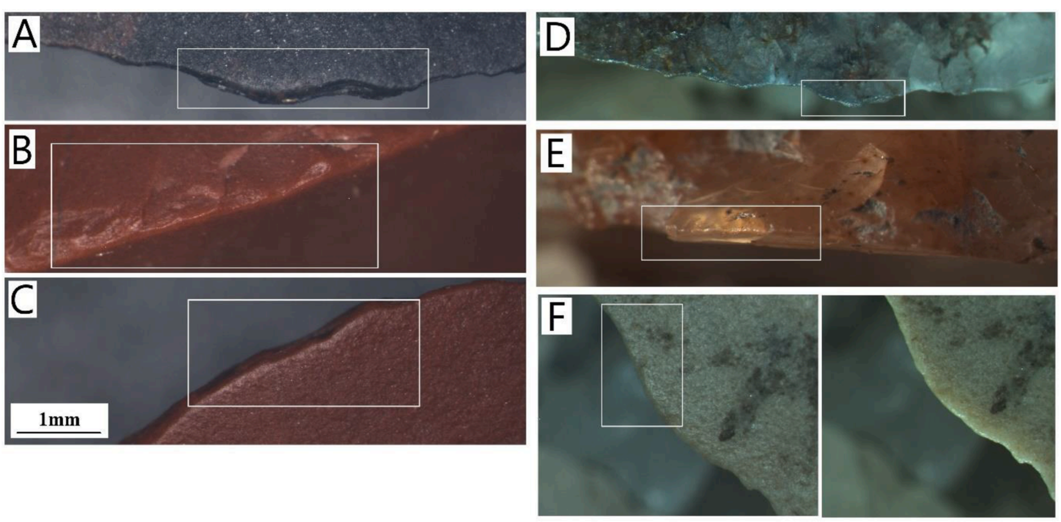

Fig. 10. A-C are experimental scrapers and D-F are artefacts. A: Rounding of the edge that contacted the hide most exhibiting polish on the ventral side as well. B: Rounding and smoothing of the working edge with moderate polish. C: Polish and slight flattening on ventral side. D-F: Artefacts showing the rounding, smoothing and ventral polish.

on the ventral side just behind the edge (Fig. 10 A, C & F) (see Fig. 11).

4.1.6. Plant

Tools were used to scrape out the inside of two halves of a butternut (Cucurbita moschata*)* and peeling two potatoes (*Solanum tuberosum*) and a carrot (*Daucus carota*). Use-wear only appeared after extensive use (over a 1000 S) and is barely visible as macro use-wear traces on protruding ridges and would be indistinguishable from an unused edge in the archaeological record. Plant use-wear can be assessed with micro use-wear analyses (D'Errico 2012; Hayes et al. 2021) but was not part of the scope of this study.

4.2. Little Muck's scraper assemblage

Of the six use-wear categories only four were present on the scrapers analysed (bone, wood, shell and hide). The category "none" was used for scrapers that showed no visible macroscopic use-wear (Table 2). These pieces might have been knapped for a stockpile or were not desirable for use after creation, or in some cases may have been retouched removing any previous use-wear. Our experimental tools indicated that very few pieces preserve use-wear after the edge was retouched, with only one out of ten having a part of the previous working edge still present. Use on plant material in these specimens cannot be excluded, as scraping softer plant material does not produce distinct macro use-wear. It is therefore possible that these tools were worked but use-wear did not form or

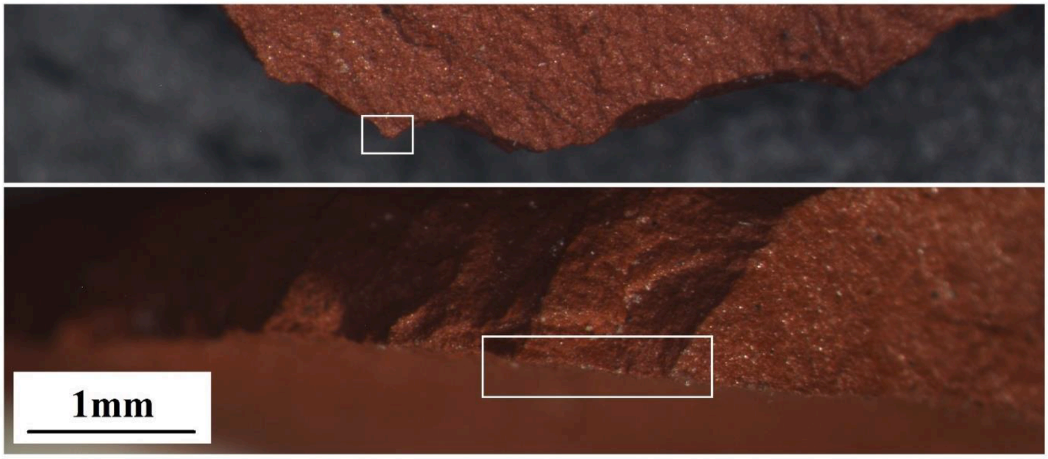

Fig. 11. Experimental scrapers used to scrape plant materials.

Table 2
Scraper-use categories by spit and layer.

Spit no.	Hide	Hide and bone	Wood	Bone	Bone and wood	Shell	None	Total
12	0	0	2	0	1	0	1	**4**
13	0	0	0	0	0	0	0	**0**
14	0	0	0	0	0	0	1	**1**
15	0	0	0	5	0	0	2	**7**
16	0	0	0	4	0	0	1	**5**
17	0	0	0	0	0	0	0	**0**
18	0	0	0	0	0	0	0	**0**
19	0	0	0	2	0	0	3	**5**
20	0	0	0	0	0	0	2	**2**
21	0	0	0	6	2	0	0	**8**
22	0	0	11	38	12	2	14	**77**
23	0	0	2	4	5	0	3	**14**
24	1	0	9	1	7	0	16	**34**
25	0	0	2	4	2	1	8	**17**
26	1	0	1	0	0	0	5	**7**
27	2	1	7	1	2	0	12	**25**
Total	**4**	**1**	**34**	**65**	**31**	**3**	**68**	**206**
Percentage	**1.9**	**0.5**	**16.5**	**31.6**	**15.0**	**1.5**	**33.0**	**100.0**
Layer	**Hide**	**Hide and bone**	**Wood**	**Bone**	**Bone and wood**	**Shell**	**None**	**Total**
GB2	0	0	1	0	0	0	0	**1**
GB3	0	0	0	1	1	0	1	**3**
B3	0	0	0	0	0	0	1	**1**
DRG1	0	0	0	6	0	0	3	**9**
B4	0	0	0	3	0	0	0	**3**
DRG1+	0	0	0	2	0	0	3	**5**
VDG1	0	0	0	0	0	0	2	**2**
PB3	0	0	0	6	2	0	0	**8**
VDG1	0	0	11	38	12	2	14	**77**
VDB1+	1	0	13	9	14	1	27	**65**
VDB2	3	1	8	1	2	0	17	**32**
Total	**4**	**1**	**33**	**66**	**31**	**3**	**68**	**206**
Percentage	**1.9**	**0.5**	**16.0**	**32.0**	**15.0**	**1.5**	**33.0**	**100.0**

preserve. As such, the use-wear indicators should be considered the minimum indicator of activity but possibly not representative of all activities.

The scraper distribution shows that there were at least six activity phases that varied with intensity. These phases are also reflected in the relative chronology, but the distribution is more clearly seen when data are plot by spits (Fig. 12). All these occupations show a predominant use of scrapers on hard materials such as bone and wood, which were placed into the "hard" category for analyses in Fig. 12, as many of these tools exhibit wear from working both bone and wood, either on two separate edges or overlapping on the same working edge (Fig. 13 shows these same categories in more detail). Scrapers used on hide and shell only appear in the earliest occupations and in small quantities, showing that some of these activities occurred here, but were not necessarily the predominant activities. There is a sizable precontact occupation, followed by a second occupation phase after the early Happy Rest farmers entered the region, showing an increase in scrapers. This is followed by a substantial increase in activity, which is tailed by three smaller peaks with a lower frequency of scrapers from Spit 19 (DRG1 +) upwards. Scrapers before the contact period shows a more predominant use on wood and hide than any of the occupations after contact. A Chi square test indicates that there is a significant difference (p0.000) between the pre-contact occupation (VDB2) and the occupation after contact (VDB1 +), where there is a shift towards working more bone. The major occupational phase (VDG1) also shows a significant difference (p0.000) from the first two, especially due to an increase in scrapers used only on bone (also apparent in Fig. 13). The next two smaller phases appear to have scraper use only on bone (Fig. 13) and the last predominantly for

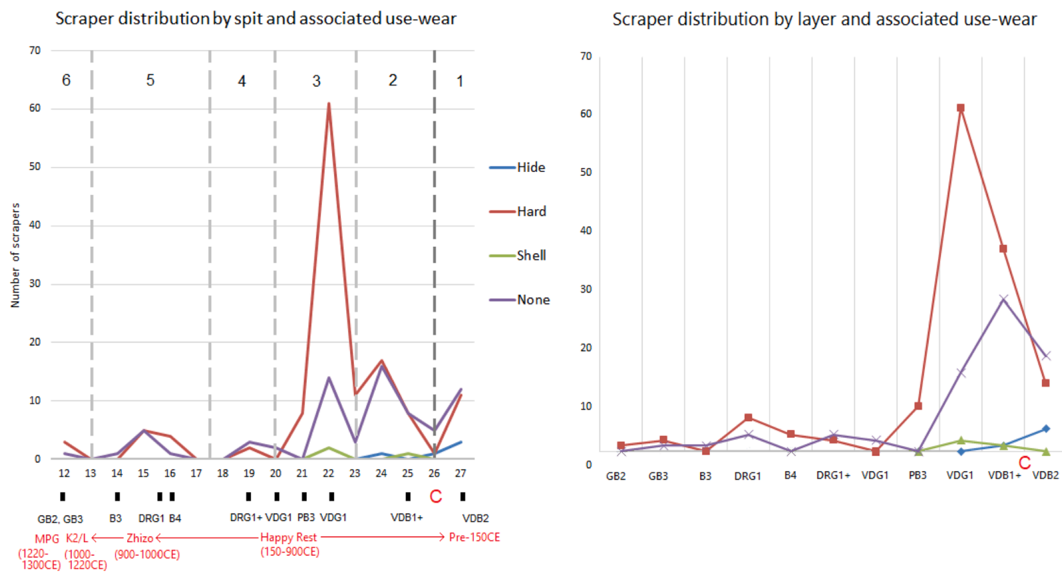

Fig. 12. Distribution of scrapers by spit and layer showing associated use-wear. Numbers 1–6 show at least 6 possible occupational phases based on scraper distribution in square I42B of Little Muck Shelter. Major stratigraphic units are shown below the first graph as well as their associated time periods. MPG: Mapungubwe (1220–1300 CE); K2/L: K2/Leokwe contact (1000–1220 CE); Zhizo: contact (900-1000CE); Happy Rest: contact (150–900 CE); C: contact period with Happy Rest farmers; Pre: Pre-contact (150 CE).

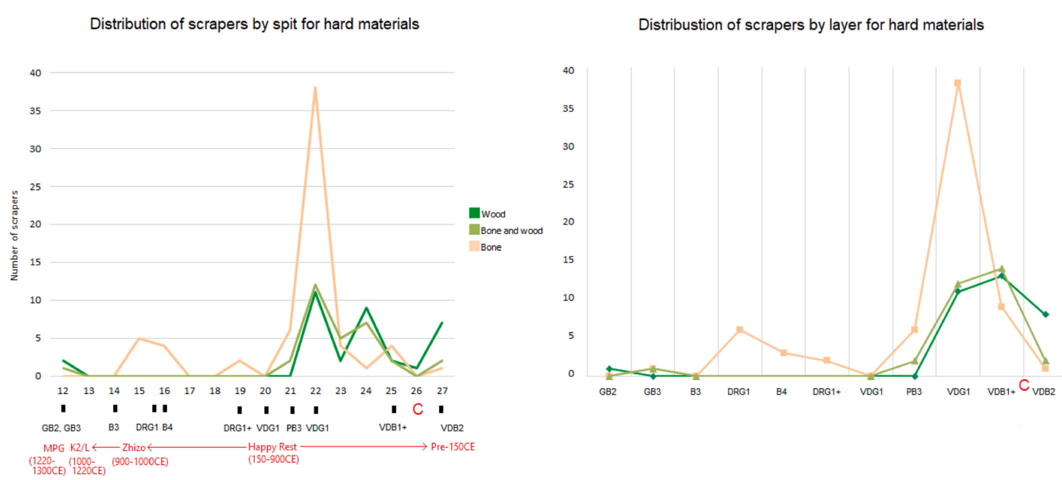

Fig. 13. Distribution of scrapers used to scrape hard materials and associated time periods.

woodworking, however, the sample sizes are too small to test any statistical significance. Future studies on surrounding units will give a much clearer picture of scraper use at the site as well as potential differences in spatial use at the site.

This study indicates that Little Muck was not predominantly used for hide-working purposes as suggested by Hall and Smith (2000), but rather for making wooden and bone implements, and confirms Forssman et al. (2018) initial findings on those units. There does appear to be a change in scraper use after contact with a switch from working wood and hide to a more predominant use on bone, indicating prioritising certain craft productions over others, possibly as a result of interaction with farmer communities. To confirm this change more data would need to be collected from other units across the site.

5. Discussion

Scraper-use at LMS reveals an interesting dichotomous pattern in the difference between the pre-contact and contact phases. Before the arrival of farmers, foragers were mostly using scrapers on a variety of materials including hide, wood, bone, and shell. After the contact period an increase in scraper numbers are evident as well as an increased use on bone, with a decline in use on hide and shell over time, thus shifting to a predominant use on hard materials showing less variation than before.

The pre-contact to contact shift is different at Little Muck than elsewhere, but it is nonetheless part of a more general shift that took place in the valley during this period. At some stage between about 1220 and 350 BCE all of the excavated sites were occupied; before then, only Tshisiku and Balerno Main were inhabited. However, from the first centuries CE, there is a rapid uptick of artefacts at all sites. At Tshisiku, artefacts increase to levels more similar to their mid-Holocene densities, albeit still lower (van Doornum 2007), Balerno 2 and 3 experience large increases as does Little Muck (Hall and Smith 2000; van Doornum 2005), and Dzombo increases slightly (Forssman 2014). Balerno Main is the only site that experiences little change. Van Doornum (2008) argued that Balerno Main served as an aggregation camp as a result of its relative isolation. Aggregation is an ethnographically recorded phenomenon in which San community members gather at a site, feasted, performed rituals, produced and shared gifts, agreed on marriage arrangements, and produced large amounts of waste on account of the resident group being larger (e.g. Wadley 1989). Aggregation's antithesis is dispersal, when smaller nucleus groups live together and perform fewer activities. Identifying aggregation camps archaeologically is based on a large build-up and variety of materials, such as appears to be the case at Balerno Main. It may also explain why little changed at the site since it represented a refuge or traditional occupation camp (van Doornum 2008). Despite this, across the valley the contact divide seems to represent a watershed moment and it marks two very different social and economic phases. However, at present, we know little of the nature of contact and the initial impact it had on forager or farmer groups, a problem that resonates with many other areas in southern Africa (Mazel 1989; Hall 1994; Wadley 1996; Fewlass et al. 2020).

The changes at Little Muck, like Dzombo, appear to reflect a change in demand patterns or opportunities. The contemporaneity of these changes, which includes a rapid increase in scraper frequencies, with the appearance of farmers is probably not coincidence but causational. Use-wear evidence has shown that hard materials, like bone but possibly wood and presumably ivory as well, were preferred after the arrival of farmers, whereas before this wood and hide were worked more extensively, and shell to a lesser extent. It has long been held, although not shown, that foragers produced bone tools for farmers. At Little Muck, there is a comparably large bone tool assemblage with 93 individual specimens (Bradfield et al. 2019). Pre-contact levels contains 17 specimens and the first millennium CE possess 67, followed by six implements in the post-1000 CE levels. The increase in bone tools tracks well with the increase in scrapers. It may, therefore, be that scrapers were being used to work bone, as well as wood, for hunting implements to either trade directly with farmer groups, or to use in hunting and trading wild meats and unworked hides. There is no evidence to suggest extensive processing of hide at the site after contact based on use-wear preserved on scrapers. However, this possibility should not be ruled out as it is possible that scrapers previously used for hide-work could have been repurposed for bone-work, eliminating hide-wear (Morales and Vergès 2014). There is evidence for this as one artefact preserves previous hide work with later heavy duty use on bone before discard. Though this artefact is from pre-contact layers alongside other pieces showing hide-work.

It is also noteworthy that shell was not being worked regularly. Hall and Smith (2000) suggested that beads formed an important part of the trading economy and that foragers produced them for trade purposes. This appears highly possible given the large amounts of shell retrieved in their and HARP's excavations, but these shells were mostly not being worked into beads, or any other item, using stone scrapers. The results from the use-wear study provide clear indications of what materials were being worked but they are not able to show us, more specifically, what was being produced.

Despite these shortcomings, the findings support earlier contentions that the site may have served as a craft centre and at which specialisation occurred (Forssman 2020). First, it is clear that from the onset of contact with farmers, forager craft activities at the site became more limited based on the dominance of hard-material use-wear and decline in hide and shell evidence. Second, this continued throughout the contact period until at least 1000 CE with evidence post-dating this but in frequencies too low to statistically test. This represents a period spanning possibly 1000 years of working hard materials, but with unknown lengths of stay or periods of use. Third, the tool's form is particularly uniform. As reported by Forssman et al. (2018) and recorded here, scraper morphology is largely consistent with the majority possessing a single worked edge (end), an angle of between 30° and 100°, a length usually between 20 and 30 mm, and predominant use of CCS. Fourth, the goods that were being produced led to the return of wealth items, such as glass beads and metal but also ceramics and perhaps their contents. These were brought to Little Muck where they seem to have remained; if foragers were mobile, as has come to be expected based on ethnographic accounts, these items remained at Little Muck and were not brought to sites such as Balerno Main, which had no glass beads and only a few ceramic sherds. Since these goods were being accumulated at Little Muck in a context that emphasised craft production and trade it is reasonable to conclude that they indicated wealth and status. Fifth, being able to obtain these trade items placed foragers within a largescale trade network that extended to the coastline and eventually southern Asia. No longer were they only involved in local exchange systems of goods sourced and produced in the region. When combined, these different lines of evidence support the notion that Little Muck was a trading centre with craft specialisation, but further evidence is required to confirm these claims.

The context under which residents of Little Muck were obtaining wealth items is worth unpacking. Their crafts were fed into a larger economy for the purpose of obtaining various goods. Initially, this represented glass beads that came from southern Asia (see Wood 2000) and locally produced earthenware ceramics and metal goods. However, from 1000 CE, these small beads came to represent wealth, prestige and status. Based on these and other wealth items, elite groups separated themselves from local society forming tiers and social stratification. Underpinning this was access to wealth. At the same time that wealth was providing the impetus to transform society, and were therefore highly valued items, Little Muck's foragers were able to obtain such items and on a regular basis. They were not excluded from the wealth economy that was propping-up local elite communities. That they were involved intimates their role in local society and shows that during this pivotal phase of socio-political development they were not excluded; instead, they participated and contributed goods into the local market that possessed enough desirability to provide them access to important wealth and status markers. Foragers were very much a part of state formation in southern Africa, despite their often-neglected presence within these systems and networks.

6. Conclusion

This study provides macro use-wear identifiers for cryptocrystalline scrapers for a range of worked materials and will be useful for future studies on scraper use. In addition, by examining stone scrapers from Little Muck we show that when use-wear analysis is used in conjunction with ethnographic and typological information a more accurate understanding of use patterns emerges. Doing so in this unusual context also demonstrates how forager activities and technologies were adjusted and deployed in social networks with farmers and, for this reason, how use-wear has the potential to signal the impact of associated interactions. More generally, it shows that foragers participated in the local economy and through their own offerings were able to obtain wealth items that at that time were supporting the establishment of elite groups and state formation. Our evidence shows that foragers were part of these socio-political developments and not disassociated with social change in the valley.

By only looking at stone scrapers we have limited our study to activities in which they were involved. The role of scrapers in working hard materials may not represent the full range of activities at the site as we know animals were being hunted and shell was worked into beads and possibly other items. To gain a fuller understanding of the craft activities, future work needs to examine the full range of tools represented in the forager toolkit, such as awls, borers, backed tools, bone implements and even the surrounding bedrock which in places contains grooves often associated with rounding and polishing activities. Furthermore, the shifts in production habits and intensity were not scrutinised across the entire site and may reflect spatial differentiation and much more complex behaviour. Hall and Smith's (2000) Square L42 and our Square I42B are near to one another and overall have limited horizontal coverage. As further analysis progresses it is expected that some of these limitations will be overcome and further details of Little Muck's sequence will emerge. In addition, use-wear studies on tools from other sites are paramount to understanding the general impact on and by forager groups in the SLCA.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

We are grateful to a postdoctoral position provided to NS from the University of Pretoria that provided the opportunity for this work to be carried out and to the National Research Foundation of South Africa for a grant to TF through the African Origins Platform (ID 136506). Support from the South African National Parks (Permit FORT1660) and the South African Heritage Resources Authority (Permit 3124) are greatly appreciated.

References

Álvarez-Fernández, A., García-González, R., Márquez, B., Carretero, J.M., Arsuaga, J.L., 2020. Butchering or wood? A LSCM analysis to distinguish use-wear on stone tools. J. Archaeol. Sci.: Rep. 31, 102377.

Antonites, A.R., 2016. Zhizo and Leokwe period human remains and burial practices at Schroda. South Afr. Archaeol. Bull. 71 (203), 14–26.

Antonites, A.R., Bradfield, J., Forssman, T., 2016. Technological, functional and contextual aspects of the K2 and mapungubwe worked bone industries. Afr. Archaeol. Rev. 33 (4), 437–463. Special Issue: South African Archaeozoology of the Last 2000 Years.

Bello-Alonso, P., Rios-Garaizar, J., Panera, J., Rubio-Jara, S., Pérez-González, A., Rojas, R., Baquedano, E., Mabulla, A., Domínguez-Rodrigo, M., Santonja, M., 2021. The first comprehensive micro use-wear analysis of an early Acheulean assemblage (Thiongo Korongo, Olduvai Gorge, Tanzania). Quat. Sci. Rev. 263, 106980.

Beyin, A., 2010. Use-wear analysis of obsidian artifacts from Later Stone Age shell midden sites on the Red Sea Coast of Eritrea, with experimental results. J. Archaeol. Sci. 37, 1543–1556.

Binneman, J., Deacon, J., 1986. Experimental determination of use-wear on stone adzes from Boomplaas Cave, South Africa. J. Archaeol. Sci. 13, 219–228.

Bisson, M.S., 2000. Nineteenth century tools for twenty-first century archaeology? Why the middle paleolithic typology of françois bordes must be replaced. J. Archaeol. Method Theory 7 (1), 1–48.

Bradfield, J., Forssman, T., Spindler, L., Antonites, A.R., 2019. Identifying the animal species used to manufacture bone arrowheads in South Africa. Archaeol. Anthropol. Sci. 11, 2419–2434.

Brumm, A., McLaren, A., 2011. Scraper reduction and "imposed form" at the Lower Palaeolithic site of High Lodge, England. J. Hum. Evol. 60, 185–204.

Calabrese, J.A., 2005. Ethnicity, class, and polity: the emergence of social and political complexity in the Shashi-Limpopo valley of southern Africa, AD 900 to 1300. University of the Witwatersrand. PhD thesis.

Clemente-Conte, I., Fernández-Lomana, J.C.D., Bernal, M.T. 2014. Use of Middle Palaeolithic tools in San Quirce (Alar del Rey, Palencia, Spain). In: Marreiros, J., Bicho, N., Gibaja-Bao, J. (Eds.), *International conference on Use-Wear Analysis. Use-wear 2012*. pp. 152 - 172.

Clemente-Conte, I., Ramos-Munoz, J., Dominguez-Bellac, S., Vijande-Vilab, E., Barrena-Tocinob, A., Almisas-Cruzb, S., Bernal-Casasolab, D., Fernandez-Sanchezb, D., del Carmen Fernandez Roperod, M., 2020. Raw materials, technology and use-wear analysis of scrapers and points of the rock shelter of Benzu. Quat. Int. 555, 6–20.

Deacon, H.J., Deacon, J., 1980. The hafting, function and distribution of small convex scrapers with an example from Boomplaas Cave. South African Archaeol. Bull. 35 (131), 31–37.

D'Errico, D. 2012. Glossy tools: innovations in the method of interpretation of use-wear produced by plant processing. International Conference on Use-Wear Analysis. Use-Wear 2012. In: Marreiros, J., Bicho, N., and Bao, J.G. (eds) *Micro-wear traces for plant work* Cambridge Scholars Publishing.

Dibble, H.L., 1984. Interpreting typological variation of Middle Paleolithic scrapers: function, style, or sequence of reduction? J. Field Archaeol. 11, 431–436.

Dibble, H.L., 1987. The interpretation of Middle Paleolithic scraper morphology. Am. Antiq. 52 (1), 109–117.

Dibble, H.L., 1995. Middle Paleolithic scraper reduction: background, clarification, and review of evidence to data. J. Archaeol. Method Theory 2 (4), 299–368.

Dibble, H.L., Holdaway, S.J., Lin, S.C., Braun, D.R., Douglass, M.J., Iovita, R., McPherron, S.P., Olszewski, D.I., Sandgathe, D., 2017. Major fallacies surrounding stone artifacts and assemblages. Anthropol. Faculty Publicat. 150.

Eastwood, E.B., Eastwood, C., 2006. Capturing the spoor: an exploration of southern African rock art. David Philip, Cape Town.

Fewlass, H., Mitchell, P.J., Casanova, E., Cramp, L.J., 2020. Chemical evidence of dairying by hunter-gatherers in highland Lesotho in the late first millennium ad. Nat. Hum. Behav. 4, 791–799.

Forssman, T., 2014. Dzombo Shelter: a contribution to the later stone age sequence of the greater Mapungubwe landscape. South African Archaeol. Bull. 69 (200), 182–191.

Forssman, T., 2015. A macro-fracture investigation of the backed stone tools from Dzombo Shelter, eastern Botswana. J. Archaeol. Sci. Rep. 3, 265–274.

Forssman, T., 2020. Foragers in the middle Limpopo Valley: trade, place-making, and social complexity. Archaeopress, Oxford.

Forssman, T., Seiler, T., Witelson, D., 2018. A pilot investigation into forager craft activities in the middle Limpopo Valley, southern Africa. J. Archaeol. Sci. Rep. 19, 287–300.

Gassin, B., Guéretb, C., Dachya, T., Gibajac, J.F., Lubelld, D., Perrina, T., 2020. Lithic industries and plant processing in the Epipalaeolithic Maghreb: Evidence from use-wear analyses. Quat. Int. 555, 47–65.

Groman-Yaroslavski, I., Prévost, M., Zaidner, Y., 2022. Tool wielding and activities at the Middle Paleolithic site of Nesher Ramla, Israel: A use-wear analysis of major tool types from unit III. Quat. Int. 624, 67–79.

Guillemard, I., Guillaume Porraz, G., 2019. What is a Wilton scraper? Perspectives from the Late Holocene assemblage of Balerno Main Shelter, Limpopo Province, South Africa. South. Afr. Humanit. 32, 135–161.

Hall, S.L., 1994. Images of interaction: rock art and sequence in the Eastern Cape. In: Dowson, T.A., Lewis-Williams, J.D. (Eds.), Contested Images: diversity in southern African rock art research. Witwatersrand University Press, Johannesburg, pp. 61–82.

Hall, S., Smith, B., 2000. Empowering Places: Rock Shelters and Ritual Control in Farmer-Forager Interactions in the Northern Province. South African Archaeological Society Goodwin Series 8, 30–46.

Hanisch, E.O.M., 1980. An archaeological interpretation of certain Iron Age sites in the Limpopo/Shashe Valley. University of Pretoria. MSc dissertation,.

Hanisch, E.O.M., 1981a. The northern Transvaal: environment and archaeology. In: Voigt, E.A. (Ed.), Guide to archaeological sites in the northern and eastern Transvaal. Pretoria, Transvaal Museum, pp. 1–6.

Hanisch, E.O.M., 1981b. Schroda: A Zhizo site in the northern Transvaal. In: Voigt, E.A. (Ed.), Guide to archaeological sites in the northern and eastern Transvaal. Pretoria, Transvaal Museum, pp. 21–39.

Hardy, B.L., Garufi, G.T., 1998. Identification of woodworking on stone tools through residue and use-wear analyses: experimental results. J. Archaeol. Sci. 25, 177–184.

Hayes, E., Fullagar, R., Kamminga, J., Prinsloo, L.C., Bordes, L., Sutikna, T., Tocheri, M. W., Saptomo, E.W., Jatmiko, R., R.g., 2021. Use-polished stone flakes from Liang Bua, Indonesia: Implications for plant processing and fibrecraft in the Late Pleistocene. J. Archaeol. Sci. Rep. 40, 103199.

Huffman, T.N., 2000. Mapungubwe and the origins of the Zimbabwe culture. South African Archaeological Society Goodwin Series 8, 14–29.

Huffman, T.N., 2002. Archaeological background. In: Van Schalkwyk, J.A., Hanisch, E.O. M. (Eds.), Sculptured in clay: Iron Age figurines from Schroda, Limpopo Province, South Africa. Pretoria, National Cultural History Museum, pp. 9–20.

Huffman, T.M., 2007. Handbook to the Iron Age: The Archaeology of Pre-Colonial Farming Societies in Southern Africa. University of Kwazulu-Natal Press 331–359.

Huffman, T.N., 2008. Climate change during the Iron Age in the Shashe-Limpopo Basin, southern Africa. J. Archaeol. Sci. 35, 2032–2047.

Huffman, T.N., 2009a. Mapungubwe and Great Zimbabwe: the origin and spread of social complexity in southern Africa. J. Anthropol. Archaeol. 28, 37–54.

Huffman, T.N., 2009b. A cultural proxy for drought: ritual burning in the Iron Age of southern Africa. J. Archaeol. Sci. 36, 991–1005.

Huffman, T.N., 2010. Intensive El Nino and the Iron Age of south-eastern Africa. J. Archaeol. Sci. 37, 2572–2586.

Huffman, T.N., 2014. Fifty years of Iron Age research: a personal odyssey. South African Archaeol. Bull. 69 (200), 213–218.

Huffman, T.N., 2015a. Social Complexity in Southern Africa. The African Archaeol. Rev. 32 (1), 71–79.

Huffman, T.N., 2015b. Mapela, Mapungubwe and the origins of states in southern Africa. South African Archaeol. Bull. 70 (201), 15–27.

Huffman, T.N., du Piesanie, J., 2011. Khami and the Venda in the Mapungubwe landscape. J. African Archaeol. 9, 189–206.

Hurcombe, L., 1992. Use wear analysis and obsidian: theory, experiments and results. Sheffield Archaeological Monographs 4. J.R. Collis Publications, Sheffield.

Kealhofer, L., Torrence, R., Fullagar, R., 1999. Integrating Phytoliths within Use-Wear/ Residue Studies of Stone Tools. J. Archaeol. Sci. 26, 527–546.

Knutsson, H., Knutsson, K., Taipale, N., Tallavaara, M., Darmark, K., 2015. How shattered flakes were used: Micro-wear analysis of quartz flake fragments. J. Archaeol. Sci. Rep. 2, 517–531.

Kuman, K.A., Gibbon, R., Kempson, H., Langejans, G.H.J., Le Baron, J.L., Pollarolo, L., Sutton, M., 2005. Stone Age signatures in northernmost South Africa: early archaeology in the Mapungubwe National Park and vicinity. In: d'Errico, F., Backwell, L. (Eds.), From Tools to Symbols: From Early Hominids to Modern Humans. Witwatersrand University Press, Johannesburg, pp. 163–182.

Latorre, A.M., Pérez, A.P., Bao, J.F.G., Zamora, G.R., Gómez-Gras, D., 2017. Use-wear analysis of Neolithic polished axes and adzes: The site of "Bòbila Madurell-Can Gambús-1-2" (Northeast Iberian Peninsula). Quat. Int. 427, 158–174.

Lemorini, C., Bourguignon, L., Zupancich, A., Gopher, A., Barkai, R., 2016. A scraper's life history: Morpho-techno-functional and use-wear analysis of Quina and demi-Quina scrapers from Qesem Cave, Israel. Quat. Int. 398, 86–93.

Lerner, H.J., 2014. Intra-raw material variability and use-wear formation: an experimental examination of a Fossiliferous chert (SJF) and a Silicified Wood (YSW) from NW New Mexico using the Clemex Vision processing frame. J. Archaeol. Sci. 48, 34–45.

Lombard, M., 2005a. Evidence of hunting and hafting during the Middle Stone Age at Sibudu Cave, KwaZulu-Natal, South Africa: a multi-analytical approach. J. Hum. Evol. 48 (3), 279–300.

Lombard, M., 2005b. A method for identifying Stone Age hunting tools. South African Archaeol. Bull. 60 (182), 115–120.

Lombard, M., 2008. Finding resolution for the Howiesons Poort through the microscope: micro-residue analysis of segments from Sibudu Cave, South Africa. J. Archaeol. Sci. 35, 26–41.

Lombard, M., Wadley, L., 2007. The morphological identification of micro-residue on stone tools using light microscopy: progress and difficulties based on blind test. J. Archaeol. Sci. 34, 155–165.

Martín-Viveros, J.I., Andreu Ollé, A., 2020. Use-wear and residue mapping on experimental chert tools. A multi-scalar approach combining digital 3D, optical, and scanning electron microscopy. J. Archaeol. Sci. Rep. 30, 102236.

Mazel, A.D., 1989. People making history: the last ten thousand years of hunter-gatherer communities in the Thukela Basin. South. Afr. Humanit. 1, 1–168.

Meyer, A., 2000. K2 and Mapungubwe. South African Archaeological Society Goodwin Series 8, 4–13.

Morales, J.I., Vergès, J.M., 2014. Technological behaviors in Paleolithic foragers. Testing the role of resharpening in the assemblage organization. J. Archaeol. Sci. 49, 302–316.

Pedergnana, A., Olle, A., 2020. Use-wear analysis of the late Middle Pleistocene quartzite assemblage from the Gran Dolina site, TD10.1 subunit (Sierra de Atapuerca, Spain). Quat. Int. 569–570, 181–211.

Robertson, G., Attenbrow, V., Hiscock, P., 2009. Multiple uses for Australian backed artefacts. Antiquity 83, 296–308.

Rolland, N., Dibble, H.L., 1990. A new synthesis of middle paleolithic variability. Am. Antiq. 55 (3), 480–499.

Rots, V., 2005. Wear traces and the interpretation of stone tools. J. Field Archaeol. 30, 61–73.

Rots, V., Pirnay, L., Pirson, P.h., Baudoux, O., 2006. Blind tests shed light on possibilities and limitations for identifying stone tool prehension and hafting. J. Archaeol. Sci. 33, 935–952.

Rots, V., Williamson, B.S., 2004. Microwear and residue analyses in perspective: the contribution of ethnoarchaeological evidence. J. Archaeol. Sci. 31, 1287–1299.

Sahle, Y., 2019. Ethnoarchaeology of compound adhesive production and scraper hafting: Implications from Hadiya (Ethiopia). J. Anthropol. Archaeol. 53, 43–50.

Sahle, Y., Negash, A., Braun, D.R., 2012. Variability in Ethnographic Hide scraper use among the Hadiya of Ethiopia: Implications for Reduction Analysis. The African Archaeological Review 29 (4), 383–397.

Schoeman, M.H., 2006. Imagining Rain-Places: Rain-Control and Changing Ritual Landscapes in the Shashe-Limpopo Confluence Area, South Africa. The South African Archaeol. Bull. 61 (184), 152–165.

Smith, J., Lee-Thorp, J., Prevec, S., Hall, S., Späth, A., 2010. A. Pre-Colonial Herding Strategies in the Shashe-Limpopo Basin, Southern Africa, Based on Strontium Isotope Analysis of Domestic Fauna. *Journal of African*. Archaeology 8 (1), 83–98.

Solheim, S., Fossum, G., Knutsson, H., 2018. Use-wear analysis of Early Mesolithic flake axes from South-eastern Norway. J. Archaeol. Sci. Rep. 17, 560–570.

Van Doornum, B.L., 2005. Changing places, spaces and identity in the Shashe-Limpopo region of Limpopo Province, South Africa. University of the Witwatersrand, Johannesburg. Unpublished Ph.D. dissertation.

Van Doornum, B., 2007. Tshisiku Shelter and the Shashe-Limpopo confluence area hunter-gatherer sequence. South. Afr. Humanit. 19, 17–67.

Van Doornum, B., 2008. Sheltered from change: hunter-gatherer occupation of Balerno Main Shelter, Shashe-Limpopo confluence area, South Africa. South. Afr. Humanit. 20, 249–284.

Viala, M.B., Giner, P.J., Sirvent-Cañadac, L.M., Piqueras, L.H., 2020. Understanding woodworking in Paleolithic times by means of use-wear Analysis. J. Archaeol. Sci. Rep. 29, 102119.

Wadley, L., 1989. Legacies from the Later Stone Age. South African Archaeol. Soc. Goodwin Series 6, 42–53.

Wadley, L., 1996. Changes in the social relations of precolonial hunter–gatherers after agropastoralist contact: an example from the Magaliesberg, South Africa. J. Anthropol. Archaeol. 15, 205–217.

Walker, N.J., 1994. The Late Stone Age of Botswana: some recent excavations. Botswana Notes and Records. 26, 1–35.

Webley, L., 1990. The use of stone 'scrapers' by semi-sedentary pastoralist groups in Namaqualand, South Africa. The South African Archaeol. Bull. 45 (151), 28–32.

Wood, M., 2000. Making connections: relationships between international trade and glass beads from the Shashe-Limpopo area. South African Archaeological Society Goodwin Series 8, 78–90.