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ORIGINAL ARTICLE

# Investigating the MIS2 Microlithic Assemblage of Umbeli Belli Rockshelter and Its Place Within the Chrono-cultural Sequence of the LSA Along the East Coast of Southern Africa

**Matthias A. Blessing · Nicholas J. Conard · Gregor D. Bader**

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**Abstract** South Africa is arguably one of the most studied regions in Stone Age research. There are, however, considerable differences in research intensity with respect to different regions and time periods. While KwaZulu-Natal is an epicenter for Middle Stone Age (MSA) research, the Late Pleistocene LSA record is largely understudied in this region. Here we present a lithic assemblage from the site Umbeli Belli near Scottburgh dated to 17.8 ± 1.5ka BP. The lithic analysis of the GH 3 assemblages revealed both gradual and abrupt changes within this stratigraphic horizon, indicating relatively short-term changes in material cultural traditions. A comparison with other Robberg sites in the wider surroundings highlights the regional variability of the Robberg techno-complex and indicates potential directions for future research.

**Résumé** L'Afrique du Sud est sans doute l'une des régions les plus étudiées dans la recherche sur le paléolithique. Il existe néanmoins des différences importantes dans l'étendue de la recherche selon les différentes régions et périodes. Alors que le KwaZulu-Natal est un épicentre de la recherche sur le *Middle Stone Age* (MSA), le *Later Stone Age* (LSA) du Pléistocène supérieur est considérablement sous-étudié dans cette région. Nous présentons ici un assemblage lithique du site Umbeli Belli près de Scottburg daté de 17.8 ± 1.5ka BP. L'analyse lithique des assemblages de la couche stratigraphique GH 3 a démontré des changements à la fois graduels et brusques au sein de cet horizon stratigraphique, indiquant des changements de durée relativement courte dans les traditions de la culture matérielle. Une comparaison avec d'autres sites de Robberg dans les environs a mis en évidence la variabilité du techno-complexe Robberg et les orientations potentielles pour les recherches futures.

**Keywords** Later Stone Age · Robberg · Lithic technology · Microlithic technology

## Introduction

The Later Stone Age (LSA) has had a long research tradition in South Africa ever since the term was introduced by Goodwin and Van Riet Lowe (1929). However, there are still major gaps in our

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understanding of the timing and attributes of the early LSA, and the relationships between the terminal Middle Stone Age and the advent of the LSA. This article contributes to clarifying the chrono-cultural sequence of the LSA along the east coast of Southern Africa, using the recent data from Umbeli Belli in the KwaZulu Natal region as the springboard of our discussion.

Research on the cultural stratigraphy of the LSA flourished between the 1970s and the 1990s (Barham, 1989a, 1989b; Deacon, 1979, 1984, 1989; Mazel, 1984, 1986, 1988; Opperman, 1987; Price-Williams, 1981; Wadley, 1978, 1996, 1997). Much work has been done recently on several previously known Late Pleistocene LSA sites. This has led to the reassessment of these sites' chronologies and archaeological assemblages (Bousman & Brink, 2018; Loftus et al., 2016, 2019; Low & Mackay, 2018; Pargeter et al., 2017, 2018; Porraz et al., 2016; Tribolo et al., 2016). A special focus has been given to the phenomenon of lithic miniaturization and its meaning for strategies of adaption to changing environmental conditions (Bader et al., 2020; Low, 2019; Low & Pargeter, 2020; Pargeter & Redondo, 2016; Porraz et al., 2016). Here, we use Late Pleistocene LSA to refer to Early Later Stone Age (ELSA) and Robberg, a common practice in South African contexts. This use of the term is somewhat different from how it is used outside of South Africa. At the site of Apollo 11 (Namibia), for example, the term refers to the assemblage post-dating the final MSA and with the absence of Robberg (Ossendorf, 2017).

The chrono-cultural unit of the Robberg technocomplex dates to roughly between 25 and 10 ka in South Africa (Bousman & Brink, 2018). It is characterized by the prevailing absence of formal tools, a strong signal for bipolar percussion on quartz in order to produce small, elongated products and large numbers of microliths (Mitchell, 2002). In addition, small handheld platform cores for bladelet production (e.g., on chert) occur in several Robberg assemblages (Bader et al., 2020; Pargeter & Redondo, 2016). Microliths are one of the most characteristic features of the Robberg complex. However, the term microlith or what constitutes a microlithic technology is not always used in the same way and often means different things depending on the researcher. The definition provided by Kuhn & Elston (2002) mentions technological and typological characteristics—bladelet or microblade production and backing—as the prevalent feature of modification of microlithic blanks. This definition combines backing and bladelet production as the third feature of microlithic technologies. A fourth characteristic is the high numerical frequency of bladelets or other microlithic artifacts. For the definition of the Robberg, however, only the technological aspects of this definition can be included; the typological aspect, mainly backed pieces, is rare, though not absent (e. g., Kaplan, 1990; Mitchell, 1995; Porraz et al., 2016). It is noteworthy that the bladelet production of the Robberg technocomplex, in contrast to what is more common in other periods and regions of the world, does not always rely on elaborate core reduction techniques. On the contrary, Robberg bladelets are frequently obtained using bipolar percussion. Other features mentioned by Kuhn & Elston (2002), such as a high frequency of microlithic artifacts alongside macrolithic ones and a high degree of standardization, are also to be found in Robberg assemblages (Mitchell, 1995; Porraz et al., 2016). Though not explicitly stated in the original publication, the list of characteristics of a microlithic assemblage provided by Kuhn & Elston (2002) should not be seen as an "all or nothing" definition. Like microlithic assemblages in East Asia, Robberg assemblages show little to no sign of modification of the bladelets. Hence, it is justifiable to call the Robberg a microlithic technology, even though it checks only some of the boxes given by Kuhn & Elston (2002).

First recognized by Abbe Breuil at Rose Cottage Cave (Wadley, 1996), the Robberg complex was subsequently defined using the assemblages from Nelson Bay Cave (Klein, 1974) and Rose Cottage Cave (Deacon, 1979, 1984; Wadley, 1996). It was then thought to mark the onset of the LSA in southern Africa during the Last Glacial Maximum (LGM) (*cf.* Villa et al., 2012). On a superficial scale, the Robberg appears uniform across the entire subcontinent of South Africa, but recent comparative studies of assemblages from different biomes suggest greater inter-regional variability than previously thought (e. g., Bader, et al., 2020; Low & Pargeter, 2020). This variability had been recognized even earlier and attributed to different geographical settings and differences in raw material availability (Mitchell, 1988a, 1988b). However, this interpretation and several others are currently debated (Low & Pargeter, 2020). Comparative studies are rare. Hence, the nature, timing, and causes of the variability within the Robberg of southern Africa remain somewhat obscure.

While considerable progress in the investigation of the Robberg has been achieved in recent years, the research has focused on distinct areas such as the highlands of Lesotho (e. g., Mitchell, 1990, 1995, 1996; Mitchell & Arthur, 2014; Pargeter, 2016; Pargeter et al., 2017) and the west coast of South Africa (e. g., Low, 2019; Low & Mackay, 2018; Porraz et al., 2016; Watson et al., 2020). Other regions, such as the coastal area of KwaZulu-Natal (KZN), remain largely understudied. With the exception of Umhlatuzana (Kaplan, 1989, 1990) and Shongweni (Davies, 1975; Davies & Gordon-Gray, 1977), little is known about the chrono-cultural expressions and variations of MIS2 assemblages in the area (see also Mackay et al., 2014).

Between 2016 and 2020, a research team led by Gregor Bader and Nicholas Conard from the University of Tübingen, Germany, conducted new excavations at Umbeli Belli, a rockshelter situated at the Mpambanyoni river, approximately 7 km inland from Scottburgh. The site has yielded extensive MSA and LSA horizons and was accurately dated using optically stimulated luminescence (Bader et al., 2018). The geological horizon 3 (GH 3) was dated to 17.8 ± 1.5-ka BP, and preliminary field observations indicated that the assemblage belongs to the Robberg tradition. Considering the gaps mentioned above and the weak chrono-cultural background for MIS2 assemblages in KZN, Umbeli Belli has the potential to provide valuable new data on the nature and timing of microlithic technologies in this part of the subcontinent. Here we provide a detailed technological study of the GH 3 assemblage from Umbeli Belli, aiming to (1) investigate the characteristic features, (2) test for inner assemblage variation, and (3) provide an estimate of the chrono-cultural assignment of the lithic inventory. We discuss our results within the overall MIS2 record of the broader region and interpret the nature, timing, and meaning of microlithic technologies at the onset of the LSA. Given our findings, a special focus of the discussion will be on the so-called early and late Robberg, as proposed by Kaplan (1990). Based on our findings, we will discuss whether or not this subdivision of the Robberg technocomplex is justifiable and, if so, how it manifests in the archaeological record.

## Umbeli Belli: Background to the Site, Stratigraphy, and Dating

Umbeli Belli is a quartzite shelter situated above the Mpambanyoni river valley (Fig. 1). Charles Cable (1984) first excavated the site in 1979 with a particular focus on the uppermost layers covering the last 2000 years of hunter-gatherers in southern Africa. After a preliminary examination of the MSA assemblage recovered from Cable's excavation, a team from the University of Tübingen led by Gregor Bader and Nicholas Conard re-excavated the site and extended Cable's old trench in 2016 (Bader et al., 2016, 2018). These excavations yielded a rich stratigraphy of MSA and LSA occupational horizons (Fig. 2). A detailed description of the stratigraphy and the dating has been published recently, together with an in-depth lithic analysis of the upper MSA layers (Bader et al., 2016, 2018).

The LSA sequence at Umbeli Belli can be subdivided into seven stratigraphic units. The uppermost three (Layers 1, 2BE, and 2AL, following Cable's classification) were not part of the Tübingen excavations, and those are published in detail by Cable (1984). The radiocarbon dates obtained from layers 2AL and 2BE show a significant hiatus in the sequence, falling between the ninth and tenth century AD and the seventeenth to the nineteenth century, respectively. The stratigraphic sequence below was excavated by the Tübingen team and divided into subunits called geological horizons (GH). GH 3, 4, 5, and 6 are the Pleistocene LSA units under our investigation, and here we focus on GH 3. Preliminary results from the units underlying GH 3 imply an Early LSA sequence spreading over GHs 4, 5, and 6. GH 3 was dated by OSL to 17.8 ± 1.5-ka BP, and preliminary field observations by Bader et al. (2018) indicated a strong microlithic component.

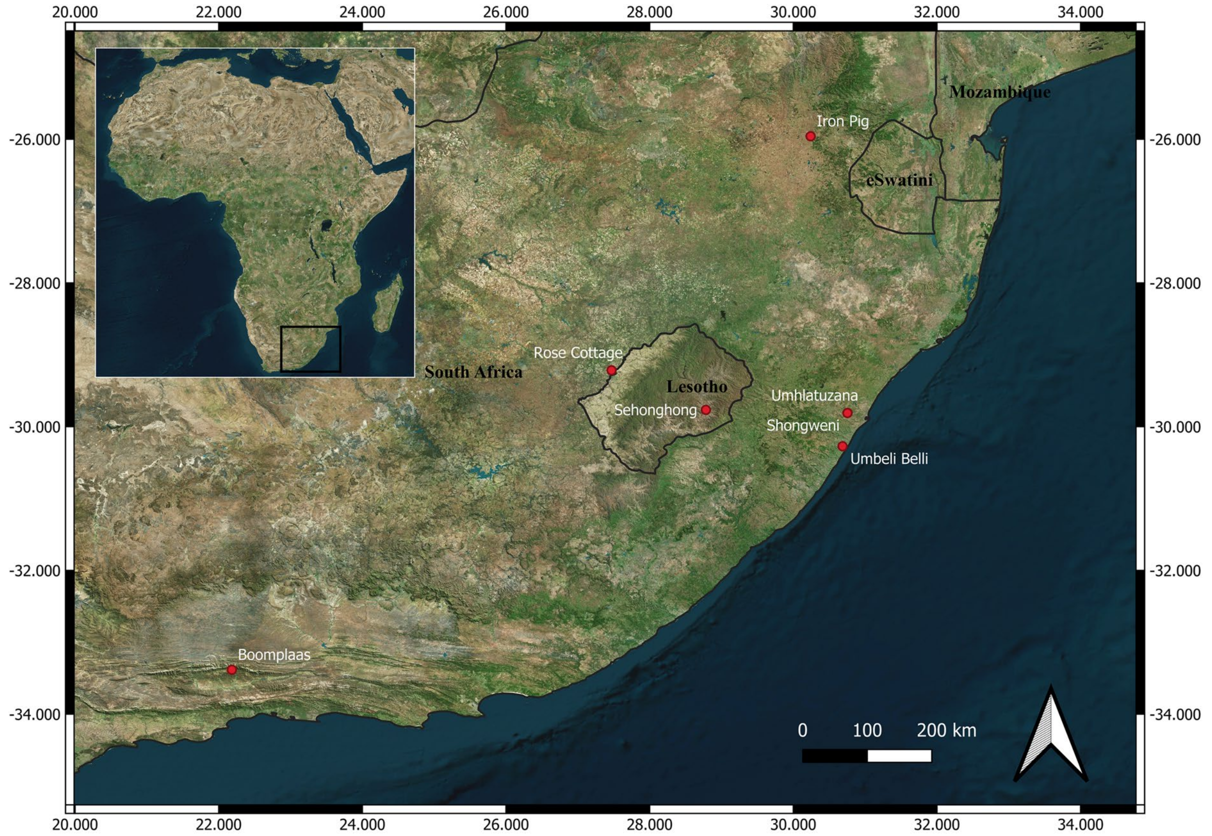


**Fig. 1** Umbeli Belli and other Robberg sites in regional and supra-regional contexts

## Materials and Methods

### Excavation and Find Processing

The excavations at Umbeli Belli followed natural geological units, which approximate cultural stratigraphic units. The excavation grid is a meter-square system following Cable's original trench (see Bader et al., 2018). In total, 18 geological units were defined following a numerical system starting with 1 at the top and 18 at the bottom. GH 2 is subdivided into 2BE and 2AL, and GH11 is subdivided into 11, 11a, and 11b. The geological horizons at Umbeli Belli were further subdivided into subunits 1–3 cm thickness following the natural inclination of the sediments. Following the German taxonomy (and in the absence of a clear equivalent in English), we call these subunits "Abtrag" or in plural "Abträge." For further details, see Bader et al. (2018). GH 3 consists of a reddish brown (Munsell 5YR, 4/4) fine silty sand with numerous small pieces of quartzite spall.

In square 3/13, GH 3 was excavated in 28 Abträge allowing a high-resolution analysis of changes in lithic technology from bottom to top. For our examination of GH 3, we use lithic attribute analysis (Andrefsky, 1998; Auffermann et al., 1990; Odell, 2012; Scerri et al., 2016) based on the framework established at Umbeli Belli (Bader et al., 2016, 2018) and Sibhudu (Will et al., 2014). We recorded a total of 2402 lithic artifacts (> 2 cm) for attribute analysis. An additional 8626 artifacts (< 2 cm) were analyzed in terms of the total number and raw material.

### Terminology

We subdivide blanks into flakes, blades, and bladelets. A blade is defined as an intentional product with parallel edges at least twice as long as wide (e. g., Hahn, 1991). Bladelets receive special attention as

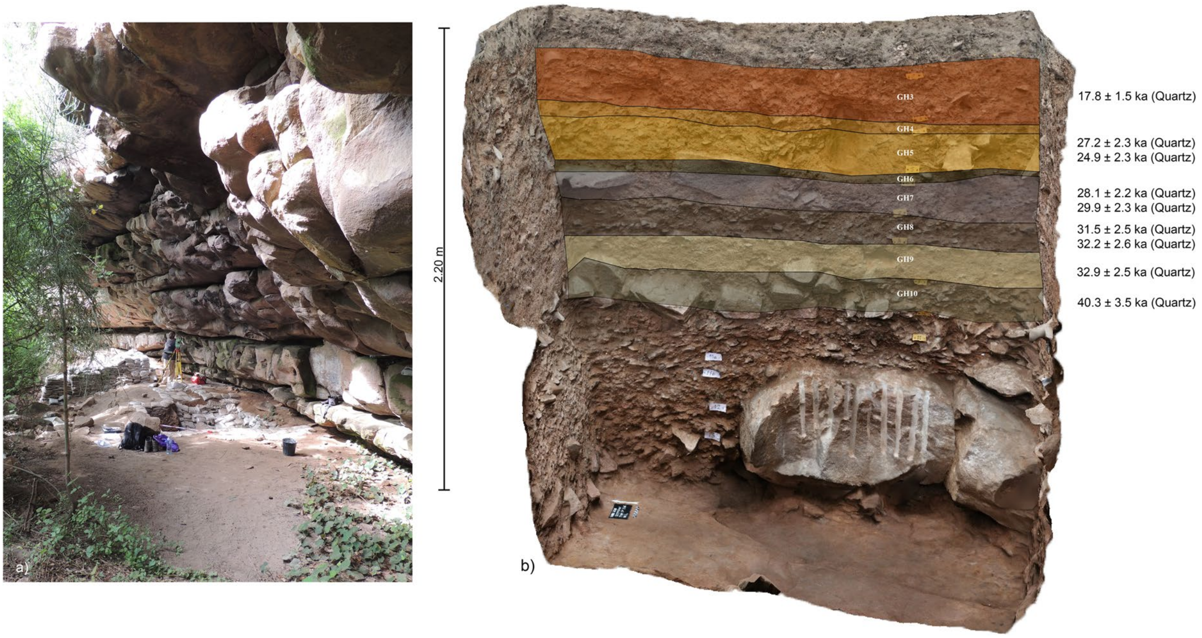


**Fig. 2** Stratigraphic sequence of Umbeli Belli and view of the shelter from the north (modified after Bader et al. 2022)

they appear in high numbers in the GH 3 assemblage. Several definitions exist, but for intra-site comparability, we follow the same systematics of lithic analysis applied to the MSA layers of Umbeli Belli (Bader et al., 2016, 2018). Hence, a bladelet is a blade that is not wider than 12 mm. The same definition is also used in recent research on other microlithic assemblages in southern Africa (Bader et al., 2020; Pargeter & Redondo, 2016). We did not measure the width of the bladelets at the midpoint as the high degree of fragmentation would cause insufficient statistical results. Instead, we measured the width at the widest preserved part of the piece.

The core terminology for non-bipolar cores follows Bader et al., (2016, 2020) and Low and Pargeter (2020), which are based on the work of Deacon (1984). Bipolar cores are not further subdivided in the analysis. Bipolar cores are recognized based on smoothed edges on opposite sides (four smoothed edges if the core was rotated). Furthermore, a bipolar piece is identified as a core if it has negatives on at least two surfaces as opposed to bipolar flakes, which will only have negatives on the dorsal surface. In advanced reduction stages, bipolar cores often become cylindrical with negatives around the core surface (Davis, 1980; Pargeter, 2016). Other authors have noted difficulties discerning bipolar-reduced pieces from splintered pieces (de la Peña, 2015; Hayden, 1980), such that splintered pieces are sometimes accounted for as a subtype of bipolar-reduced pieces (Porraz et al., 2016). A recent series of experiments confirmed that a qualitative assessment to distinguish bipolar blank production from the use of splintered pieces (piecés esquillès) is not suitable for quartz (de la Peña, 2015). However, for raw materials other than quartz, the distinction between a bipolar core and a splintered piece rests mainly on the fact that the working edge of a splintered piece does not develop a splintered retouch, which is why a splintered piece will only have one such edge (de la Peña, 2011, 2015). Therefore, we emphasize that parts of the statistics on cores and tools might contain a slight overemphasis on bipolar cores made on quartz in the core assemblage and a slight overrepresentation of splintered pieces made of raw materials other than quartz in the tool assemblage. However, Pargeter and de la Peña (2017) noted that bipolar reduction performed on milky quartz in relationship to lithic miniaturization holds some advantages over freehand production, which offer an alternative explanation for the potential overrepresentation of bipolar quartz cores.

The tool taxonomy follows the system commonly used for South African LSA sites (Bader et al., 2020;

Deacon, 1984; Porraz et al., 2016). For retouched pieces, we will also use the term formal tools. Previous work has indicated that bladelets and flakes might have been used as tools without retouching them (e.g., Binneman, 1997; Binneman & Mitchell, 1997). Porraz et al. (2016) have noted the difficulty of distinguishing between intentional edge modification and edge modification deriving from the use of unretouched pieces. In the absence of backing, it seems likely that bladelets were used without retouch, but we have not yet tested our assemblage for this possibility. We assume that this also occurred at Umbeli Belli and wish to distinguish between retouched (formal) and unretouched (informal) tools.

## Results

Out of the 2402 lithic artifacts larger than 2 cm, 24 (1%) were identified as manuports of non-quartzite raw material and 134 (6%) as angular debris of various raw materials. As shown in Fig. 3, the assemblage is dominated by unretouched blanks (*n* = 2122; 88%), while cores and formal tools are comparatively rare (*n* = 88; 4% and *n* = 34; 1%, respectively). There is a gradual increase in artifact density from bottom to top, with around 50 artifacts per Abtrag from Abtrag 28 to Abtrag 19. In Abtrag 11 to 1, the artifact density is around 100 artifacts per Abtrag, while Abtrag 18 to 12 reach intermediate values. The density of artifacts in the small debitage category follows a very similar trend. In Abtrag 28 to 19, the density of small debitage lies between about 86 and 175. The highest density is reached in Abtrag 11 to 1, where it reaches a maximum of 636 in Abtrag 9 and never drops below 250. Abtrag 18 to 12 show a gradual increase overall (Electronic Supplementary Material [ESM]-Fig. 1). Since undiagnostic angular debris and manuports mainly carry information about the raw material economy, they will be excluded from the analyses of the assemblage.

### Raw Materials

While there is not much variability within the frequency of different lithic categories throughout GH 3, there is a notable change in the frequency of raw materials (Fig. 4). Concerning the entire GH 3 assemblage, quartzite (32.9%), quartz (32.3%), hornfels (25.4) and a yet to be determined coarse-grained material (7.2%) were most commonly used. Other raw materials such as shale, mudstone, or chert are extremely rare, so we will focus our analysis on the four most abundant raw materials mentioned before. Numerical data are provided in Table 1.

In Abtrag 28 to 18, between 50 and 60% of all lithics are knapped from quartzite. The frequencies of quartz, hornfels, and coarse-grained material range between 20 and 10%. Beginning with Abtrag 17 and up to Abtrag 10, quartzite, hornfels, and quartz are

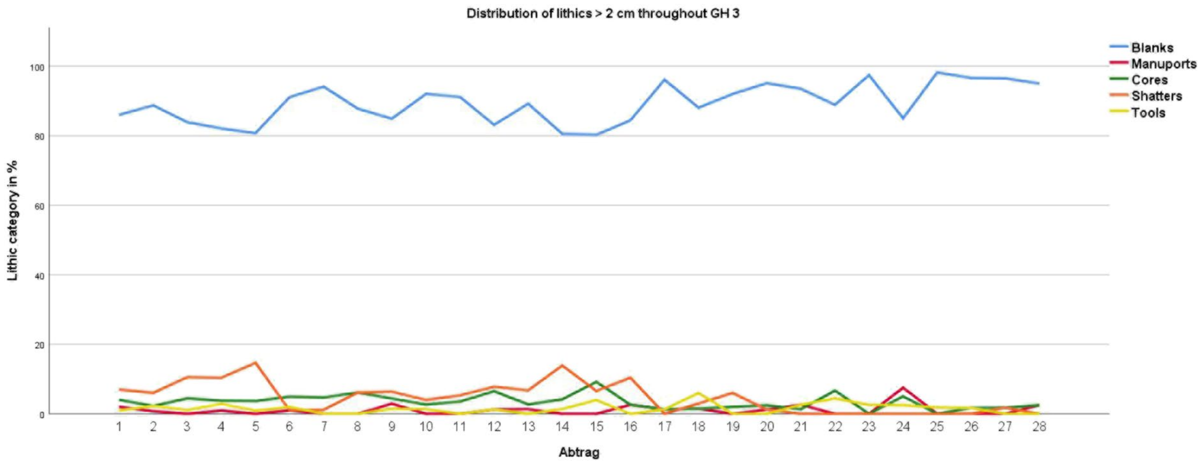


**Fig. 3** Frequency of lithic categories > 2 cm throughout the sequence of GH3 of Umbeli Belli; df: 351, $p < 0.01$ (generated with SPSS 26)

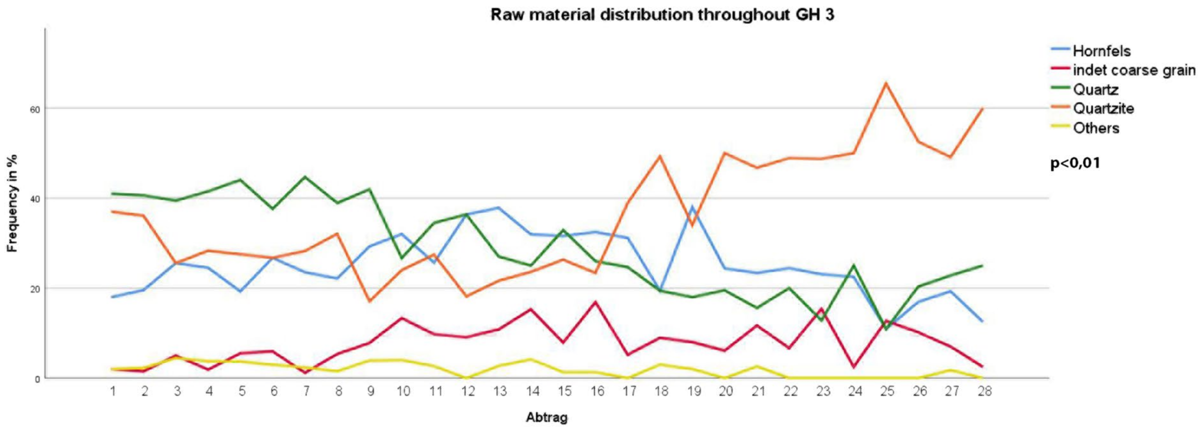


**Fig. 4** Raw material frequency throughout the sequence of GH3 of Umbeli Belli (generated with SPSS 26)

about 30% each, while the coarse-grained raw material remains around 10%. In Abtrag 9 to 1, quartz is the dominant raw material accounting for up to 40% of the assemblage. Quartzite and hornfels range between 25 and 30%, while the coarse-grained raw material drops below 5% in frequency. We note that the undetermined coarse-grained raw material might be heavily weathered hornfels. If future mineralogical tests confirm this assumption, then the higher frequency of this particular raw material and its decreasing frequency in the upper part of GH 3 compared to the lower ones might reflect different stages of preservation.

## Cortex

Only 23% ($n = 549$) of all lithic artifacts from GH 3 exhibit cortex, most of them being blanks. We observed cortex only on six cores and eight tools. We classified the cortical parts in steps of 10, from 0% (no cortex) to 100% (blank dorsal surface fully covered with cortex). About 10–30% of the cortical pieces' dorsal surfaces are covered with cortex. We recorded the cortex percentage visible on the artifact regardless of preservation state and found no difference in cortex distribution between complete and broken artifacts. There is no clear trend in the sequence regarding how much cortex is left on the cortical artifacts. In general, cortical pieces are not very common and non-cortical pieces dominate. About 65% of the pieces in Abtrag 19 are non-cortical, and this value peaks at 94% in Abtrag 24. Likewise, there is no clear trend with respect to the frequency of cortical pieces throughout GH 3.

There is a trend, however, regarding raw materials and cortex: 49% of the hornfels artifacts exhibit cortex, while only 14% of the quartz artifacts and 16% of quartzite artifacts do so. With few exceptions, the cortex on hornfels and quartz artifacts is of cobble type, indicating a provenance from a secondary quarry, most likely the nearby Mpambanyoni River (see Bader et al., 2016, 2018). Slab cortex is rare. The cortex on most quartzite artifacts resembles the surface of the shelter, indicating a local provenance.

## Knapping Technique

Out of the entire assemblage, 1450 (72%) blanks were knapped using a handheld core reduction technique, 516 (26%) pieces were knapped using bipolar reduction, and the other 38 (2%) blanks could not be classified into either category due to the poor state of preservation. Most pieces that could not be sorted into either category are angular debris made from hornfels. These lack any feature allowing a determination of the knapping technique. The ratio of the knapping technique is not uniform throughout the GH 3 sequence. There is a gradual change from the bottom to the top of the sequence (OSM 1—Fig. 2). In Abtrag 28 to 17, handheld knapping makes up around 80%. From Abtrag 16 towards the top of the layer, there is a steady decrease of handheld pieces in favor of bipolar reduction. This parallels the pattern of raw material use from bottom to top of GH 3.

**Table 1** Frequency of raw materials per Abtrag in GH 3 of Umbeli Belli counted for artifacts > 2 cm. Dominant raw material in bold

| Abtrag | Quartz % | Quartzite % | Hornfels % | Indet. coarse-grained % | Chert % | Other % | Total % | Total n |
|---|---|---|---|---|---|---|---|---|
| 1 (9 l) | **41.0** | 37.0 | 18.0 | 2.0 | 0.0 | 2.0 | 4.3 | 100 |
| 2 (15 l) | **40.6** | 36.1 | 19.5 | 1.5 | 0.0 | 2.3 | 5.5 | 133 |
| 3 (19 l) | **39.4** | 25.6 | 25.6 | 5.0 | 0.0 | 4.4 | 7.4 | 180 |
| 4 (11 l) | **41.5** | 28.3 | 24.5 | 1.9 | 2.8 | 1.0 | 4.4 | 106 |
| 5 (10 l) | **44.0** | 27.5 | 19.3 | 5.5 | 0.9 | 2.8 | 4.5 | 109 |
| 6 (9 l) | **37.6** | 26.7 | 26.7 | 5.9 | 1.0 | 2.1 | 4.3 | 101 |
| 7 (10 l) | **44.7** | 28.2 | 23.5 | 1.2 | 1.2 | 1.2 | 3.5 | 85 |
| 8 (11 l) | **38.9** | 32.1 | 22.1 | 5.3 | 0.8 | 0.8 | 5.5 | 131 |
| 9 (17 l) | **42.0** | 17.1 | 29.3 | 7.8 | 1.0 | 2.8 | 8.6 | 205 |
| 10 (9 l) | 26.7 | 24.0 | **32.0** | 13.3 | 1.3 | 2.7 | 3.1 | 75 |
| 11 (11 l) | **34.5** | 27.4 | 25.7 | 9.7 | 0.0 | 2.7 | 4.8 | 113 |
| 12 (10 l) | **36.4** | 18.2 | 36.3 | 9.1 | 0.0 | 0.0 | 3.2 | 77 |
| 13 (10 l) | 27.0 | 21.6 | **37.8** | 10.8 | 2.7 | 0.1 | 3.1 | 74 |
| 14 (10 l) | 25.0 | 23.6 | **31.9** | 15.3 | 1.4 | 2.8 | 3.0 | 72 |
| 15 (11 l) | **32.9** | 26.3 | 31.6 | 7.9 | 1.3 | 0.0 | 3.1 | 76 |
| 16 (10 l) | 26.0 | 23.4 | **32.5** | 16.9 | 0.0 | 1.2 | 3.2 | 77 |
| 17 (12 l) | 24.7 | **39.0** | 31.2 | 5.1 | 0.0 | 0.0 | 3.2 | 77 |
| 18 (11 l) | 19.4 | **49.3** | 19.4 | 9.0 | 1.5 | 1.4 | 2.9 | 67 |
| 19 (11 l) | 18.0 | 34.0 | **38.0** | 8.0 | 0.0 | 2.0 | 2.1 | 50 |
| 20 (16 l) | 19.5 | **50.0** | 24.4 | 6.1 | 0.0 | 0.0 | 3.4 | 82 |
| 21 (18 l) | 15.6 | **46.8** | 23.4 | 11.7 | 1.3 | 1.2 | 3.2 | 77 |
| 22 (10 l) | 20.0 | **48.9** | 24.4 | 6.7 | 0.0 | 0.0 | 1.8 | 45 |
| 23 (9 l) | 12.8 | **48.7** | 23.1 | 15.4 | 0.0 | 0.0 | 1.6 | 39 |
| 24 (9 l) | 25.0 | **50.0** | 22.5 | 2.5 | 0.0 | 0.0 | 1.6 | 40 |
| 25 (9 l) | 10.9 | **65.5** | 10.9 | 12.7 | 0.0 | 0.0 | 2.3 | 55 |
| 26 (12 l) | 20.3 | **52.5** | 16.9 | 10.2 | 0.0 | 0.1 | 2.5 | 59 |
| 27 (11 l) | 22.8 | **49.1** | 19.3 | 7.0 | 1.8 | 0.0 | 2.4 | 57 |
| 28 (9 l) | 25.0 | **60.0** | 12.5 | 2.5 | 0.0 | 0.0 | 1.6 | 40 |
| Total (319 l) | 32.3 | 32.9 | 25.4 | 7.2 | 0.7 | 1.5 | 100.0 | 2402 |

A very strong pattern is observable in the relationships between knapping techniques and raw materials. Except for a few blanks ($n = 8$) made from quartzite, hornfels, and rare raw materials, bipolar knapping was performed exclusively on quartz ($n = 508$). There is a possibility that the bipolar flakes made from raw materials other than quartz are splintered pieces and were used like chisels. However, we are unable to identify the characteristics that resulted from the repeated hammering on one edge (e.g., de la Peña, 2015).

For the analysis of platform types, we could only include pieces that are either complete or in a state of preservation that includes the proximal end ($n = 1019$). The most common platform types are plain (53%), crushed (33%), and cortical (6%). Other platform characteristics, such as linear, dihedral, and facetted, are rare (7%). While crushed platforms occur on pieces that were knapped from handheld cores, they are mainly a feature associated with bipolar knapping (OSM 1—Fig. 3). Among the handheld knapped blanks, plain platforms are predominant. Only five bipolar blanks have a plain platform. Prepared platforms rarely occur, most commonly on hornfels blanks, although the majority of hornfels blanks exhibit plain platforms. The rare raw materials were predominantly knapped without previous platform preparation. Cortical platforms are present in all main raw material categories, but all of these blanks

**Fig. 5** Selection of blanks other than bladelets from Umbeli Belli GH3. **a**–**e** and **h**–**j** Flakes; **f**, **g** blades; **a** quartzite; **b**, **e**, **f** hornfels; **c**, **d** chert; **g**–**j** quartz (pieces are oriented with platform facing downwards)

are flakes; there are no cortical platforms on blades or bladelets.

*Blanks (Fig. 5)*

Flakes dominate the blank assemblage (Table 2), making up 83% (*n* = 1740). With 212 specimens (10%), bladelets are the second most common blank type. Blades are not frequent (*n* = 52; 3%). Slabs and other manuports account for 4% (*n* = 92). The presence of slabs in the assemblage proves that the prehistoric people occasionally transported such raw material pieces to the site, likely intending to knap them. Further technological information cannot be generated from these pieces, however.

Only 29% of the blanks are completely preserved.

*Bladelets (Fig. 6)*

Only 33% (*n* = 66) of the bladelets are completely preserved. Radial fractures are the most common kind of fragmentation. One hundred fifteen pieces (63%) are missing the proximal or distal end or both. Only ten bladelets (4%) are broken along the striking axis. Five pieces are missing a part of one lateral edge, thus still allowing for measuring width at the widest point. The mean width of the bladelets is 7.4 ± 1.9 mm. There is no clear pattern regarding the width of bladelets plotted against raw material (Table 3), but quartz bladelets are slightly narrower (7.1 ± 1.7 mm) than those made from hornfels (7.8 ± 2.2 mm) and quartzite (8.2 ± 1.9 mm). Sixty-six bladelets are completely preserved, and ten lack only parts of a lateral edge. Thus, 76 bladelets can be included in the analysis of mean length. The mean length of the bladelets is 17.6 ± 3.9 mm. Quartz bladelets are, on average, somewhat shorter than bladelets made from hornfels or quartzite (Table 4).

There is a strong emphasis on bladelet production on quartz. One hundred forty-one bladelets (66%) are made from quartz, 42 bladelets (20%) from quartzite, 27 (13%) from hornfels, and only two (1%) from the

**Table 2** Number of blanks and slabs/manuports per Abtrag in GH 3 assemblage from Umbeli Belli

| Abtrag | Flake | | Blade | | Bladelet | | Slab/manuport | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| 1 | 77 | 89.5 | 2 | 2.3 | 3 | 3.5 | 4 | 4.7 | 86 | 4.1 |
| 2 | 94 | 80.3 | 2 | 1.7 | 19 | 16.2 | 2 | 1.7 | 117 | 5.6 |
| 3 | 123 | 85.4 | 4 | 2.8 | 15 | 10.4 | 2 | 1.4 | 151 | 7.2 |
| 4 | 69 | 81.2 | 1 | 1.2 | 14 | 16.5 | 1 | 1.2 | 87 | 4.2 |
| 5 | 75 | 86.2 | 0 | 0.0 | 11 | 12.6 | 1 | 1.1 | 88 | 4.2 |
| 6 | 68 | 78.2 | 1 | 1.1 | 15 | 17.2 | 3 | 3.4 | 92 | 4.4 |
| 7 | 64 | 81.0 | 1 | 1.3 | 10 | 12.7 | 4 | 5.1 | 80 | 3.8 |
| 8 | 99 | 86.1 | 2 | 1.7 | 8 | 7.0 | 6 | 5.2 | 115 | 5.5 |
| 9 | 146 | 83.9 | 1 | 0.6 | 21 | 12.1 | 6 | 3.4 | 174 | 8.3 |
| 10 | 60 | 87.0 | 1 | 1.4 | 4 | 5.8 | 4 | 5.8 | 69 | 3.3 |
| 11 | 90 | 88.2 | 0 | 0.0 | 3 | 2.9 | 9 | 8.8 | 102 | 4.9 |
| 12 | 51 | 79.7 | 2 | 3.1 | 7 | 10.9 | 4 | 6.3 | 64 | 3.1 |
| 13 | 56 | 84.8 | 0 | 0.0 | 7 | 10.6 | 3 | 4.5 | 66 | 3.1 |
| 14 | 46 | 79.3 | 1 | 1.7 | 7 | 12.1 | 4 | 6.9 | 58 | 2.8 |
| 15 | 46 | 75.4 | 3 | 4.9 | 8 | 13.1 | 4 | 6.6 | 61 | 2.9 |
| 16 | 51 | 78.5 | 3 | 4.6 | 5 | 7.7 | 6 | 9.2 | 65 | 3.1 |
| 17 | 61 | 85.9 | 1 | 1.4 | 6 | 8.5 | 3 | 4.2 | 74 | 3.5 |
| 18 | 48 | 81.4 | 3 | 5.1 | 5 | 8.5 | 3 | 5.1 | 59 | 2.8 |
| 19 | 43 | 93.5 | 0 | 0.0 | 1 | 2.2 | 2 | 4.3 | 46 | 2.2 |
| 20 | 66 | 86.8 | 4 | 5.3 | 5 | 6.6 | 1 | 1.3 | 78 | 3.7 |
| 21 | 56 | 80.0 | 4 | 5.7 | 5 | 7.1 | 5 | 7.1 | 72 | 3.4 |
| 22 | 36 | 92.3 | 2 | 5.1 | 0 | 0.0 | 1 | 2.6 | 40 | 1.9 |
| 23 | 30 | 78.9 | 2 | 5.3 | 5 | 13.2 | 1 | 2.6 | 38 | 1.8 |
| 24 | 21 | 61.8 | 0 | 0.0 | 9 | 26.5 | 4 | 11.8 | 34 | 1.6 |
| 25 | 44 | 81.5 | 4 | 7.4 | 3 | 5.6 | 3 | 5.6 | 54 | 2.6 |
| 26 | 46 | 80.7 | 4 | 7.0 | 6 | 10.5 | 1 | 1.8 | 57 | 2.7 |
| 27 | 41 | 74.5 | 3 | 5.5 | 6 | 10.9 | 5 | 9.1 | 55 | 2.6 |
| 28 | 33 | 86.8 | 1 | 2.6 | 4 | 10.5 | 0 | 0.0 | 38 | 1.8 |
| Total | 1740 | 83.0 | 52 | 2.5 | 212 | 10.1 | 92 | 4.4 | 2096 | 100.0 |

coarse-grained raw material (OSM 1, Fig. 4). Analogous to the preference of bipolar knapping for quartz, most of the quartz bladelets ($n = 131$) were knapped using bipolar percussion. Only two quartzite bladelets (1%) knapped from a bipolar core, and none of the hornfels bladelets were produced using this technique. Except for seven bladelets (3%) for which we were unable to determine the reduction technique (six quartz, one quartzite), all other bladelets ($n = 41$; 33%) were produced from handheld cores (OSM 1—Fig. 5).

Cortical bladelets are rare, 192 bladelets (91%) are non-cortical. It is hard to determine any clear temporal trend regarding cortex distribution on different raw materials because the sample size for raw materials other than quartz is relatively small. Bladelets made from hornfels have cortex remains on them more often than any other raw material category (10 out of 27), whereas bladelets made from quartz rarely have cortex remains (137 out of 140). Cortex is also rare on quartzite bladelets (5 out of 42). Quartz bladelets were found throughout every Abtrag of GH 3. While in the bottom part (Abtrag 28 to 20), bladelets from quartz, quartzite, and hornfels occur in almost similar low frequencies, quartz dominates the bladelet assemblage above Abtrag 20. Between 60 and 80% of bladelets in the upper levels are made from quartz. This parallels the increased use of quartz and the increase of the bipolar reduction method in the upper part of GH 3 (OSM 1—Fig. 6).

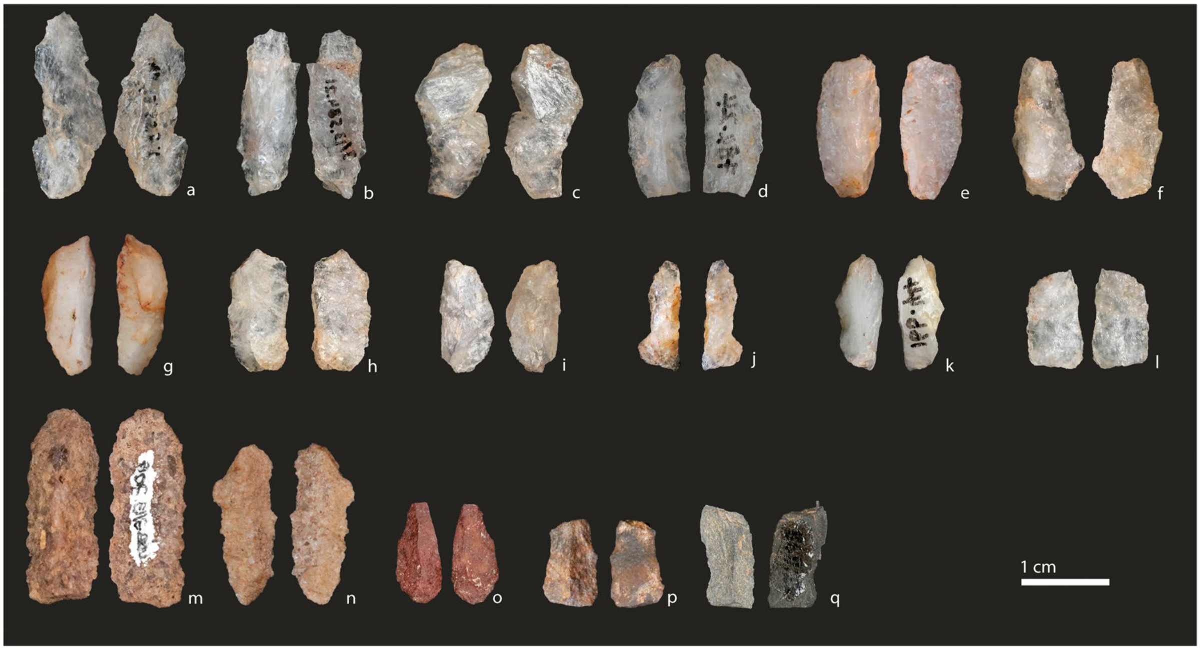


**Fig. 6** Selection of bladelets from Umbeli Belli GH3. **a**–l Quartz; **m**, **n** quartzite; **o** chert; **p**, **q** hornfels (pieces are oriented with platform facing downwards)

**Table 3** Mean width of bladelets in the GH 3 assemblage of Umbeli Belli

| Raw material | Mean width | Total *n* | Std. deviation |
|---|---|---|---|
| Quartz | 7.07 | 137 | 1.75 |
| Quartzite | 8.20 | 2 | 1.92 |
| Hornfels | 7.77 | 26 | 2.16 |
| Indet coarse-grained | 9.00 | 40 | 1.14 |
| Total | 7.40 | 205 | 1.89 |

**Table 4** Mean length of bladelets per raw material in GH 3 assemblage of Umbeli Belli

| Raw material | Mean length | Total (*n*) | Std. deviation |
|---|---|---|---|
| Quartz | 17.1 | 61 | 3.57 |
| Quartzite | 19.4 | 8 | 2.62 |
| Hornfels | 19.7 | 7 | 6.53 |
| Indet coarse-grained | N/A | 0 | N/A |
| Total | 17.6 | 76 | 3.90 |

### *Tools (Fig. 7)*

Only 11 formal tools (33%) are preserved completely, but except for one piece, all tools are at least 50% complete, allowing a typological classification. More than half of the tools ($n=20$; 59%) are splintered pieces, almost all of them made on hornfels, and 35% ($n=12$) are scrapers, with side scrapers being the most common ($n=10$). The other two formal tools are one retouched flake and one retouched blade. The one micro scraper in the assemblage is a tanged scraper made from quartz with a round working edge (Fig. 7k). The scraper is unifacially shaped, except for the cap, which is bifacially retouched. The tang is slightly v-shaped, and it is a complete piece, except for the little fracture at the end. We did not observe any traces of hafting on the tang. Backed pieces are absent in GH 3. About 73% of all formal tools are made from hornfels, although hornfels only accounts for 25% of the total raw material in GH 3. While chert is not very common in the overall lithic assemblage, three formal tools (two splintered pieces and one scraper) were made from this material (Table 5). The low frequency of tools throughout GH 3 does not allow us to observe any trends regarding changes in the frequency of tools. However, the distribution of tool types, specifically splintered pieces, and scrapers

**Fig. 7** Selection of tools from Umbeli Belli GH3. **a** Retouched flake; **b**, **c**, **e**–**g**, **i** splintered pieces; **d**, **h** sidescrapers; **j** retouched blade; **k** microscraper

**Table 5** Tools per raw material in GH 3 assemblage of Umbeli Belli

| Raw material | Ret. blade | Ret. flake | End-scraper | Micro-scraper | Side-scraper | Splintered piece | Total (*n*) |
|---|---|---|---|---|---|---|---|
| Quartz | 0 | 0 | 0 | 1 | 0 | 2 | 3 |
| Quartzite | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Hornfels | 1 | 1 | 1 | 0 | 6 | 15 | 24 |
| Indet coarse-grained | 0 | 0 | 0 | 0 | 2 | 1 | 3 |
| Chert | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Total | 1 | 1 | 1 | 1 | 10 | 20 | 34 |

reveals that scrapers are only part of the assemblage upwards from Abtrag 19.

### *Cores (Fig. 8)*

Except for Abtrag 28 to 18, where the frequency of both cores and tools is generally low, cores are the second most common lithic category, accounting for 9% of the assemblage in Abtrag 15 (excluding undiagnostic shatters and manuports). Two broad types of cores were identified—platform cores and bipolar cores. Three of the 13 platform cores could not be further classified. Among the remaining ten, eight could be classified as semi-circumferential and two as circumferential (see Bader et al., 2016, 2020).

In terms of raw material preference for specific core reduction methods, a clear distribution can be observed. Bipolar cores are exclusively made from quartz, while platform cores are made from chert, hornfels, mudstone, quartzite, and quartz

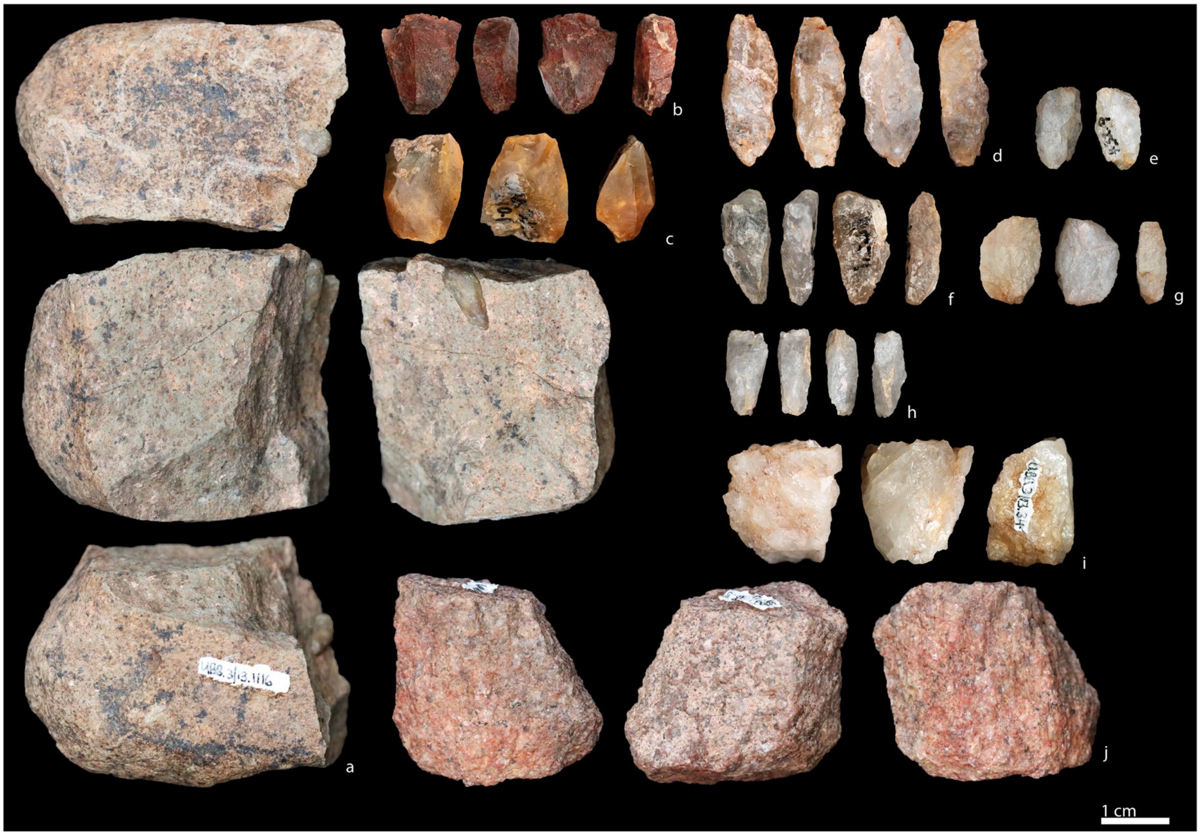


**Fig. 8** Selection of cores from Umbeli Belli GH3. **a** Handheld core, hornfels; **b**, **c** handheld cores, chert; **d**–**i** bipolar cores, quartz; **j** handheld core, quartzite (pieces are oriented with platform facing upwards)

(OSM 1—Fig. 7). Thus, despite the high numbers of quartzite and hornfels blanks in the assemblage, there are only a few cores that can be attributed to these raw materials. The undetermined coarse-grained raw material is absent from the core assemblage. Among the bipolar cores, 40 (45%) preserve bladelet scars, and 33 (38%) preserve flake scars. However, we could not identify scars on one bipolar core because of the high degree of fragmentation. Knappers used platform cores to produce both bladelets ($n=5$; 6%) and flakes ($n=6$; 7%). Two platform cores were too fragmented to determine the intended product.

Both bladelets and flakes were detached from quartz cores. Hornfels and quartzite were used to produce bladelets and flakes, but their low numbers make it impossible to infer a potential pattern in raw material use. Because the majority of cores are bipolar cores, the distribution of removal direction is commonly parallel and bidirectional. Looking at the removal direction on platform cores, no clear patterns were observed, although the low sample size of that category might distort the picture. A parallel removal strategy seems prevalent, and evidence for other strategies, such as centripetal, irregular, or alternating, is rare.

## Discussion

### The Internal Chronology of GH 3

It is hard to estimate how much time is covered by GH 3. Firstly, this is due to the hiatus between GH 3 and

GH 2, which leaves us only with the minimum age of the Robberg technocomplex in general. Secondly, GH 4 has not been dated yet, but there are two OSL dates from GH 5, ranging between 22 and 21 ka (University of Bordeaux Montaigne, Archaeosciences Laboratory; see Bader et al., 2018). The OSL date from GH 3 (17.8 ± 1.5 ka; University of Bordeaux Montaigne, Archaeosciences Laboratory) has been taken from a different square, and the inclination of the sediments hampers a direct correlation, but the date most likely dates the upper part of the Robberg sequence above Abtrag 17. Based on these dates, the age range for the lower sequence is between 21- and 17-ka BP (perhaps less depending on the age of GH 4) and between 17 and ~ 10-ka BP for the upper part. These ranges are in the general timeframe for the Robberg technocomplex (Bousman & Brink, 2018; *cf.* Porraz et al., 2016). Micromorphological studies are underway that can potentially illuminate the period of GH 3. Based on the data and dates we currently have, we are unable to resolve the issue of how much time GH 3 covers.

## Inner Assemblage Variability

The 28 Abträge of GH 3 provide a detailed resolution exhibiting substantial cultural change. These changes are both gradual and abrupt at times and involve many aspects of technology and typology. The most pronounced changes occur between Abtrag 19 and 17. At this position within the stratigraphy, we see shifts in raw material, bladelet production, and knapping technique. Although the sample size is small, changes in the tool and core assemblages coincide with the other developments in the lithic assemblage.

Splintered pieces occur throughout the sequence, but scrapers, for example, become part of the assemblage only above Abtrag 19. Among these scrapers is the tanged one with a round working edge, which is usually not characteristic of assemblages associated with the Robberg complex. A tanged scraper is more likely to be found in later periods of the LSA like the Wilton (but see Bader et al., 2020; Deacon, 1984). Among all raw materials, hornfels has the highest cortex percentages at Umbeli Belli. The change in core frequency is small, but in general, their absolute numbers increase above Abtrag 19 compared to the lower units.

Further, we observe a gradual shift in how bladelets are produced from Abtrag 18 upward. While bladelets are knapped mostly handheld in the lower Abträge and made from hornfels, they are knapped on quartz using bipolar percussion in the upper Abträge. Arguments have been brought forward that bipolar percussion is an inevitable outcome of using quartz as a raw material (Bousman, 2005; Jeske, 1992; Kaplan, 1990; Shott, 1989), but more recent studies of the assemblages from Klipfonteinrand (South Africa) and Sehonghong (Lesotho) suggest that the relationship between raw material and reduction technique might be more complex (Low & Pargeter, 2020). At Iron Pig Rockshelter further north in Mpumalanga, Bader et al. (2020) also observed the use of bipolar and handheld percussion to produce bladelets from quartz. In addition, well-flaked examples of bifacial quartz points in the MSA context of several sites, including Umbeli Belli (Bader et al., 2016, 2018) and Sibhudu (Will & Conard, 2018), strongly argue against a generalized assumption that the properties of quartz necessitate bipolar percussion. Nonetheless, in GH 3 at Umbeli Belli, knappers frequently apply bipolar technology to quartz. Our observation indicates that only eight bipolar blanks are made from a raw material other than quartz, and no bipolar cores are made from non-quartz raw materials.

We also tested the assemblage for differences in the size of the blanks, but we could not identify major changes. The difference is merely 1 mm with a large overlap in standard deviation. Thus, there was no increased lithic miniaturization at Umbeli Belli between the lower and upper part of GH 3. However, this is not the single decisive factor in lithic miniaturization. There is still a lively debate concerning the definition of "microlithic assemblages." There is a common understanding that size alone should not be the determining factor, but also bladelet production and/or proportions of backed tools should be included in our consideration. No backed tools were observed at Umbeli Belli, and we are therefore left with only bladelet production to make an inference about increasing lithic miniaturization over time. While there are more bladelets in total in the upper part than in the lower part, it is striking that the frequency of bladelets only differs by 0.5% between the two assumed phases. At the same time, as the number of bladelets increases, so does the overall find density. Hence, we see a general intensification of blank production rather than an intensification of bladelet production. It is debatable, if the existence of small blanks and tools alone justifies the use of the term "microlithic assemblage."

In our opinion, the tendency to produce small laminar blanks, which are present in the Umbeli Belli's Robberg assemblage alongside the corresponding cores that are specifically exploited to obtain bladelets, proves them to be the intended product. Therefore, we argue that the frequency of microliths in an assemblage should not be the main factor in classifying an assemblage as microlithic, nor can it be a simple presence/absence argument. Rather, the microlithic identity of an assemblage should be based on whether or not there is a distinct technological trait designed for obtaining bladelets to produce retouched tools or use them unretouched. Similar to biology, a technological trait in this context refers to a heritable cultural practice, which can be a mode of production, operational chain, or the form of a finished artifact (e.g., Foley & Lahr, 2003; Lycett & von Cramon-Taubadel, 2015). It is important to distinguish between the presence of microliths according to the definition by Kuhn and Elston (2002) and a microlithic assemblage. A microlithic assemblage, as we interpret it, rarely encompasses the entirety of the lithic technological system or even dominates it, but is always a subset of artifacts *within* a technocomplex (see Kuhn & Elston, 2002). Such a subset becomes diagnostic, if a clear mode of production can be identified for the production of bladelets. In our assemblage, this mode of production is predominantly bipolar percussion on quartz. If bladelets were not the intended end product, but products of core preparation or maintenance, we would expect to see more cortex, crested blades, or bladelets and a different percussion technique. Bipolar flakes, including larger ones, might as well be a by-product of reducing a quartz cobble to the desired size for bladelet production. However, without further experimental studies and/or refits, it cannot be determined whether this is an intended preparation within the *châine opératoire* or just the by-product of the expediency of bipolar knapping. After identifying a subset of artifacts as microlithic, it needs to be determined what its purpose might have been. In some cases, bladelets might derive from core preparation and/or rejuvenation strategies. In the case of the Robberg, it seems that they are intended products for further use. In this sense, the Robberg technocomplex comprises a variety of lithic technological traits, one of them being microlithic.

Summing up the observations provided in this article, we can conclude that the GH 3 assemblage at Umbeli Belli can securely be ascribed to the Robberg technocomplex based on the abundance of bladelets, the frequency of bipolar knapping on quartz, and the scarcity of tools. We further observed considerable technological variability throughout the chronological sequence, becoming most evident in the change in knapping technique and raw material use between the lower and upper parts of the sequence. An increase in the frequency of quartz as a raw material is paralleled by an increase in bipolar knapping, which is mostly performed on quartz. Comparable chronological trends have been observed at other Robberg sites in southern Africa (e.g., Bader et al., 2020; Mackay et al., 2014; Pargeter et al., 2018), raising questions about potential recurrent patterns in material culture based on similar subsistence strategies at specific times during MIS2. Thus, a detailed regional and chronological review of other Robberg assemblages in the wider surroundings of Umbeli Belli is required.

## A Regional Perspective on the Robberg from Umbeli Belli

The closest Robberg sites near Umbeli Belli are Shongweni and Umhlatuzana, both in KwaZulu-Natal. Both sites are situated about 60 km to the northwest and further inland. Shongweni, although described as "microlithic" in the upper occupation zone, is not well suited for comparison because of the low number of finds recovered (Davies, 1975). It seems, however, that quartz was a major component of the raw material economy there—at least in the lower occupation—which dates between 13.5-ka BP and 27.7-ka BP (Davies, 1975). Thus, it seems likely that this assemblage represents a mix of Robberg and the Early Later Stone Age.

In contrast, Umhlatuzana is better suited for a techno-typological comparison because the lithic assemblage is richer. Initially, the integrity of the sediments that contained late MSA, so-called transitional MSA/LSA layers, and both Robberg and Holocene LSA assemblages at Umhlatuzana were thought to be compromised (Kaplan, 1990; McCall & Thomas, 2009), but in a recent geoarchaeological study, Sifogeorgaki et al. (2020) could not find any evidence for large-scale post-depositional sediment movements. Hence, the assemblages recovered in the 1985 excavation (Kaplan, 1989, 1990) can be considered unmixed and well suited for a techno-typological comparison.

The raw material composition in the Robberg assemblage at Umhlatuzana differs strongly from Umbeli Belli. Quartz is the most commonly used raw material at Umhlatuzana followed by hornfels, with only minor components of quartzite and chert present (Kaplan, 1990). Quartz is less commonly used in the lower part of the Robberg sequence of Umhlatuzana than in the upper part. Kaplan (1990) used these raw material differences, typological characteristics, and radiocarbon dates to subdivide the Robberg into "early and late Robberg."

The techno-typological features of the two sites are different as well. Umhlatuzana's Robberg assemblage shows a larger variety of tool types than the Robberg of Umbeli Belli. Backed tools, adzes, and unifacial points, which all occur in the Robberg layers of Umhlatuzana (Kaplan, 1990), are absent in the tool assemblage of Umbeli Belli. Furthermore, the cores from the two sites are fundamentally different. At Umhlatuzana, only 11% of the cores are bipolar, while this is by far the most common core type at Umbeli Belli. A comparison of the number of bladelets throughout the sequences of Umhlatuzana and Umbeli Belli is impossible because Umhlatuzana was analyzed without a cut-off size, and the published data are difficult to compare to our data from Umbeli Belli. At present, we can only say that systematic bladelet production occurred on both sites (Kaplan, 1990). It is also unclear whether the bladelets at Umhlatuzana were produced from handheld or bipolar cores. Given the changes within the GH 3 assemblage, Umbeli Belli may represent an early and a late Robberg phase. For these reasons, Umhlatuzana and Umbeli Belli can only be compared meaningfully on a broad level, and it is difficult to conclude anything with certainty.

Sehonghong, situated in the highlands of Lesotho, has yielded a long stratigraphy that is of major importance to the region (Carter, 1977; Mitchell, 1988a, 1988b). The bladelet-rich layers of Sehonghong were dated between 13.5-ka BP and 12.7-ka BP (Carter & Vogel, 1974; Mitchell, 1988a, 1988b, 1995; Pargeter et al., 2017). New excavations and dates have allowed the identification of periods of abandonment and (re-) occupation at Sehonghong. According to the new data, there was an occupation period prior to the Robberg (between 25- and 23-ka BP), after which the site was abandoned for most of the earlier millennia of the Robberg between 23- and 16-ka BP (Pargeter et al., 2017). An occupation period during the Robberg is only documented around 15- and 13-ka BP (Pargeter et al., 2017). Consequently, the GH 3 assemblage at Umbeli Belli likely predates the Robberg resettlement of Sehonghong by several hundred years at least.

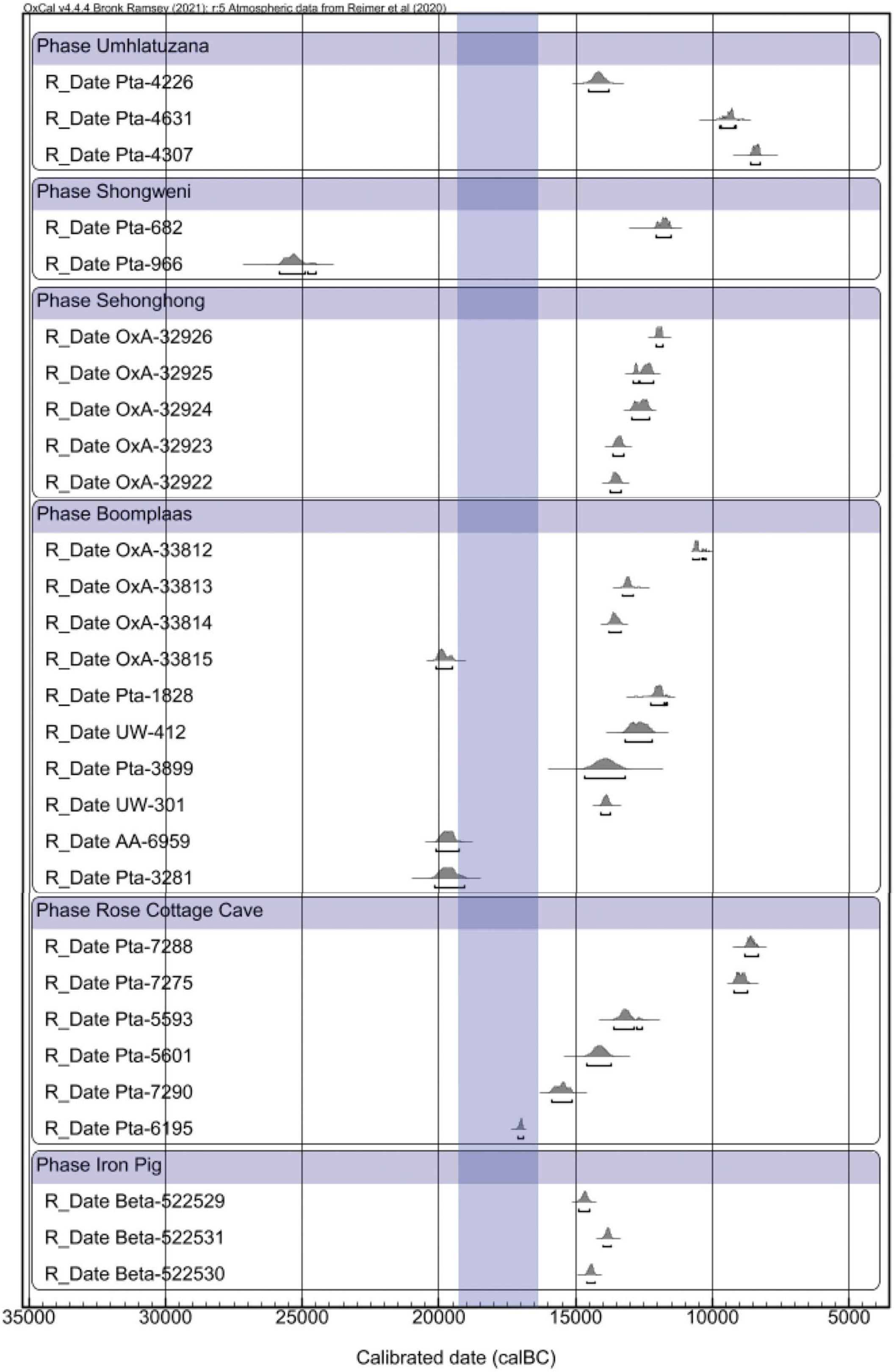
The main raw material used at Sehonghong is opalines. These were used for the production of all lithic artifact classes, especially bladelets. Tools, however, were also frequently made on hornfels/dolerite. The technology focuses on the production of bladelets as well, but mostly using handheld single-platform cores, and bipolar percussion is uncommon (Mitchell, 1995). Low and Pargeter (2020) proposed that bipolar flaking at Sehonghong was part of a continuous reduction sequence, in which bipolar percussion was used on handheld bladelet cores once they had gotten too small to be further reduced freehandedly. We could not find evidence for such a continuous reduction strategy at Umbeli Belli based on core mass values or damage that would be observable if a conical core was placed on an anvil (see Hiscock, 2015; Low & Pargeter, 2020). A similarity between GH 3 at Umbeli Belli and Sehonghong is the low frequency of tools. There are only a few scrapers, retouched blanks, and other formal tools at both sites. It seems that both sites indicate correlations between tool types and raw materials, though this should be treated with caution because of the problems of discerning splintered pieces from bipolar cores made on quartz. Sehonghong has what is considered to be a true microlithic assemblage that can easily be attributed to the Robberg (Mitchell, 1995). The high frequency of opaline in this assemblage is somewhat unusual in the Robberg of South Africa and Lesotho and can be explained by the intrinsically high knapping quality of opalines. In contrast, there is a low frequency of bipolar knapping at the site (Low & Pargeter, 2020; Mitchell, 1995).

On the western border of Lesotho, another key site for the Robberg is Rose Cottage Cave. Excavated for the first time in the 1940s, it was later dated to 16.5- to 14.5-ka BP, thus slightly overlapping with Umbeli Belli (Wadley, 1996). Opalines are also the most commonly used raw material at Rose Cottage Cave, but unlike Sehonghong, almost all tools are made from opalines (Wadley, 1996). Unfortunately, nothing has been published on the percussion techniques of the Rose Cottage Cave Robberg assemblages. However, the great similarity to Sehonghong, in terms of raw material, makes it likely that the bladelets at Rose Cottage Cave were also produced using handheld core reduction. Like in other Robberg assemblages, the frequency of tools is low; however, in contrast to Umbeli Belli, Rose Cottage Cave contained backed tools alongside unstandardized scrapers and retouched blanks (Wadley, 1996).

The Iron Pig rockshelter was recently excavated and analyzed by Bader and colleagues (Bader et al., 2020). The site, situated within the Komati valley in Mpumalanga province, yielded two layers with Robberg assemblages. The upper layer 5 was $^{14}$C-dated to between 16.5- and 15.5-ka BP (Beta-522529, Beta-522531) and thus overlaps tightly with the Umbeli Belli assemblage. The lower layer 6 revealed insufficient dating results and can only be determined to be older than layer 5. Numerous bladelets and low percentages of retouched tools were found in both layers. Like in Umbeli Belli, there are chrono-cultural variations in the assemblage, specifically in the production of bladelets and raw material selection. Hornfels is the most commonly used raw material throughout the sequence, followed by quartz. Towards the top of layer 5, chert becomes more frequent. While knappers produced bladelets during both periods of occupation in comparable numbers, a clear shift is observed in their production technology linked to different raw material choices. During the older period, bladelets were mostly knapped in a bipolar fashion from quartz nodules. In the younger part of the sequence associated with layer 5, chert was increasingly more often used for bladelet production. They were detached from small narrow-sided, and semi-rotational handheld platform cores (Bader et al., 2020). The trend observed in raw material choice and knapping technique for the production of bladelets reflects exactly the opposite trend at Umbeli Belli, where the younger phase is associated with bipolar knapping on quartz and the older one with handheld percussion on a fine-grained raw material, in this case, hornfels (Bader et al., 2020).

Boomplaas (Southern Cape) is another interesting example of changing patterns in lithic technology throughout the Robberg. The preservation of organic material made it possible to get a fine chronology from the Robberg layers (CL and GWA), from 12.1- to 21.1-ka BP. Though not obvious in the stratigraphic sequence, the radiocarbon dates revealed a hiatus in the occupation between layers CL and GWA of about 3000 years (Pargeter & Faith, 2020), with the occupation in CL starting around 18 ka, a date comparable to the Robberg sequence at Umbeli Belli. Building on Deacon's work (1982, 1984), Pargeter and Faith (2020) identify patterns of change throughout the LGM and Late Glacial sequence of Boomplaas, which seem to chronologically coincide with the changes observed at Umbeli Belli. Pargeter and Faith (2020) identify a much higher frequency in bipolar cores in the Late Glacial member CL compared to the underlying layers dating to the LGM (GWA and LP). They also identify a higher bladelet core percentage in CL than GWA and LP. Finally, they observed a higher reduction intensity in CL, almost twice the intensity of the lower levels. None of these measures employed by Pargeter and Faith are mirrored in the Umbeli Belli assemblage. However, Umbeli Belli might still display an increase in occupation intensity as shown, by the generally higher abundance of lithic artifacts in the upper parts of GH 3. Thus, although the reduction intensity measured by Pargeter and Faith (2020) is more or less the same throughout GH 3, we might still observe a trend similar to that reported from Boomplaas (Pargeter & Faith, 2020). Additionally, Deacon (1982, 1984) reports a dramatic shift in raw material frequency from LP to CL which parallels our findings from Umbeli Belli.

The comparison between Umbeli Belli and other sites with a Robberg component in the regional and supra-regional surroundings reveals that they share some similarities on a broader level. However, striking differences also set them apart from Umbeli Belli and from each other. This might partly be due to the differing dates of those sites (Fig. 9, Table 6) and to different environmental settings such as distance to the ocean and altitude. Furthermore, a bias stemming from different analytical approaches cannot be excluded. The Robberg assemblages from Rose Cottage Cave are much younger than Umbeli Belli, as are the later Robberg phases at Sehonghong. These age differences might account for some of the differences between assemblages. In contrast, the differences in terms of raw material are best explained by the geological setting, although doubts about this connection


OxCal v4.4.4 Bronk Ramsey (2021); r:5 Atmospheric data from Reimer et al (2020)
Phase Umhlatuzana
R_Date Pta-4226
R_Date Pta-4631
R_Date Pta-4307
Phase Shongweni
R_Date Pta-682
R_Date Pta-966
Phase Sehonghong
R_Date OxA-32926
R_Date OxA-32925
R_Date OxA-32924
R_Date OxA-32923
R_Date OxA-32922
Phase Boomplaas
R_Date OxA-33812
R_Date OxA-33813
R_Date OxA-33814
R_Date OxA-33815
R_Date Pta-1828
R_Date UW-412
R_Date Pta-3899
R_Date UW-301
R_Date AA-6959
R_Date Pta-3281
Phase Rose Cottage Cave
R_Date Pta-7288
R_Date Pta-7275
R_Date Pta-5593
R_Date Pta-5601
R_Date Pta-7290
R_Date Pta-6195
Phase Iron Pig
R_Date Beta-522529
R_Date Beta-522531
R_Date Beta-522530
35000
30000
25000
20000
15000
10000
5000
Calibrated date (calBC)

◂**Fig. 9** Chronology of the comparative sites used. [Calibrations were made with SHCal20 (Hogg et al., 2020) and the figure was generated using OxCal 4.4 (Bronk Ramsey, 2009). Range of the OSL date from Umbeli Belli GH 3 is indicated as a blue bar

have been raised recently (Low & Pargeter, 2020). Moreover, the changes throughout the Late Pleistocene, compiled by Mackay et al. (2014), seem to be reflected in the GH 3 assemblage at Umbeli Belli.

## Conclusions

The GH 3 assemblage of Umbeli Belli shares many features commonly associated with the Robberg techno-complex. These include the frequent use of bipolar percussion, bladelet production, a low frequency of formal tools, and the common use of quartz as raw material for knapping. Furthermore, the OSL date from GH 3 falls within the timeframe of the Robberg complex. A definite interpretation of the shifts and changes observed within the layer cannot be given at the moment. Since there seems to be evidence for an earlier and a later Robberg phase near Umbeli Belli, it is possible that the archaeological signal we found confirms this bimodality. However,

**Table 6** Radiometric dates from comparative sites in South Africa and Lesotho

| Site | Lab No. | Age (calBP) | Method | Reference |
|---|---|---|---|---|
| Umbeli Belli | N/A | 19.3 to 16.3 ka | OSL | Bader et al., 2018 |
| Umhlatuzana | Pta-4226 | 14.5 to 13.8 ka | $^{14}C$ | Kaplan, 1989 |
| Umhlatuzana | Pta-4307 | 8.6 to 8.2 ka | $^{14}C$ | Kaplan, 1989 |
| Umhlatuzana | Pta-4631 | 9.7 to 9.1 ka | $^{14}C$ | Kaplan, 1989 |
| Shongweni | Pta-682 | 12.1 to 11.5 ka | $^{14}C$ | Davies & Gordon Gray, 1977 |
| Shongweni | Pta-966 | 25.8 to 24.9 ka | $^{14}C$ | Davies & Gordon Gray, 1977 |
| Sehonghong | OxA-32926 | 14.0 to 13.7 ka | $^{14}C$ | Pargeter et al., 2017 |
| Sehonghong | OxA-32925 | 14.7 to 14.1 ka | $^{14}C$ | Pargeter et al., 2017 |
| Sehonghong | OxA-32924 | 14.9 to 14.2 ka | $^{14}C$ | Pargeter et al., 2017 |
| Sehonghong | OxA-32923 | 15.6 to 15.2 ka | $^{14}C$ | Pargeter et al., 2017 |
| Sehonghong | OxA-32922 | 15.7 to 15.3 ka | $^{14}C$ | Pargeter et al., 2017 |
| Border Cave | Pta-5598 | 23.3 to 22.0 ka* | $^{14}C$ | Wadley, 1997 |
| Border Cave | N/A | 17.1 to 16.9 ka | $^{14}C$ | Wadley, 1997 |
| Border Cave | Pta-5601 | 14.5 to 13.7 ka | $^{14}C$ | Wadley, 1997 |
| Border Cave | Pta-7275 | 13.5 to 12.8 ka | $^{14}C$ | Wadley, 1997 |
| Boomplaas | OxA-33812 | 12.7 to 12.1 ka | $^{14}C$ | Pargeter et al., 2018 |
| Boomplaas | Pta-1828 | 14.1 to 13.6 ka | $^{14}C$ | Deacon, 1982 |
| Boomplaas | UW-412 | 15.1 to 14.1 ka | $^{14}C$ | Deacon, 1982 |
| Boomplaas | OxA-33813 | 15.2 to 14.6 ka | $^{14}C$ | Pargeter et al., 2018 |
| Boomplaas | Pta-3899 | 16.6 to 15.1 ka | $^{14}C$ | Vogel, 2001 |
| Boomplaas | OxA-33814 | 15.7 to 15.2 ka | $^{14}C$ | Pargeter et al., 2018 |
| Boomplaas | UW-301 | 17.9 to 16.5 ka | $^{14}C$ | Fairhall et al., 1976 |
| Boomplaas | OxA-33815 | 21.9 to 21.4 ka | $^{14}C$ | Pargeter et al., 2018 |
| Boomplaas | U-368 | 22.0 to 21.0 ka | $^{14}C$ | Vogel, 2001 |
| Boomplaas | AA-6959 | 21.9 to 21.1 ka | $^{14}C$ | Miller et al., 1999 |
| Heuningneskrans | Pta-114 | 12.7 to 11.7 ka | $^{14}C$ | Porraz & Val, 2019 |
| Heuningneskrans | Lj-3150 | 14.7 to 13.8 ka | $^{14}C$ | Porraz & Val, 2019 |
| Heuningneskrans | Pta-100 | 16.0 to 15.3 ka | $^{14}C$ | Porraz & Val, 2019 |
| Heuningneskrans | AA-5829 | 14.9 to 14.1 ka | $^{14}C$ | Porraz & Val, 2019 |
| Heuningneskrans | AA-8564 | 14.9 to 14.1 ka | $^{14}C$ | Porraz & Val, 2019 |

in-depth analysis of the Umhlatuzana assemblage will be essential to further elaborate on this. Other possibilities are changes in site use and occupation intensity throughout the sequence of GH 3. Umbeli Belli adds another spot on the archaeological map providing useful insights into a better understanding of the Robberg techno-complex along the east coast of South Africa. Concerning Umbeli Belli and other Robberg assemblages investigated recently, there is increasing evidence that these assemblages exhibit regional and time-specific variations in lithic technology. In order to go beyond this preliminary descriptive conclusion, it will be essential to apply various statistical analyses to the archaeological data, integrate these into experimental data, and conduct more research on the use-wear patterns of unretouched bladelets. Moreover, provenance tracing of raw materials, using geochemical methods, can provide valuable information about raw material provisioning strategies and networks of exchange among prehistoric groups. Detailed investigations of sites with good organic preservation are needed to reconstruct past environmental conditions and their relationships to settlement dynamics. This study of the lithic assemblage of GH 3 from Umbeli Belli adds valuable data to ongoing research on the Robberg techno-complex. It also highlights potential avenues for future research at Umbeli Belli and beyond.

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## Declarations

**Conflict of Interest** The authors declare no competing interests.

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