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Discussion Forum

THE SOUTHERN AFRICAN STONE AGE SEQUENCE UPDATED (II)

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INTRODUCTION

A decade ago, we summarised the South African and Lesotho Stone Age technocomplex sequence as a heuristic exercise, anchored in 242 dated assemblages (Lombard *et al.* 2012). Following Clarke (1968), Sampson (1974) and Deacon (1980), we defined a technocomplex as a group of industries characterised by assemblages that have many, but not all, properties in common. Spatiotemporal changes and shifts in artefact design and frequencies owing to material use/availability and socio-economic factors are built into the framework. The accompanying dataset was intended to serve as a useful resource to both students and professionals, and to fuel research and debate.

The sequence served to contextualise lithic studies (Porráz *et al.* 2013; Ryano *et al.* 2017; Brenner & Wurz 2019; Low & Pargeter 2020) and, together with the accompanying human remains/fossil record (Dusseldorp *et al.* 2013), it proved useful for scholars working on a wide variety of topics. Among others, themes include subsistence behaviours (Sadr 2015; Dusseldorp 2016; Jerardino *et al.* 2016; Langejans *et al.* 2017), hunting strategies (Clark & Kandel 2013; Lombard 2021), archaeological theorising (Bousman & Brink 2018; Will & Mackay 2020; Dusseldorp & Lombard 2021), ancient DNA and fossil hominin evolution (Will & Stock 2015; Berger *et al.* 2017; Grine *et al.* 2017; Galway-Witham *et al.* 2019), and language, behavioural and cognitive evolution (Klein 2017, 2019; Schmidt *et al.* 2020).

The proposed sequence also increased the feasibility of interpreting aspects of open-air sites or undated/undatable assemblages (Mackay *et al.* 2014; Steele *et al.* 2016; Lotter & Kuman 2018; Ames *et al.* 2020; Caruana *et al.* 2020; Watson *et al.* 2020), and troubleshooting dating dilemmas (Nami *et al.* 2016; Loftus *et al.* 2019; Ecker *et al.* 2017; Van Couvering & Delson 2021; Pazan *et al.* 2022). It proved a useful background for alternative chronological proxies such as rainfall, vegetation, fauna and other climatic controls (Loftus *et al.* 2015; Chase *et al.* 2018; Jerardino *et al.* 2018; Robinson & Wadley 2018; Morrissey *et al.* 2020; Puech *et al.* 2021; Wurz 2021; Herbert & Fitchett 2022). Although it was specific to South Africa and Lesotho, its geographic reach proved much wider (Dibble *et al.* 2013; Douze & Delagnes 2016; Ossendorf 2017a; Bicho *et al.* 2018; Niekus *et al.* 2019; Tryon 2019; Shipton *et al.* 2021).

OUR APPROACH TO THIS UPDATE

Again, we use only dated assemblages to confine the sequence, but now also include open-air assemblages, and assemblages from Namibia, Botswana, Zimbabwe, eSwatini and Mozambique. Definitions for the technocomplexes remain intact (Table 1), but we made minor adjustments in nomenclature:

- We return to the use of the informal post-Howiesons Poort, instead of a formal Sibudu technocomplex, because the latter has not gained general traction.
- We exclude the pre-Still Bay as a separate technocomplex because, where it was scrutinised, it was found not to differ statistically significantly from the Still Bay (Lombard *et al.* 2019).
- We exclude the Klasies River (MSA 1) as technocomplex because thus far too few assemblages have been identified as such.
- Informed by recent work (Chazan 2015; Eltzholtz 2020; Kuman *et al.* 2020; Richard *et al.* 2020), we use the formal Fauresmith instead of the informal ESA-MSA transitional technocomplex.

For this update, we gathered data from 450 assemblages, resulting in more than 1200 age estimates (Appendix A). Most of these dates have mean, as well as maximum and minimum values, resulting in more than 3700 datapoints with which to assess the progression of key trends in the southern African Stone Age sequence. Where possible, we re-calibrated the radiocarbon dates following the most recent calibration curve for the southern hemisphere, SHCal20 (Hogg *et al.* 2020), listing only the range of the largest intercept, not the full 95.4% range for each date. Correcting marine shell and ostrich eggshell radiocarbon calibrations for material-specific effects, however, fell outside the scope of this contribution. We again include marine isotope stages (MISs), but now also align the sequence to climatic proxies from the Indian Ocean of southeastern Africa, spanning most of the sequence (Caley *et al.* 2018).

No concise overview can capture the richness and variability expressed over more than two million years of the southern African Stone Age, but it can highlight trends, overlaps, gaps and outliers. Because they stimulate problem-driven research, we consider ‘sequential problems’ such as overlaps, gaps and outliers equally or more important than the ‘perfect fit’. In mentioning gaps and overlaps, it is also necessary to grapple with the realities of deep-time dating, which we touch upon in the sections below. We present the three Stone Age periods separately, before summarising the full sequence. The demarcations between periods and technocomplexes are, however, seen as porous, membrane-like partitions, because in any evolutionary context “there can be no hard and fast boundaries” between units that are “created in the process of study depending on what is being studied and why” (Davidson 2020: 36).

THE LATER STONE AGE (LSA) SEQUENCE

Orton (2014: 110) responded to our first update for the LSA by suggesting that, regardless of similarities, assemblages that are far away from type sites should not be grouped. He mentions an example of the Wilton being used as far afield as Somalia (Clark 1954). We cannot account for its use in eastern Africa, but we highlight that local hunter-gatherers had social networks with radii reaching ~100 km or more (Marshall 1976;

TABLE 1. Summary of the general characteristics for the different technocomplexes in the southern African Stone Age sequence (also see Deacon 1984; Wadley 1993; Lombard *et al.* 2012).

| Technocomplex | General characteristics |
|--|--|
| ceramic final Later Stone Age | Broadly similar to the final Later Stone Age but includes grit- or grass-tempered pottery. Stone tool assemblages are often microlithic, and in some areas dominated by long end-scrapers, but also include few backed microliths; in other areas formal tools are absent or rare. Grindstones are common. Ground stone artefacts, stone bowls and boat-shaped grinding grooves may occur. Ceramics can be coarse, or well-fired and thin-walled; sometimes with lugs, spouts and conical bases; sometimes with decoration; sometimes shaped as bowls. Ochre and ostrich eggshell (OES) are common, and metal objects and glass beads may occur. |
| final Later Stone Age (regional variant: Smithfield) | Much variability can be expected. Variants include macrolithic assemblages that are mostly informal, often characterised by large, untrimmed flakes. Microlithic scrapers, blades and bladelets, backed tools and adzes may occur. Worked bone, ochre, and OES are common. Metal objects are rare, and ceramics are absent. |
| Wilton | A fully developed microlithic tradition with numerous formal tools, highly standardised backed microliths often made from blades/bladelets and small convex scrapers. Ochre and OES are common, and bone, shell and wooden artefacts occur. |
| Oakhurst (regional variants: Albany, Lockshoek, Kuruman) | A flake-based industry characterised by round, end, and D-shaped scrapers and adzes and few or no microliths. A wide range of polished bone tools occur. |
| Robberg | Characterised by systematic bladelet production and the occurrence of <i>outils écaillés</i> or scaled pieces with significant numbers of unretouched bladelets and bladelet cores, and few formal tools. Some sites have a significant macrolithic element. |
| early Later Stone Age | Characterised by unstandardised, often microlithic, pieces and includes the bipolar knapping technique. Described at some sites, but not always clear whether assemblages represent an archaeological phase or a mixture of LSA and MSA artefacts. |
| final Middle Stone Age | Characterised by high regional variability in triangular flake and blade industries that may include, unifacial, bifacial and hollow-based points. Points are relatively short and stout. Some assemblages can be microlithic, include bipolar technology and backed geometric shapes such as segments and side scrapers. |
| post-Howiesons Poort | Most points are produced using the Levallois technique. Most formal retouch is aimed at producing unifacial points characterised by faceted platforms with somewhat elongated shapes compared to the final Middle Stone Age. Some side scrapers are present and backed pieces are rare. |
| Howiesons Poort | Characterised by blade technology although flake technology also occurs. It includes small (<4 cm) geometric backed tools, such as segments and trapezes, backed blades and scrapers. Some blades are denticulated and points are generally rare or absent, although some sites contain bifacial points. Bone points and engraved artefacts may occur. |
| Still Bay | Characterised by thin, bifacially worked foliate or lanceolate points with semi-circular or wide-angled pointed butts. Could include blades and finely serrated points. Sometimes include bone points, bone artefacts and shell beads. |
| Mossel Bay | Characterised by recurrent unipolar Levallois point and blade reduction. Products have faceted platforms, straight profiles and percussion bulbs are prominent and often splintered or ring-cracked. Formal retouch is infrequent, and include notches and scrapers. So-called Pietersburg assemblages share some features with the Mossel Bay. |
| early Middle Stone Age | Assemblages generally include discoidal and Levallois flake technologies, sometimes elongated with diffused bulbs, blades and a generalised toolkit. This phase needs future clarification regarding the designation of material culture and sequencing. |
| Fauresmith | Assemblages have large blades, points flaked using Levallois technology, and small bifaces/handaxes. Small picks, heavy- and light-duty denticulated and notched scrapers may occur. The Fauresmith includes the less well-described Sangoan variant. |
| Acheulean | Characterised by handaxes and cleavers (typically bifacially worked), large flake blanks (>10 cm), some with deliberate retouch sometimes classified as scrapers. Gives impression of being deliberately shaped but could indicate result of knapping strategy. Sometimes shows core preparation. Generally found in disturbed open-air locations. |
| Oldowan | Consists of cobble, core or flake tools with little retouch and no flaking to predetermined patterns. Hammerstones, manuports, cores and polished bone fragments/tools may occur. |

Wiessner 1982; Wadley 1993). Within such systems, ideas originating anywhere on the landscape could spread from group to group across the subcontinent within a single human generation without groups/individuals travelling vast distances (Jerardino *et al.* 2014; Högberg & Lombard 2020). We therefore do not see distance as a disqualifier for using type-site designations.

In terms of lithic technology, Orton (2014) is also concerned

about too much emphasis on similarity and not enough on variability. Yet, the purpose of a heuristic sequence is to summarise multi-faceted data to aid further learning, discovery, or problem-solving. It is best understood as a pragmatic ‘shorthand’ – instead of a detailed representation – that is both comprehensive and flexible enough to facilitate working with complex data when fine-grained explanations are either impossible or impractical. Differently scaled approaches serve

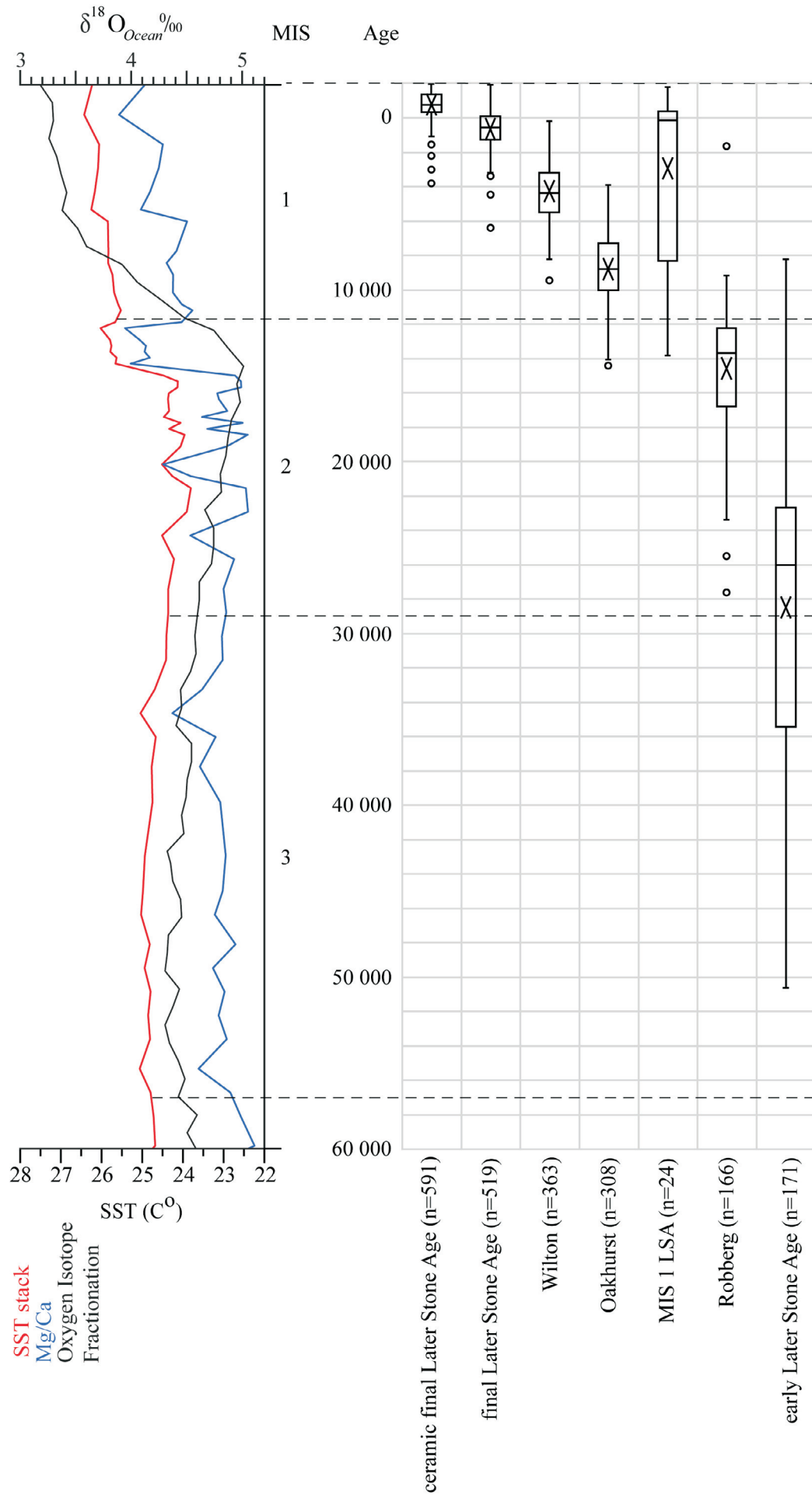


FIG. 1. The Later Stone Age sequence in terms of technocomplexes and marine isotope stages, with MIS1 LSA representing assemblages that have not been identified/interpreted to fit within a named technocomplex. n = datapoints (minimum, average, and maximum estimates) per published date. Sea surface temperature (SST Stack and Mg/Ca) and isotope data from Caley et al. (2018).

to highlight different aspects of the archaeological record. For example, the purpose of a synthesised sequence is to highlight broad spatiotemporal trends, whereas variation is best addressed through finer scaled intra- or inter-assemblage comparisons (Wadley & Mohapi 2008; Archer *et al.* 2015; Soriano *et al.* 2015; Lombard *et al.* 2019). Orton's (2014) proposed alternative for the LSA sequence is as follows: late Holocene assemblages post-3000 BP, Holocene microlithic post-8000 BP, Terminal Pleistocene/early Holocene non-microlithic 7000–12 000 BP, late Pleistocene microlithic 9500–19 000 BP and early LSA pre-18 000 BP. It has not been demonstrated how this scheme helps to better understand variation, and it still lacks data-driven assessment of its applicability.

Where assemblages have been interpreted or assessed (based on their descriptions) in terms of the technocomplexes, the current data demonstrate a relatively well-sorted LSA sequence, especially during MIS1 (Fig. 1). We suggest that the bars in Fig. 1 represent the general duration of the main expressions of these technocomplexes, and that the 'thin-data' overlaps potentially indicate transitional phases that require further investigation to understand shifts in techno-behavioural trends that may or may not correlate with ecological changes (see discussion on environmental determinism in Fekadu 2014; Arponen *et al.* 2019). During the LSA, the Robberg technocomplex stands out as a probable techno-behavioural response to the climatic fluctuations that occurred during the second half of MIS2 (also see Porraz *et al.* 2016; Chase *et al.* 2018; Pargeter *et al.* 2018; Loftus *et al.* 2019).

THE MIDDLE STONE AGE (MSA) SEQUENCE

Conard and Porraz (2015: 127) followed Orton's discussion with their commentary on the Middle Stone Age, arguing that chronological syntheses relying on the stratigraphic layering and dating of the Still Bay and Howiesons Poort at deep-sequence sites require revision. Using Diepkloof as example, they highlight that different age ranges were proposed by different laboratories for the same industries (Jacobs, Roberts *et al.* 2008; Tribolo *et al.* 2013; Jacobs & Roberts 2017). It is our view that, rather than a 'sequential' problem, such discrepancies likely represent complex interplay between varying approaches to dating, assemblage categorisation, site taphonomy and interpreting Pleistocene human behaviour. Simply put, regardless of age, and wherever present at the same site, the Howiesons Poort always follows on the Still Bay, which always follows on Levallois-type assemblages such as the Mossel Bay (Fig. 2). Thus, the relative sequence remains uncompromised.

The optically stimulated luminescence (OSL) method is mostly used for Still Bay and Howiesons Poort age estimates, but the method still has problems that can occur at any stage of the work (from sampling to interpretation). For example, accurate determination of the natural radiation levels at the precise sampling site is essential. This can be done by gamma (γ) spectrometry (targeting potassium (K), U and Th), *in situ* and/or on samples of the material in which the sample was embedded, chemical/isotope analysis, or a combination of these techniques. A recurrent problem with γ spectrometry is that U is often not detected or is underestimated (due to radon loss), which leads to an overestimation of the OSL age. The best way to solve potential problems is to combine gamma spectrometry with U/Th disequilibrium studies on the samples (Dirks *et al.* 2017).

Our analysis shows a well-sorted sequence for the post-MIS5 MSA (Fig. 2). It reveals overlaps between ~90 ka and 70 ka. These overlaps may indicate that:

- Different researchers define assemblages differently, some-

times without assessing them against the broad techno-complex criteria (Table 1), and often without publishing descriptions/data that enable such assessment.

- Human socio-technical behaviour in southern Africa was highly variable during this phase.
- Dating inconsistencies impact on the resolution of the sequence.

Regardless of cause/s, this phase requires more intense scrutiny (Porraz *et al.* 2018; Jacobs *et al.* 2020; Lombard *et al.* 2019; Wilkins 2020; Högberg & Lombard 2022; Pazan *et al.* 2022), as does the informally named early MSA currently spanning MIS6–8 (Fig. 2).

Following Shea's (2014) call to 'sink the Mousterian', Wilkins (2020) suggested the 'retirement' of the type-site naming tradition of southern African stone tool industries but acknowledged the lack of a better solution. She ties the custom to the culture history paradigm, despite researchers not using the sequence in that context. She also queries the use of the same name for a technocomplex (a regional spatiotemporal trend) and an industry (a site-specific or local expression of a regional technocomplex). To clarify, the Howiesons Poort is a technocomplex with wide distribution across southern Africa, but it is one of several MSA industries at Sibudu Cave where it has at least three recognised phases varying through time (Fig. 3). In Figure 3 we illustrate how the detection of spatiotemporal variation and subtle technological change is facilitated within the technocomplex system (contra Wilkins 2020).

Wilkins' (2020) alternative of examining lithic variability against the MIS scale relies heavily on the finality and accuracy of chronometric dating, even though such methods are not always exact, feasible or possible. Date ranges and climate proxies may give some resolution, but they are not absolute, with standard errors often spanning thousands of years. For example, advances in the precision and accuracy of $^{40}\text{Ar}/^{39}\text{Ar}$ dating are exemplified by the dating of the last Mt Toba eruption to 75 ± 0.9 ka at one standard error (Mark *et al.* 2014). Depending on the argument, the estimate may appear precise enough, but it implies that there is only a ~67% chance that the eruption happened sometime between 75.9 ka and 74.1 ka. This spread represents 1800 years, or 72 human generations at ~25 years per generation. Doubling the standard error increases the probability that the eruption happened between 76.8 ka and 73.2 ka to ~95%, but now the possible span becomes 2700 years, or 108 human generations during which the event may have occurred.

If OSL age estimates, with their own uncertainties/inaccuracies, are then used to infer contemporaneity with the Mt Toba eruption or each other, the possible spread in real time or human generations may stretch or shrink. In some instances, such correlation perhaps provides local resolution (Wilkins 2020) – but this inference still lacks critical assessment. Moreover, the abundance of tephra is frequently very low, and this may lead to challenges (Smith *et al.* 2019). Such correlations have not yet revealed new subcontinental socio-technical trends, nor do they provide a robust alternative for the southern African Stone Age sequence.

THE EARLIER STONE AGE (ESA) SEQUENCE

Many ESA sites and assemblages remain undated, but the advent of multicollector inductively-coupled plasma mass spectrometry (MC-ICP-MS) enables the analysis of small speleothem samples with low uranium contents, widening the scope of uranium-thorium (U/Th) disequilibrium dating of speleothems (Cheng *et al.* 2013). Although the age limit of U/Th

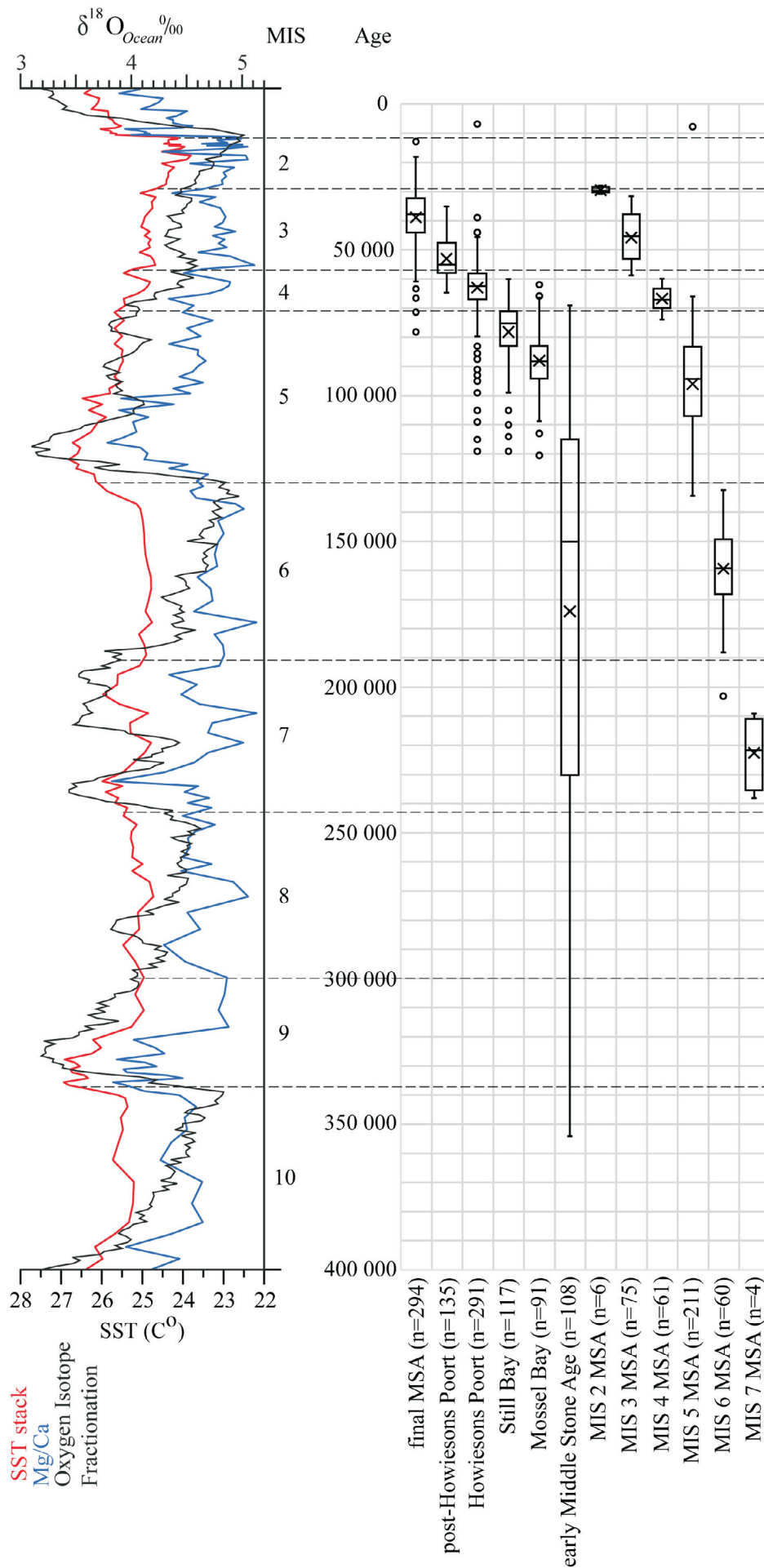


FIG. 2. The Middle Stone Age sequence in terms of technocomplexes and marine isotope stages, with MIS2–7 MSA representing assemblages that have not been identified/interpreted to fit within a named technocomplex. n = datapoints (minimum, average, and maximum estimates) per published date. Sea surface temperature (SST Stack and Mg/Ca) and isotope data from Caley et al. (2018).

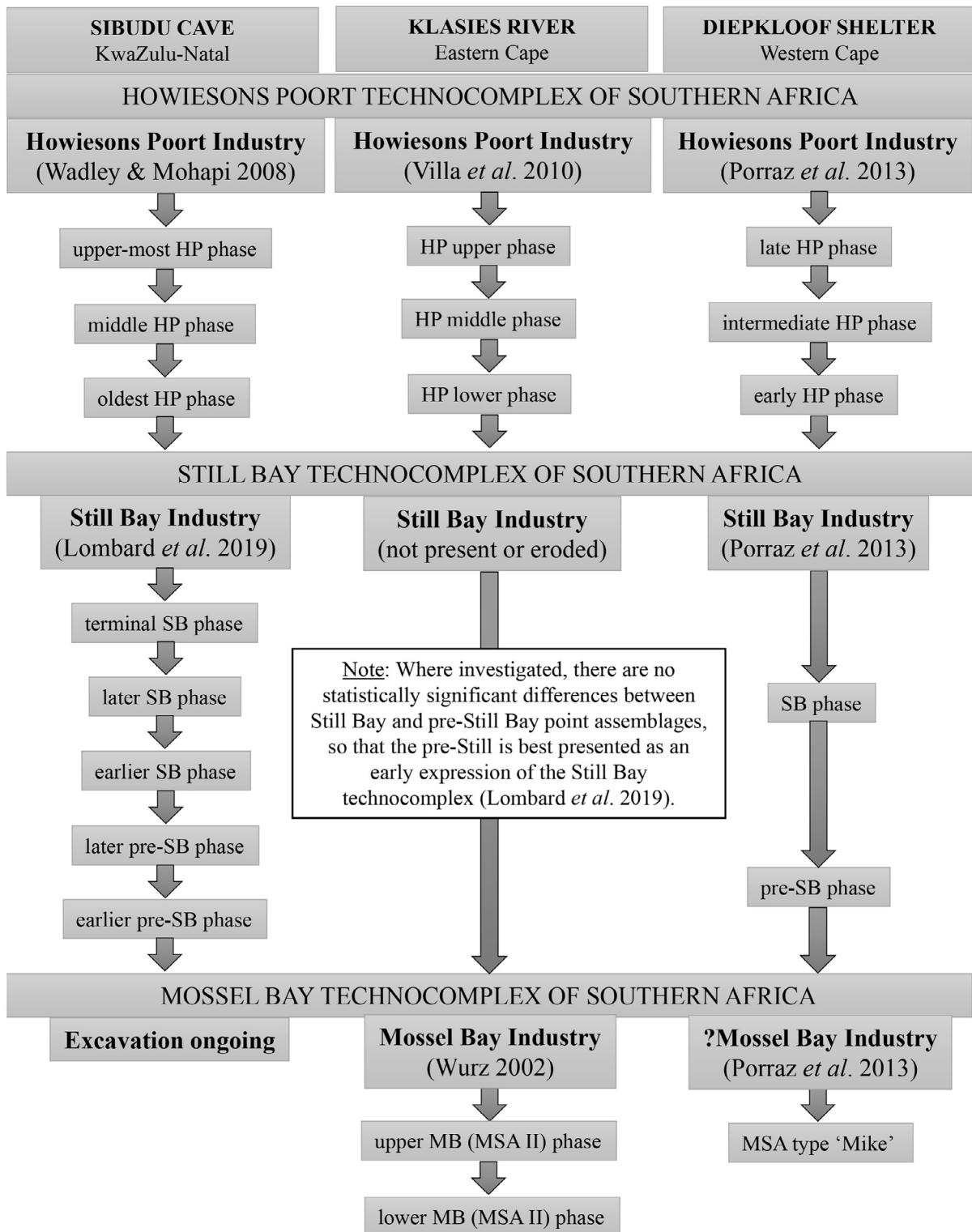


FIG. 3. Explanation of how the same names apply to both technocomplexes and industries, and how depending on question and scope of research, fine-grained observations regarding spatiotemporal variability becomes possible within the technocomplex system. Similar to other taxonomies, a '?' before a name would indicate similarity, but uncertainty pending further analysis.

dating remains confidently at ~500 ka, it can be stretched to ~700 ka (Cheng *et al.* 2013). Usually, ^{234}U is found to have been initially present in excess of $^{234}\text{U}/^{238}\text{U}$ equilibrium. This initial disequilibrium reduces to non-measurable levels only after about 3 Ma and can thus be corrected for in U/Th dating, as well as in U–Pb and uranium-thorium-helium ((U,Th)-He) dating of samples younger than 3 Ma (Makhubela & Kramers 2022).

For ages younger than 2 Ma, where the initial excess of ^{234}U

can be well constrained, a good consistency between uranium-lead (U–Pb), OSL and palaeomagnetism results has been demonstrated (Pickering *et al.* 2013; Pickering & Edwards 2021). The U–Pb dating method has been applied successfully to older speleothems (Walker *et al.* 2006; Pickering *et al.* 2010; Pickering *et al.* 2013), and is particularly successful in combination with palaeomagnetism (Herries & Shaw 2011; Dirks *et al.* 2010). In the same family of methods, (U,Th)-He dating has been successfully tested on calcium carbonate speleothems

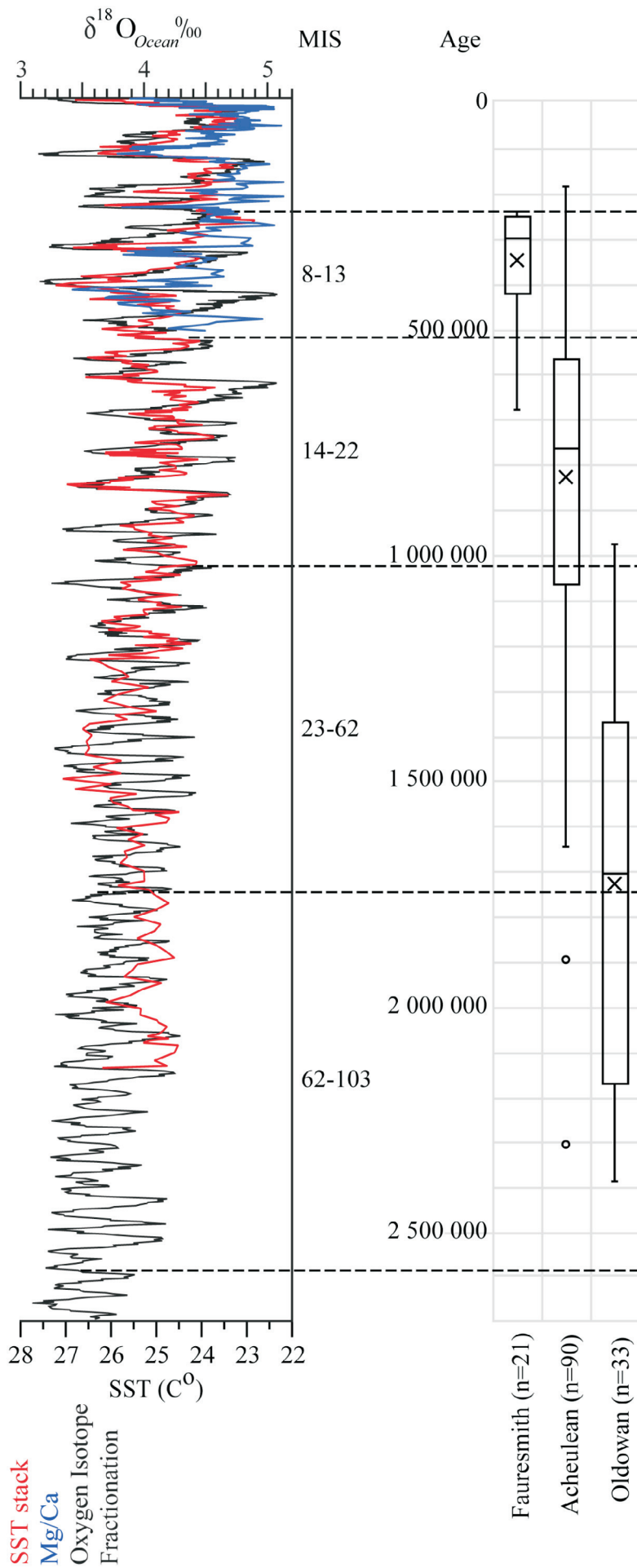


FIG. 4. The Earlier Stone Age sequence in terms of technocomplexes and marine isotope stages. n = datapoints (minimum, average, and maximum estimates) per published date. Sea surface temperature (SST Stack and Mg/Ca) and isotope data from Caley et al. (2018).

(Makhubela & Kramers 2022), holding promise in particular for ‘dirty’ and/or uranium-poor speleothems aged ≥ 100 ka.

Similar to OSL, Electron spin resonance (ESR) quantifies radiation-induced accumulated defects and further supplements the dating arsenal. ESR can be applied to dental apatite for the direct dating of fossils (Deino 2013). A further addition is the application of cosmogenic nuclides in determining erosion rates and surface exposure as well as burial times – in particular, beryllium-10 and aluminium-26 (^{10}Be and ^{26}Al) with half-lives of 708 ka and 1.39 Ma, respectively (Granger *et al.* 2013; Granger 2014). Lastly, in argon ($^{40}\text{Ar}/^{39}\text{Ar}$) dating of young volcanic rocks, which has been crucial in constraining the timeline for hominin evolution in eastern Africa, a new generation of multicollector noble gas mass spectrometers has increased the precision five-fold, leading to new perspectives in archaeological applications for this method (Schaen *et al.* 2021).

Despite the plethora of dating methods, numerous problems remain. For example, U–Pb dating on calcium carbonate speleothem samples associated with Little Foot (STW573, Sterkfontein Cave, Cradle of Humankind), initially yielded an age of 2.18 ± 0.10 Ma (Walker *et al.* 2006). Later it was found that the sample material came from intrusive veins rather than from flowstones (Bruxelles *et al.* 2014), resulting in a minimum age only. A subsequent multi-sample $^{26}\text{Al}/^{10}\text{Be}$ burial age determination yielded an age of 3.67 ± 0.16 Ma (Granger *et al.* 2015), but careful analysis of the data indicated that although some samples were in the cave for about 3.5 Ma, one of the samples could not have been underground for longer than ~ 2.8 Ma (Kramers & Dirks 2017a,b; Stratford *et al.* 2017). The problem with burial ages of clastic deposits in caves is thus heterogeneity and histories of burial prior to deposition at the present site.

Dating fossils in caves using the cosmogenic nuclides

burial method thus tends to yield maximum ages. It is of course different for manuports and stone tools made of chert, which can be directly burial-dated *via* their cosmogenic nuclide content (Fujioka *et al.* 2022). But even for such samples there may be problems, particularly in a karst landscape where the dissolving of the bedrock created sinkholes, sinking streams, caves, springs, and other features. This is highlighted by a study on soils and chert clasts around the Rising Star cave site, where the soil quartz showed lower $^{26}\text{Al}/^{10}\text{Be}$ abundance ratios than expected at surface, attributed to long (up to 1 Ma) residence times of deep soil undergoing bioturbation (Makhubela *et al.* 2019). When sediments with such a complex exposure history are deposited in a cave, the burial ages can be overestimated and or underestimated, as is the case at Wonderwerk Cave (Shaar *et al.* 2021). This should be considered when using sediment burial ages to demarcate the upper age limits of lithic assemblages (Kuman *et al.* 2021).

If the ESA sequence is constrained to its three main technocomplexes, of which the Fauresmith probably represents a socio-technical transition into the MSA (Kuman *et al.* 2020), then sorting between the units is well-defined (Fig. 4). While some researchers have started to identify phases (variation) within the Acheulean such as early or late expressions (Leader *et al.* 2018; Li *et al.* 2018), it is not always clear whether these phases are identified based on technological trends (e.g. Lotter *et al.* 2021), or on where they occur in a sequence (Shaar *et al.* 2021).

THE UPDATED SEQUENCE IN CONCLUSION

With a larger number of numeric age estimates, we suggest that it is possible to refine the most probable durations for each of the recognised technocomplexes. In Table 2 we present the newly generated median ages (most unaffected by outliers)

TABLE 2. Revised chrono-stratigraphic Stone Age sequence for southern Africa.

| Technocomplex | 2012 suggested durations | Revised age estimates | | |
|--|--------------------------|-----------------------|------------------------|------------------------|
| | | Median age | Mean age \pm SD | Most probable duration |
| LATER STONE AGE | | | | |
| Expect variability between assemblages, a wide range of formal tools, particularly scrapers (microlithic and macrolithic), backed artefacts, evidence of hafted stone and bone tools, borers, bored stones, upper and lower grindstones, grooved stones, ostrich eggshell (OES) beads and other ornaments, undecorated/decorated OES fragments, flasks/flask fragments, bone tools (sometimes with decoration), fishing equipment, rock art, and ceramics in the final phase. | | | | |
| ceramic final Later Stone Age | <2 ka | AD 774 | AD 795 \pm 698 | AD 1493–97 |
| final Later Stone Age | 0.1–4 ka | 546 BC | 658 BC \pm 1290 | AD 632–1948 BC |
| Wilton | 4–8 ka | 4387 BC | 4260 BC \pm 1574 | 2686–5834 BC |
| Oakhurst | 7–12 ka | 8814 BC | 8797 BC \pm 2042 | 6755–10839 BC |
| Robberg | 12–18 ka | 13 705 BC | 14 584 BC \pm 3389 | 11 195–17 973 BC |
| early Later Stone Age | 18–40 ka | 25 998 BC | 28 474 BC \pm 8780 | 19 694–37 254 BC |
| MIDDLE STONE AGE | | | | |
| General characteristics include Levallois or prepared core techniques in which triangular flakes with convergent dorsal scars, often with faceted striking platforms, are produced. Discoidal systems and intentional blade production from volumetric cores also occur. Formal tools may include unifacially and bifacially retouched points, backed artefacts, scrapers, and denticulates. Early traces of hafting are present, and marine shell beads, bone points, engraved ochre nodules, engraved OES fragments, engraved bone fragments, and grindstones are sometimes present. | | | | |
| final Middle Stone Age | 20–40 ka | 37.7 ka | 38.8 \pm 8.9 ka | 29.9–47.7 ka |
| post-Howiesons Poort | 45–58 ka | 55.1 ka | 53 \pm 6.6 ka | 46.4–59.6 ka |
| Howiesons Poort | 58–66 ka | 62.4 ka | 62.9 \pm 11.4 ka | 51.5–74.3 ka |
| Still Bay | 70–77 ka | 75.2 ka | 78.1 \pm 10.7 ka | 67.4–88.8 ka |
| Mossel Bay | 77–105 ka | 88.2 ka | 87.9 \pm 10.5 ka | 77.4–98.4 ka |
| early Middle Stone Age | 130–300 ka | 206.5 ka | 196.5 \pm 70 ka | 126.5–266.5 ka |
| EARLIER STONE AGE | | | | |
| Early stages include simple flakes struck from cobbles, core and pebble tools. Later stages include intentionally shaped handaxes, cleavers and picks. The final or transitional stages have tools that are smaller than the preceding stages and include large blades. | | | | |
| Fauresmith | 200–600 ka | 305 ka | 352.6 \pm 118.9 ka | 233.7–471.5 ka |
| Acheulean | 300 ka–1.5 Ma | 770 ka | 834.2 \pm 402.6 ka | 431.6 ka–1.23 Ma |
| Oldowan | 1.5–2 Ma | 1.61 Ma | 1.63 Ma \pm 546.5 ka | 1.08–2.18 Ma |

and most probable durations (mean \pm SD) for each, showing how it differs from our previous interpretation of the sequence.

The purpose of this sequence is again to serve as up-to-date heuristic shorthand for communicating and learning about complex data and broad trends associated with the Stone Age of southern Africa. It does not automatically imply culture

historical assumptions, nor does it assume a teleological understanding of evolutionary processes (biological or socio-technical). Instead, it provides a data-driven catalyst for future discussion and exploration by creating a template to situate large-scale techno-typological patterning within a chronological framework.

APPENDIX A

The southern African Stone Age sequence updated (II)

Note: Marine isotope stages are aligned with the averaged age estimates of the assemblages, so that minimum and maximum ages may fall outside the current isotope stage parameters.

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|---|--|--|
| /Hei-/komas (Vaalhoek), South Africa (Northern Cape) | 1 | >AD 1798 (Pta-5444), AD 1462–166 (Pta-5452), AD 1444–1630 (Pta-5458), AD 21–120 (Pta-5530) | ceramic final LSA | Webley 2001 |
| ≠Gi, Botswana | 1 | AD 1660–1823 | LSA (similar to ceramic final LSA) | Helgren 1984 |
| ≠Gi, Botswana | 5 | 77 \pm 11 ka | MSA (mixed open-air?) | Kuman 1989; Brooks <i>et al.</i> 1990 |
| Amanzi Springs (Area 1), South Africa (Eastern Cape) | 11 | 398.7 \pm 31.6 ka, 403.9 \pm 23.4 ka | late Acheulean | Herries <i>et al.</i> 2022 |
| Apollo 11, Namibia | 2 | 13 631–13 246 BC (KIA-3591), 13 796–13 334 BC (KIA-35914), 11 5447–15 128 BC (KIA-35916) | Robberg | Vogelsang <i>et al.</i> 2010 |
| Apollo 11, Namibia | 2–3 | 29 085–27 185 BC (Pta-1032), 32 311–30 298 BC (KIA35917), 29.4 \pm 1.4 ka, 30.1 \pm 1.6 ka, 34 638–31 442 BC (KN-4068), 34 289–32 672 BC (Pta-1040), 34 957–32 617 BC (KN-1813), 37 135–34 377 BC (KN-2056) | late MSA I (consistent with final MSA) | Vogelsang <i>et al.</i> 2010 |
| Apollo 11, Namibia | 3 | 42 317–37 048 BC (KN-4069), 41 467–37 898 BC (KN-2115), 42 449–38 746 BC (KN-1869) | late MSA II | Vogelsang <i>et al.</i> 2010 |
| Apollo 11, Namibia | 3 | 43 926–42 686 BC (KIA55918), 42.9 \pm 2.7 ka, 47 556–42 466 BC (Pta-1041), 55.9 \pm 3.0 ka | late MSA III (consistent with post-Howiesons Poort/Sibudu) | Vogelsang <i>et al.</i> 2010; Jacobs & Roberts 2017 |
| Apollo 11, Namibia | 4 | 63 \pm 6 ka, 63.2 \pm 2.3 ka, 64.7 \pm 2.8 ka, 66.3 \pm 3 ka, 69 \pm 7 ka | Howiesons Poort | Miller <i>et al.</i> 1999; Vogelsang <i>et al.</i> 2010; Jacobs & Roberts 2017 |
| Apollo 11, Namibia | 4 | 70 \pm 2.9 ka, 70.7 \pm 2.5 ka | Still Bay | Vogelsang <i>et al.</i> 2010; Jacobs & Roberts 2017 |
| Atmar Farm (Sundays River), South Africa (Eastern Cape) | 16 | 650 \pm 120 ka | Acheulean | Lotter & Kuman 2018a |
| Balerno Main Shelter, South Africa (Limpopo) | 1 | AD 880–1073 (Pta-8614), AD 652–776 (Pta-8603) | ceramic final LSA | Van Doornum 2007 |
| Balerno Main Shelter, South Africa (Limpopo) | 1 | AD 27–244 (Pta-7997), 211–51 BC (Pta-8609) | final LSA | Van Doornum 2007 |
| Barberspan, South Africa (North West) | 3 | 43.2 \pm 5 ka | MSA | Caruana <i>et al.</i> 2020 |
| Batlharos 1, South Africa (Northern Cape) | 1 | AD 1664–1815 | LSA | Beaumont & Vogel 1989 |
| Bernol Farm (Sundays River), South Africa (Eastern Cape) | 34 | 1.14 \pm 0.2 Ma | Acheulean | Lotter & Kuman 2018a |
| Bestwood 1, South Africa (Northern Cape) | 10 | 366 \pm 32 ka | Fauresmith | Richard <i>et al.</i> 2020 |
| Biesje Poort 2, South Africa (Northern Cape) | 1 | AD 1460–1661 (Pta-9505), AD 1030–1181 (Pta-9506), AD 416–605 (Pta-5578) | ceramic final LSA | Beaumont <i>et al.</i> 1995; Parsons 2008 |
| Big Elephant Shelter, Namibia | 1 | AD 542–881 (UCLA-724B), | Similar to final LSA | Wadley 2012 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-----|--|---|---|
| | | 802–412 BC (UCLA-724A), 826–514 BC (Pta-1556), 892–1054 BC (Pta-1558), 1442–1224 BC (Pta-1557) | | |
| Blind River, South Africa (Eastern Cape) | 5 | <118 ± 7 ka | <i>Homo sapiens</i> | Wang <i>et al.</i> 2008 |
| Blinkklipkop, South Africa (Northern Cape) | 1 | >AD 1810 (Pta-2841), AD 1721–1813 (Pta-2833), AD 1497–1699 (Pta-2839), AD 846–1022 (Pta-2840), AD 880–1022 (Pta-2835) | ceramic final LSA | Thackeray <i>et al.</i> 1983 |
| Bloeddrift 23, South Africa (Northern Cape) | 1 | AD 1503–1595 (Pta-7942) | ceramic final LSA | Smith <i>et al.</i> 2001 |
| Blombos Cave, South Africa (Western Cape) | 1 | AD 1625–1670 (Pta-6184), AD 116–364 (Pta-6185), AD 56–130 (Wk-25554) | ceramic final LSA | Henshilwood 2008 |
| Blombos Cave, South Africa (Western Cape) | 4–5 | 67 ± 7 ka, 68 ± 6 ka, 81 ± 10 ka, 69.0 ± 4.0 ka, 77.1 ± 4.1 ka, 71.5 ± 4.3 ka, 72.3 ± 3.8 ka, 73.7 ± 4.2 ka, 75.1 ± 3.2 ka, 77 ± 8 ka, 77.5 ± 3.8 ka, 82 ± 8 ka, 105 ± 9 ka | Still Bay (M1, M2 upper), <i>H. sapiens</i> | Grine <i>et al.</i> 2000; Grine & Henshilwood 2002; Tribolo <i>et al.</i> 2006; Henshilwood <i>et al.</i> 2011; Jacobs <i>et al.</i> 2020 |
| Blombos Cave, South Africa (Western Cape) | 4–5 | 71.0 ± 4.0 ka, 76 ± 7 ka, 77.4 ± 4.2 ka, 80.0 ± 7.8 ka, 82.9 ± 3.8 ka, 85.5 ± 4.3 ka | pre-Still Bay (M2 lower), <i>H. sapiens</i> | Grine & Henshilwood 2002; Jacobs <i>et al.</i> 2020 |
| Blombos Cave, South Africa (Western Cape) | 5 | 77.4 ± 6.5 ka, 81.5 ± 4.7 ka, 83.4 ± 3.8 ka, 84.7 ± 3.9 ka, 85.3 ± 4.0 ka, 85.9 ± 4.1 ka, 86.3 ± 4.2 ka, 86.3 ± 4.2 ka, 88.0 ± 3.9 ka, 88.2 ± 5.3 ka, 88.7 ± 4.2 ka, 89.1 ± 5.1 ka, 90.9 ± 4.3 ka, 92.1 ± 4.6 ka, 93.2 ± 4.3 ka, 93.3 ± 4.1 ka, 94.0 ± 5.6 ka, 94.9 ± 4.8 ka, 99.3 ± 5.0 ka, 100.9 ± 4.6 ka, 108.7 ± 11.8 ka | MSA M3 (Mossel Bay) <i>H. sapiens</i> | Grine <i>et al.</i> 2000; Grine & Henshilwood 2002; Tribolo <i>et al.</i> 2006; Henshilwood <i>et al.</i> 2011; Jacobs <i>et al.</i> 2020 |
| Blombos Cave, South Africa (Western Cape) | 5 | 100.3 ± 7.6 ka, 101.0 ± 6.0 ka, 110.2 ± 4.8 ka | MSA pre-M3 | Jacobs <i>et al.</i> 2020 |
| Blombosfontein 1, South Africa (Western Cape) | 1 | 5926–5668 BC (Pta-6177) | Wilton | Henshilwood 2008 |
| Blombosfontein 2, South Africa (Western Cape) | 1 | 5727–5512 BC (Pta-6181) | Wilton | Henshilwood 2008 |
| Blombosfontein 3, South Africa (Western Cape) | 1 | 4996–4611 BC (Pta-6180) | Wilton | Henshilwood 2008 |
| Blombosfontein 4, South Africa (Western Cape) | 1 | 4620–4347 BC (Pta-6176) | Wilton | Henshilwood 2008 |
| Blombosfontein 5, South Africa (Western Cape) | 1 | 4461–4224 BC (Pta-6182) | Wilton | Henshilwood 2008 |
| Blombosfontein 6, South Africa (Western Cape) | 1 | 2142–1746 BC (Pta-6709), 2776–2451 BC (Pta-6178) | Wilton | Henshilwood 2008 |
| Blombosfontein 7, South Africa (Western Cape) | 1 | 1445–1196 BC (Pta-6179), 1458–1291 BC (Pta-6183) | final LSA | Henshilwood 2008 |
| Blombosfontein 9, South Africa (Western Cape) | 1 | AD 1402–1510 (Pta-6187), AD 1026–1226 (Pta-6248) | ceramic final LSA | Henshilwood 2008 |
| Boegoeberg 2, South Africa (Northern Cape) | 3 | 44 242–46 709 BP (Pta-6956) | MSA | Klein <i>et al.</i> 1999; Dewar & Stewart 2016 |
| Bokvasmaak 3, South Africa (Northern Cape) | 1 | >AD 1797 (Pta-4872) | ceramic final LSA | Beaumont <i>et al.</i> 1995; Parsons 2008 |
| Boomplaas, Western Cape | 1 | AD 416–656 (UW-307), AD 340–557 (UW-337), AD 239–436 (UW-338) | ceramic final LSA | Deacon 1982, 1984 |
| Boomplaas, South Africa (Western Cape) | 1 | 52–242 BC (UW-336) | final LSA | Deacon 1982, 1984 |
| Boomplaas, South Africa (Western Cape) | 1 | 5480–5270 BC (UW-306) | Wilton | Deacon 1982, 1984 |
| Boomplaas, South Africa (Western Cape) | 1 | 8627–7807 BC (UW-410), 10 684–9889 BC (UW-411) | Oakhurst | Deacon 1982, 1984 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|--|------------------------------------|--|
| Boomplaas, South Africa (Western Cape) | 1–2 | 10 669–10 578 BC (OxA-33812), 11 911–11 649 BC (OxA-33811), 12 179–11 657 BC (Pta-1828), 13 151–12 159 BC (UW-412), 14 055–13 680 BC (Pta-2259), 16 042–14 592 BC (UW-301), 20 129–19 063 BC (Pta-3283) | Robberg | Deacon 1982, 1984; Pargeter <i>et al.</i> 2018 |
| Boomplaas, South Africa (Western Cape) | 2–3 | 20 066–19 486 BC (OxA-33815), 23 835–23 017 BC (Pta-2298), 23 940–23 179 BC (Pta-1810), 24 151–22 319 BC (UW-300) | early LSA | Deacon 1982, 1984; Pargeter <i>et al.</i> 2018 |
| Boomplaas, South Africa (Western Cape) | 3 | 31 220–30 320 BP (Pta-2268), 37 490–36 000 BP (Pta-2274), 38 370–34 980 BP (UW-304), 39 600–34 970 BP (Beta-33543), 39 690–37 890 BP (OxA-33818), 39 970–38 360 BP (Pta-2220), 40 130–36 350 (Pta-2219), 40 250–38 540 BP (OxA-33819) | late MSA | Deacon 1982, 1984; Pargeter <i>et al.</i> 2018 |
| Boomplaas, South Africa (Western Cape) | 3–4 | 35.2 ± 2.6 ka, 36 890–34 480 BP (Pta-2302), 44 ± 4 ka, 44 550–39 370 BP (Pta-1811), 61 210–46 880 BP (OxA-33820) | MSA | Deacon 1982, 1984; Pargeter <i>et al.</i> 2018 |
| Boomplaas, South Africa (Western Cape) | 4 | 56 ± 6 ka, 58 ± 3.7 ka, 64 ± 3.2 ka, 66.1 ± 13 ka | Howiesons Poort | Deacon 1978; Pargeter <i>et al.</i> 2018 |
| Border Cave, South Africa (KwaZulu-Natal) | 3 | 40 316–37 688 BC (Pta-423), 40 742–38 047 BC (Pta-422), 42 241–39 196 BC (Pta-4711), 42 267–40 532 BC (Pta-4880), 42 658–39 387 BC (Pta-4779), 42 862–39 606 BC (Pta-4744), 42 977–38 777 BC (Pta-4697), 43 591–38 900 BC (Pta-704), 46 773–38 746 BC (Pta-4793), 47 776–39 515 BC (Pta-4776) | early LSA | Beaumont & Vogel 1972; Beaumont <i>et al.</i> 1978; Vogel <i>et al.</i> 1986; Wadley 1993 |
| Border Cave, South Africa (KwaZulu-Natal) | 3 | 39 ± 4 ka, 47 ± 2 ka | late post-Howiesons Poort | Beaumont 1978; Grün <i>et al.</i> 2003 |
| Border Cave, South Africa (KwaZulu-Natal) | 4 | 60 ± 3 ka | early post-Howiesons Poort | Beaumont 1978; Grün <i>et al.</i> 2003 |
| Border Cave, South Africa (KwaZulu-Natal) | 4–5 | 56 ± 2 ka, 64.2 ka, 64 ± 3 ka, 72 ± 4 ka, 74 ± 4 ka, 74 ± 5 ka | epi-Pietersburg, <i>H. sapiens</i> | Beaumont 1994; Grün <i>et al.</i> 2003; d'Errico & Backwell 2016 |
| Border Cave, South Africa (KwaZulu-Natal) | 5 | 77 ± 2 ka | Pietersburg | Grün <i>et al.</i> 2003; Backwell <i>et al.</i> 2018 |
| Border Cave, South Africa (KwaZulu-Natal) | 5 | 113 ± 5 ka, 115 ± 8 ka | late Pietersburg | Beaumont 1978; Grün <i>et al.</i> 2003 |
| Border Cave, South Africa (KwaZulu-Natal) | 6 | 144 ± 11 ka, 161 ± 10 ka, 168 ± 5 ka, 183 ± 20 ka | early Pietersburg | Beaumont 1978; Grün <i>et al.</i> 2003 |
| Border Cave, South Africa (KwaZulu-Natal) | 7 | 227 ± 11 ka | MSA | Beaumont 1978; Grün <i>et al.</i> 2003 |
| Brand se Baai, South Africa (Western Cape) | 1 | AD 1148–1288 (Pta-6050) | LSA (similar to ceramic final LSA) | Halkett <i>et al.</i> 1993 |
| Brand se Baai, South Africa (Western Cape) | 1 | 209–47 BC (Pta-6052), 591–387 BC (Pta-6049), 1228–922 BC (Pta-6051), 3346–3024 BC (Pta-6053) | LSA (similar to final LSA) | Halkett <i>et al.</i> 1993 |
| Buffelskloof, South Africa (Western Cape) | 1 | 2471–2021 BC (UW-341), 3993–3706 BC (Pta-1481), 6401–5967 BC (UW-340), 6427–6213 BC (Pta-1841) | Wilton | Opperman 1978 |
| Buffelskloof, South Africa (Western Cape) | 1 | 8286–7787 BC (Pta-1484), 11 941–11 536 BC (Pta-1805) | Oakhurst | Opperman 1978 |
| Bundu Farm, South Africa (Northern Cape) | 6 | 145.7 ± 16 ka | early MSA | Kiberd 2006 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|--------------|--|---|--|
| Bundu Farm, South Africa (Northern Cape) | 8 | 245 ka | ESA/lower levels (Fauresmith) | Kiberd 2006 |
| Bushman Rock Shelter, South Africa (Mpumalanga) | 1–2 | 8931–8617 BC, 9160–8705 BC, 9687–9242 BC, 12 221–11 797 BC, 12 376–11 831 BC, 13 155–12 241 BC, 13 173–12 133 BC | Oakhurst | Sampson 1974 |
| Bushman Rock Shelter, South Africa (Mpumalanga) | 5 | 73 ± 6 ka, 91 ± 10 ka | upper Pietersburg | Porraz <i>et al.</i> 2018 |
| Bushman Rock Shelter, South Africa (Mpumalanga) | 5 | 75 ± 6 ka, 97 ± 10 ka | lower Pietersburg | Porraz <i>et al.</i> 2018 |
| Buzz Shelter, South Africa (Western Cape) | 1 | 3370–3017 BC (AA89911), 4358–4159 BC (AA89912) | Wilton | Orton <i>et al.</i> 2011 |
| Byneskranskop 1, South Africa (Western Cape) | 1 | AD 1483–1690 (Pta-1864), AD 1383–1450 (Pta-1866), AD 23–250 (Pta-1865) | ceramic final LSA | Schweitzer & Wilson 1982 |
| Byneskranskop 1, South Africa (Western Cape) | 1 | 1775–1503 BC (Pta-1569) | final LSA | Schweitzer & Wilson 1982 |
| Byneskranskop 1, South Africa (Western Cape) | 1 | 2488–2140 BC (Pta-1571), 5320–4660 BC (UW-409), 5478–5202 BC (Pta-1772), 5563–5357 BC (Pta-1905), 6777–6394 BC (Pta-2347) | Wilton | Schweitzer & Wilson 1982 |
| Byneskranskop 1, South Africa (Western Cape) | 1 | 9315–9043 BC (Pta-1587) | Oakhurst | Schweitzer & Wilson 1982 |
| Byneskranskop 1, South Africa (Western Cape) | 2 | 13 719–12 331 BC (I-7948) | Robberg | Schweitzer & Wilson 1982 |
| Canteen Kopje (Hutton Sands), South Africa (Northern Cape) | 1 | 0.13 ± 0.01 ka, AD 1436–present | late Holocene Smithfield (consistent with final LSA) | Forssman <i>et al.</i> 2010; Chazan <i>et al.</i> 2013 |
| Canteen Kopje (Hutton Sands), South Africa (Northern Cape) | 1 | 11.3 ± 0.4 | LSA (consistent with Oakhurst) | Chazan <i>et al.</i> 2013 |
| Canteen Kopje (Pit 6), South Africa (Northern Cape) | 36 or ≥51 | 1.2 ± 0.7 Ma, 1.51 ± 0.8 Ma, >1.51 Ma | early Acheulean | Leader 2014 |
| Cave James, South Africa (Gauteng) | 1 | 2464–2141 BC (Wits-1383) | final LSA | Wadley 1987, 1996a |
| Cave James, South Africa (Gauteng) | 1 | 5230–4776 BC (Wits-1744) | Wilton | Wadley 1987, 1996a |
| Cave James, South Africa (Gauteng) | 3 | >29 000 bp (Wits-1386) | early LSA | Wadley 1987, 1993 |
| Cave of Hearths, South Africa (Limpopo) | 19 | <780 ka | late Acheulean, <i>H. heidelbergensis</i> or archaic <i>H. sapiens</i> | Tobias 1971; Curnoe 2009; Latham & Herries 2009 |
| Clarke's Shelter, South Africa (KwaZulu-Natal) | 1 | AD 406–596 (Pta-2973), AD 362–88 BC (Pta-2971) | ceramic final LSA | Mazel 1984a |
| Collingham Shelter, South Africa (KwaZulu-Natal) | 1 | AD 1277–1401 (Pta-5092), AD 663–881 (Pta-5408), AD 202–412 (Pta-5274), AD 125–380 (Pta-5096), AD 117–402 (Pta-5265), AD 107–265 (Pta-5098), AD 50–247 (Pta-5101) | ceramic final LSA | Mazel 1992 |
| Cooper's Cave D, South Africa (Gauteng) | 52 | 1.526 ± 0.088 Ma (refined age estimate) | ESA (Mode 1/Oldowan) | De Ruiter <i>et al.</i> 2009; Sutton <i>et al.</i> 2017 |
| Cornelia-Uitzoek, South Africa (Free State) | 27–31 | 0.99–1.07 Ma | Acheulean | Brink <i>et al.</i> 2012 |
| Cunene, Namibia | 7 | 223.8 ± 22.2 ka | early MSA | Nicoll 2010 |
| De Hoop, South Africa (Free State) | 1 | 2061–1749 BC (Pta-6785), 1128–818 BC (Pta-6787) | final LSA | Klatzow 2010 |
| Depression Rock Shelter, Botswana | 1 | 51 BC–AD 365, AD 1412–1670 | ceramic final LSA | Robbins & Campbell 1989 |
| Depression Rock Shelter, Botswana | 1 | 11 819–9881 BC | Oakhurst | Robbins & Campbell 1989 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-----|--|---|---|
| Depression Rock Shelter, Botswana | 2 | 14 457–12 818 BC | Robberg | Robbins & Campbell 1989 |
| Depression Rock Shelter, Botswana | 2 | 21 393–20 468 BC | Similar to early LSA | Robbins & Campbell 1989 |
| Deurspring 16, South Africa (Western Cape) | 1 | 991–802 BC (Pta-7129), 3340–3010 BC (Pta-6742), 4341–4041 BC (Pta-7132), 4453–4242 BC (Pta-6740) | Similar to final LSA | Jerardino <i>et al.</i> 2016 |
| Diamond Shelter, South Africa (KwaZulu-Natal) | 1 | 3796–3515 BC (Pta-3246) | Wilton | Mazel 1984a |
| Diana's Vow, Namibia | 1 | 10 796–10 520 BC | Lockshoek (similar to Oakhurst) | Cooke 1979 |
| Die Kelders, South Africa (Western Cape) | 1 | AD 425–559 (weighted mean), AD 370–773 (GX-1685), AD 202–657 (GaK-3955), AD 202–59 (GaK-3877), 53 BC–AD 204 (weighted mean), 1058–512 BC (GaK-3878) | ceramic final LSA | Schweitzer 1979, 1984; Deacon 1982; Sadr & Sampson 2006 |
| Die Kelders, South Africa (Western Cape) | 3 | 50.6 ± 4.6 ka, 50.7 ± 4.7 ka, 51.4 ± 6 ka | late MSA (post-HP?), <i>H. sapiens</i> | Feathers & Bush 2000; Grine 2000; Schwarcz & Rink 2000; Thackeray 2000 |
| Die Kelders, South Africa (Western Cape) | 4–5 | 58.6 ± 5.4 ka, 67 ± 10 ka, 69.9 ± 6.5 ka, 70.3 ± 5.8 ka, 75.3 ± 6.8 ka, 79.7 ± 15.6 ka | middle MSA (Levallois & blades), <i>H. sapiens</i> | Feathers & Bush 2000; Grine 2000; Schwarcz & Rink 2000; Thackeray 2000 |
| Diepkloof, South Africa (Western Cape) | 3 | 43.6 ± 1.9 ka, 51.9 ± 2.3 ka | post Howiesons Poort, <i>H. sapiens</i> | Tribolo <i>et al.</i> 2013; Verna <i>et al.</i> 2013; Feathers 2015; Jacobs & Roberts 2017 |
| Diepkloof, South Africa (Western Cape) | 3–5 | 49.1 ± 2.2 ka, 52 ± 5 ka, 56.0 ± 2.5 ka, 57.5 ± 2.6 ka, 59.2 ± 2.7 ka, 60.8 ± 2.6 ka, 52 ± 5 ka, 61.6 ± 2.7 ka, 63.1 ± 3.9 ka, 65 ± 8 ka, 65.9 ± 3.0 ka, 72.7 ± 4.6 ka, 77 ± 8 ka, 79.4 ± 8.1 ka, 79.7 ± 5.8 ka, 83 ± 8 ka, 85 ± 9 ka, 105 ± 10 ka, 109 ± 10 ka | Howiesons Poort, <i>H. sapiens</i> | Tribolo <i>et al.</i> 2013; Verna <i>et al.</i> 2013; Feathers 2015; Jacobs & Roberts 2017 |
| Diepkloof, South Africa (Western Cape) | 4–5 | 65.1 ± 2.8 ka, 73.2 ± 5.9 ka, 76.5 ± 3.3 ka, 88.2 ± 4.4 ka, 88.4 ± 4.0 ka, 93.3 ± 4.4 ka, 109 ± 10 ka | Still Bay | Tribolo <i>et al.</i> 2013; Jacobs & Roberts 2017 |
| Diepkloof, South Africa (Western Cape) | 5 | 89 ± 9 ka | MSA/Jack | Tribolo <i>et al.</i> 2013 |
| Diepkloof, South Africa (Western Cape) | 5 | 100 ± 10 ka | pre-Still Bay | Tribolo <i>et al.</i> 2013 |
| Diepkloof, South Africa (Western Cape) | 5 | 100 ± 10 ka, 107 ± 11 ka | MSA/uncharacterised lower deposit | Tribolo <i>et al.</i> 2013 |
| Dikbosch 1, South Africa (Northern Cape) | 1 | AD 425–60 (Pta-3412), AD 248–437 (Pta-3413) | ceramic final LSA | Humphreys & Thackeray 1983 |
| Dikbosch 1, South Africa (Northern Cape) | 1 | 1443–1119 BC (Pta-1065) | final LSA | Humphreys & Thackeray 1983 |
| Dikbosch 1, South Africa (Northern Cape) | 1 | 7057–6688 BC (Pta-3411) | Wilton | Humphreys & Thackeray 1983 |
| Dikbosch 1, South Africa (Northern Cape) | 2 | 13 042–12 173 BC (Pta-1067), 14 309–13 538 BC (Pta-1200), 14 670–13 904 BC (Pta-1288), 15 081–14 317 BC (Pta-1068) | Oakhurst | Humphreys & Thackeray 1983 |
| Driekoppen, South Africa (Eastern Cape) | 2 | 32 261–20 261 BP (GdTI-203) | Similar to early LSA | Wallsmith 1990 |
| Driekoppen, South Africa (Eastern Cape) | 3 | 45 661–33 661 BP (GdTI-204) | Consistent with late MSA | Wallsmith 1990 |
| Driel Shelter, South Africa (KwaZulu-Natal) | 1 | AD 225–390 (Pta-1384) | ceramic final LSA | Maggs & Ward 1980 |
| Drimolen, South Africa (Gauteng) | 77 | 2.041 ± 0.24 Ma | <i>H. erectus</i> , <i>Homo</i> sp. | Keyser <i>et al.</i> 2000; Moggi-Cecchi <i>et al.</i> 2010; Herries <i>et al.</i> 2020 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-----|--|--|---|
| Drotsky's Cave, Botswana | 1 | 4461–4050 BC | Similar to final LSA | Robbins <i>et al.</i> 1996 |
| Drotsky's Cave, Botswana | 1 | 11 073–10 812 BC, 12 098–11 785 BC | Oakhurst | Robbins <i>et al.</i> 1996 |
| Duinefontein II, South Africa (Western Cape) | 8 | 265 ± 48 ka, 272 ± 83 ka, 292 ± 55 ka | Acheulean | Feathers 2002 |
| Dunefield Midden 1, South Africa (Western Cape) | 1 | AD 772–987 (Pta-6738), AD 771–901 (Pta-5031), AD 1380–1450 (Pta-7889), AD 1276–1396 (Pta-4799), AD 966–1185 (Pta-6732), AD 888–1024 (Pta-5070), AD 916–986 (Pta-6735), AD 635–888 (Pta-4801) | Consistent with ceramic final LSA | Orton 2004; Parkington 2013 |
| Dunefield Midden 1, South Africa (Western Cape) | 1 | 5533–4981 BC (IT-C-1905) | Group 3 assemblage (similar to Wilton) | Orton 2020 |
| Dzombo Shelter, Botswana | 1 | AD 1810–present (OxA-27139), AD 1879–1928 (OxA-342860), AD 1668–1785 (OxA-27136), AD 1026–1160 (OxA-27138), 594–401 BC (OxA-27137) | Consistent with ceramic final LSA | Forssman 2014 |
| Elands Bay Cave, South Africa (Western Cape) | 1 | AD 1462–1674 (Pta-1815), AD 674–776 (Pta-5595), AD 202–413 (Pta-5820) | ceramic final LSA | Orton 2004 |
| Elands Bay Cave, South Africa (Western Cape) | 1 | 200–98 BC (Pta-5810), 2885–2566 BC (Pta-5805) | final LSA | Orton 2004 |
| Elands Bay Cave, South Africa (Western Cape) | 1 | 2885–2566 BC (Pta-5805), 3110–2867 BC (Pta-5313), 7044–6569 BC (Pta-1872), 7081–6598 (Pta-1829), 7206–6694 (AA-5832), 7531–7136 (Pta-1871), 8231–7651 (Pta-5305) | Wilton | Mitchell <i>et al.</i> 1996; Parkington 2012 |
| Elands Bay Cave, South Africa (Western Cape) | 1 | 9232–8704 BC (Pta-868), 9253–8736 BC (Pta-5306), 9770–8731 BC (OxA-456), 9324–8775 BC (Pta-3086), 9811–9266 BC (Pta-2481), 10230–9237 BC (UW-193), 10386–8710 BC (Pta-2592), 10558–10022 BC (Pta-5336), 10791–10478 (Pta-5361), 10806–10479 BC (Pta-732), 10816–10486 BC (Pta-5369), 10839–10515 BC (Pta-737), 10963–10783 BC (AA-5833), 11222–10510 BC (OxA-478) | Oakhurst, <i>H. sapiens</i> | Soper 1974; Morris 1992; Mitchell <i>et al.</i> 1996; Orton 2004; Parkington 2012 |
| Elands Bay Cave, South Africa (Western Cape) | 2 | 11 494–11 208 BC (AA-5834), 11 232–10 789 (UW-192), 14 938–14 013 BC (Pta-4321), 13 568–11 841 (GaK-4338), 14 938–14 013 BC (Pta-4321) | Robberg | Soper 1974; Maggs 1977; Wadley 1993; Orton 2004 |
| Elands Bay Cave, South Africa (Western Cape) | 2 | 20097–19040 BC (Pta-5308), 22 903–21 835 BC (Pta-1597), 23 278–22 029 BC (Pta-5304) | early LSA | Parkington 1992; Wadley 1993 |
| Elands Bay Cave, South Africa (Western Cape) | 3 | 33 270 ± 430 bp, 35 ± 3 ka, 37 ± 3 ka | late MSA | Tribolo <i>et al.</i> 2016; Porráz <i>et al.</i> 2016 |
| Elands Bay Cave, South Africa (Western Cape) | 5–8 | 83 ± 14 ka, 227 ± 22 ka, 231 ± 20 ka, 249 ± 24 ka | early MSA | Tribolo <i>et al.</i> 2016; Porráz <i>et al.</i> 2016 |
| Equus Cave, South Africa (Northern Cape) | 1 | 590–349 BC (Pta-2452) | LSA (consistent with final LSA) | Vogel <i>et al.</i> 1986 |
| Equus Cave, South Africa (Northern Cape) | 1 | 3957–3700 BC (Pta-2789), 4370–4050 BC (Pta-2791), 6443–6211 BC (Pta-2495) | Wilton | Vogel <i>et al.</i> 1986 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-------|---|---|---|
| Equus Cave, South Africa (Northern Cape) | 1 | 11 291–9931 BC (Pta-4051) | Oakhurst | Vogel <i>et al.</i> 1986 |
| Equus Cave, South Africa (Northern Cape) | 2 | 23660–22394 BC (OxA-4277), 18121–17251 BC ([no lab number]), 9756–8816 BC (AA-5826) | <i>H. sapiens</i> | Grine & Klein 1985; Scott 1987; Scott <i>et al.</i> 2022 |
| Erb Tanks, Namibia | 1 | <5 ka | LSA (consistent with Wilton) | McCall <i>et al.</i> 2011 |
| Erb Tanks, Namibia | 3–5 | 45 ka, 60 ka, 65 ka, 85 ka | MSA (open-air mixed) | McCall <i>et al.</i> 2011 |
| Falls Rock Shelter, Namibia | 1 | AD 1219–1404 (Wits-1100), AD 118–111 BC (Pta-2930), AD 60–259 (Pta-2927) | LSA (similar to ceramic final LSA) | Kinahan 2018 |
| Falls Rock Shelter, Namibia | 1 | 3114–2873 BC (Pta-3122), 1769–1492 BC (Pta-3121) | LSA (similar to final LSA) | Kinahan 2018 |
| Faraoskop Rock Shelter, South Africa (Western Cape) | 1 | 111 BC–AD 217 (Pta-4955), 190 BC–AD 75 (Pta-4965), 190 BC–AD 30 (Pta-5283), 201 BC–AD 31 (Pta-5281), 232 BC–AD 28 (Pta-4964), 773–413 BC (Pta-4890), 3132–2893 BC (Pta-4809) | final LSA | Sealy <i>et al.</i> 1992; Manhire 1993 |
| Faraoskop Rock Shelter, South Africa (Western Cape) | 2 | 10 976–10 659 BC (Pta-4816), 11 650–11 221 BC (Pta-4817), 18 361–17 564 BC (Pta-4822) | Robberg | Manhire 1993 |
| Fateng Tsa Pholo, Lesotho | 1 | 5984–5752 BC (UGAMS-04668), 6068–5895 BC (UGAMS-04670) | Wilton | Arthur <i>et al.</i> 2018 |
| Florisbad, South Africa (Free State) | 5 | 121 ± 6 ka, 128 ± 22 ka | MSA | Grün <i>et al.</i> 1996; Kuman <i>et al.</i> 1999 |
| Florisbad, South Africa (Free State) | 6–8 | 133 ± 31 ka, 146 ± 15 ka, 157 ± 21 ka, 259 ± 35 ka, 279 ± 47 ka, 281 ± 73 ka | early MSA, archaic <i>H. sapiens</i> , <i>H. helmei</i> or <i>H. heidelbergensis</i> | Dreyer 1935; Grün <i>et al.</i> 1996; Bruner & Lombard 2020 |
| Ga-Mohana, South Africa (Northern Cape) | 2 | 16 389–16 175 BC | Robberg | Wilkins <i>et al.</i> 2020; Wilkins 2021 |
| Ga-Mohana, South Africa (Northern Cape) | 3 | 39 364–29 745 BC | early LSA | Wilkins <i>et al.</i> 2020; Wilkins 2021 |
| Ga-Mohana, South Africa (Northern Cape) | 3 | 30.9 ± 1.8 ka | final MSA | Wilkins <i>et al.</i> 2020 |
| Ga-Mohana, South Africa (Northern Cape) | 5 | 99.2 ± 7.7 ka, 103 ± 6.5 ka, 109.8 ± 5.7 ka | undescribed MSA | Wilkins <i>et al.</i> 2020 |
| Gehle Shelter, South Africa (KwaZulu-Natal) | 1 | AD 1226–1323 (Pta-1381), AD 674–894 (Pta-3242) | ceramic final LSA | Mazel 1984b |
| Gladysvale (Internal deposits), South Africa (Gauteng) | 7 | 255.30 ± 2.51 ka, 240.80 ± 15.97 ka, 255 ± 30.5 ka | (?archaic) <i>H. sapiens</i> hair | Backwell <i>et al.</i> 2009 |
| Gladysvale (External deposits), South Africa (Gauteng) | 16–18 | 626 ± 48 ka, 650 ± 63 ka, 779 ± 51 ka | Acheulean, <i>Homo</i> sp. | Schmid & Berger 1997; Lacruz <i>et al.</i> 2002 |
| Goedgeloof C1/M1, South Africa (Eastern Cape) | 1 | 1132–902 BC (Pta-4066) | final LSA | Binneman 2004/2005 |
| Goergap 113 KR, South Africa (Limpopo) | 1 | AD 1485–1693 (Pta-5653), AD 1456–1643 (Pta-5511), AD 1386–1484 (Pta-5510), AD 1379–1446 (Pta-5213), AD 1268–1398 (Pta-5507), AD 1226–1329 (Pta-5512), AD 1098–1275 (Pta-5508) | final LSA | Van der Ryst 1998 |
| Gondolin, South Africa (Gauteng) | 64–62 | 1.78 Ma | <i>Homo</i> sp. | Menter <i>et al.</i> 1999; Adams <i>et al.</i> 2007 |
| Good Hope Shelter, South Africa (KwaZulu- Natal) | 1 | 198–51 BC (Pta-838) | ceramic final LSA | Cable <i>et al.</i> 1980 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|---|---|---|
| Good Hope Shelter, South Africa (KwaZulu-Natal) | 1 | 5699–5394 BC (Pta-1480) | Wilton | Cable <i>et al.</i> 1980 |
| Grassridge Rock Shelter, South Africa (Eastern Cape) | 1 | 5211–4783 BC (Pta-2970), 5365–5005 BC (Pta-2713), 5370–5044 BC (Pta-2952), 5913–5538 BC (Pta-2949) | Wilton | Opperman 1988 |
| Grassridge Rock Shelter, South Africa (Eastern Cape) | 3 | 31.6 ± 2.5 ka, 34.3 ± 2.9 ka, 34.4 ± 3.6 ka, 35.3 ± 4.1 ka, 36.4 ± 3.4 ka, 37.6 ± 2.6 ka, 43.1 ± 4.8 ka | final-late MSA | Ames <i>et al.</i> 2020 |
| Groot Kloof, South Africa (Northern Cape) | 8 | 248 ± 37 ka | early MSA | Curnoe <i>et al.</i> 2006 |
| Grootrif B, South Africa (Western Cape) | 1 | 235–52 BC (Pta-4081), 542–147 BC (Pta-4098), 1324–1046 BC (Pta-4067) | LSA (similar to final LSA) | Jerardino & Navarro 2018a |
| Grootrif D, South Africa (Western Cape) | 1 | 401–181 BC (Pta-4075), 763–400 BC (Pta-4085), 791–460 BC (Pta-4083), 935–745 BC (Pta-4060) | LSA (similar to final LSA) | Jerardino & Navarro 2018a |
| Grootrif G, South Africa (Western Cape) | 1 | AD 1286–1396 (Pta-4070), 570–344 BC (Pta-4055), 2468–2286 BC (Pta-8742) | LSA (similar to final LSA) | Jerardino & Navarro 2018a |
| Ha Makotoko, Lesotho | 1 | 7546–7173 BC (Pta-5191), 8282–7780 BC (Pta-5192), 8712–8287 BC (Pta-5204), 9770–9249 BC (Pta-5205) | Oakhurst | Mitchell 1993a; Mitchell & Arthur 2010 |
| Ha Makotoko, Lesotho | 2–3 | 28 047–27 527 BC (UGAMS-11595), 31 392–30 306 BC (UGAMS-11598) | final MSA | Mitchell & Arthur 2014 |
| Ha Makotoko, Lesotho | 3 | 41 171–40 697 BC (UGAMS-11596), 41 964–40 897 BC (UGAMS-8988), 42 201–40 361 BC (OxA-27317), >52 200 BC (OxA-27318) | late MSA | Mitchell & Arthur 2014 |
| Ha Mokotoko, Lesotho | 2 | 13 156–12 852 BC (UGAMS-11594) | Robberg | Mitchel & Arthur 2014 |
| Ha Soloja, Lesotho | 3 | 48 123–37 792 BC (Pta-741), 50 628–40 530 BC (Pta-771) | late MSA | Carter & Vogel 1974 |
| Haalenberg, Namibia | 3 | 40 100 ± 1630 bp (Pta-2115) | MSA (consistent with final MSA) | Vogel & Visser 1981 |
| Hartman valley 95, Namibia | 1 | AD 1178–1277 (KN-5286), AD 596–774 (KN-4851), AD 577–659 (KN-5287) | LSA (similar to final LSA) | Vogelsang & Eichhorn 2011 |
| Heuningneskrans, South Africa (Mpumalanga) | 1 | 6221–5893 BC (Pta-112) | similar to Wilton | Porráz & Val 2019 |
| Heuningneskrans, South Africa (Mpumalanga) | 1 | 8642–8241 BC (Lj-3198), 9685–9241 BC (AA-8563) | consistent with Oakhurst | Porráz & Val 2019 |
| Heuningneskrans, South Africa (Mpumalanga) | 2 | 12 640–11 856 BC (Lj-3150), 14 034–13 351 BC (Pta-100) | consistent with Robberg | Porráz & Val 2019 |
| Heuningneskrans, South Africa (Mpumalanga) | 2 | 21 871–20 800 BC (LJ-3135), 27 630–26 316 BC (AA-8565) 22 761–21 348 BC (LJ-3136), 23 335–21 954 BC (LJ-3137), 24 575–23 839 BC (AA-6451), 26 787–24 896 BC (LJ-3138), 27 610–26 018 BC (AA-8565) | ?early LSA/Robberg | Vogel & Marais 1971; Beaumont & Vogel 1972; Linick 1977; Beaumont 1981; Wadley 1993; Porráz & Val 2019 |
| Heuningneskrans, South Africa (Mpumalanga) | 2 | 29 317–27 965 BP (Pta-101) | final MSA | Vogel & Marais 1971; Porráz & Val 2019 |
| Highlands Rock Shelter, South Africa (Eastern Cape) | 1 | 1985–1739 BC (Pta-563), 3121–2882 BC (Pta-536) | final LSA | Deacon 1976 |
| Hoedjies Punt, South Africa (Western Cape) | 5 | ~130–100 ka | early MSA | Will <i>et al.</i> 2013; Tribolo <i>et al.</i> 2022 |
| Hofmeyr, South Africa (Eastern Cape) | 3 | 36.2 ± 2.2 ka | <i>H. sapiens</i> skull | Grine <i>et al.</i> 2007 |
| Holkrans, South Africa (North West) | 1 | AD 1665–1895 (Beta-265301), AD 1225–1320 (Beta-304277), | LSA (consistent with ceramic final LSA) | Witelson 2016 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-----|---|---|---|
| | | AD 586–688 (Beta-304273), AD 195–344 (Beta-284941), 323–192 BC (Beta-265360) | | |
| Hollow Rock Shelter, South Africa (Western Cape) | 4–5 | 71 ± 3 ka, 73 ± 6 ka, 79.4 ± 8.1 ka | Still Bay | Högberg & Larsson 2011; Högberg & Lombard 2022; Feathers 2015 |
| Hollow Rock Shelter, South Africa (Western Cape) | 5 | 83 ± 3 ka, 87 ± 4 ka | Mossel Bay | Högberg & Larsson 2011; Högberg & Lombard 2022 |
| Hololo Crossing, Lesotho | 1 | AD 1720–1813 (Pta-5411), AD 1439–1711 (Pta-5412) | post-Classic Wilton (consistent with final LSA) | Kaplan & Mitchell 2012 |
| Hope Hill Shelter, South Africa (Gauteng) | 1 | 3362–2856 BC (Wits-1565) | final LSA | Wadley 1989; Wadley & Turner 1987 |
| iNkolimahashi Shelter, South Africa (KwaZulu-Natal) | 1 | AD 1461–1648 (Pta-7227), AD 1390–1456 (Pta-7459), AD 837–990 (Pta-7229), 1580 bp (Pta-7230), AD 410–602 (Pta-7231) | ceramic final LSA | Mazel 1999 |
| iNkolimahashi Shelter, South Africa (KwaZulu-Natal) | 1 | 67 BC–AD 210 (Pta-7384), 776–453 BC (Pta-7232), 540–1048 BC (Pta-7234) | final LSA | Mazel 1999 |
| Iron Pig Rock Shelter, South Africa (Mpumalanga) | 1 | >16000 cal BP to <9000 cal BP | Robberg | Bader <i>et al.</i> 2020 |
| Jagt Pan 7, South Africa (Northern Cape) | 1 | AD 385–599 (Pta-4300), 766–391 BC (Pta-4309), 1002–777 BC (Pta-4193) | final LSA | Beaumont <i>et al.</i> 1995; Parsons 2008 |
| Jakkalsberg A, South Africa (Northern Cape) | 1 | AD 681–750 (Pta-6100), AD 649–883 (Pta-5958) | ceramic final LSA | Brink & Webley 1996; Webley 1997 |
| Jakkalsberg B, South Africa (Northern Cape) | 1 | AD 632–775 (Pta-6101), AD 636–683 (Pta-6122) | ceramic final LSA | Brink & Webley 1996; Webley 1997 |
| Jakkalsberg L, South Africa (Northern Cape) | 1 | 1764–1418 BC (GX-32065) | final LSA | Orton & Halkett 2010 |
| Jakkalsberg N, South Africa (Northern Cape) | 1 | 3352–3009 BC (Pta-8496), 3659–3516 BC (GX-32754A), 3799–3635 BC (GX-32755A) | Wilton | Orton & Halkett 2010 |
| Jubilee Shelter, South Africa (North West) | 1 | AD 699–774 (Wits-1399), AD 465–640 (Wits-1381), AD 116–364 (Wits-1398) | ceramic final LSA | Wadley 1987 |
| Jubilee Shelter, South Africa (North West) | 1 | 1640–906 BC (Wits-1214), 1626–1376 BC (Wits-1449), 2236–1898 BC (Wits-1382), 2881–2440 BC (Wits-1450), 4336–3762 BC (Wits-1462) | Wilton | Wadley 1987, 1989 |
| Jubilee Shelter, South Africa (North West) | 1 | 8242–7027 BC (Wits-1436) | Oakhurst | Wadley 1987 |
| Kabeljous River Mouth 1A, South Africa (Eastern Cape) | 1 | AD 435–636 (Pta-3970) | ceramic final LSA | Binneman 2004/2005 |
| Kabeljous River Mouth 2B, South Africa (Eastern Cape) | 1 | 807–466 BC (Pta-3970) | final LSA | Binneman 2004/2005 |
| Kabeljous River Shelter, South Africa (Eastern Cape) | 1 | 766–391 BC (Pta-4614) | final LSA | Binneman 2006/2007 |
| Kabeljous River Shelter, South Africa (Eastern Cape) | 1 | 4725–4360 BC (Pta-4061) | Wilton | Binneman 2006/2007 |
| Kangkara Cave, South Africa (Western Cape) | 1 | 4266–4038 BC (Pta-2286), 5635–5367 BC (Pta-2287) | Wilton | Deacon 1982, 1984 |
| Kangkara Cave, South Africa (Western Cape) | 1 | 6389–5990 BC (Pta-2812), 8645–8276 BC (Pta-2307) | Oakhurst | Deacon 1982, 1984 |
| Kangkara Cave, South Africa (Western Cape) | 2 | 13 221–12 276 BC (Pta-782), 14 418–13 658 BC (Pta-782) | Oakhurst | Deacon 1982, 1984 |
| Kassimatis, Mozambique | 3 | <38 532–34 716 BC (SR-72) | <i>H. sapiens</i> | Barradas 1965, 1967 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-------|---|---------------------------------------|---|
| Kasteelberg A, South Africa (Western Cape) | 1 | AD 576–773 (OxA-3865), AD 416–640 (Pta-8461), AD 341–602 (OxA-3864), AD 360–436 (Pta-8459), AD 335–414 (Pta-8462), AD 204–390 (Pta-3461), AD 66–362 (Pta-3711) | ceramic final LSA | Smith 1987; Sealy & Yates 1994; Sadr <i>et al.</i> 2003; Sadr 2004 |
| Kasteelberg B, South Africa (Western Cape) | 1 | AD 1665–1895 (Pta-3737), AD 1136–1283 (Pta-3747), AD 1045–1270 (Pta-3787), AD 1042–1229 (Pta-3742), AD 829–990 (Pta-3994), AD 771–990 (Pta-3998), AD 656–894 (Pta-3995) | ceramic final LSA | Smith 1987; Sadr 2004 |
| Kasteelberg D, South Africa (Western Cape) | 1 | AD 434–640 (Pta-8094), AD 423–607 (Pta-8090), AD 337–587 (Pta-8093), AD 324–536 (Pta-8091), AD 205–425 (Pta-8095) | ceramic final LSA | Sadr <i>et al.</i> 2003; Sadr 2004 |
| Kasteelberg E, South Africa (Western Cape) | 1 | AD 203–416 (Pta-8450), AD 16–83 (Pta-8453) | ceramic final LSA | Sadr <i>et al.</i> 2003; Sadr 2004 |
| Kasteelberg G, South Africa (Western Cape) | 1 | AD 423–607 (Pta-8735), AD 361–474 (Pta-8719), AD 331–524 (Pta-8436), AD 16–246 (Pta-8732), 195 BC–AD 65 (Pta-8725) | ceramic final LSA | Sadr <i>et al.</i> 2003; Sadr 2004; Sadr & Sampson 2006 |
| Kasteelberg G, South Africa (Western Cape) | 1 | 776–415 BC (Pta-8452), 792–456 BC (Pta-8446), 2476–2135 BC (Pta-8762) | final LSA | Sadr <i>et al.</i> 2003; Sadr 2004; Sadr & Sampson 2006 |
| Kasteelberg G, South Africa (Western Cape) | 1 | 3374–3011 BC (Pta-8769) | Wilton | Sadr 2004; Sadr & Sampson 2006 |
| Kasteelberg M, South Africa (Western Cape) | 1 | 776–407 BC (Pta-8431) | ceramic final LSA | Sadr <i>et al.</i> 2003 |
| Kasteelberg N, South Africa (Western Cape) | 1 | AD 410–594 (Pta-8443), AD 201–387 (Pta-8441) | ceramic final LSA | Sadr <i>et al.</i> 2003 |
| Kathu Pan 1, South Africa (Northern Cape) | 8 | 291 ± 45 ka | early MSA | Porat <i>et al.</i> 2010 |
| Kathu Pan 1, South Africa (Northern Cape) | 12–14 | 464 ± 47 ka, 542 ± 140/-107 ka | Fauresmith (ESA-MSA transition?) | Porat <i>et al.</i> 2010 |
| Kathu Pan 2, South Africa (Northern Cape) | 1 | AD 199–390, 1324–1004 BC, 3121–2882 BC | LSA (similar to final LSA) | Beaumont & Morris 1990; Wilkins 2021 |
| Kathu Pan 2, South Africa (Northern Cape) | 1 | 6421–6061 BC | LSA (similar to Wilton) | Beaumont & Morris 1990; Wilkins 2021 |
| Kathu Pan 5, South Africa (Northern Cape) | 2 | 22 528–21 112 BC (Pta-3586) | early LSA | Beaumont <i>et al.</i> 1984; Beaumont & Morris 1990; Wadley 1993 |
| Kathu Pan 5, South Africa (Northern Cape) | 3 | 31 270–27 839 BC (I-13040), 31 250–28 788 BC (Pta-3566), 32 ± 0.78 ka, 37 171–33 157 BC (Pta-3591) | final MSA | Beaumont & Morris 1990 |
| Kathu Pan 6, South Africa (Northern Cape) | 1 | 1688–1415 BC | LSA (similar to final LSA) | Beaumont & Morris 1990; Wilkins 2021 |
| Kathu Pan 6, Northern Cape | 1 | 2.3 ± 0.1 ka, 5.7 ± 0.3 ka | Wilton | Lukich <i>et al.</i> 2019 |
| Kathu Pan 6, South Africa (Northern Cape) | 3 | 55 ± 7 ka | Howiesons Poort (open probably mixed) | Lukich <i>et al.</i> 2019 |
| Kathu Pan 6, South Africa (Northern Cape) | 5 | 74 ± 5 ka, 76 ± 8 ka | Howiesons Poort/Still Bay | Lukich <i>et al.</i> 2019 |
| Kathu Pan 6, South Africa (Northern Cape) | 5 | 100 ± 6 ka | Howiesons Poort/Still Bay | Lukich <i>et al.</i> 2019 |
| Kathu Pan 6, South Africa (Northern Cape) | 5–8 | 80 ± 7 ka, 95 ± 6 ka, 106 ± 11 ka, 121 ± 6 ka, 123 ± 8 ka, 157 ± 11 ka, 169 ± 19 ka, 200 ± 11 ka, 275 ± 16 ka | early MSA | Lukich <i>et al.</i> 2019 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|--|--|--|
| Kathu Pan 8, South Africa (Northern Cape) | 1 | AD 678–880, 3382–3029 BC | LSA (similar to final LSA) | Beaumont & Morris 1990; Wilkins 2021 |
| Kathu Pan 8, South Africa (Northern Cape) | 1 | 7040–6569 BC | Wilton | Beaumont & Morris 1990; Wilkins 2021 |
| Kathu Pan 9, South Africa (Northern Cape) | 5 | 91 ± 5 ka | early MSA | Beaumont & Morris 1990; Lukich <i>et al.</i> 2019 |
| Klasies River 1, South Africa (Eastern Cape) | 4 | 56.3 ± 4.6 ka, 65 ka, 66.5 ± 4.8 ka, 70.7 ± 7.4 ka | MSA IV | Bada & Deems 1975; Feathers 2002; Nami <i>et al.</i> 2016 |
| Klasies River 1, South Africa (Eastern Cape) | 5 | 68.4 ± 6.5 ka, 70.9 ± 5.1 ka, 85.2 ± 2.1 ka, 88.3–93.5 ka, 89 ka, 94.6 ± 3.2 ka, 100.8 ± 7.5 ka, 101 ± 12 ka, <126.0 ± 1.5 ka; 106 ± 2.1 ka, 109.8 ± 0.97 ka, 110.06 ± 1.1 ka | Mossel Bay, <i>H. sapiens</i> | Bada & Deems 1975; Grün <i>et al.</i> 1990; Vogel 2001; Feathers 2002; Eggins <i>et al.</i> 2005; Deacon 2008; Millard 2008; Wurz <i>et al.</i> 2018; Grine <i>et al.</i> 2020; Wurz <i>et al.</i> 2022 |
| Klasies River 1, South Africa (Eastern Cape) | 5 | 90 ka, 110 ka, 106.8 ± 12.6 ka, 108.6 ± 3.4 ka | MIS 5 MSA (Klasies River), <i>H. sapiens</i> | Bada & Deems 1975; Vogel 2001; Feathers 2002; Deacon 2008 |
| Klasies River 1A, South Africa (Eastern Cape) | 3–4 | 43.4 ± 3.0 ka, 50.8 ± 6.6 ka, <52 ka, 57 ± 4 ka, 57.9 ± 2.3 ka, 59.3 ± 2.8 ka | post-Howiesons Poort, <i>H. sapiens</i> | Grün <i>et al.</i> 1990; Feathers 2002; Grine 2012; Millard 2008; Tribolo <i>et al.</i> 2013; Jacobs & Roberts 2017 |
| Klasies River 1A, South Africa (Eastern Cape) | 3–5 | 45.6 ± 6.7 ka, 46.7 ± 3.3 ka, 48 ± 4 ka, 50 ± 5 ka, 52 ± 4 ka, 52 ± 6 ka, 52 ± 8 ka, 53 ± 6 ka, 54 ± 6 ka, 54 ± 7 ka, 55 ± 5 ka, 55 ± 8 ka, 56 ± 7 ka, 58 ± 7 ka, 53–64 ka, 63.2 ± 2.7 ka, 65.6 ± 5.3 ka, >80 ka | Howiesons Poort, <i>H. sapiens</i> | Grün <i>et al.</i> 1990; Brooks <i>et al.</i> 1993; Vogel 2001; Feathers 2002; Eggins <i>et al.</i> 2005; Millard 2008; Grine 2012; Tribolo <i>et al.</i> 2013; Jacobs & Roberts 2017 |
| Klasies River 1A, South Africa (Eastern Cape) | 4–5 | 66.4 ± 6.1 ka, 77.4 ± 7.0 ka, 85 ± 8 ka | Mossel Bay, <i>H. sapiens</i> | Grün <i>et al.</i> 1990; Churchill <i>et al.</i> 1996; Vogel 2001; Deacon 2008; Tribolo <i>et al.</i> 2013 |
| Klasies River 1A, South Africa (Eastern Cape) | 5 | 71.8 ± 4.7 ka, 80.6 ± 17.6 ka | pre-Howiesons Poort | Feathers 2002; Jacobs & Roberts 2017 |
| Klasies River 2, South Africa (Eastern Cape) | 3–4 | 52.4 ± 4.0 ka, 63.3 ± 2.9 ka, 66.9 ± 3.3 ka | Howiesons Poort | Feathers 2002; Jacobs & Roberts 2017 |
| Klasies River 2, South Africa (Eastern Cape) | 4 | 69.9 ± 6.2 ka | pre-Howiesons Poort | Jacobs & Roberts 2017 |
| Klein Kliphuis, South Africa (Western Cape) | 3 | 32.6 ± 1.3 ka, 33.3 ± 1.3 ka | final MSA | Jacobs, Roberts <i>et al.</i> 2008; Mackay 2010; Jacobs & Roberts 2017 |
| Klein Kliphuis, South Africa (Western Cape) | 3–4 | 55.2 ± 2 ka, 55.6 ± 2.7 ka, 56.1 ± 2.4 ka, 57.8 ± 2.4 ka, 59.4 ± 2.5 ka, 60.4 ± 2.5 ka | post-Howiesons Poort | Jacobs, Roberts <i>et al.</i> 2008; Mackay 2010; Jacobs & Roberts 2017 |
| Klein Kliphuis, South Africa (Western Cape) | 4 | 59.1 ± 2.4 ka, 59.7 ± 2.7 ka, 62.6 ± 2.6 ka, 64 ± 2.8 ka, 64.7 ± 3 ka, 66.7 ± 3 ka, 68.2 ± 2.8 ka | Howiesons Poort | Jacobs, Roberts <i>et al.</i> 2008; Mackay 2010; Jacobs & Roberts 2017 |
| Klipdrift Cave, South Africa (Western Cape) | 1 | 9031–8816 BC (Beta-347865), 11 132–10 881 BC (Beta-347868), 11 658–11 451 BC (Beta-347866), 11 649–11 451 BC (Beta-347867), 11 832–11 629 BC (Beta-347869) | Oakhurst | Ryano <i>et al.</i> 2017 |
| Klipdrift Shelter, South Africa (Western Cape) | 3 | 51.7 ± 3.3 ka | post-Howiesons Poort | Henshilwood <i>et al.</i> 2014 |

Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|--|--|---|
| Klipdrift Shelter, South Africa (Western Cape) | 4 | 59.4 ± 4.6 ka, 60 ± 4.0 ka, 60.3 ± 3.8 ka, 63.5 ± 4.7 ka, 64.6 ± 4.2 ka, 65.5 ± 4.8 ka | Howiesons Poort, <i>H. sapiens</i> | Henshilwood <i>et al.</i> 2014; Harvati <i>et al.</i> 2015 |
| Klipdrift Shelter, South Africa (Western Cape) | 4 | 71.6 ± 5.1 ka | pre-Howiesons Poort? | Henshilwood <i>et al.</i> 2014 |
| Klipgats Pan, South Africa (Northern Cape) | 1 | AD 991–1048 (UGAMS-21096), AD 1451–1509 (UGAMS-21095), AD 1396–1439 (UGAMS-21094), AD 1348–1390 (UGAMS-21093) | Similar to ceramic final LSA | Orton & Parsons 2018 |
| Kliprandfontein, South Africa (Western Cape) | 2 | 12 397–11 485 BC (DAMA-002439), 14 382–13 987 BC (DAMS-003797), 16 254–15 835 BC (DAMS-001839), 16 551–16 351 BC (DAMS-002440), 17 353–16 974 BC (DAMS-002441), 20 381–20 042 BC (DAMS-003800) | Robberg | Low & Mackay 2018; Low 2019 |
| Knysna Heads, South Africa (Western Cape) | 2 | 10 515–9245 BC (GrA-23223) | <i>H. sapiens</i> | Morris 1992; Stynder <i>et al.</i> 2007 |
| Kreefbaai C, South Africa (Western Cape) | 1 | 763–400 BC (Pta-3313), 767–407 BC (Pta-3589), 763–396 BC (Pta-4047), 1536–1258 BC (Pta-4045) | LSA (similar to final LSA) | Jerardino & Navarro 2018 |
| Kruger Cave, South Africa (Gauteng) | 1 | AD 641–690 (Wits 1153), AD 967–1217 (Wits-1181) | final LSA | Mason 1988 |
| Kruger Cave, South Africa (Gauteng) | 1 | 4539–3901 BC, 5673–5313 BC, 5723–5315 BC, 5738–5467 BC, 831–5477 BC, 56452–6222 BC, 8487–7956 BC, 9261–8606 BC, 9405–8761 BC, 10 021–9316 BC, 10 551–9661 BC, 10 751–9810 BC | Oakhurst | Mason 1988 |
| Kuidas Springs, Namibia | 1 | AD 573–642 (OxA- 27896), AD 1719–1814 (OxA-27891), AD 1726–1810 (OxA-27892), 383–188 BC (OxA-27894) | ceramic final LSA | Veldman <i>et al.</i> 2017 |
| Leholamogoa, South Africa (Limpopo) | 1 | AD 1650–1819 (Beta-236646), AD 1617–1679 (Beta-236647) | ceramic final LSA | Bradfield <i>et al.</i> 2009 |
| Leholamogoa, South Africa (Limpopo) | 1 | 189–44 BC (Beta-236644), 210–39 BC (Beta-236645) | final LSA | Bradfield <i>et al.</i> 2009 |
| Leliehoek, South Africa (Free State) | 1 | 3804–3367 BC (Wits-2009), 4250–3757 BC (Wits-2010) | Wilton | Esterhuysen <i>et al.</i> 1994 |
| Leopard Cave, Namibia | 1 | 208–59 BC (Beta-270163), 673–381 BC (Beta-236963), 1541–1398 BC (Beta-236964), 1293–1047 BC (SocA42299) | Wilton preceramic LSA (similar to final LSA) | Mauran <i>et al.</i> 2020 |
| Leopard Cave, Namibia | 2 | 13 834–13 358 BC (SocA51310) | LSA | Mauran <i>et al.</i> 2020 |
| Likoang, Lesotho | 1 | AD 766–887 (GrA-23237), AD 768–880 (GrA-26831), AD 640–903 (Pta-7877) | ceramic final LSA | Mitchell <i>et al.</i> 2008, 2011 |
| Likoang, Lesotho | 1 | AD 203–255 (Pta-7865), AD 117–340 (Pta-7092), AD 200–250 (Pta-7097), 111 BC–AD 217 (Pta-9048), 141 BC–AD 136 (Pta-7876), 43 BC–AD 73 (Pta-7098), 590–349 BC (Pta-7101), 99–474 BC (GrA-23236), 7919–718 BC (Pta-7093), 1048–812 BC (GrA-23233), 1127–898 BC (GrA-26178), 1445–1196 BC (GrA-23535) | final LSA | Mitchell 2009; Plug <i>et al.</i> 2010; Mitchell <i>et al.</i> 2011 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|---|---|---|
| Limerock, South Africa (Northern Cape) | 1 | AD 28–252, AD 199–390 | LSA (similar to final LSA) | Beaumont & Morris 1990; Wilkins 2021 |
| Lincoln Cave, South Africa (Gauteng) | 5 | 115.3 ± 7.7 ka | MSA | Reynolds <i>et al.</i> 2007 |
| Lincoln Cave, South Africa (Gauteng) | 8 | 252.6 ± 35.6 ka | early MSA | Reynolds <i>et al.</i> 2007 |
| Lion Cavern, Eswatini | 3 | 31 152–29 627 BC (GrN-5020) | final MSA | Vogel 1970 |
| Lion Cavern, Eswatini | 3 | 43.2 + 1.35/–1.2 ka | late MSA/Pietersburg? | Vogel 1970; Dart & Beaumont 1971 |
| Liphofung, Lesotho | 1 | 1003–753 BC (Pta-6106), 3193–2875 BC (Pta-6109), 6381–5789 BC (Pta-6113) | post-Classic Wilton (similar to final LSA) | Kaplan & Mitchell 2012 |
| Lithakong, Lesotho | 1 | AD 1398–1489 (Pta-7077), AD 1150–1273 (Pta-7072) | post-Classic Wilton (consistent with ceramic final LSA) | Kaplan & Mitchell 2012 |
| Lithakong, Lesotho | 1 | 3641–3493 BC (Pta-7075) | post-Classic Wilton (similar to final LSA) | Kaplan & Mitchell 2012 |
| Litsoetse, Lesotho | 1 | AD 1032–1156 (UGAMS-11593), AD 336–476 (OxA-x-2479) | LSA (similar to ceramic final LSA) | Arthur <i>et al.</i> 2018 |
| Little Witkrans, South Africa (Northern Cape) | 1 | AD 21–258, 3638–3329 BC | LSA (similar to final LSA) Wilkins 2021 | Beaumont & Morris 1990; Wilkins 2021 |
| Little Witkrans, South Africa (Northern Cape) | 1 | 6461–6215 BC | Similar to Wilton | Beaumont & Morris 1990; Wilkins 2021 |
| Lovedale, South Africa (Free State) | 4 | 77 ± 7 ka, 69 ± 7 ka, 56 ± 6 ka | Still Bay | Wroth <i>et al.</i> 2022 |
| Lusu, Zimbabwe | 1 | 541 BC–AD 579 | pre-ceramic Wilton (similar to final LSA) | Clark & Fagan 1965 |
| Mafusing 1, South Africa (Eastern Cape) | 1 | AD 246–386 (Beta-327310), AD 123–255 (Beta-327311), 590–400 BC (Beta-346496), 1695–1533 BC (Beta-346499) | final LSA | Pinto <i>et al.</i> 2018 |
| Mafusing 1, South Africa (Eastern Cape) | 1 | 3805–3649 BC (Beta-346500), 6012–5801 BC (Beta-346498) | Wilton | Pinto <i>et al.</i> 2018 |
| Maloney's Kloof Rock Shelter, South Africa (Northern Cape) | 1 | 11 350–10 666 BC | LSA | Doran <i>et al.</i> 2015 |
| Maqonqo Shelter, South Africa (KwaZulu-Natal) | 1 | 2031–1689 BC (Pta-6244), 2670–2469 BC (Pta-6245), 2871–2557 BC (Pta-6256), 925–2864 BC (Pta-5900), 3533–3122 BC (Pta-6251), 3643–3490 BC (Pta-5898), 3823–3624 BC (Pta-6255), 4620–4347 BC (Pta-6253), 5381–5001 BC (Pta-6258), 6515–6014 BC (Pta-6260), 8214–7468 BC (Pta-6259) | Wilton | Mazel 1996 |
| Matjes River, South Africa (Western Cape) | 1 | 3379–3319 BC (Pta-6877), 3539–3369 BC (Pta-6856), 4253–3968 BC (UCLA-1746-C-1), 4333–4039 BC (Pta-6976), 4341–4041 BC (Pta-6975), 4691–4361 BC (Pta-6917), 5666–5526 BC (Pta-6811), 6016–5716 BC (Pta-6691), 6008–5837 BC (Pta-6817), 6225–6054 BC (OxA-V-2064-52), 6412–6076 BC (Pta-6988) | Wilton | Döckel 1998; Sealy <i>et al.</i> 2006 |
| Matjes River, South Africa (Western Cape) | 1 | 6269–6081 BC (Pta-6823), 6588–6432 BC (Pta-6831), 7051–6564 BC (Pta-6688), 549–6083 BC (Pta-6687), 9331–8426 BC (Pta-6686), 9244–9115 BC (OxA-V-2064-56), 9384–8811 BC (Pta-6937), 9478–9201 BC (Pta-6936), 9690–9352 BC (Pta-6925), | Oakhurst, <i>H. sapiens</i> | Protsch & Oberholzer 1975; Morris 1992; Döckel 1998; Sealy <i>et al.</i> 2006 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|---|--|---|
| | | 9838–9661 BC (Pta-6838), 9979–9811 BC (Pta-6951), 10 385–9231 BC (UCLA-1746-C-2), 10 524–9269 BC (Pta-6848), 12 126–10 473 BC (L-336H) | | |
| Mauermanshoek, South Africa (Free State) | 1 | AD 1654–1895 (Pta-5929) | ceramic final LSA | Wadley 2001 |
| Mauermanshoek, South Africa (Free State) | 1 | AD 340–429 (Pta-6301), 1982–1672 BC (Pta-5930) | final LSA | Wadley 2001 |
| Mbabane Shelter, South Africa (KwaZulu-Natal) | 1 | AD 1410–1509 (Pta-3848), AD 1394–1508 (Pta-3684), AD 468–657 (Pta-3678) | ceramic final LSA | Mazel 1986a |
| Maidenhead 1, South Africa (Northern Cape) | 1 | AD 1654–1895 | LSA (similar to ceramic final LSA) | Beaumont & Vogel 1989 |
| Melikane, Lesotho | 3 | 22 611–21 777 BC (OxA-23028) | early LSA | Stewart <i>et al.</i> 2012 |
| Melikane, Lesotho | 3 | 40 982–39 361 BC (OxA-22794), 40 410–34 358 BC (OxA-22793), 39 513–37 808 BC (OxA-22964), 38 728–35 362 BC (OxA-23031), 38 943–35 242 BC (OxA-23029), 38 647–35 112 BC (OxA-22792), 8 271–35 856 BC (OxA-22839), 341.3 ± 3 ka, 45.9 ± 3.8 ka | final MSA | Stewart <i>et al.</i> 2012; Jacobs & Roberts 2017 |
| Melikane, Lesotho | 3 | 49.2 ± 2.5 ka, 50 ± 1.9 ka, 53.8 ± 3.2 ka | post-Howiesons Poort | Stewart <i>et al.</i> 2012; Jacobs & Roberts 2017 |
| Melikane, Lesotho | 4 | 59.5 ± 3.3 ka, 61 ± 2.5 ka | Howiesons Poort | Stewart <i>et al.</i> 2012; Jacobs & Roberts 2017 |
| Melikane, Lesotho | 5 | 78.2 ± 4 ka, 79.5 ± 3.1 ka, 83.2 ± 6.3 ka | Afromontane MSA (pre-Still Bay Afromontane variant?) | Stewart <i>et al.</i> 2012; Jacobs & Roberts 2017; Pazan <i>et al.</i> 2022 |
| Melkboom 1, South Africa (Northern Cape) | 1 | AD 1441–1663 (Pta-9514), AD 1391–1483 (Pta-4496) | ceramic final LSA | Beaumont <i>et al.</i> 1995; Parsons 2008 |
| Melkbosstrand, South Africa (Western Cape) | 1 | AD 1054 (Pta-8797), AD 744 (Pta-7792), AD 715 (Pta-7800) | ceramic final LSA | Sealy <i>et al.</i> 2004 |
| Melkhoutboom Cave, South Africa (Eastern Cape) | 1 | 1231–810 BC (Pta-706) | final LSA | Deacon 1976 |
| Melkhoutboom Cave, South Africa (Eastern Cape) | 1 | 4951–4496 BC (Pta-680), 5985–5715 BC (Pta-668), 6266–5984 BC (UW-234) | Wilton | Deacon 1976 |
| Melkhoutboom Cave, South Africa (Eastern Cape) | 1 | 6645–6360 BC (Pta-666), 10 814–9763 BC (GaK-1538) | Oakhurst | Deacon 1976 |
| Melkhoutboom Cave, South Africa (Eastern Cape) | 2 | 16 931–16 622 BC (UW-223) | Robberg | Deacon 1976 |
| Malkoppan, South Africa (Western Cape) | 1 | 671–397 BC (Pta-6219), 2908–2617 BC (Pta-6220) | LSA (similar to final LSA) | Jerardino & Navarro 2018b |
| Mertenhof, South Africa (Western Cape) | 2 | 16 708–16 313 BC (DAMS-003801), 17 579–17 234 BC (DAMS-003802) | Robberg | Low & Mackay 2018 |
| Mgede Shelter, South Africa (KwaZulu-Natal) | 1 | > AD 1801 (Pta-3669), AD 1158–1300 (Pta-3665) | ceramic final LSA | Mazel 1986b |
| Mgede Shelter, South Africa (KwaZulu-Natal) | 1 | 3193–2875 BC (Pta-3505), 5567–5330 BC (Pta-3508) | Wilton | Mazel 1986b |
| Mohapa Site 1, Botswana | 1 | 1543–1256 BC, 65 BC–AD 139, AD 1379–1446, AD 1451–1636 | LSA (similar to ceramic final LSA) | Yellen & Brooks 1989 |
| Moshebi's Shelter, Lesotho | 1 | AD 1105–1217 (UGAMS-11591), 206–106 BC (UGAMS-11589), 3012–2872 BC (UGAMS-11590) | post-Classic Wilton (similar to final LSA) | Badenhorst <i>et al.</i> 2019 |
| Muela, Lesotho | 1 | AD 1810–present (Pta-6335), AD 1461–1648 (Pta-6332), | post Classic Wilton (consistent with ceramic final LSA) | Kaplan & Mitchell 2012 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|---|-------------------------------|---|
| | | AD 1625–1894 (Pta-6328), AD 1265–1395 (Pta-6329) | | |
| Mwulu's Cave, South Africa (Limpopo) | 5 | ~90 ka | MSA (Pietersburg?) | De la Peña <i>et al.</i> 2019; Feathers <i>et al.</i> 2020 |
| Mzinyashana Shelter, South Africa (KwaZulu-Natal) | 1 | AD 1281–1424 (Pta-6715), AD 1206–1319 (Pta-6541), AD 1024–1212 (Pta-6538), AD 572–640 (Pta-6543) | ceramic final LSA | Mazel 1997 |
| Mzinyashana Shelter, South Africa (KwaZulu-Natal) | 1 | 2671–2285 BC (Pta-6540), 3028–2337 BC (Pt-6535) | Wilton | Mazel 1997 |
| Mzinyashana Shelter, South Africa (KwaZulu-Natal) | 1 | 393–151 BC (Pta-6542), 904–517 BC (Pta-6700), 1126–812 BC (Pta-6708), 1209–985 BC (Pta-6539) | final LSA | Mazel 1997 |
| Nauga, South Africa (Northern Cape) Wilkins 2021 | 1 | AD 316–529 | LSA (similar to final LSA) | Beaumont & Morris 1990; |
| Nelson Bay Cave, South Africa (Western Cape) | 1 | AD 1433–1506 (Pta-1361), AD 1290–1416 (Pta-3362), AD 1150–1292 (Pta-3361), AD 542–651 (Pta-1360) | ceramic final LSA | Inskeep 1987 |
| Nelson Bay Cave, South Africa (Western Cape) | 1 | AD 15–250 (GrN-5703), 150 BC–AD 29 (Pta-1363), 766–391 BC (Pta-2921), 791–460 BC (GrN-5715), 1212–970 BC (GrN-5702), 1316–902 BC (Pta-1485), 1302–971 BC (Pta-2913), 1308–1053 BC (Pta-2920), 1536–1258 BC (Pta-3095), 1688–1381 BC (Pta-3097) | final LSA | Inskeep 1987 |
| Nelson Bay Cave, South Africa (Western Cape) | 1 | 3715–3496 BC (UW-217), 4555–3640 BC (Pta-2933), 5008–4342 BC (UW-187), 4908–4440 BC (UW-216), 4846–4494 BC (Pta-2915), 905–4536 BC (Pta-2909), 45224–4501 BC (UW-176), 5225–4670 BC (UW-222) | Wilton | Deacon 1982, 1984; Inskeep 1987 |
| Nelson Bay Cave, South Africa (Western Cape) | 1 | 7533–6462 BC (UW-181), 8015–7175 BC (UW-184), 297–7816 BC (Pta-391), 810 023–9322 BC (Pta-392), 10 112–9356 BC (UW-164), 10 551–9307 BC (Q-1085), 10 770–10 069 BC (UW-178), 11 551–10 632 BC (I-6515), 11 565–11 121 BC (UW-162), 12 168–11 515 BC (UW-177) | Oakhurst | Deacon 1982, 1984 |
| Nelson Bay Cave, South Africa (Western Cape) | 2 | 18 780–17 602 BC (I-6516), 21 181–18 575 BC (UW-175), 20 947–20 403 BC (GrN-5884) | Robberg | Deacon 1982, 1984 |
| New Belgium, South Africa (Limpopo) | 1 | AD 1643–1823 (Pta-5790), AD1482–1676 (Pta-5138) | final LSA | Van der Ryst 1998 |
| Ngalue, Mozambique | 3 | 40.6 ± 3.3 ka, 45.3 ± 3.7 ka, 5 50.3 ± 4.4 ka, 50.7 ± 4.4 ka, 5.1 ± 5.8 ka, 55.2 ± 14.6 ka | late-final MSA | Mercader <i>et al.</i> 2009 |
| Ngalue, Mozambique | 5 | 105.3 ± 13.6 ka | MSA | Mercader <i>et al.</i> 2009 |
| Niassa, Mozambique | 2 | 29 +3/-11 ka | final MSA | Mercader <i>et al.</i> 2012 |
| Nkupe Shelter, South Africa (KwaZulu-Natal) | 1 | 765–404 BC (Pta-3443), 1536–1258 BC (Pta-3269) | final LSA | Mazel 1988 |
| Nkupe Shelter, South Africa (KwaZulu-Natal) | 1 | 2580–2196 BC (Pta-3275), 3516–3022 BC (Pta-3276), 4725–4440 BC (Pta-3460), 5672–5468 BC (Pta-3455) | Wilton | Mazel 1988 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-----|---|---|--|
| Nooitgedacht 1, South Africa (Northern Cape) | 1 | AD 1015–1185 | LSA (similar to ceramic final LSA) | Beaumont & Vogel 1989 |
| Ntloana T oana, Lesotho | 1 | 7875–7606 BC (Pta-5238), 8928–8307 BC (Pta-5237), 9306–8706 BC (Pta-5207), 10 151–9331 BC (Pta-5208), 12 373–11 656 BC (Pta-5236) | Oakhurst | Mitchell 1993a; Mitchell & Arthur 2010 |
| Ntloana T oana, Lesotho | 3 | 55.5 ± 3 ka, 56 ± 1.8 ka | post-Howiesons Poort | Mitchell & Steinberg 1992; Jacobs, Roberts <i>et al.</i> 2008; Jacobs & Roberts 2017 |
| Ntloana T oana, Lesotho | 4 | 59.8 ± 3.2 ka, 60.9 ± 2.8 ka | Howiesons Poort | Mitchell & Steinberg 1992; Jacobs, Roberts <i>et al.</i> 2008; Jacobs & Roberts 2017 |
| Oakhurst, South Africa (Western Cape) | 1 | 1899–1533 BC (Pta-520), 7043–6587 BC (Pta-377) | Wilton | Schrire 1962 |
| Oakhurst, South Africa (Western Cape) | 1 | 9286–7750 BC (Pta-410) | Oakhurst | Schrire 1962 |
| Olieboomspoort, South Africa (Limpopo) | 5–6 | 77–78 ka, 149 ± 15 ka, 150 ± 14 ka | MSA (Pietersburg?) | Mason 1962; Val <i>et al.</i> 2021 |
| Omungunda 99, Namibia | 1 | AD 1097–1284 (KN-5288) | late Ceramic LSA (consistent with ceramic final LSA) | Vogelsang & Eichhorn 2011 |
| Omungunda 99, Namibia | 1 | AD 419–581 (KN-5285), 319–196 BC (KN-5675), 811–727 BC (KN-5674) | microlithic LSA (similar to final LSA) | Vogelsang & Eichhorn 2011 |
| Omungunda 99, Namibia | 1 | 7066–6771 BC (KIA-11984) | Oakhurst | Vogelsang & Eichhorn 2011 |
| Omungunda 99, Namibia | 2 | 12 227–12 016 BC (KIA-11983), 12 602–12 118 BC (UtC-9879) | Robberg | Vogelsang & Eichhorn 2011 |
| Orange Springs, South Africa (Free State) | 1 | 1086–796 BC (Wits-2002) | final LSA | Thorp 1996 |
| Oruwanje 95, Namibia | 1 | AD 1405–1453 (KN-4849), AD 870–1049 (KN-5299), AD 245–435 (KN-4850), AD 65–247 (KN-5302), 234–92 BC (KN-5005) | early Ceramic Phase (consistent with ceramic final LSA) | Vogelsang & Eichhorn 2011 |
| Ovizorombuku 96, Namibia | 1 | AD 1447–1516 (KN-5372), AD 1098–1217 (KN-5260), 198–51 BC (KN-5371) | microlithic LSA (consistent with ceramic final LSA) | Vogelsang & Eichhorn 2011 |
| Ovizorombuku 96, Namibia | 1 | 1207–922 BC (KN-5326) | LSA (similar to Wilton) | Vogelsang & Eichhorn 2011 |
| Ovizorombuku 96, Namibia | 1 | 8289–8160 BC (UtC-8104), 7591–7174 BC (KN-5310) | Oakhurst | Vogelsang & Eichhorn 2011 |
| Ovizorombuku 98, Namibia | 1 | AD 520–643 (KN-5465), 1463–1369 BC (KIA-27702) | microlithic LSA (similar to final LSA) | Vogelsang & Eichhorn 2011 |
| Ovizorombuku 98, Namibia | 1 | 6068–5970 BC (KIA-17711) | Oakhurst | Vogelsang & Eichhorn 2011 |
| Ovizorombuku 98, Namibia | 2 | 12 794–12 381 BC (KIA-17712) | Robberg | Vogelsang & Eichhorn 2011 |
| Penhill Farm (Sundays River), South Africa (Eastern Cape) | 44 | <1.37 ± 0.16 Ma | Acheulean | Lotter & Kuman 2018b; Lotter 2020 |
| Pinnacle Point Cave 13B, South Africa (Western Cape) | 5 | 90.5 ± 4.9 ka, 91.3 ± 5.0 ka, 92.2 ± 5.0 ka, 92.7 ± 4.9 ka, 93.4 ± 5.6 ka, 93.8 ± 5.3 ka, 96.3 ± 5.6 ka, 98.4 ± 5.0 ka, 98.4 ± 5.8 ka, 98.8 ± 5.4 ka, 110.1 ± 5.3 ka, 110.2 ± 5.2 ka, 112.8 ± 5.1 ka, 122.3 ± 6.2 ka, 122.4 ± 8.1 ka, 124.7 ± 6.1 ka, 125.4 ± 6.9 ka, 126.8 ± 7.6 ka, 127.8 ± 4.7 ka | MSA/MIS 5 | Jacobs 2010 |
| Pinnacle Point Cave 13B, South Africa (Western Cape) | 6 | 156.8 ± 10.2 ka, 159.1 ± 8.4 ka, 159.9 ± 8.0 ka, 162.0 ± 9.4 ka, 166.1 ± 8.5 ka | MSA/MIS 6 | Jacobs 2010 |
| Pinnacle Point Cave 5-6, South Africa (Western Cape) | 3–4 | 51 ± 2 ka, 52 ± 3 ka, 61 ± 4 ka, 62 ± 3 ka, | MSA with backed pieces (Howiesons Poort?) | Brown <i>et al.</i> 2012; Karkanas <i>et al.</i> 2015; <i>Continued on p. 196</i> |

Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-------|--|---|---|
| | | 63 ± 3 ka, 64 ± 3 ka, 69 ± 3 ka, 70.6 ± 2.3 ka, 71 ± 3 ka | | Wilkins <i>et al.</i> 2017; Smith <i>et al.</i> 2018 |
| Pinnacle Point Cave 5-6, South Africa (Western Cape) | 5 | 72 ± 3 ka | MSA/ALBS (small sample quartzite, Mount Toba isochron) | Karkanas <i>et al.</i> 2015 |
| Pinnacle Point Cave 5-6, South Africa (Western Cape) | 5 | 81 ± 4 ka, 96 ± 6 ka | MSA/MIS 5 | Karkanas <i>et al.</i> 2015 |
| Pinnacle Point Shell Midden, South Africa (Western Cape) | 1 | 325–191 BC (Beta-380658), 1405–981 BC (Beta-390661) | Holocene LSA (similar to final LSA) | McGrath <i>et al.</i> 2015 |
| Pniel 6, South Africa (Northern Cape) | 6 | >120 ka, likely 130-190 ka | early MSA | Beaumont 1999; Lisiecki & Raymo 2005; Hutson 2018 |
| Pockenbank, Namibia | 2 | 21 950–20 551 BC (KN-1623), 22 214–21 142 BC (Pta-1203) | early LSA | Ossendorf 2013; Vogel & Visser 1981 |
| Pockenbank, Namibia | 3 | 34 405–32 666 BC (Pta-544), 39 908–37 565 BC (Pta-503) | early LSA/MSA | Ossendorf 2013; Vogel & Visser 1981 |
| Pockenbank, Namibia | 3 | 34 423–32 676 BC (Pta-544), 39 908–37 565 BC (Pta-503), >46 055 BC (Pta-504) | MSA | Vogel & Visser 1981 |
| Port Nolloth Midden PN2009/001, South Africa (Northern Cape) | 1 | 846–770 BC (UGAMS-6607) | Holocene microlithic (similar to final LSA) | Webley & Orton 2013 |
| Posberg Reserve, Drie Susters (Main), South Africa (Western Cape) | 1 | AD 957–1181 (Pta-5478) | ceramic final LSA | Smith <i>et al.</i> 1991 |
| Praia de Chizavane, Mozambique | 1 | AD 1641–1673 (Wk-45800), AD 1389–1412(Wk-45799), AD 1215–1706 (St-8589), AD 1020–1316 (St-8590) | LSA (similar to ceramic final LSA) | Robb <i>et al.</i> 2021 |
| Putslaagte 8, South Africa (Western Cape) | 2 | 15 800–18 200 BP (PL8-8) | Robberg | Low & Mackay 2016 |
| Putslaagte 8, South Africa (Western Cape) | 2 | 21 060–19 827 BC (AA99784), 25 700–29 500 BP (PL8-5) | LSA (consistent with early LSA) | Low & Mackay 2016 |
| Putslaagte 8, South Africa (Western Cape) | 3 | 33.2 ka- 44.5 ka | late MSA | Mackay <i>et al.</i> 2015 |
| Putslaagte 8, South Africa (Western Cape) | 4 | 65.1 ± 5.5 ka, 66.0 ± 4.9 ka | Howiesons Poort (also bifacial points, SB?) | Mackay <i>et al.</i> 2015 |
| Putslaagte 8, South Africa (Western Cape) | 5 | 75.5 ± 6.0 | pre-Howiesons Poort (Still Bay?) | Mackay <i>et al.</i> 2015 |
| Ravenscraig, South Africa (KwaZulu-Natal) | 1 | 10 151–9331 BC (Pta-3450) | Oakhurst | Opperman 1987 |
| Reception Shelter, South Africa (Western Cape) | 1 | AD 1286–140 (AA89907), AD 1187–1293 (AA89909) | ceramic final LSA | Orton <i>et al.</i> 2011 |
| Reception Shelter, South Africa (Western Cape) | 1 | 802–473 BC (AA89910) | final LSA | Orton <i>et al.</i> 2011 |
| Reception Shelter, South Africa (Western Cape) | 2 | 24 429–23 951 BC (AA89908) | early LSA | Orton <i>et al.</i> 2011 |
| Red Balloon, South Africa (Limpopo) | 5 | 91 ± 6 ka, 96 ± 5 ka, 104 ± 9 ka | MSA (unifacial, bifacial and Levallois points, Pietersburg?) | Wadley <i>et al.</i> 2021 |
| Rhino Cave, Botswana | 1 | AD 986–1270, AD 249–598 | LSA (similar to final LSA) | Robbins, Brook <i>et al.</i> 2000 |
| Rietputs 15 Pit 5, South Africa (Northern Cape) | 39–41 | 1.27 ± 0.20 Ma, 1.31 ± 0.21 Ma | early Acheulean | Leader <i>et al.</i> 2018 |
| Rising Star, South Africa (Gauteng) | 8 | 231 ± 41 ka, 232 ± 8 ka, 244 ± 3 ka, 247 ± 37 ka, 96 ± 14 ka, 353 ± 61 ka, 2478 + 107/-41 ka, 502 + 181/-53 ka | <i>H. naledi</i> | Berger <i>et al.</i> 2015; Dirks <i>et al.</i> 2017; Robbins <i>et al.</i> 2021 |
| Roodam 1, South Africa (Northern Cape) | 5 | 108 ± 9 ka | MSA | Szabo & Butzer 1979; Eltzholtz 2020 |
| Roodam 1, South Africa (Northern Cape) | 6 | 174 ± 20 ka | early MSA | Szabo & Butzer 1979; Eltzholtz 2020 |
| Rooikrans, South Africa (Free State) | 1 | 5231–4793 BC (Wits-2003) | Wilton | Thorp 1996 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|---|-------------------------------|---|
| Rooikrans, South Africa (Free State) | 1 | >AD 1806 (Pta-5761), >AD 1798 (Pta-5762), AD 1435–1645 (AxA-3386) | ceramic final LSA | Thorp 1996 |
| Roosfontein, South Africa (Free State) | 1 | AD 670–892 (Pta-5931) | ceramic final LSA | Klatzow 2000 |
| Roosfontein, South Africa (Free State) | 1 | AD 670–892 (Pta-5931), AD 17–252 (Pta-5932) | final LSA | Klatzow 2000 |
| Rose Cottage Cave, South Africa (Free State) | 1 | AD 1394–1508 (Pta-6788), AD 1281–1405 (Pta-5622) | ceramic final LSA | Wadley & Vogel 1991; Wadley 1992; Thorp 1996 |
| Rose Cottage Cave, South Africa (Free State) | 2–3 | 27.6 ± 2.3 ka, 29.8 ± 1.6 ka, 31.7 ± 1.8 ka, 34.8 ± 22 ka | final MSA | Pienaar <i>et al.</i> 2008 |
| Rose Cottage Cave, South Africa (Free State) | 1 | 394–104 BC (Pta-7117) | final LSA | Wadley & Vogel 1991; Wadley 1992; Thorp 1996 |
| Rose Cottage Cave, South Africa (Free State) | 1 | 5003–4652 BC (Pta-5934), 6599–6330 BC (Pta-6783) | Wilton | Wadley 2000a,b |
| Rose Cottage Cave, South Africa (Free State) | 1 | 8.6 ± 0.6 ka, 7351–6901 BC (Pta-7122), 7545–7180 BC (Pta-5600), 7682–7530 BC (Pta-5560), 8617–8290 BC (Pta-5599) | Oakhurst | Wadley 1997, 2000a; Pienaar <i>et al.</i> 2008 |
| Rose Cottage Cave, South Africa (Free State) | 2 | 13.0 ± 1.2 ka, 13 530–12 834 BC (Pta-5593), 13.6 ± 1.4 ka, 14 544–13 651 BC (Pta-5601) | Robberg | Wadley 1996b; Pienaar <i>et al.</i> 2008 |
| Rose Cottage Cave, South Africa (Free State) | 2 | 23 415–22 139 BC (Pta-5598), 25 371–24 431 BC (Pta-1417), 25 871–25 317 BC (Pta-1416), 28 298–27 303 BC (GrN-5300), 31 120–28 768 BC (Pta-211) | early LSA | Wadley & Vogel 1991; Wadley 1993; Clark 1999 |
| Rose Cottage Cave, South Africa (Free State) | 3–4 | 47.1 ± 10.2 ka, 49.4 ± 10.1 ka, 50.5 ± 4.6 ka, 56 ± 2.6 ka, 9.4 ± 4.5 ka, 61.8 ± 2.8 ka | post-Howiesons Poort | Valladas <i>et al.</i> 2005; Jacobs, Roberts <i>et al.</i> 2008; Pienaar <i>et al.</i> 2008 |
| Rose Cottage Cave, South Africa (Free State) | 3–4 | 41.7 ± 3.7 ka, 48.9 ± 5.3 ka, 54 ± 4.4 ka, 56.3 ± 4.5 ka, 58.6 ± 6.6 ka, 60.4 ± 4.6 ka, 62.5 ± 2.9 ka, 63 ± 2.3 ka, 63.2 ± 2.3 ka, 64.2 ± 3 ka, 64.6 ± 3 ka, 65 ± 3.5 ka, 68.7 ± 2.7 ka | Howiesons Poort | Valladas <i>et al.</i> 2005; Jacobs, Roberts <i>et al.</i> 2008; Pienaar <i>et al.</i> 2008; Jacobs & Roberts 2017 |
| Rose Cottage Cave, South Africa (Free State) | 4–5 | 64.5 ± 6.6 ka, 68.4 ± 8.3 ka, 71.4 ± 4.2 ka, 72.5 ± 6.8 ka, 76.3 ± 14.8 ka, 95.9 ± 6.6 ka | pre-Howiesons Poort | Valladas <i>et al.</i> 2005; Pienaar <i>et al.</i> 2008 |
| Schurfpoort 112 KR, South Africa (Limpopo) | 1 | AD 1282–1395 (Pta-5127), AD 1151–1296 (Pta-5133), AD 1148–1288 (Pta-5132) | final LSA | Van der Ryst 1998 |
| Scott's Cave, South Africa (Eastern Cape) | 1 | AD 1437–1680 (Yale University Laboratory), AD 669–1047 (Gulbenkian Laboratory, Salisbury) | ceramic final LSA | Deacon & Deacon 1963; Deacon 1967 |
| Sehonghong, Lesotho | 1 | AD 770–907 (Pta-8064), AD 596–774 (Pta-885), AD 338–423 (Pta-6063) | ceramic final LSA | Mitchell 1996a, 2010; Vinnicombe 2009 |
| Sehonghong, Lesotho | 1 | 4993–4607 BC (Pta-6154), 5845–5624 BC (Q-3174) | Wilton | Mitchell 1996b |
| Sehonghong, Lesotho | 1 | 5994–5722 BC (Pta-6083), 6065–5751 BC (Pta-6280), 6229–5889 BC (Pta-6072), 6262–5982 BC (Pta-6278), 8570–8304 BC (Pta-6368), 9406–8699 BC (Pta-6057) | Oakhurst | Mitchell 1996b |
| Sehonghong, Lesotho | 2 | 12 520–11 821 BC (Pta-6282), | Robberg | Mitchell 1995 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-----|--|---|--|
| | | 12 686–12 216 BC (Pta-6062), 13 128–11 636 BC (Q-3176), 13 316–11 624 BC (Q-3165), 13 984–12 250 BC (Q-3173), 13 984–13 171 BC (Pta-884), 14 291–13 383 BC (Q-3172), 17 391–16 741 BC (Pta-6060), 20 303–18 940 BC (Q-1452), 21 832–21 023 BC (Pta-6281) | | |
| Sehonghong, Lesotho | 2 | 23 269–22 062 BC (Pta-6059), 28 032–26 827 BC (Pta-6271), 29 095–27 498 BC (Pta-6268) | early LSA | Mitchell 1994; Plug & Mitchell 2008 |
| Sehonghong, Lesotho | 3 | 29 205–30 190 BP, 30.3 ± 3.4 ka, 31.2 ± 1.5 ka, 31.6 ± 1.2 ka | final MSA | Mitchell 1994; Jacobs, Roberts <i>et al.</i> 2008; Jacobs & Roberts 2017; Pargeter <i>et al.</i> 2017 |
| Sehonghong, Lesotho | 3 | 45.9 ± 2.7 ka, 46.5 ± 2.5 ka, 49 ± 2.4 ka, 57.6 ± 2.3 ka | post-Howiesons Poort | Jacobs, Roberts <i>et al.</i> 2008; Jacobs & Roberts 2017 |
| Sehonghong, Lesotho | 4 | 62.2 ± 1.7 ka, 63.9 ± 3.7 ka | Howiesons Poort | Barré & Lamothe 2010 |
| Sesfontein N2005/1, Namibia | 1 | 905–803 BC (KIA-29630), 2505–2293 BC (KN-5797) | Wilton-like microlithic (similar to final LSA) | Ossendorf 2017b |
| Sesfontein N2005/1, Namibia | 1 | 4448–4326 BC (KIA-29629) | Wilton | Ossendorf 2017b |
| Sesfontein N2005/2, Namibia | 1 | 148 BC–AD 25 (KN-5798) | Wilton-like microlithic (similar to final LSA) | Ossendorf 2017b |
| Sesfontein N2005/2, Namibia | 1 | 8216–7810 BC (KIA-29631) | Oakhurst | Ossendorf 2017b |
| Shongweni, South Africa (KwaZulu-Natal) | 2 | 25 816–24 869 BC (Pta-966) | early LSA | Davies 1975; Vogel <i>et al.</i> 1986; Wadley 1993 |
| Sibebe Rock Shelter, eSwatini | 1 | 16–225 AD (Pta-3347) | Ceramic final LSA | Bader <i>et al.</i> 2022 |
| Sibebe Rock Shelter, eSwatini | 1 | 1744–1538 BC (Beta-594921), 117–251 AD (Beta-594923), 522–642 AD (Beta-594922) | final LSA | Bader <i>et al.</i> 2022 |
| Sibebe Rock Shelter, eSwatini | 2 | 42350–40849 BC (Beta-541993), 35881–32354 BC (Pta-3349), 25451–24921 BC (GrN-5314) | final MSA | Vogel 1970; Price-Williams 1981; Bader <i>et al.</i> 2022 |
| Sibudu Cave, South Africa (KwaZulu-Natal) | 3 | 37.6 ± 2.4 ka, 38 ± 2.6 ka | final MSA | Jacobs, Roberts <i>et al.</i> 2008; Jacobs, Wintle <i>et al.</i> 2008 |
| Sibudu Cave, South Africa (KwaZulu-Natal) | 3 | 49.4 ± 2.3 ka, 46 ± 1.9 ka, 46.6 ± 2.3 ka, 47.6 ± 1.9 ka, 48 ± 2.4 ka, 49.1 ± 2.1 ka | late MSA | Jacobs, Roberts <i>et al.</i> 2008; Jacobs, Wintle <i>et al.</i> 2008 |
| Sibudu Cave, South Africa (KwaZulu-Natal) | 3–4 | 56.7 ± 2.1 ka, 57.6 ± 2.1 ka, 58.2 ± 2.4 ka, 58.3 ± 2 ka, 58.6 ± 2.1, 59.6 ± 2.3 ka | post-Howiesons Poort (Sibudu) | Jacobs, Roberts <i>et al.</i> 2008; Jacobs, Wintle <i>et al.</i> 2008 |
| Sibudu Cave, South Africa (KwaZulu-Natal) | 4 | 61.7 ± 2 ka, 63.8 ± 2.8 ka, 64.7 ± 2.3 ka | Howiesons Poort, <i>H. sapiens</i> | Jacobs, Roberts <i>et al.</i> 2008; Jacobs, Wintle <i>et al.</i> 2008; Riga <i>et al.</i> 2018; Will <i>et al.</i> 2019 |
| Sibudu Cave, South Africa (KwaZulu-Natal) | 4 | 70.5 ± 2 ka | Still Bay | Jacobs, Roberts <i>et al.</i> 2008; Lombard <i>et al.</i> 2019 |
| Sibudu Cave, South Africa (KwaZulu-Natal) | 5 | 72.5 ± 2 ka, 73.2 ± 2.3 ka, 77.3 ± 2.2 ka | pre-Still Bay (consistent with Still Bay), <i>H. sapiens</i> | Jacobs, Roberts <i>et al.</i> 2008; Riga <i>et al.</i> 2018; Lombard <i>et al.</i> 2019; Will <i>et al.</i> 2019 |
| Simon se Klip at Steenbokfontein, South Africa (Western Cape) | 1 | AD 704 (GX32343), AD 851 (GX32342), AD 972 (GX32341) | ceramic final LSA | Jerardino & Maggs 2007 |
| Siphiso Shelter, eSwatini | 1 | AD 1452–1671 (Tx-5622), AD 810–775 (Tx-5619), AD 900–880 (Tx-5620) | ceramic final LSA | Barham 1989 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-------|---|-------------------------------------|--|
| Siphiso Shelter, eSwatini | 1 | 5217–3958 BC (Tx-5621), 5929–5302 BC (Tx-5624), 5721–5470 BC (Tx-5625), 5887–5305 BC (Tx-5623), 5921–5535 BC (Tx-5626), 6378–5943 BC (Tx-5627) | Wilton | Barham 1989 |
| Siphiso Shelter, eSwatini | 1 | 6572–6240 BC (Pta-3533), 8017–7523 BC (Pta-3540), 8209–7246 BC (Tx-5630), 8826–8301 BC (Tx-5628), 9151–8275 BC (Y-1996), 9231–8228 BC (Tx-5629), 10 252–7744 BC (Pta-004) | Oakhurst | Barham 1989 |
| Siphiso Shelter, eSwatini | 2 | 10 151–9196 BC (Tx-5782), 12 630–11 148 BC (Tx-5631), 12 934–11 364 BC (Tx-5783) | Robberg | Barham 1989 |
| Siphiso Shelter, eSwatini | 2 | 15 195–13 173 BC (Tx4784), 14 800 ± 800 (ESR) | LSA (similar to early LSA) | Barham 1989 |
| Siphiso Shelter, eSwatini | 2 | 15 195–13173 BC (Tx4784), 14 800 ± 800 (ESR) | final MSA | Barham 1989 |
| Soutpanskliphuwel, South Africa (Western Cape) | 1 | AD 1105–1217 (UGAMS-10296), AD 889–994 (UGAMS-8560), AD 884–994 (UGAMS-8865), 2940–2863 BC (UGAMS-8567) | LSA (similar to final LSA) | Jerardino <i>et al.</i> 2018 |
| Spitzkloof A, South Africa (Northern Cape) | 3–4 | >50 507 BC (UBA-17618), 52 007–48 728 BC (UBA-17617), >59 250 bp (UBA-17616) | MSA | Dewar & Stewart 2016 |
| Spoeg River Cave, South Africa (Northern 1 Cape) | | AD 766–900 (GrA-9027), AD 598–775 (Pta-4753), AD 542–688 (Pta-6750), AD 57–241 (Pta-4745), AD 21–245 (Pta-6749), 179 BC–AD 75 (OxA-3862) | ceramic final LSA | Webley 1992, 2002; Sealy & Yates 1994 |
| Spoeg River Cave, South Africa (Northern 1 Cape) | | AD 57–255 (GrA-9029), AD 28–252 (GrA-9028), 546–371 BC (Pta-7200), 1951–1667 BC (Pta-6754), 2038–1736 BC (Pta-6987) | final LSA | Webley 2002 |
| St Francis Bay, South Africa (Eastern Cape) | 1 | AD 203–420 (Pta-9311) | ceramic final LSA | Binneman 2004/2005 |
| St Francis Bay 2/4, South Africa (Eastern Cape) | 1 | 2885–2566 BC (Pta-7550) | final LSA | Binneman 2004/2005 |
| Steenbokfontein, South Africa (Western Cape) | 1 | 235–58 BC (Pta-6136), 541–346 BC (Pta-6136), 762–409 BC (Pta-6505), 983–749 BC (Pta-6134) | final LSA | Jerardino & Yates 1996 |
| Steenbokfontein, South Africa (Western Cape) | 1 | 1939–1665 BC (Pta-6794), 2142–1866 BC (Pta-6850), 2628–2277 BC (Pta6420), 6070 bp (Pta-6808) | Wilton | Jerardino & Yates 1996 |
| Sterkfontein, South Africa (Gauteng) | 8 | 252 ± 42 ka | early MSA | Ogola 2009 |
| Sterkfontein (Member 5a), South Africa (Gauteng) | 63–49 | 1.64 ± 0.15 Ma | <i>H. habilis</i> , <i>Homo</i> sp. | Curnoe & Tobias 2006; Curnoe 2010; Herries & Shaw 2011; Wood 2011; Pickering <i>et al.</i> 2019 |
| Sterkfontein (Member 5 East), South Africa (Gauteng) | 41–84 | 1.32 ± 0.08 Ma, 2.18 ± 0.21 Ma | Oldowan, <i>Homo</i> sp. | Curnoe & Tobias 2006; Curnoe 2010; Herries & Shaw 2011; Granger <i>et al.</i> 2015; Pickering <i>et al.</i> 2019 |
| Sterkfontein (Member 5 West), South Africa (Gauteng) | 34 | 1.13 ± 0.13 Ma | early Acheulean, <i>H. ergaster</i> | Kuman & Clarke 2000; Curnoe & Tobias 2006; Curnoe 2010; |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-------|---|--|---|
| | | | | Herries & Shaw 2011; Pickering <i>et al.</i> 2019 |
| Strathalan B, South Africa (KwaZulu-Natal) | 2 | 25 321–24 332 BC (Pta-4858), 25 998–24 962 BC (Pta-4869), 28 890–27 212 BC (Pta-4644), 29 819–28 192 BC (Pta-5040), 32 378–31 176 BC (Pta-5569) | final MSA | Opperman & Heydenrych 1990; Opperman 1996 |
| Sunnyside 1, South Africa (Free State) | 3 | 30.3 ± 1.4 ka | Similar to early LSA | Henderson <i>et al.</i> 2006 |
| Sunnyside 1, South Africa (Free State) | 3 | 30.3 ± 1.4 ka | final MSA | Henderson <i>et al.</i> 2006 |
| Sunnyside 1, South Africa (Free State) | 4 | 62.3 ± 2.3 ka | MSA (consistent with Howiesons Poort) | Henderson <i>et al.</i> 2006 |
| Swartkrans (Member 4), South Africa (Gauteng) | 5 | <110.3 ± 1.9 ka | MSA | Sutton <i>et al.</i> 2009 |
| Swartkrans (Member 1 Hanging remnant), South Africa (Gauteng) | 84–65 | 2.249 ± 0.077 Ma, 1.706 ± 0.069 Ma, 1.63 ± 0.16 Ma (ESR) | <i>H. erectus</i> , <i>Homo</i> sp. | Grine 1989; Susman 1989; Curnoe <i>et al.</i> 2001; Susman <i>et al.</i> 2001; Wood 2011; Pickering <i>et al.</i> 2012 |
| Swartkrans (Member 1 Lower Bank), Gauteng | 63–87 | 1.80 ± 0.09 Ma, 1.83 ± 1.38 Ma, 2.19 ± 0.08 Ma, 2.22 ± 0.09 Ma, 2.25 ± 0.08 Ma | Oldowan, <i>Homo</i> sp. | Balter <i>et al.</i> 2008; Gibbon <i>et al.</i> 2014; Kuman <i>et al.</i> 2021; Pickering <i>et al.</i> 2011 |
| Swartkrans (Member 2), Gauteng | 43 | 1.36 ± 0.29 Ma | early Acheulean, <i>H. erectus</i> , <i>Homo</i> sp. | Grine 1989; Susman 1989; Susman <i>et al.</i> 2001; Balter <i>et al.</i> 2008; Wood 2011; Pickering <i>et al.</i> 2012 |
| Swartkrans (Member 3), Gauteng | 21–22 | 830 ± 210 ka, 960 ± 90 ka | Acheulean, <i>Homo</i> sp. | Grine 1989; Susman 1989; Balter <i>et al.</i> 2008; Gibbon <i>et al.</i> 2014 |
| Tandjiesberg, South Africa (Free State) | 1 | AD 1104–1295 (Wits-2004) | ceramic final LSA | Thorp 1996, 1997; Wadley & McLaren 1998 |
| The Havens Cave, South Africa (Eastern Cape) | 1 | 5306–4897 BC (Pta-3917), 5665–5331 BC (Pta-3913) | Wilton | Binneman 1997 |
| The Havens Cave, South Africa (Eastern Cape) | 1 | 9384–8811 BC (Pta-4620) | Oakhurst | Binneman 1997 |
| Tloutle, Lesotho | 1 | 5231–4786 BC (Pta-5158), 5914–5629 BC (Pta-5162), 6233–5964 BC (Pta-5171) | Wilton | Mitchell 1993b |
| Toromoja, Botswana | 1 | 1311–1011 BC | Consistent with Wilton | Helgren 1984 |
| Toteng 1, Botswana | 1 | AD 422–578, AD 353–658, 177 BC–AD 26, 2.1 ± 0.7 ka, 3.5 ± 0.5 ka, 5 ± 0.8 ka | Similar to ceramic final LSA | Robbins <i>et al.</i> 2008 |
| Toteng 3, Botswana | 1 | AD 415–591, AD 331–524 | LSA (similar to ceramic final LSA) | Robbins <i>et al.</i> 2008 |
| Toteng Quarry, Botswana | 3–4 | 51.5 ± 7.2 ka, 51.9 ± 8.5 ka, 55.8 ± 10.5 ka, 58.2 ± 10.2 ka | MSA | Brook <i>et al.</i> 2008 |
| Tshisiku Shelter, South Africa (Limpopo) | 1 | 1296–928 BC (Pta-8654) | final LSA | Van Doornum 2007 |
| Tshisiku Shelter, South Africa (Limpopo) | 1 | 4355–4153 BC (Pta-8652), 5728–5522 BC (Pta-8709) | Wilton | Van Doornum 2007 |
| Tuinplaas, South Africa (Limpopo) | 2 | 20 ± 3 ka - 11 ± 0.7 ka | <i>H. sapiens</i> skeleton | Pike <i>et al.</i> 2004 |
| Twyfelpoort, South Africa (Free State) | 1 | AD 60–259 (Pta-6171) | final LSA | Backwell <i>et al.</i> 1996 |
| Uitspankraal 9, South Africa (Western Cape) | 2 | 25 400–29 600 BP (UoW-2007) | Robberg | Watson <i>et al.</i> 2020 |
| Umbeli Belli Rock Shelter, South Africa (KwaZulu-Natal) | 2 | 29 ± 2 ka | final MSA | Bader <i>et al.</i> 2018 |

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Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|--|-----|--|---------------------------------------|--|
| Umhlatuzana, South Africa (KwaZulu-Natal) | 1 | 1325–916 BC, 1545–986 BC | Holocene LSA (consistent with Wilton) | Kaplan 1990; Lombard <i>et al.</i> 2010 |
| Umhlatuzana, South Africa (KwaZulu-Natal) | 1 | 14 495–13 676 BC (Pta-4226), 8626–8218 BC (Pta-4307) | late Robberg | Kaplan 1990; Lombard <i>et al.</i> 2010; Sifogeorgaki <i>et al.</i> 2020 |
| Umhlatuzana, South Africa (KwaZulu-Natal) | 3 | 37 183–33 667 BC (Pta-4389) | early LSA | Kaplan 1990; Lombard <i>et al.</i> 2010 |
| Umhlatuzana, South Africa (KwaZulu-Natal) | 3 | 37 183–33 667 BC (Pta-4389), 41 511–33 891 BC (Pta-4228), 43 044–40 344 BC (Pta-4331), 43 331–40 340 BC (Pta-4663) | final MSA | Kaplan 1990; Lombard <i>et al.</i> 2010; Sifogeorgaki <i>et al.</i> 2020; Reidsma <i>et al.</i> 2021 |
| Umhlatuzana, South Africa (KwaZulu-Natal) | 3 | 43 582–39 602 BC (Pta-4288), 46 038–39 084 BC (Pta-4235), 43 971–41 343 BC (Pta-4366), 41.9 ± 2.6 ka, 45 433–42 197 BC (Pta-4665), 48 466–42 648 BC (Pta-4333) | late MSA | Kaplan 1990; Lombard <i>et al.</i> 2010 |
| Umhlatuzana, South Africa (KwaZulu-Natal) | 4 | 60 ± 3.5 ka | Howiesons Poort | Kaplan 1990; Lombard <i>et al.</i> 2010 |
| Umhlatuzana, South Africa (KwaZulu-Natal) | 4 | 70.5 ± 4.7 ka | Still Bay | Kaplan 1990; Lombard <i>et al.</i> 2010; Högberg & Lombard 2016 |
| Uniondale, South Africa (Eastern Cape) | 1 | 199 BC–AD 58 (Pta-1804), 190–42 BC (weighted mean), 201 BC–AD 31 (Pta-1803) | ceramic final LSA | Leslie-Brooker 1987; Sadr & Sampson 2006 |
| Varsche Rivier 003, South Africa (Western Cape) | 3 | 40.4 ± 2.9 ka, 41.7 ± 2.9 ka, 42.3 ± 2.7 ka, 45.7 ± 2.8 ka | late MSA | Steele <i>et al.</i> 2016 |
| Varsche Rivier 003, South Africa (Western Cape) | 4 | 59.9 ± 3.4 ka, 61.4 ± 3.8 ka | Howiesons Poort | Steele <i>et al.</i> 2016 |
| Varsche Rivier 003, South Africa (Western Cape) | 5 | 74.5 ± 1.3 ka, 80.8 ± 4.6 ka | Still Bay | Steele <i>et al.</i> 2016 |
| Varsche Rivier 003, South Africa (Western Cape) | 5 | 88.3 ± 3.2 ka, 89.9 ± 5.0 ka, 90.7 ± 0.7 ka | Undefined MSA | Steele <i>et al.</i> 2016 |
| Varsche River 048, South Africa (Western Cape) | 1 | AD 1391–1500 (IT-C-678) | Similar to ceramic final LSA | Orton 2018 |
| Vleesbaai Area B, South Africa (Western Cape) | 5 | 73.4 ± 5.2 ka, 73.9 ± 4.2 ka | MSA | Smith <i>et al.</i> 2018; |
| Vlermuisgat, South Africa (Northern Cape) | 1 | >AD 1797 (Pta-9504), AD 1430–1635 (Pta-9511), AD 1401–1511 (Pta-9510) | ceramic final LSA | Parsons 2008 Wilkins 2020 |
| Voëlvlei, South Africa (Western Cape) | 1 | AD 1482–1631 (Pta-5547), AD 594–689 (Pta-5527) | ceramic final LSA | Smith <i>et al.</i> 1991 |
| Voëlvlei, South Africa (Western Cape) | 1 | AD 22–248 (Pta-5551) | final LSA | Smith <i>et al.</i> 1991 |
| Waterfall Bluff, South Africa (Eastern Cape) | 2–3 | 27.8 ± 2.1 ka, 37.6 ± 4.2 ka | MSA | Fisher <i>et al.</i> 2020 |
| White Paintings, Botswana | 3–5 | 33.9 ± 0.3 ka, 45.2 ± 12.6 ka, 54.2 ± 9.5 ka, 55.4 ± 4.7 ka, 55.43 ± 4.7 ka, 58.5 ± 12.2 ka, 61.2 ± 12.4 ka, 66.4 ± 6.5 ka, 94.3 ± 9.4 ka | MSA | Feathers 1997; Robbins, Murphy <i>et al.</i> 2000; Ivester <i>et al.</i> 2010 |
| Wilton Large Rock Shelter, South Africa (Eastern Cape) | 1 | 545–46 BC (GaK-1540) | final LSA | Deacon 1972 |
| Wilton Large Rock Shelter, South Africa (Eastern Cape) | 1 | 3814–3362 BC (I-2565) | Wilton | Deacon 1972 |
| Wilton Large Rock Shelter, South Africa (Eastern Cape) | 1 | 7382–7065 BC (GaK-1541) | Oakhurst | Deacon 1972 |
| Witklip, South Africa (Western Cape) | 1 | AD 1462–1669 (Pta-5467), AD 1394–1508 (Pta-5469), AD 632–775 (Pta-4608), AD 110–341 (Pta-4609) | ceramic final LSA | Smith <i>et al.</i> 1991 |
| Witkrans, South Africa (Northern Cape) | 5 | 44053–31164 BC (UCLA-706), 103–86 ka | <i>H. sapiens</i> deciduous | Berger & Libby 1966; Clark 1971; McCrossin 1994 |

Continued on p. 202

Appendix A (continued)

| Site name, country (province if SA) | MIS | Published/calibrated dates | Assemblage/fossil designation | References |
|---|-------|---|-------------------------------|---|
| Wonderkrater, South Africa (Limpopo) | 2 | 25.8–27.9 ka, 26.4–28.5 ka | final MSA | Backwell <i>et al.</i> 2014 |
| Wonderkrater, South Africa (Limpopo) | 3–6 | 30.8 ± 0.7 ka, 32.18 ± 3.6 ka, 46.3 ± 4.7 ka, 56.4 ± 4 ka, 58 ± 4.1 ka, 63.1 ± 5.8 ka, 70 ± 10 ka, 100.62 ± 7.6 ka, 102.36 ± 6.5 ka, 138.01 ± 7.7 ka | MSA | Barré <i>et al.</i> 2012; Backwell <i>et al.</i> 2014 |
| Wonderwerk Cave, South Africa (Northern Cape) | 1 | AD 771–993 (Pta-2779) | ceramic final LSA | Humphreys & Thackeray 1983 |
| Wonderwerk Cave, South Africa (Northern Cape) | 1 | 2628–2277 BC (Pta-2785), 3798–3500 BC (Pta-2797), 6396–6086 BC (Pta-2798), | Wilton | Humphreys & Thackeray 1983 |
| Wonderwerk Cave, South Africa (Northern Cape) | 1 | 9695–9286 BC (Pta-2790), 10 148–9361 BC (Pta-2786) | Oakhurst | Humphreys & Thackeray 1983 |
| Wonderwerk Cave, South Africa (Northern Cape) | 5–6 | 73 ± 5 ka, 73.3 ± 4.8 ka, 78 ± 4 ka, 95.7 ± ka, 97 ± 3 ka, 123 ± 5 ka, 132 ± 5 ka, 141 ± 5 ka, 152 ± 9 ka, 153 ± 15 ka, 168 ± 14 ka, 155 ± 4 ka, 172 ± 15 ka, 187 ± 8 ka, 188 ± 21 ka | MSA | Vogel 2001; Beaumont & Vogel 2006; Chazan <i>et al.</i> 2020 |
| Wonderwerk Cave, South Africa (Northern Cape) | 7 | 220 ± 14 ka, 238 ± 13 ka | early MSA | Vogel 2001; Beaumont & Vogel 2006; Chazan <i>et al.</i> 2020 |
| Wonderwerk Cave, South Africa (Northern Cape) | 8 | 276 ± 29 ka, 278 ± 26 ka, 286 ± 29 ka | Fauresmith | Beaumont & Vogel 2006 |
| Wonderwerk Cave, South Africa (Northern Cape) | 13–31 | 490 ± 140 ka, 510 ± 140 ka, 610 ± 140 ka, 734 ± 69 ka, 760 ± 160 ka, 760 ± 170 ka, 770 ± 150 ka, 839 ± 26 ka, 860 ± 150 ka, 1.05 ± 0.160 Ma | Acheulean | Chazan <i>et al.</i> 2008; Pickering 2015; Shaar <i>et al.</i> 2021 |
| Wonderwerk Cave, South Africa (Northern Cape) | 40–56 | 1.15 ± 0.17 Ma, 1.3 ± 0.16 Ma, 1.53 ± 0.18 Ma, 1.61 ± 0.17 Ma | Oldowan | Chazan <i>et al.</i> 2008; Shaar <i>et al.</i> 2021 |
| Xai Xai 2, Botswana | 1 | AD 202–595, AD 115–421, 175 BC–AD 248, 394–46 BC, 1224–771 BC | LSA | Yellen & Brooks 1989 |

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