Journal of Human Evolution 62 (2012) 533–547

Contents lists available at SciVerse ScienceDirect

Journal of Human Evolution

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

New ages for Middle and Later Stone Age deposits at Mumba rockshelter, Tanzania: Optically stimulated luminescence dating of quartz and feldspar grains

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ARTICLE INFO

Article history:
Received 13 September 2011
Accepted 13 February 2012
Available online 17 March 2012

Keywords:
East Africa
Chronology
Single grains
Dose distributions
Past environments

ABSTRACT

The archaeological deposits at Mumba rockshelter, northern Tanzania, have been excavated for more than 70 years, starting with Margit and Ludwig Köhl-Larsen in the 1930s. The assemblages of Middle Stone Age (MSA) and Later Stone Age (LSA) artefacts collected from this site constitute the type sequences for these cultural phases in East Africa. Despite its archaeological importance, however, the chronology of the site is poorly constrained, despite the application since the 1980s of several dating methods (radiocarbon, uranium-series and amino acid racemisation) to a variety of materials recovered from the deposits. Here, we review these previous chronologies for Mumba and report new ages obtained from optically stimulated luminescence (OSL) and infrared stimulated luminescence (IRSL) measurements on single grains of quartz and multi-grain aliquots of potassium (K) feldspar from the MSA and LSA deposits. Measurements of single grains of quartz allowed the rejection of unrepresentative grains and the application of appropriate statistical models to obtain the most reliable age estimates, while measurements of K-feldspars allowed the chronology to be extended to older deposits. The seven quartz ages and four K-feldspar ages provide improved temporal constraints on the archaeological sequence at Mumba. The deposits associated with the latest Kisele Industry (Bed VI-A) and the earliest Mumba Industry (Bed V) are dated to 63.4 ± 5.7 and 56.9 ± 4.8 ka (thousands of years ago), respectively, thus constraining the time of transition between these two archaeological phases to ~60 ka. An age of 49.1 ± 4.3 ka has been obtained for the latest deposits associated with the Mumba Industry, which show no evidence for post-depositional mixing and contain ostrich eggshell (OES) beads and abundant microlithics. The Nasera Industry deposits (Bed III) contain large quantities of OES beads and date to 36.8 ± 3.4 ka. We compare the luminescence ages with the previous chronologies for Mumba, and briefly discuss how the revised chronology fits in the context of existing archaeological records and palaeoclimatic reconstructions for East Africa.

Introduction

Mumba rockshelter contains one of the richest and most continuous Middle Stone Age (MSA) to Iron Age archaeological sequences in East Africa. Its MSA and Later Stone Age (LSA) assemblages, in particular, have become the type sequences for these cultural phases in East Africa. The best known and most notable feature is the presence of geometric microlithic stone artefacts and ostrich eggshell (OES) beads found throughout a large portion of the sequence. Microlithic technologies and the manufacture of personal ornaments play a central role in deliberations about the origins of modern human behaviour, the dispersals of modern humans within and out of Africa, and their responses to factors such as climate change (e.g., Ambrose, 1998, 2002; Wurz, 1999; McBrearty and Brooks, 2000; Mellars, 2006; McCall, 2007; Clarkson et al., 2009; Jacobs and Roberts, 2009; Petraglia et al., 2009). The abundant occurrence of microlithics and personal ornaments in the archaeological record is often used to differentiate between the LSA and MSA in Africa (Ambrose, 1998, 2002). Although they are the hallmark of the LSA, it is well known that they also occur in some MSA contexts, such as the Howieson's Poort in southern Africa, thereby obscuring the clear distinction between

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doi:10.1016/j.jhevol.2012.02.004

the MSA and the LSA, and the timing of the transition between them.

This ambiguity applies also to Mumba, where the 'Mumba Industry' in Bed V was defined by Mehlman (1989) as a 'transitional' industry between the MSA and LSA, based on the co-occurrence of LSA-like geometric microlithics and knives, OES beads, and MSA-like stone points. The transitional nature of the assemblage, the presence of microlithic tools, and their reduction in size and increased abundance in the younger deposits at the site have been interpreted by some researchers as supporting the gradual emergence of modern human behaviour within the African MSA (e.g., McBrearty and Brooks, 2000; Henshilwood and Marean, 2003; Mellars, 2006). On the basis of amino acid racemisation (AAR) ages of 45–65 thousands of years ago (ka) for ostrich eggshell from Mumba, McBrearty and Brooks (2000) suggested that the rockshelter contains the earliest evidence for geometric microlithic tools in East Africa. These tools, together with the occurrence of OES beads, portable art (a cross-hatched OES fragment) and ochre (stones with red colour traces and ochre fragments) in Bed V and lower Bed III, were taken by McBrearty and Brooks (2000) as indicators of complex human behaviour, supporting their model for the gradual development of modern human behaviour from the earliest MSA. Deacon and Deacon (1999) noted the similarity between the Howieson's Poort (65–59 ka) in southern Africa and the backed artefacts from Mumba, and linked this to the distribution of 'click' language speakers in these two regions to infer the long-distance dispersal and exchange of ideas. Mellars (2006) proposed that the earliest microlithic toolmakers in Africa may have been among the first populations that spread to other parts of the world, including South Asia. As evidence, he drew comparisons between the microlithic tools in southern and East Africa with those in India and Sri Lanka. Others have used the same assemblages to argue for the independent development of microlithic technology in South Asia about 35 ka, in response to increasing population size and deteriorating environmental conditions (e.g., Clarkson et al., 2009; Petraglia et al., 2009).

Until recently, such comparisons have been based on the original assemblage for Mumba rockshelter, collected by Margit and Ludwig Köhl-Larsen in the 1930s, which is thought to be heavily biased against smaller artefacts and to favour, instead, larger cores and flakes made from exotic materials such as obsidian and chert (Mehlman, 1989). The collection of artefacts excavated subsequently by Mehlman is incomplete and mostly unstudied (Mehlman, 1989; Prendergast et al., 2007; Diez-Martín et al., 2009). In addition, the Köhl-Larsen and Mehlman excavations were dug in spit depths of 20–40 cm and 10 cm, respectively, and assumed that the deposit was formed by the accumulation of horizontal beds (Prendergast et al., 2007). Mehlman also suggested that the Mumba deposits and the associated artefacts had been mixed after burial, so that the archaeological levels cannot be clearly distinguished (Mehlman, 1989; Prendergast et al., 2007). Furthermore, the ages reported thus far for Mumba have been obtained using sample preparation and measurement procedures that are no longer considered reliable or that were applied to unsuitable materials (e.g., uranium-series dating of bone), and ages have also been published without any associated uncertainties or supporting information.

Given these archaeological and chronological shortcomings, new excavations were undertaken at Mumba rockshelter in 2005 to facilitate a complete reassessment of site formation and stratigraphy, and to obtain an unbiased artefact assemblage for typological and technological characterisation. Importantly, Prendergast et al. (2007) showed that the entire deposit had not accumulated as a series of horizontal beds. Instead, they observed significant lateral and vertical changes within each level and were able to discriminate between different geological units on the basis of their separation by thin layers of culturally sterile sediments and distinct layers of rock fall. Their observations cast doubt on the presumption of contemporaneity of artefacts collected from relatively thick and horizontal spits by the previous excavators. In addition, the supposed 'transitional' nature of the assemblage was not supported by Diez-Martín et al. (2009), who performed a systematic analysis of the technology and typology of the unbiased artefact assemblage newly excavated from levels equivalent to Bed V of Mehlman and the Köhl-Larsens. They found no evidence for technological change or for MSA attributes. Instead, their entire 'Bed V' assemblage was consistent with LSA technology, containing a large proportion of tools produced using the bipolar technique. From their typological analysis, however, they observed a change in the relative abundance and size of geometric microlithics between the lower and upper levels, but could not discount the possibility that this change was a function of the limited sample size.

In both southern and East Africa, it has become increasingly evident that defining the LSA and MSA, and the transition between them, is not straightforward. The technological and typological approaches that have customarily been used to differentiate between these periods do not yield unambiguous results. A possible means of surmounting this predicament is to compare and contrast assemblages based on their numerical ages. Resolving subtle differences in timing, however, can only be achieved if a common chronology is constructed for all assemblages at a given site. To this end, we collected sediment samples from Mumba rockshelter in 2007 for optically stimulated luminescence (OSL) dating. We used the new stratigraphic sequence of Prendergast et al. (2007) to securely tie the OSL sample locations to well-defined archaeological units from which unbiased artefact assemblages have been examined using current technological and traditional typological approaches (Diez-Martín et al., 2009). By dating the Mumba samples with the same instruments and procedures as employed at several other African sites, we can align the Mumba sequence on the same timeline as archaeological sequences in southern Africa (Jacobs et al., 2008a) and search for common patterns that might link these two regions.

The aim of this paper, therefore, is four-fold:

- To provide numerical age estimates for the Mumba microlithics and for the most recent pre-microlithic (MSA) levels in the sequence (Diez-Martín et al., 2009).
- To directly test the claims for stratigraphic integrity of the most recently excavated deposits at Mumba (Prendergast et al., 2007).
- To assess the temporal (dis)continuity of the revised archaeological and sedimentological sequences proposed by Diez-Martín et al. (2009) and Prendergast et al. (2007), respectively.
- To assess possible reasons for changes in technology at Mumba by comparing their timing with existing archaeological and palaeoclimatic records for East Africa.

Site setting, stratigraphy and archaeological context

Mumba rockshelter (3°17′47″E, 3°32′26″S) is located ~1050 m above mean sea level on the southeastern side of Lake Eyasi in northern Tanzania, ~62 km south of Olduvai Gorge (Fig. 1). The Lake Eyasi basin is situated near the southwestern terminus of the Crater Highlands volcanic area, but volcanic debris is found only in the northernmost portion of the lake and does not reach the rockshelter. The basin is of Pleistocene age and is now filled mostly with sediment. When dry, the lakebed is subject to severe aeolian deflation by strong northerly winds, but the lake level has