



Holocene paleoenvironmental change in southeastern Africa (Makwe Rockshelter, Zambia): Implications for the spread of pastoralism



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ABSTRACT

The paleoenvironmental conditions surrounding the origins of pastoralism and the movement of herders from eastern to southern Africa sometime between ~4000 and 2000 ybp have been much debated. We lack, however, detailed paleoenvironmental data from sites sampling the hunter-to-herder transition in southeastern Africa, the likely corridor from eastern to southern Africa for early pastoralists. Here we report on new paleoenvironmental data from a site in the under-sampled area of eastern Zambia, Makwe Rockshelter, which has two aggregates of archaeological horizons representing the mid-Holocene (~5700–5000 ybp) and the late Holocene (~1600–800 ybp). The mid-Holocene sediments at Makwe document a foraging society, whereas the late Holocene sediments include both wild game and domestic livestock. Using stable carbon isotopes ($\delta^{13}\text{C}$) of herbivore enamel ($n = 107$), we show that the shift from mid-Holocene to late Holocene paleoenvironments was characterized by an increase in C_4 vegetation. These data are complemented by paleoenvironmental records from Lake Malawi that show that C_4 vegetation peaked after ~2000 ybp and was coincident with the onset of cooler, more arid climates. This combined paleoenvironmental record has implications for the spread of pastoralism across southeastern Africa between ~3000 and 2000 ybp and potential 'animal disease barriers' these early herders may have faced.

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1. Introduction

Dedicated pastoralism emerged in eastern Africa at least ~4000 years before present (ybp) at sites such as Dongodien (Gaj14) and Koobi Fora Ridge (Gaj12) east of Lake Turkana (Marshall et al., 1984; Barthelme, 1985), Enkapune ya Muto in the Central Rift Valley (Marean, 1992; Ambrose, 1998), and Wadh Lang'o, Gogo Falls, and Usenge 3 near Lake Victoria (Prendergast, 2010, 2011; Hildebrand and Grillo, 2012; Chritz et al., 2015). However, the earliest evidence for domesticated animals in southern Africa does not appear until ~2300 ybp at Leopard Cave in Namibia (Pleurdeau et al., 2012) and slightly later at Spoegrivier, Blombos, and Kasteelberg in South Africa (Sealy and Yates, 1994; Henshilwood, 1996) and Toteng in Botswana (Robbins et al., 2005, 2008). Recent isotopic data (Chritz et al., 2015) show that a potential dispersal corridor for pastoralists in the Lake Victoria Basin was characterized by open grasslands until at least ~1900–1600 ybp, suggesting that the woody tsetse fly barrier to livestock waxed and waned in response to climatic

conditions (Smith, 1984, 2005; Gifford-Gonzalez, 2000, 2016). New dates and sites from Lake Eyasi and the Mbulu Plateau in northern Tanzania show the appearance of domesticated animals by ~3000–2800 ybp (Prendergast et al., 2013, 2014), in agreement with paleoenvironmental evidence for an early, open tsetse-free corridor permitting movement of pastoralists southward. Unfortunately, however, we have very little knowledge of Holocene paleoenvironments in southeastern Africa during the spread of pastoralism across the continent.

The savannas and Highveld of Zambia are an often overlooked but critical connection between eastern and southern Africa. Eastern Zambia in particular has produced several middle to late Holocene archaeological sites that fill a spatial gap in our understanding of the hunter-to-herder transition in sub-Saharan Africa. One such site, Makwe Rockshelter (Fig. 1A), traverses this transition and may document the earliest domesticated animals and relationships between hunters and herders in the region. Here we present stable carbon ($\delta^{13}\text{C}$) and oxygen ($\delta^{18}\text{O}$) isotopes of herbivore enamel and reconstruct middle to late Holocene paleoenvironments at Makwe. The mid-Holocene sediments of Makwe (~5700–5000 ybp) preserve evidence of a foraging society and are

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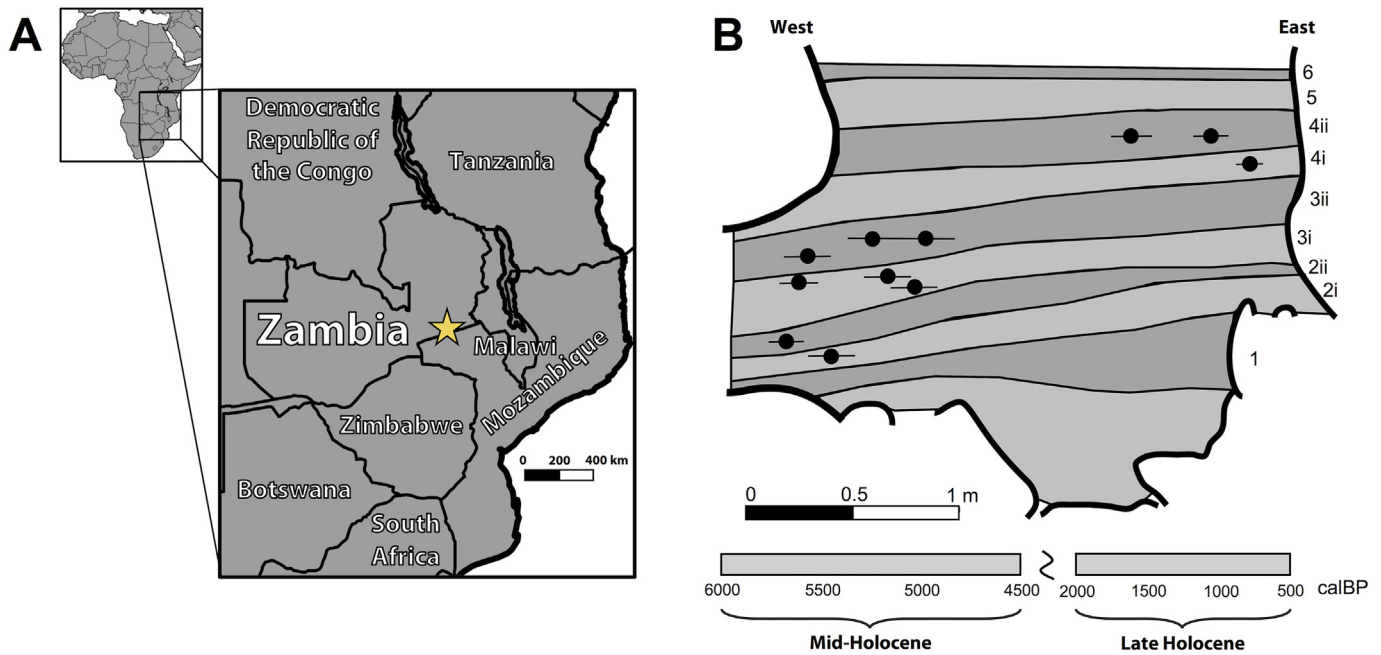


Fig. 1. (A) Map of southeastern Africa with the location of Makwe Rockshelter noted by the gold star and (B) cross-section through the Makwe deposits (adapted from Phillipson, 1976) with radiocarbon dates shown as black circles and lines depicting error bars.

entirely composed of wild game, whereas the late Holocene sediments (~1600–800 ybp) preserve both wild game and domestic livestock. Even in the late Holocene sediments, wild game is abundant ($n = 142$) and outnumbers domesticates (wild game = 74.3% fauna), permitting paleoenvironmental inferences to be made. We ask whether the transition from the mid-Holocene to the late Holocene was characterized by a shift to more C_4 -dominated paleoenvironments, as the onset of arid conditions in the late Holocene and a decrease in woody cover has been argued to have been favorable to the spread of pastoralism (Marean, 1992; Kusimba, 2003; Gifford-Gonzalez, 2000, 2016).

1.1. Geological context

Makwe Rockshelter is located in the southwestern corner of Zambia's Katete District (14°24.8' S; 31°56.0' E) approximately 1.0 km from the international border with Mozambique (Fig. 2). The rockshelter is located in the northeast side of a large granite dome known as Little Makwe kopje at 1000–1050 m above sea level on the grassy, well-watered plateau of the Zambian Highveld (Phillipson, 1973, 1976). The rockshelter itself is formed by an overhang 20 m long and 9 m high extending 8.5 m into the granite dome. The presence of large boulders restricts the surface area to ~45 m². A maximum depth of 2.08 m was recorded in nine stratigraphic horizons named from oldest to youngest: 1, 2i, 2ii, 3i, 3ii, 4i, 4ii, 5, and 6 (Phillipson, 1973, 1976) (Fig. 1B). Details of the excavations can be found in Phillipson (1976).

Phillipson (1976) obtained radiocarbon dates from charcoal samples in all horizons except the earliest, Horizon 1, from which there was no charcoal, and the surface level, Horizon 6. Additionally, the sample from Horizon 5 was reported as “too young to date.” For the material that was datable, we have corrected Phillipson's (1976) dates at 95.4% confidence using the ShCal13 curve (Hogg et al., 2013) with OxCal 4.2 (Bronk Ramsey, 2009). The corrected radiocarbon dates demonstrate a depositional hiatus in the sequence between Horizons 3ii and 4i, a gap that roughly spans from ~5000 ybp to ~1600 ybp (Table 1; Fig. 1B). The earlier part of

the sequence is constrained between 5717 calibrated y B.P. (calBP) $\pm$ 149 in Horizon 2ii and 4950 calBP $\pm$ 203 in Horizon 3ii. While there are some stratigraphic inconsistencies in the radiocarbon dates for this part of the sequence, all dates are tightly grouped between ~5700 and 5000 ybp. Three reliable radiocarbon dates were obtained from the upper part of the sequence: 838 calBP $\pm$ 66 for Horizon 4i, and 1600 calBP $\pm$ 128 and 1071 calBP $\pm$ 91 for 4ii. Again, these dates are stratigraphically inconsistent, but clearly group separately from those in Horizons 2i through 3ii. For analytical purposes, we aggregate Horizons 1–3ii into a ‘mid-Holocene’ unit (~5700–5000 ybp) and Horizons 4i–5 into a ‘late Holocene’ unit (~1600–800 ybp), as they are separated by a depositional hiatus spanning several thousand years. In addition, mid-Holocene sediments preserve evidence of a foraging society whereas the late Holocene sediments contain both wild game and domestic livestock (see below). We do not include Horizon 6 (the cave floor) in the late Holocene unit given its very young age.

1.2. Archaeological context

Phillipson (1976) named the Makwe Industry from the lithic remains of the site, although Inskeep (1979) suggested it is simply a local variation of the older Nachikufan I Industry. The Makwe Industry is present in all horizons at Makwe except the surface sediments of Horizon 6. In Horizons 4i to 5, the Makwe Industry is found with traces of the early Iron Age (Chifumbaze Industry). Phillipson (1976) provides an age estimate of ~10,000–8000 ybp for Horizon 1 based on similar composition of the Makwe Industry in layers of that age at the nearby site of Kalemba Rockshelter, and notes that the low artifact density in the bottom meter of the sequence may extend to the latest Pleistocene.

The Makwe Industry is characterized by reduction in artifact size from the Nachikufan I and the abandonment of the radial-core technique for single and double platform cores. Retouched implements are mostly backed microliths with few scrapers and no points. Phillipson's (1976) analysis suggests a continuous usage, but gradual development, of the Makwe Industry at the site. For

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