Short communication

Middle Palaeolithic occupation in the Thar Desert during the Upper Pleistocene: the signature of a modern human exit out of Africa?

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Abstract

The Thar Desert marks the transition from the Saharo-Arabian deserts to the Oriental biogeographical zone and is therefore an important location in understanding hominin occupation and dispersal during the Upper Pleistocene. Here, we report the discovery of stratified Middle Palaeolithic assemblages at Katoati in the north-eastern Thar Desert, dating to Marine Isotope Stages (MIS) 5 and the MIS 4–3 boundary, during periods of enhanced humidity. Hominins procured cobbles from gravels at the site as evidenced by early stages of stone tool reduction, with a component of more formalised point production. The MIS 5c assemblages at Katoati represent the earliest securely dated Middle Palaeolithic occupation of South Asia. Distinctive artefacts identified in both MIS 5 and MIS 4–3 boundary horizons match technological entities observed in Middle Palaeolithic assemblages in South Asia, Arabia and Middle Stone Age sites in the Sahara. The evidence from Katoati is consistent with arguments for the dispersal of Homo sapiens populations from Africa across southern Asia using Middle Palaeolithic technologies.

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1. Introduction

The path of hominin dispersal from Africa to Asia is commonly illustrated as a coastal corridor (e.g. Stringer, 2000; Field and Lahr, 2005). However, recent field investigations in the Sahara and the Arabian Peninsula have begun to illustrate how Middle Stone Age and Middle Palaeolithic populations expanded along continental corridors during periods of enhanced humidity (Armitage et al., 2011; Drake et al., 2011, 2013; Dennell and Petraglia, 2012). The Thar Desert (Fig. 1), which ranges across western India and south-eastern Pakistan, is part of the mid-latitude arid belt, which appears to have shared similar palaeoenvironmental responses to global climatic change through the Upper Pleistocene. Hominin colonisation of the central Thar may have been impossible during periods of increased aridity, effectively preventing continental routes of dispersal through this region (Field et al., 2007). However, the presence of dense networks of palaeo-channels across the Thar Desert (Gupta et al., 2011) suggests continental routes of dispersal may have existed during periods of enhanced humidity.

The Palaeolithic archaeology of the Thar Desert is predominately known from the results of surface surveys, which indicate repeated associations between humid landforms, such as palaeochannels and pedogenised dune deposits, and Middle Palaeolithic artefacts (Allchin et al., 1978; Misra et al., 1982; Raghaven and Courty, 1987; Blinkhorn, 2012). Secure and reasonably well-dated evidence for hominin occupations in the Thar Desert during the Upper Pleistocene is limited to the site of 16R Dune (Misra and Rajaguru, 1986; Raghavan et al., 1989). At this large sand dune, overlooking Didwana Lake, a Middle Palaeolithic occupation horizon is constrained by dates of 80–40 ka, with non-diagnostic occupations stretching back to ca 180 ka (Gaillard, 1993; Achyuthan et al., 2007; Singhvi et al., 2010; Blinkhorn, 2013). Here, we report the initial results of an excavation at Katoati, ca 50 km from 16R Dune, which have identified Middle Palaeolithic occupations in Marine Isotope Stage (MIS) 5 and at the boundary between MIS 4 and 3.

2. The Katoati study site

Katoati is located in Nagaur District, Rajasthan in the north-eastern Thar Desert at (E74°11′35.44″, N27°13′19.38″). The Jayal Formation, a tectonically uplifted boulder-conglomerate horizon (of Early or Pre-Quaternary origin) overlying a ferricretised sandstone basement, provides the major source of topographic relief in
Fig. 1. a) Map indicating the position of Katoati and the Thar Desert with respect to contemporary Middle Palaeolithic sites in southern Asia; b) Map indicating the position of Katoati in relation to other Palaeolithic sites in the north-eastern Thar Desert.
the immediate surroundings. Previous studies on the Jayal boulder beds have identified Late Acheulean assemblages in excavated contexts at Jayal and Chhajoli (Misra et al., 1980, 1982). Late Acheulean and Middle Palaeolithic artefacts have been identified on the surface of the boulder beds (Misra et al., 1980, 1982), and gravel spreads downslope. To the north of the Jayal Formation exists a suite of fluvial deposits overlain by aeolian sediments.

Reconnaissance survey of the sedimentary deposits at Katoati identified stratified cultural horizons with abundant lithic assemblages. Initially, a small collection of sixteen single-platform, multi-platform, radial and Levallois cores was made from pebble and gravel deposits in the upper fluvial deposits. The stratigraphic position of the cores corresponded with a sample of ostrich eggshell (Struthio camelus) AMS radiocarbon dated to 45.35 ± 0.65 ka BP (OxA-19407). A test excavation (KAT1) was subsequently conducted to recover a larger sample of lithic artefacts and to study their sedimentary context.

KAT1 is situated within the fluvio-aeolian deposits, where a gully exposed a deep, stratified sequence. A 3 m wide step-trench was excavated to a depth of 4.48 m (Fig. 2), revealing eight sedimentary strata (S1–S8), five of which are dated using Optically Stimulated Luminescence (OSL) (Table 1; see Supplementary information). The two uppermost deposits, which occur to a depth of 1.3 m, are aeolian dune deposits, with limited evidence for pedogenesis or carbonate formation. An OSL age of 12 ± 4 ka dates the sediments at the base of S2. In the top of S3, a thin pebble line is observed, which is laterally extensive across the immediate landscape, and is interpreted as evidence of a sheetwash erosion event. Beneath this pebble line there is a dramatic increase in the proportion of CaCO₃ present within the sediments. An OSL age of 61 ± 9 ka dates the base of S3, ca 3 m below surface, which marks the lowest aeolian deposits identified.

Strata 4, 6 and 8 comprise medium sands supporting occasional gravels and rare cobbles. These three strata are separated by S5 and S7, which comprise medium sands with very rare gravel inclusions. The OSL age of S4 is 48 ± 11 ka, while two fragments of ostrich eggshell (S. camelus) from S4 are dated to >57.9 ka BP (OxA-25897) and >62 ka BP (OxA-25898) by AMS radiocarbon dating. Although the OSL ages from S3 and S4 are inverted, their error ranges overlap, they are statistically indistinguishable, and the ages are also consistent with the AMS dates. As we suggest below, this dates to the period during which there is a change from fluvial to aeolian deposition, which probably occurs at Katoati around the transition between MIS 4 and 3 ca 60 ka. This is corroborated by the OSL age of 77 ± 18 ka for S5. The base of fluvial activity exposed through excavation dates to 95.6 ± 13.1 ka. The fluvial sediment sequence is interpreted as having been formed as sand and gravel bars within or at the edge of a braided stream.

Stable isotope analyses of pedogenic carbonates indicate a change in floral composition between periods of aeolian and fluvial deposition. Pedogenic carbonates from the fluvial sediments (S4–8) returned δ¹³C values of ~0‰, suggesting 80–90% of vegetation of the site comprise C₄ plant types. In contrast, 60–70% C₄ plant coverage is suggested by results from S3 between 2 and 3 m depth.

![Fig. 2. Schematic diagram of the sediment profile at KAT1 displaying eight strata (labelled S1–S8); the position of OSL samples locations are indicated by solid black circles with associated age estimates (ka); 0.1 m horizon yielding ostrich eggshell marked ‘X’; sampling location for sedimentary analyses is highlighted on the left of the profile. The results of % CaCO₃ and stable carbon isotope analyses are presented to the right.](http://dx.doi.org/10.1016/j.quascirev.2013.06.012)
of ~ 2%o. Dispersed isotope results observed between 1.5 and 2 m suggest proximity to an ancient land surface, which is consistent with the interpretation of a sheet wash event scouring this horizon. Lithic assemblages from KAT1 were recovered from S3, S4, S5, S6, and S8 (Table 2). A collection of 58 artefacts was recovered in association with the pebble line at 1.5 m (S3a), and size class characteristics suggest this is the fine fraction of a transported assemblage. Eight artefacts were found towards the base of S3 (S3b). Large collections of artefacts were made from S4 (n = 436), S6 (n = 627), and S8 (n = 327), which present well matched evidence for size sorting, weathering and rounding. Limited post-depositional disturbance has removed the smallest (<20 mm) fraction, whereas the larger fraction (>20 mm) of these assemblages are largely undisturbed. This suggests exploitation of the site after deposition of each gravel horizon. The assemblage from S5 (n = 62) appears to have been subject to more significant post-depositional alteration. Overall, the lithic assemblages appear to have been produced following periods of fluvial activity in a predominantly C4 habitat.

3. Lithic technology

Raw material use at KAT1 is dominated by immediately available materials, particularly quartzites (96%), with low proportions of quartz (n = 50), chert (n = 5) and sandstone (n = 2). A single limestone artefact is the only example of imported raw material. The presence of numerous large and highly cortical cores and flakes indicates early stage reduction activities were undertaken at the site. Core technology within the largest assemblages, S4 (n = 76), S6 (n = 108) and S8 (n = 64) is homogenous, comprising informal (single and multi-platform) and formal (prepared and Levallois) types. Two Levallois cores from S4 and one from S8 exhibit a mixture of distal divergent and lateral preparation of the flaking surface to produce a distal–medial ridge resulting in the removal of prepared points (Fig. 3). These reduction schemes are consistent with descriptions of Nubian Levallois technologies (Rose et al., 2011; Usik et al., 2013).

Variability amongst flakes predominately relates to reduction intensity, with highly cortical flakes with fewer scars on the dorsal surface typically larger than flakes lacking cortical surfaces with more numerous prior removals. A single flake from S4 presents a combination of distal divergent and lateral removals on the dorsal surface and a prior removal of a pre-determined pointed flake, indicative of the use of Nubian Levallois strategies (Fig. 3). A small number (n = 3) of Levallois points present further evidence for debitage strategies orientated towards point production. Retouched tools are most abundant in S4 (n = 42) and S6 (n = 50), but mostly present informal retouch of a single side, or a single side and either one or two ends of each artefact. Formal retouched artefacts include a single bifacial point, and eleven delineated pieces, including notched, nosed, tongued, shouldered and tanged artefacts (Fig. 5). A total of seven large bifaces were found in S8, including a single ovate biface. The presence of prepared point core production and delineating retouch of pointed artefacts stands out among the formalised reduction strategies at KAT1. The technology and antiquity of the lithic assemblages supports assignment of the Katoati assemblages to the South Asian Middle Palaeolithic.

4. Discussion

We have presented archaeological evidence for stratified Middle Palaeolithic assemblages at Katoati, indicating repeated hominin occupation of the Thar Desert between MIS 5 and the MIS 4–3 boundary in association with periods of enhanced humidity. The Katoati findings corroborate the archaeological evidence from 16R Dune, indicating the presence of hominin populations in the Thar Desert between 80 and 40 ka. The archaeological findings clearly extend the occurrence of Middle Palaeolithic hominins in South Asia to MIS 5c ca 95 ka. A Middle Palaeolithic occupation of the Thar Desert during MIS 5a corresponds with evidence from Jwalapuram in southern India ca 78 ka (Petraglia et al., 2007, 2012b). The presence of hominins employing Middle Palaeolithic technology at the transition between MIS 4/3 fills a lacuna for dated archaeological sites in the South Asian Palaeolithic record. The age range for Middle Palaeolithic occupations at KAT1 also overlaps with the hominin occupations of Arabia (Armitage et al., 2011; Petraglia et al., 2011, 2012a; Delagnes et al., 2012, 2013; Rose et al., 2011) and the Sahara (Smith et al., 2007; Hill, 2009). The identification of cultural continuities between these regions may be critical to assess different models for the dispersal of hominin populations.

The discoveries at KAT1 are pertinent to the current debate regarding the dispersals of Homo sapiens into South Asia and...
routes or exploitation of the Indus corridor (Field et al., 2007). The evidence from S4 suggests fluvial activity and hominin occupation at the MIS 4/3 transition may have facilitated continental routes of dispersal using riverine networks. The presence of Middle Palaeolithic technologies in the Thar Desert at ca 60 ka clearly occurs within the timeframe that have been suggested by genetic studies for the arrival of H. sapiens in South Asia (e.g. Macaulay et al., 2005; Scally and Durbin, 2012; Fu et al., 2013). This contradicts the hypothesis that modern humans arrived in South Asia using “small crescentic forms...that are markedly similar to those that define the so-called Howiesons Poort technology” (Mellars, 2006: 797).

Comparable technologies, principally based around microblade production, are not observed in South Asia until 40–30 ka (Clarkson et al., 2009; Perera, 2010) or after the Last Glacial Maximum in the Thar Desert (Blinkhorn, 2012). Instead, the Katoati evidence is consistent with arguments for the dispersal of H. sapiens populations using Middle Palaeolithic technologies (Petraglia et al., 2010, 2012c; Boivin et al., 2013).

Technological continuity in Middle Palaeolithic assemblages at Katoati before and after the eruption of Toba at 75 ka (Mark et al., 2013) matches evidence observed in southern India (Petraglia et al., 2007, 2012b). The tanged point at KAT1 is similar to a specimen from Jwalapuram (Locality 22) (Fig. 4), with further examples observed within the Thar Desert (Blinkhorn, 2012). This supports suggestions of technological continuities in the use of Middle Palaeolithic technologies across South Asia. Critically, the focus upon point production at KAT1, observed across core, flake and retouched artefact categories, indicates a number of similarities with the Arabian (Armitage et al., 2011; Rose et al., 2011; Usik et al., 2013) and Saharan (Scerri, 2013) archaeological records in the Upper Pleistocene. In particular, the appearance of core technologies analogous to Nubian point cores is notable as they exhibit a highly restricted distribution within the eastern Sahara and southern Arabia (Rose et al., 2011). Similarly, the presence of delineated pointed artefacts, including tanged specimens, may be comparable with Aterian industries in the Sahara (Scerri, 2013).

Further archaeological research is required to identify where these similarities are the result of convergent evolution of tool forms, their adaptive significance for exploiting arid landscapes, or cultural connections across the mid-latitude arid belt. The discoveries described from Katoati indicate the Thar Desert is a critical region to evaluate the relationship between climate changes, hominin demography and cultural evolution that help to illuminate evidence for the dispersal of H. sapiens from Africa into South Asia.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.quascirev.2013.06.012.
References


