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Early hominin landscape use in the Lower Omo Valley, Ethiopia: Insights from the taphonomical analysis of Oldowan occurrences in the Shungura Formation (Member F)

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ABSTRACT

The Oldowan archeological record of the Shungura Formation, Member F (Lower Omo valley, Ethiopia) comprises more than one hundred occurrences distributed within archeological complexes, where multiple small spots were found in association with one or two larger occurrences. Such spatial patterning could reflect hominin spatial behavior, repeated occupations within a single sedimentary unit, or taphonomic and/or collection biases. Here we test these hypotheses by way of a geoarcheological and taphonomical analysis using four criteria to assess the preservation of the lithic assemblages: (1) size composition, (2) artifact abrasion, (3) bone abrasion, and (4) orientations of lithic artifacts and bones (i.e., fabrics). We propose a new model of taphonomically induced spatial patterning where the multiple, small, well circumscribed occurrences result primarily from post-depositional processes and therefore do not reflect any underlying behavioral patterns. The large number of archeological occurrences documented in Member F, therefore, corresponds to a limited number of primary occupations (<10). The archeological occupation is mainly restricted to the lower part of Member F and may reflect a single or a small number of occupation episodes, which were located on previous levees of the paleo-Omo River, in nearby floodplain areas, or on the riverbank. This strongly suggests that most of the knapping activities originally took place close to the river. This preference of the Omo toolmakers for riverine environments could explain the scarcity of archeological material in the upper part of Member F that comprises primarily distal floodplain sedimentary facies.

1. Introduction

A significant number of recent studies have greatly improved our understanding of technological skills shared by Oldowan toolmakers in eastern Africa (Isaac and Harris, 1997; Ludwig, 1999; de la Torre et al., 2003, 2004; Delagnes and Roche, 2005; Mora and de la Torre, 2005; Braun et al., 2009a; Hovers, 2009; Faisal et al., 2010; Stout et al., 2010; Barsky et al., 2011; Yustos et al., 2015), including aspects of raw material provisioning (Stout et al., 2005; Blumenschine et al., 2008; Braun et al., 2008, 2009a, b; Harmand, 2009; Goldman-Neuman and Hovers, 2012). By contrast, very little is known about patterns of landscape use (Blumenschine, 2003), despite their being crucial for assessing the abilities of hominins to adapt to varying environmental conditions. Site distribution, density, and spatial extension in the Oldowan differ significantly from one context to another. Contexts with a limited number of dense and well circumscribed archeological occurrences, such as Hadar (Kimbel et al., 1996), Lokalalei (Roche et al., 2003), Kanjera South (Plummer et al., 1999), Melka Kunture (Chavaillon and Piperno, 2004), Fejej (de Lumley and Beyene, 2004), and Nyabusosi (Pickford et al., 1989) contrast with contexts comprising multiple small spots associated with one or two more consequential occurrences. This latter type of spatial patterning is characteristic of the Oldowan archeological record of Gona (Semaw, 2000), Peninj (de la Torre et al., 2003), Koobi Fora (Harris, 1997), Olduvai Gorge (Leakey and Clark, 1971; Blumenschine et al., 2012), and Shungura Formation-Member F (Lower Omo valley, Ethiopia), where our

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recent surveys revealed the presence of more than one hundred occurrences at a micro-regional scale, mostly clustered within a limited number of archeological complexes (Delagnes et al., 2011; Delagnes, 2012).

Such spatial patterning suggests three non-mutually exclusive hypotheses: (1) these occurrences relate directly to hominin spatial behavior, either as an adaptive response to the specific characteristics of the meandering landscape of the paleo-Omo River (Delagnes et al., 2011) or as a result of a functional complementarity between "mini-" and "macro-sites" reflecting a home-based spatial behavior, as suggested by Isaac at Koobi Fora (Isaac, 1981; Isaac et al., 1981); (2) they correspond to repeated but still indistinguishable occupational phases within a single sedimentary unit; and/or (3) they reflect taphonomic and/or site inventory biases.

Here we test these hypotheses by way of a geoarcheological and taphonomical analysis of the archeological occurrences from the Shungura Formation-Member F, dated to between 2.32 ± 0.02 million years (Ma) and 2.27 ± 0.04 Ma (McDougall and Brown, 2008; McDougall et al., 2012). Although fine-grained alluvial sedimentation is favorable to the good preservation of archeological sites, several studies have demonstrated such contexts do not systematically guarantee the integrity of the lithic assemblages (Isaac, 1967; Schick, 1987; Sitzia et al., 2012). Taphonomic analyses of Oldowan sites are currently limited to single criteria, for instance fabrics at Kanjera South (Plummer et al., 1999) or artifact breakage by trampling or sediment compaction in A.L. 894 at Hadar (Hovers, 2003). Our multi-dimensional analysis combines an investigation of the spatial and stratigraphic distribution of archeological occurrences within the meandering Omo River context that prevailed during the deposition of Member F, with a taphonomic approach that considers artifact size sorting, edge abrasion, bone surface modifications, and fabric analysis. Based on these data, we propose a taphonomically induced spatial model, which provides key insights for understanding the spatial behavior of toolmakers in the Shungura Formation relative to the other Oldowan site complexes.

2. Materiel and methods

The Shungura Formation is located along the Omo Valley in the East African Rift system of southwestern Ethiopia (Fig. 1). The archeological potential of this area has been documented and investigated since the late 1960s and early 1970s by the International Omo Research Expedition (IORE), which focused primarily on Member F. Jean Chavaillon (1976) and Harry Merrick (1976) excavated seven archeological occurrences. Artifacts were piece-plotted and numbered, with the associated sediment sieved and sorted (Rensberger, 1973). The homogeneous lithic assemblages are composed primarily of small quartz flakes, flake fragments, angular fragments, and cores (Chavaillon, 1976; Merrick and Merrick, 1976; Ludwig, 1999; de la Torre et al., 2004). Although extremely abundant in the overall Shungura sequence, faunal remains are scarce in the archeological occurrences.

The Omo Group Research Expedition (OGRE) restarted multidisciplinary fieldwork in the Shungura Formation in 2006, including paleontological, archeological, and geological analyses and paleoenvironmental reconstructions (Boisserie et al., 2008). Outcrops assigned to Members B to G of the Shungura Formation (type area, see de Heinzelin, 1983) were extensively surveyed in order to refine the temporal and spatial extent of hominin occupation in the area (Boisserie et al., 2010; Delagnes et al., 2011). Only Member F and the lower part of Member G yielded unquestionable archeological occurrences, which have been dated to between approximately 2.3 and 2.0 Ma within a stratigraphic sequence that ranges from 3.6 to 1.0 Ma.

2.1. Archeological data

Our study focuses on six complexes of archeological occurrences, OMO 79, OMO 1/E, OMO 123, FtJi 1-3-4, FtJi 2, and FtJi 5 (Fig. 2, Supplementary Online Material [SOM] Table S1), for which both excavation and surface collection data are available. Artifacts in Member F are not randomly distributed across the outcrops (Delagnes et al., 2011; Delagnes, 2012; Maurin et al., 2014) but cluster in areas designated here as "archeological complexes" (Figs. 1 and 2; Maurin et al., 2014). Such archaeological complexes correspond to specific areas within Member F (<1 ha), where at least one dense occurrence is found in spatial proximity and stratigraphic continuity with multiple smaller occurrences. The stratigraphic position of occurrences forming each archeological complex can be inferred with a high degree of confidence when artifacts were visibly eroded from the outcrops. Artifacts are either in situ (i.e., still embedded in the sediment), sub-in situ (i.e., the layer of origin is clearly identifiable), or redistributed on the slope by erosion.

Here we present an analysis of 4000 artifacts from both the IORE and OGRE field investigations: OMO 123 (Chavaillon, 1976 and unpublished data from Delagnes and colleagues), FtJi 1-3-4, FtJi 2, FtJi 5 (Merrick and Merrick, 1976), OMO 1/E, and OMO 123 (unpublished data from Delagnes and colleagues). Artifacts are generally small (Chavaillon, 1976; Merrick and Merrick, 1976) and primarily made of quartz (97.3%, $n = 3892$). Lithic objects less than 5 mm in width were excluded from the analysis in order to render them directly comparable with assemblages that derive from excavated and sieved material, and from non-sieved surface assemblages.

2.1.1. FtJi 1-3-4 Located in the northern part of the type area, the FtJi 1-3-4 complex was studied by H. Merrick in the early 1970s, who excavated one occurrence (OMO A16) with in situ artifacts in a lens of sand and fine gravels. He also collected material from two others (OMO A17 and OMO A18) by scraping and screening the soft upper 10 cm of the deposit (Merrick, 1976; Merrick and Merrick, 1976; IORE archives). All of these occurrences were located at the base of an approximately 10 m thick sandy layer some 6 m above Tuff F′ that cuts and laterally replaces Tuff F (de Heinzelin, 1983; Howell et al., 1987).

2.1.2. FtJi 2 This single occurrence (OMO A2) was excavated by H. Merrick (Merrick and Merrick, 1976). The majority of the artifacts were found (SOM Table S1) embedded in situ within a clay rich in white nodular $CaCO_3$ concretions approximately 6 m above Tuff F' (Merrick and Merrick, 1976; de Heinzelin, 1983; and Merrick's IORE archives). This locally reworked deposit was previously referred to as Tuff F'γ (Merrick, 1976; de Heinzelin, 1983; Howell et al., 1987).

2.1.3. FtJi 5 This complex is composed of eight occurrences (OMO A19, OMO A95, OMO 97, OMO A98, OMO A99, OMO A101, OMO A102, and OMO A103) all located in Tuff F' or in a sandy layer overlaying Tuff F. Our study focused on one occurrence at the base of a hill just above a large indurated tuff slab excavated by H. Merrick (OMO A19; Merrick and Merrick, 1976). While several artifacts (23 of 107) were found in a coarse sand and gravel layer, the majority are surface finds (SOM Table S1). OGRE recorded seven other occurrences in the vicinity (OMO A95, OMO 97, OMO A98, OMO A99, OMO A101, OMO A102, and OMO A103) from which no artifacts were collected.

2.1.4. OMO 123 This complex, discovered in 1972 (Coppens et al., 1973; Chavaillon, 1974), comprises 15 occurrences, the majority of which yielded in situ or sub-in situ artifacts. The assemblages were collected from a sandy layer and overlying loamy deposit (Fig. 3), forming a sub-continuous 0.5 m thick archeological layer (Fig. 4). Three occurrences (OMO A13, OMO A12, and OMO A15)