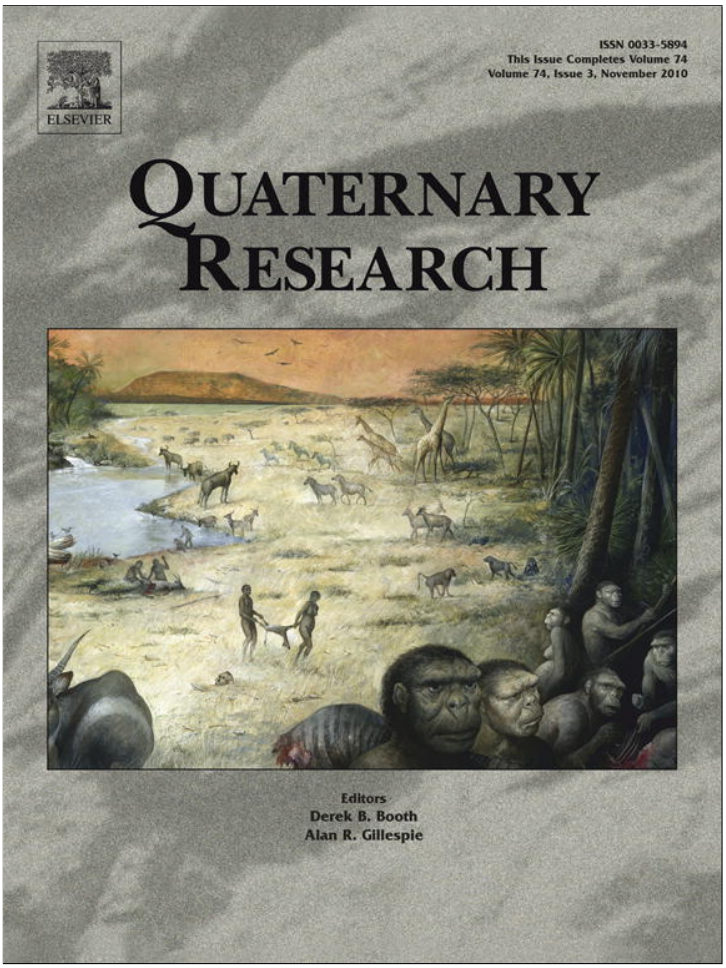

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Introduction to the Special Issue on Olduvai Gorge

Paleoecology and hominin behavior during Bed I at Olduvai Gorge (Tanzania)

Fifty years after Mary Leakey's excavation of the FLK *Zinjanthropus* (FLK Zinj) site, we honor the decades of pioneering work by Mary and Louis Leakey at Olduvai with this special issue in which we report on the recent research results by The Olduvai Paleoanthropology and Paleoecology Project (TOPPP). Near FLK Zinj, our team has discovered a freshwater spring system about 200m away at FLK North and abundant phytoliths, indicating that palms and other woody vegetation characterized the location. This new reconstruction replaces the conventional setting of FLK Zinj on a barren, grassy lacustrine floodplain (Blumenschine and Masao, 1991) and offers an explanation for why herbivores, carnivores, and hominins were all attracted to the location where early *Homo* accumulated and butchered several dozen large herbivores. A similar freshwater spring characterized the slightly younger levels at FLK North, where many of the animal fossils are, unsurprisingly in such a lush setting, the result of large carnivore predation and feeding. The data gathered also refute the idea that systematic scavenging of felid-consumed prey was practiced by hominins at the Bed I sites. The papers in this issue present new evidence and some provocative reconstructions that address a key paleoanthropological question: How human was early *Homo*?

The exploratory expeditions to Olduvai undertaken by the Leakeys from 1931 to 1947 had the following goals: establishing a sequence of the evolutionary stages of culture across all beds, surveying the gorge to spot as many sites as possible for future selection for excavation, and obtaining a picture of the geological history of the gorge and its relevance to the climatic history of East Africa (Leakey, 1965). What Leakey (1965) referred to as the second stage of research at Olduvai, initiated in the early 1950s, was focused on finding and excavating "living floors" to reconstruct "early man's" behaviour. Extensive open-air excavations were subsequently carried out at BK and SHK in Bed II. In the meantime, survey continued in Bed I, and by 1959, hominin fossils had been discovered at MK and, most spectacularly with the skull of *Zinjanthropus* (*Paranthropus boisei*), at FLK.

The discovery of Zinj switched temporarily the Leakey's attention from the Bed II "living floors" to the Bed I "living floors", and it yielded significant funding from the Wilkie and Wenner-Gren Foundations and from the National Geographic Society. This marked a crucial moment in East African paleoanthropology. For paleontology, it led to the discovery of some of the most important hominin fossils in decades, among them the first *Homo habilis*. For archaeology, it enabled the prolonged excavation of several sites during the 1960s and the horizontal exposure of some of the most impressive "living floors". Still today, some of these sites (e.g., FLK Zinj) remain the most extensive open-air excavations carried out in early Pleistocene archaeology in Africa (Leakey, 1971).

The abundant, well-preserved fossils and artifacts from these Olduvai Bed I sites have constituted the core of debates about early human behavior for the past half century. Early taphonomic work on these assemblages appeared to corroborate with butchery evidence the basically anthropogenic nature of Leakey's living floors and Glynn Isaac's (1971, 1978) comparable home bases at Koobi Fora, Kenya (Bunn et al., 1980; Bunn, 1981; Potts and Shipman, 1981), but this taphonomic perspective actually catalyzed more extensive debate rather than bringing consensus or closure to it. One alternative taphonomic approach, for example, employed feeding experiments with large carnivores and resulting bone damage as a proxy for reconstructing ancient hominin behavior (e.g., Blumenschine, 1987, 1988), instead of using the direct archaeological evidence of hominin behavior available from Olduvai, and especially from the FLK Zinj site (Bunn and Kroll, 1986, 1988; see review in Domínguez-Rodrigo et al., 2007).

Ironically, while these debates continued, no large-scale excavations were conducted at the very sites at the core of the debates, which Leakey had partially excavated some forty to fifty years earlier. Instead, in the 1980s it became more popular for teams working on the African early Pleistocene to gather information off-site to understand hominin behavior more from a paleoecological and adaptive perspective. Landscape archaeology projects became widespread at places like Koobi Fora and Olorgesailie (Kenya), as well as at Olduvai after Leakey ceased working at the gorge. OLAPP (Olduvai Landscape Paleoanthropology Project) has carried out systematic work targeting the lowermost Bed II stratum for the past 20 years (Blumenschine and Masao, 1991). The results of their research should provide valuable information on hominin behavior along the landscape, which will complement the wealth of information derived from the on-site approach.

In 2004, all the assemblages excavated by Leakey at the Bed I sites were taphonomically analyzed (Domínguez-Rodrigo et al., 2007). The results of this analysis were surprising. They suggested that most of the "living floors" were palimpsests resulting from one of the following scenarios: little or no hominin involvement in carcass processing, no carnivore–hominin interaction, independent overlap in the use of the same space by hominins and carnivores (resulting in no functional link between stone tools and bone deposition), and production of most bone assemblages from felid–hyenid interactions (Domínguez-Rodrigo et al., 2007). One exception stuck out as the most taphonomically supported anthropogenic site prior to 1 Ma: FLK Zinj (Bunn, 1982; Bunn and Kroll, 1986, 1988; Domínguez-Rodrigo, 2009). There, hominins accumulated a large number of carcasses, which were butchered with stone tools and constitute the best preserved evidence of meat-eating by early humans. The taphonomic study of these assemblages produced a large number of questions that could only be addressed with renewed field work at the same sites. Among these questions were: why were hominins and carnivores

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drawn to the same sites (all but one clustered in the same area of the gorge) for so many thousands of years? What was the functionality in terms of hominin behavior of these taphonomically diverse spots? What is FLK Zinj in terms of human behavior?

To answer these questions TOPPP (The Olduvai Paleoanthropology and Palaeoecology Project) emerged. TOPPP's philosophy was to approach these questions by integrating on-site research with off-site paleoecological information. From 2006 until present, research has been carried out in several Olduvai sites, among which all of the Bed I sites formed in proximity to one another (FLK, FLK N, and FLK NN). DK, stratigraphically lower than the other sites and located further away from the paleo-lake shore, was not approached because it related to different questions and was already under study by other researchers.

The work presented in this special issue provides new information that contributes to understanding the formation of these extraordinary sites. Detailed geological work described in the paper by Ashley et al. provides firm evidence that during the FLK Zinj period, a fresh water spring existed at the nearby locality of FLK NN, only 200 m away from FLK Zinj. Abundant woody dicotyledon and palm phytoliths found at the site and its periphery attest that the site was surrounded by dense woodland and suggests that the location would be highly attractive to hominins.

The archaeological study of the surrounding landscape, as shown in Domínguez-Rodrigo et al.'s paper, provides more information in this regard by showing that although bone scatters exist on the landscape, the density of fossils found at Zinj stands out as an anomaly, suggesting that the accumulation of carcasses was intentionally formed by hominins at that specific location. This is further supported by the concentration of lithics and butchered bones at the site. The data permit a detailed reconstruction of the paleoecology of the area (including its paleovegetation) and the conditions in which FLK Zinj was formed (see cover illustration).

The wooded nature of the landscape near the spring is documented not only in FLK Zinj time but also throughout the middle and upper Bed I sequence. The microfaunal analysis of Level 20 at FLK NW, situated between FLK and FLK NN, as described in Arcos-Fernández et al.'s paper, shows that trees were a conspicuous feature of the landscape. This is further supported by the analysis of paleobotanical remains at the top of the sequence (FLK N level1-2), where the paper by Ashley et al. on the reconstruction of the paleolandscape during FLK N times shows the presence of a wetland created by the same spring system as at FLK Zinj (see also Ashley et al., 2010). The paper by Barboni et al. provides a detailed description of over 140 different species of plants, among which trees are predominant, around FLK N. This indicates that although open landscape could potentially have been predominant along the gorge, especially south of the gorge junction (Bamford et al., 2008), the area surrounding FLK N was heavily wooded and perhaps even forested. This could explain its repetitive selection by hominins and carnivores through time. This reconstruction, supporting Fernández-Jalvo et al.'s (1998) work, contrasts with previous interpretations that depicted FLK N as a fairly open landscape.

Bunn et al.'s paper provides a fresher look at the densest bone assemblage found at Olduvai: FLK N 1-2. A previous taphonomic analysis of Leakey's fossil assemblage (Domínguez-Rodrigo et al., 2007) documented how minor the hominin role was in forming the bone assemblage at FLK N, in contrast to the dominant role of carnivores. At FLK N 1-2, renewed excavations have yielded more than 1000 new large mammal fossils, which show minimal butchery evidence (3 cut-marked bones, 1 hammerstone percussion-notched bone) amid abundant evidence of carnivore gnawing/fracture, rodent gnawing, and sediment abrasion.

The relative importance of hominins and carnivores is also documented through the archaeological sequence at FLK N. The excavations have uncovered more archaeological levels in Bed I than reported by Leakey by excavating below her level 6. Nine archaeological levels have been reported in the new excavation of the site, which shows recurrent deposition of artifacts and bones by hominins and carnivores from Middle Bed I to upper Bed I, as reported in Dominguez et al.'s paper on the site. These authors also report on the lack of evidence of hominin-butchered bones from small and medium-sized carcasses derived from scavenging from the felid-accumulated assemblages across the sequence.

If hominins were not scavenging carcass remains from felids, what were they doing so repeatedly at the site? A technological analysis of the new lithic assemblage is described in Diez-Martín et al's paper, which shows that flaking and core reduction were very marginal strategies of hominin technological behavior at the site, while percussion/battering activities occurred more regularly throughout the sequence. If hominins were not involved in regular carcass processing (through bone breaking), as the taphonomic studies suggest, then hominins' sporadic and low-impact visits to the site over a long period of time must have been driven by other activities probably linked to the exploitation of alternative resources, despite their occasional butchery of very few carcasses at the site. This remains one of the archaeological mysteries that require further exploration.

Two papers included in this volume by Bunn and Pickering (one on the theory of age profiling and the other on its application to FLK Zinj and FLK N) constitute an improvement over the interpretation of primary access (either by hunting or confrontational scavenging) elaborated by taphonomic analyses on how hominin acquired the carcasses that they processed at FLK Zinj. If hominins were scavenging those carcasses from carnivores (either passively or by confrontation), the age profile of this assemblage should be similar to the prey age profile of the carnivores that provided the scavengeable kills. Instead, the age profiles of the carcasses lie outside the predominant age profile of felids specialized in hunting small and medium-sized herbivores. This constitutes strong evidence that hominins were not passive scavengers but rather actively hunted most of the carcasses that they accumulated at FLK Zinj.

The results presented in this special issue should contribute to interpreting the behavioral meaning of the Olduvai Bed I sites. Ongoing research at other Olduvai sites will provide a wider framework to understand the evolution and variability of the behaviour of early *Homo* beyond the behavior inferred at FLK Zinj, within an evolutionary process involving the transition from the Oldowan to the Acheulian.

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