

## 2024 EAAPP Conference Abstracts

(amended draft, July 24, 2024)

Abstracts are listed in alphabetical order by first author's surname.

Abstracts for podium presentations and poster presentations are listed together.

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### **Decolonizing human evolution museum displays: a case study of the HUMANITY exhibition**

Like many scientific disciplines, palaeoanthropology has a colonial history. As a result, narratives of human origins are often racist and patriarchal, and demographic representation remains skewed to the Global North. How we tell our origin story to the public matters. Narratives that “other” can alienate young people and impede transformation. Here we discuss a new permanent human evolution museum exhibit, titled HUMANITY, at the Iziko South African Museum. Our goal in producing this exhibit was to decolonize the narrative of human evolution and decentre Whiteness (e.g. the Great White Explorer narrative of discovery). These are particularly important issues in post-Apartheid South Africa but are also relevant to the discipline more broadly. This exhibit was created in an inclusive manner, with active community engagement, and input from researchers, curators, artists, community leaders and more. All exhibition components, from research to the establishment of design principles, were developed to create a space that is welcoming and inclusive to make everyone feel invested in our collective origin story. The exhibit does not fit traditional Western museum aesthetics. Importantly, we use the biological and cultural diversity of people in South Africa today as a means for exploring how that diversity came to be, in both the recent and deeper evolutionary past. Throughout the exhibit, we weave a story of complex human interconnectedness, a narrative that is consistent with our current understanding of the braided stream analogy for human origins. The exhibit also addresses the negative legacies of palaeoanthropological practice and encourages critical reflection on race, skin colour variation, and privilege. We are currently developing education programmes, as well as free digital resources for schools and museums across South Africa and the continent, to encourage meaningful scholar engagement with the exhibition and extend its message beyond the confines of Iziko to reach a wider audience.

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### **Lucy's children: the impact of a great discovery on subsequent discoveries**

Pioneering scientists including Maurice Taieb and John Kalb discovered the fossil rich sites of the Lower and Middle Awash Valley. Combined, the sites represent an unmatched and continuous sedimentary sequence spanning the last 6 million years. A great deal of fossil and archeological data relevant to the biological and cultural evolution of the hominin lineage has been recovered, and the A.L.288-1 skeleton, popularly known as Lucy, occupies a special place. Lucy was discovered 50 years ago at Hadar and has inspired many generations of paleoanthropologists to conduct research in the broader Afar basin. One such project is the Dikika Research Project (DRP), which has yielded a wealth of fossil evidence pertaining to some of the most prominent issues regarding the paleobiology of *Australopithecus*. The discovery and analysis of the Dikika Child, also known as Selam, has played a key role in advancing our knowledge of ontogeny, patterns of brain development, locomotion, etc., in *Australopithecus*.

Tantalizing evidence from cutmarked bones dated to 3.4 Ma has triggered and also inspired renewed discussions on the role of stone tool use and meat consumption in our lineage. The DRP has also taken the issues of generational continuity seriously, offering training opportunities to both international and local students and young researchers both in the field and at various international institutions. In this presentation a short summary of DRP's contribution to science and training is provided.

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### **The late Miocene fossiliferous site As-Sahabi (Libya): state of knowledge and assessment of discovered fauna**

As-Sahabi in northeast Libya is a reference Miocene fossiliferous site since it is situated at a biogeographic crossroad between Africa and Eurasia. It has been sampled over two distinct time spans. The pioneer research was done by Italian researchers in the 1930s, while an international team (ISRP and ELNRP) relaunched work between the 1970s and 2010. Here we review the geology and palaeontology of the site, and assess the quality of the fossil record with respect to faunal composition by comparing the Italian sample with the more recent one. The Italian team surveyed three sectors at the south of the site via five campaigns over a span of six years. Conversely, the international team surveyed 11 sectors across the whole site through several field campaigns in eight cumulative years. A comparison of the fauna collected by the Italian and the international teams shows that the latter is taxonomically more evenly distributed. The Italian collection shows a bias toward selacian remains and very large mammals, which suggests that most fossils were surface collected. We also found that most of the fossils, and the most diverse fauna and flora, come from the upper member of the Sahabi Formation (unit U1 within Qarat Makada member). However, it seems that U1 is overrepresented in the collection because it was the object of a higher sampling effort than other units. Collections from units T, U2, and V (Early Pliocene Qarat Weddah Formation) yield fewer taxa, but it remains to be tested if this is due to lower sampling effort or if these units really yielded less diverse communities than U1. Finally, we identify five U1 localities that show good records of community composition. This work lays the foundations for future studies, which will aim to reconstruct the site's paleoecology during the Late Miocene-Early Pliocene period.

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### **East African origin for the Later Stone Age and ostrich eggshell beads**

Assemblages combining features of Middle Stone Age (MSA) and Later Stone Age (LSA) technologies are found in Mumba Bed V and Kisese II (Tanzania), Ntumot (GvJh11, Ntuka River, Kenya), and the Endingi Industry at Enkapune Ya Muto (GtJi12, Kenya), dating to >56-65 ka. The earliest Later Stone Age (LSA) technologies in Kenya include Enkapune Ya Muto (>50 ka) and Norikiushin (GJh12), and Panga Ya Saidi (~60 ka). The Naisiusiu Beds LSA (Olduvai Gorge, northern Tanzania), is dated ~50-60 ka. These occurrences are older than the earliest Later Stone Age elsewhere in Africa and older than the earliest Upper Paleolithic of the Levant. Perforated, punctured marine gastropod shells with evidence of microwear consistent with strung ornaments are found in MSA sites in South Africa and Kenya, and in Middle Paleolithic sites in North Africa and the Levant, dating to ~76-120 ka. Ostrich eggshell (OES) beads are the oldest artifacts made by rotary drilling. In Tanzania, an OES bead from an MSA horizon at Magubike rock shelter is dated >50 ka. The earliest OES beads at Kisese II date to ~45 ± 1 ka. Mumba Bed 5, with 2 OES beads, is dated by amino acid racemization and OSL to 51-52 ka. In Kenya, OES beads associated with an informal LSA industry at Mogoti (GvJh47, Ntuka River) date to 48.37 ± 1.37 cal ka BP. OES beads associated with the LSA Sakutiek Industry at Enkapune Ya Muto date to 47.44 ± 1.06 cal ka BP. OES is present at Naisiusiu and Norikiushin, but OES beads are absent in these

earliest LSA assemblages. Therefore, the beginning of the LSA in Kenya and northern Tanzania appears to be several millennia earlier than the beginning of rotary drilling and OES bead manufacture.

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### **Exploring factors of shape and size variability in extant crocodylian bite marks: implications for paleobiological and taphonomic inferences**

Bite marks allow reconstruction of trophic interactions in past ecosystems, but their use is hindered by a poor understanding of their variability. We use extant crocodylians to explore the influence of biological factors of the biting animal (size, bite force, dental morphology, dental wear, and orientation of biting movements) on the shape and size of bite marks produced in controlled settings. We built a reference data set of 99 bite marks and 132 tooth apices from four extant crocodylian taxa (*Crocodylus niloticus*, *Alligator mississippiensis*, *Osteolaemus tetraspis*, *Mecistops cataphractus*). Bite marks and tooth apices were molded using silicone and digitized using confocal microscopy. The resulting high-resolution 3D surfaces allowed us to extract cross-section profiles along marks and following several orientations for tooth apices (parallel, perpendicular, oblique to the mesiodistal carina). Elliptic Fourier Analyses and Principal Component Analyses were applied to these profiles (10 profiles per bite mark, 4 profiles per tooth apex) to quantify shape and size variability and test correlations between their morphologies and producers' factors. Crocodylian bite marks reveal large intraspecific variabilities and small interspecific differences in profile shapes and sizes. Profiles extracted at different heights and orientations along the cervicoapical axis of teeth are different, confirming that different bite forces, penetration depths, and tooth orientations would result in different mark morphologies. Variability in dental morphology and tooth wear degree are also reflected in large profile shape variations of tooth apices. In *C. niloticus*, bite marks produced by small and large individuals are different. In *A. mississippiensis*, restrained and unrestrained conditions leave different bite marks, suggesting a behavioral influence on bite mark morphology. Our preliminary results highlight the complex interplay of numerous factors that result in bite mark variability and are promising for paleobiological and taphonomic inferences.

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### **A new *Victoriapithecus* distal humerus from Chepetet West, Nyakach, Nyanza Rift (Kenya): a preliminary approach to its morphological and functional affinities and locomotor inferences**

A fragment of humerus preserving the distal epiphysis and part of the shaft was recovered in 2022 from Chepetet West, in the Nyakach Formation, Nyanza Rift (Kenya). The specimen was qualitatively and quantitatively compared to extant and fossil primates including hominoids, cercopithecoids, ceboids, two *Victoriapithecus* individuals and other fossil catarrhines (e.g., *Ekembo heseloni*) to assess its morphological, functional affinities and infer its locomotor behavior. KNM-NC 79045 is a well-preserved distal humerus of *Victoriapithecus* measuring 24.4 mm. The medial and lateral epicondyles are gently rounded, and the olecranon fossa is deep. The medial trochlear crest is high, the lateral trochlea crest is low and more rounded, and the lateral supracondylar crest is minimally rounded. The medial epicondyle is short, and the trochlear groove is shallow, and similar in depth to the zona conoidea. The lateral and medial olecranon pillars are well defined and minimally worn. Qualitative comparisons indicate that KNM NC 79045 differs in size and overall morphology from stem hominoids (e.g., *Ekembo heseloni*), but

shares some similarities in aspects of the epicondyles, olecranon fossa, and shallow zona conoidea and trochlear groove. Similarly, KNM NC 79045 differs from other small eastern African catarrhines—such as *Limnopithecus*—being more similar both in size and general traits to other *Victoriapithecus* individuals. Quantitative results support similar conclusions: KNM-NC 79045 is more similar to other *Victoriapithecus* than to small eastern African fossil catarrhines or stem hominoids. Among extant taxa, KNM NC 79045 is most similar to hylobatids, cercopithecoids, colobines and platyrrhines for most measurements, but shows a smaller trochlea and a wider zona conoidea than all extant groups and other fossils. The overall results suggest that KNM-NC 79045 would have relied on agile quadrupedalism in both terrestrial and arboreal settings.

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### **3.0-2.5 Ma geologic framework at Ledi-Geraru, Lower Awash, Afar, Ethiopia**

The Ledi-Geraru Research Project (LGRP) has assembled an integrated geological framework to place archeological and paleontological observations in their temporal and depositional environmental contexts. Detailed geological mapping, stratigraphic profiling, tephrochronology, and geochronology have been used to describe the faulted sedimentary and volcanic rocks of the eastern portion of the LGRP study area, located west of the Awash River in a region incised by the Mille and Geraru drainages and their tributaries. We have documented fluvial and lacustrine sediments cut by northwest and north-northeast trending extensional faults. The sedimentary sequence is divided into sedimentary packages exposed in fault blocks within a 5 km by 20 km north-south oriented outcrop belt. The stratigraphic sequence includes numerous pedogenic horizons and at least one prominent unconformity. More than 16 dated tuffs are integrated with tephra correlations and magnetostratigraphy to provide the chronostratigraphy. The oldest sedimentary package in the eastern LGRP is 2.95 Ma. Tuffaceous and fossiliferous layers from 2.8 to 2.5 Ma span the Gauss-Matuyama reversal. The paleoenvironments and faulting history suggest a transition from broader and deeper lake(s) with basalt lava emplacement in the early portion of the LGRP history, to more complex fluvial, deltaic, and lacustrine dominated landscapes by 2.5 Ma.

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### **Insights into Late Quaternary eastern African paleoenvironment: multi-proxy analysis of Lake Haramaya sediments, southeastern Ethiopian Highlands**

Eastern African environments are highly variable and influenced by global scale phenomena (e.g., changes in solar radiation due to orbital parameters) and by local and regional topography, mainly the East African Rift System and adjoining highlands. Here, we present Late Quaternary environmental changes in eastern Africa, based on multi-proxy analyses of a ~27.3 m long sediment core from the highly fluctuating Lake Haramaya, located on the southeastern Ethiopian highlands (~2010 m asl), at the edge of the Main Ethiopian Rift and the Afar Depression. This location makes the record ideally suited to testing the refugial hypothesis that early human populations survived arid intervals by moving to highland refugia. An age model spanning ~173,000 years, a significant period for human dispersal within and out of Africa, was developed using 2 bulk sediment radiocarbon ages and 12 luminescence ages. Geochemical and sedimentological proxies are used to reconstruct the paleoenvironment of the basin. A combination of Ca/Ti and K/Zr ratios serve as a proxy for aridity, complemented by an inverse relationship with Rb/K ratio. Sedimentological insights and statistical tools like PCA support these

interpretations. Extremely low depositional rates between 86 ka and 4 ka suggest an extreme dry phase causing hiatus, possibly during MIS 2 as evidenced in nearby lakes and archaeological sites. Additionally, the records indicate two distinct drier periods with carbonate-dominated sediment deposition. These extended dry periods were preceded and followed by unstable, relatively wet periods characterised by silicate-rich, sandier silty clay elastic sediment deposition. Shorter scale minor fluctuations, identified mainly in other proxies (e.g., Rb/K & K/Zr), further interrupted the long term dry and wet periods. The findings of our study offer valuable insights into the environmental conditions surrounding the cultural transformations observed during the Middle and Later Stone Age periods, as evidenced in the nearby archaeological sites (e.g., Goda Buticha, Pore Epic, etc.).

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### **An investigation on public perception and response towards the practice of public archaeology in Ndali, western Uganda**

This paper explores public perceptions and responses towards the practice of public archaeology in Ndali. Public archaeology has been referred to in literature for some time as a practice geared towards the inclusion, education, and engagement of the public in all archaeological investigations. In spite of all the scholarly recognition, its practice, especially in sub-Saharan African countries, is still in embryonic stages, given that many archaeological sites are unconsciously destroyed following economic developments. A situation that presents questions such as: Does public archaeology work or is it what the community wants? With limited data on these gaps in Africa, this study evaluated the practice of public archaeology in Ndali, western Uganda, through the eyes of local people (perceptions and responses) and describes how best this concept can be embraced in the country.

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### **$\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ and $87\text{Sr}/86\text{Sr}$ isotope insights into the late Pleistocene paleoecology of MSA foragers from Gotera, southern Ethiopia**

Ecological and climatic changes are thought to have driven cultural and ecological adaptation including dispersal and vicariance, and adaptation and resilience of *Homo sapiens* within and beyond Africa. However, refined studies on the regional and local paleoenvironmental and paleoclimatic contexts of MSA foragers are hampered by site-based research lacunas. Ecological reconstruction of late Pleistocene sites constrained partly due to the fragmentary nature of proxy records such as poor preservation of faunal assemblages. In order to address this critical issue, here, we present stable carbon ( $\delta^{13}\text{C}$ ), stable oxygen ( $\delta^{18}\text{O}$ ), and strontium ( $87\text{Sr}/86\text{Sr}$ ) isotope analysis of mammalian tooth enamel from the MSA of Gotera site. The preliminary  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  isotope results at Gotera suggests the presence of a more open, arid, and predominantly C<sub>4</sub> grassland environment. A minimum extent of woody habitat ecology has been inferred from  $\delta^{13}\text{C}$  value of mixed feeder herbivores. The carbon isotope value agrees with the  $\delta^{18}\text{O}$  values with an indication of a semi-arid climatic setting. Our isotope data is consistent with the analysis of faunal assemblages at Gotera, showing the dominant presence of open habitat-adapted faunas and the absence of aquatic and water-sensitive herbivores. At Gotera, the presence of an open grassland and patchy wooded corridor may have offered opportunities for dispersal of *H. sapiens*.

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### **Paleoenvironmental reconstruction via ecomorphology in the Upper Burgi, KBS, and Okote members of the Koobi Fora Formation, Kenya**

Past environmental change likely had a significant impact on shaping morphological and behavioral adaptations throughout hominin evolution. As such, it is critical to understand the habitats of ancient hominins. In this study, we reconstruct the paleoenvironmental conditions within three geologic members of the Koobi Fora Formation (Kenya): Upper Burgi, KBS, and Okote, dating between 1.98 and 1.38 million years ago. This time encompasses aspects of our evolutionary history that include significant shifts in behavioral and biological evolution, such as expanding brains and tool use specialization. Here, we examine environmental shifts from the perspective of bovid distal metapodial ecomorphology. To assess morphological variation in bovid distal metapodials, a 3D geometric morphometric analysis was applied to extant and fossil bovid specimens (n=109; metatarsal=32; metacarpal=77) using a 20-landmark protocol, followed by a generalized Procrustes analysis and a principal components analysis. A discriminant function analysis was then used to compare fossil bovid distal metapodials to extant bovids with known habitat preferences. Our results indicate the prevalence of dynamic environments with the predominance of open habitat adapted bovids in all three geologic members, suggesting that open environments were dominant. The data also signal a general trend of increasing open habitats during much of the Koobi Fora Formation. However, a large proportion of closed habitat adapted bovids were also present, suggesting a mix of habitats through time. In conclusion, it is likely that this varied ecological setting provided opportunities for the diversification of later hominins, including the genus *Homo*.

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### **A cut above: traceological and taphonomic study of the faunal assemblage from Got10 site in southern Ethiopia**

The human behavior dynamics and the exploitation of the environment in Ethiopia and in the Horn of Africa during MIS 3 (~59-29 Ka) are still to be clarified. The Got10 site in southern Ethiopia is an open-air site in a modern savannah environment preserving a stratigraphic sequence rich in artifacts and fauna in primary contexts dated to MIS 3. The analysis of the faunal record at Got10 in southern Ethiopia provides an opportunity to explore aspects of forager occupation, mobility, animal resource exploitation, and adaptations to climatic changes during the Late Pleistocene. A range of taphonomic processes including burial time, exposure, fire alteration, and immersion in water can negatively impact bone surface observations, faunal identifications and trace associations, but some effects (e.g., fire) may also reveal new insights into past human behaviour. Here we report on a high-resolution analysis of traces – especially cut-marks - present on the surfaces of bones at Got10 and consider them holistically in relation to other processes. We analyse synchronic and diachronic variability in their morphology, location and orientation of cut marks across the Got10 faunal assemblages. This approach has rarely been applied to open-air contexts in East Africa due the scarcity of well stratified and dated MSA sequences with well-preserved bone. The results of this study provide potential new insights on aspects of human behaviour including settlement patterns, site function and environmental adaptation strategies.

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### **Canids from the Pleistocene: a comparative study between eastern and southern Africa**

The guilds of African extinct and extant canids include a wide variety of taxa, ranging in size from foxes to wild dogs and in dietary adaptations from insectivores to hypercarnivores. Canids are really abundant and particularly well preserved in the karstic palaeontological sites of southern Africa and in the open-air sites of eastern Africa. Among them, medium-sized jackal-like canids dominate the assemblages, and this is reflected in the sympatry of several species in some present-day African ecosystems (e.g., extant *L. mesomelas*, *L. adustus* and *C. lupaster* in eastern Africa savannah). Despite this preponderance, their fossil remains are little studied and their taxonomic identifications are often limited at the genus rank or even referred to extant species simply based on the overall size and/or geographical distribution. This work focuses on the comparative analysis of the canid guilds from the Pleistocene of eastern Africa (with particular attention on Olduvai Gorge in Tanzania) and southern Africa (with focus on some cave complexes such as Gcuihaba in Botswana and Kromdraai Member 2 in South Africa). In both areas, wild dogs are associated with smaller-sized canids throughout the Pleistocene. For instance, (1) in Kromdraai Mb.2, the species *Canis hewitti* co-occurs with *Lupulella mesomelas*; (2) in Olduvai Geolocality 83, the first African fossils unquestionably referable to *Canis lupaster* are identified, together with few remains of *Vulpes rueppellii*. This different taxonomic composition between the two areas can reflect (1) palaeoenvironmental variations (i.e., trophic availability), (2) palaeobiogeographic reasons, or (3) chronological differences. Our research underlines the need to face the study of African fossil mammals - and the canids in particular - with a purely systematic approach, to achieve reliable taxonomic identifications. This applies above all for medium-sized canids, for which a renewed knowledge of their morphological characteristics is necessary for a correct systematic interpretation of the fossil record.

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### **Thinking outside the rift: quantifying the magnitude of sampling bias on our understanding of hominin evolution**

The Eastern African Rift System preserves much of the early hominin fossil record, but reflects less than 2% of the spatial area of the continent. This mismatch undoubtedly colors our understanding of human evolution, but how important is this bias? To address this, we ask: how would our understanding of rift-dwelling extant mammal habitats be different if all we knew about was their occurrence within the rift? Using mammal range maps from IUCN, we compared environmental variables for a species' full range to the subset of the range occurring within the rift. The median spatial overlap between a species' full range and the rift is only 1.6%. Using repeated measures ANOVA, the rift is significantly ( $p < 0.05$ ) drier and has less tree cover and more grass cover than the full species ranges. These differences would have been less extreme in the Plio-Pleistocene when the elevational difference between the rift and its surrounds were less pronounced, but the direction of the bias would have been the same. We then use published morphometric datasets for extant baboons and guenons to ask: how good is the rift at sampling morphological variation in widely distributed primate species? We quantified morphological variation in a 3-dimensional morphospace created using Principal Component Analysis on Procrustes coordinates. We compared morphospace sampling of the eastern rift to a) the full range of variation in baboons and guenons, and b) to sampling units of similar size and shape to the rift scattered at random across Africa. Results indicate that the rift captures a modest sampling (<15%) of the overall morphological variation in extant guenons and baboons, and performs slightly worse than average in capturing morphological variation compared to randomly-placed rift-shaped sampling units. Overall, these results call for caution in making inferences about widely distributed generalist primate species from spatially restricted occurrences.

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### **First reconstruction of the trophic network of Morocco's earliest hominins: a case study of Thomas Quarry I: Grotte à Hominidés (Casablanca, Morocco)**

The ca. 0.7 Ma old Thomas Quarry I - Grotte à Hominidés (ThI-GH) in Casablanca (Morocco) has yielded well-preserved faunal remains (including *Homo* sp.) as well as Acheulean artefacts, offering a unique opportunity to study the environment and ecology of the earliest hominins in Morocco. The ThI-GH faunal assemblage is taxonomically diverse, comprised of herbivores and abundant carnivores including jackals, hyenas, panthers, and bears. The presence of bite marks on bones, including on a partial human femur, raises questions about trophic level structure and inter-specific interactions at ThI-GH. Thus, this fossil assemblage serves as an excellent case study for food web reconstruction of an early Middle Pleistocene northern African ecosystem using stable isotope ecology. Nitrogen isotopes ( $\delta^{15}\text{N}$ ) contain information about an individual's position in the food web and are frequently used in conjunction with stable carbon isotopes ( $\delta^{13}\text{C}$ ) to reconstruct dietary niche. However,  $\delta^{15}\text{N}$  is typically measured in collagen extracted from bones or dentin that are younger than 0.1 Ma. As the ThI-GH remains are much older than this, and because collagen preservation in dry and warm environments like Morocco is very poor,  $\delta^{15}\text{N}$  data cannot be obtained using traditional methods. Here, we employ a biogeochemical method that enables high precision  $\delta^{15}\text{N}$  analyzes of the mineral-bound organic matter preserved in diagenetically resistant tooth enamel. We use this method in conjunction with cryofocusing high-precision mass spectrometry to establish an ecological baseline for the ThI-GH faunal assemblage.  $\delta^{15}\text{N}$ ,  $\delta^{13}\text{C}$  and oxygen isotopes from carnivores ( $n = 23$ ), herbivores ( $n = 37$ ) and omnivores ( $n = 20$ ) were analyzed in <5 mg of tooth enamel. Using Bayesian niche modeling and diet reconstructions, we model the trophic network of the ThI-GH assemblage. This dataset can serve as an isotopic baseline for potential future hominin isotope studies.

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### **PALEONILE: paleontological and archaeological discoveries in the Middle to Late Pleistocene of Sudan**

Despite the existence of the Nile River in some form since the early Oligocene, very little is known about its potential role as an ecological refugium or faunal and cultural dispersal route during this long timeframe. Sudan covers a large portion of the Nile Basin, yet its vertebrate fossil record remains little explored. Since 2018 our team has conducted yearly fieldwork in Sudan with the aim of exploring faunal, archaeological, and environmental evolution during the Middle to Late Pleistocene of the Nile Basin. Our renewed investigations along the middle Atbara River valley in eastern Sudan have resulted in the discovery of many new sites, the recovery of a diverse fauna that includes hominins, excavation of a well-preserved Acheulean assemblage, and a new high-density OSL and  $^{14}\text{C}$  geochronology spanning ~250 ka to ~15 ka. With over 30 species represented, the new fossil assemblage provides the opportunity to examine late Quaternary extinctions, morphocline variations, and the emergence of modern phylogeography. Extinct forms include *Elephas jolensis*, *Kolpochoerus majus*, *Syncerus antiquus*, and a hipparionine equid. Other finds include the first record of a macaque (*Macaca*) in sub-Saharan Africa and robust cranial and postcranial remains attributable to Middle Pleistocene *Homo*. An in-situ Acheulean assemblage consists of large cutting tools made from split river cobbles, large cores, percussive tools including spheroids and hammerstones, and a core-flake component following discoidal and centripetal flaking methods. At ~160-80 ka, the hominin and Acheulean remains suggest the late persistence of



archaic hominins and Early Stone Age culture in the middle Atbara area, long after *Homo sapiens* and Middle Stone Age technologies had emerged elsewhere. Additionally, surveys in 2023 targeted the Blue and White Nile rivers, and included the relocation and dating of the sites of Sinja and Abu Hujar, the initial results of which will be presented here.

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### **Lucy's pet hippos: unlocking the taxonomy of eastern African hippopotamids**

Eastern Africa has the longest, most abundant and most diverse fossil record for the family Hippopotamidae. This record has therefore a particularly significant bearing on the evolutionary history of these megaherbivores that are major elements of late Cenozoic African ecosystems. Plio-Pleistocene hippopotamids from eastern Africa have been designated as “aff. *Hippopotamus*” for the last twenty years, following the suggestion of using the genus name *Hexaprotodon* for mostly South Asian species. This open nomenclature terminology indicates that these species share some similarities with but nevertheless differ from the extant genus *Hippopotamus*. This terminology may not be uneasy to use, more importantly it also potentially obscures phylogenetic relationships and biogeographical patterns. It was initially proposed because of uncertainties on systematics of the hippopotamids collected in the 1970s by the International Afar Research Expedition at Hadar and also at other sites of the Afar Region (Ethiopia). These hippopotamids were initially described in the early 1980s under the names *Trilobophorus afarensis* and *Hexaprotodon coryndonae*. The holotype of the former species was found at Geraru and related to most specimens from the Hadar Formation. However, specimens of *T. afarensis* from Geraru and Hadar display consistent differences in size (the latter being significantly larger) and craniomandibular morphology. The holotype of *Hex. coryndonae* is a mandible with a pathological dentition. It can be most parsimoniously interpreted as a female specimen of the large species that dominates the Hadar Formation assemblage and forms the major part of the hypodigm of *T. afarensis*. Following these observations, I propose taxonomic reattributions for most of IARE and more recently discovered specimens from these sites. Comparisons with hippopotamid collections from the Omo Group (Turkana Depression, Ethiopia and Kenya) allows for taxonomic changes for the Plio-Pleistocene hippopotamids from eastern Africa, and should ease the analysis of their evolutionary history.

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### **New insights into Kanyimangin: an Early to Middle Pleistocene site in West-Turkana, Kenya**

The Early to Middle Pleistocene Transition (EMPT, 1250-750 ka) sees substantial morphological and behavioural change in the genus *Homo*. Kanyimangin (south-west of the Turkana basin, Kenya), is one of the few known sites in East Africa dating back to the EMPT. Here we present new insights on the site's stratigraphy, the lithic and faunal assemblages and propose an updated interpretation of its chronology. The lithic assemblage comprises both Acheulean and Middle Stone Age lithic components, that were in part recovered from buried contexts. The substantial faunal assemblage is distributed across 24 taxa and includes: *Palaeoloxodon (Elephas) recki* cf. *recki*, *Loxodonta adaurora*, *Canis* sp., *Panthera*

cf. *pardus*, *Hyaena hyaena*, *Equus grevyi*, Rhinocerotidae, *Kolpochoerus (limnetes) heseloni*, *Phacocoerus aethiopicus*, Hippopotamidae including: *Hippopotamus amphibius*, *Giraffa* cf. *camelopardus*, *Syncerus caffer*, Antilopini, *Ourebia ourebi*, Reduncini, *Aepyceros melampus*, Alcelaphini including: *Alcephalus buselaphus* as well as *Euthecodon brumpti*, a broad-snouted crocodile, turtles/tortoises, snakes, fish and amphibians. The mixed aquatic and terrestrial faunal composition comprising obligatory drinkers together with a relative lack of fish suggests a more riverine habitat rather than a lake shore. Kanyimangin contains approximately 15-meter-deep sediments including a series of five sandstones (SS1–5). The oldest sandstone (SS5) comprises *Loxodonta adaurora* and *Kolpochoerus (limnetes) heseloni* fossils suggesting a Late Pliocene/Early Pleistocene age for the base of the sequence. Palaeomagnetic results reveal a normal polarity for sterile sediments below Sandstone 2 and evidence for a subsequent period of reverse polarity in faunal-bearing sediments covering Sandstone 1 (the youngest in the sequence). The reversed polarity of the faunal-bearing sediments together with the presence of *Palaeoloxodon recki* cf. *recki* and well-fossilised *Phacocoerus* sp. and *Alcephalus buselaphus* specimens recovered from the surface suggests a Jaramillo (1.06–0.90 Ma) or Cobb Mountain (1.19 Ma) age for the site. The origin of the MSA component at the site is still under investigation.

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### **Reviewing the top part on the Olduvai Gorge sequence: depositional processes and stratigraphy**

Olduvai Gorge in Tanzania is as an invaluable repository of palaeontological, palaeoanthropological and archaeological discoveries, disclosing a unique 2 Ma insight into human evolution amidst eastern African Quaternary environmental change. Whilst the older layers of its sequence (Beds I–IV) have been extensively studied due to their rich palaeoanthropological evidence, the younger ones (Masek, Ndutu, and Naisiusiu Beds) remain relatively unexplored. Consequently, there is scanty lithologic, mineralogical, and palaeontological evidence that can be used to differentiate these Beds. Following the discovery of a rich and well-preserved faunal assemblage within the Naisiusiu Beds at Geolocality 83 -which we dated to 38.8–34.6 cal14C ka- we reviewed the sedimentology, mineralogy, micromorphology, and stratigraphy of the Ndutu-Naisiusiu Beds in most of their outcrops along the Gorge (including the Ndutu and Naisiusiu type-sections), with the aim of reconstructing their depositional history and reassessing their stratigraphy and chronology. We highlight inconsistencies in stratigraphy, lithology, and sedimentology at the Ndutu-Naisiusiu boundary in different localities, so that this event cannot be formalised within the Gorge stratigraphy. On the other hand, our results show that multiple hyperconcentrated flow was crucial -though not exclusive- in forming the Ndutu and Naisiusiu Beds. Multiple events were deposited by channelled (mainly in the Ndutu) and overland (mainly Naisiusiu) flow with variable density and energy between the mid-Middle and the latest Pleistocene. Notably, the identification of vertebrate taxa like crocodiles and -particularly- foxes, corroborate and refine our interpretation of the Olduvai palaeoenvironment, pointing to contrasting climatic conditions. This study contributes significantly in explaining depositional dynamics and palaeontological richness of the Olduvai Gorge sequence during the Late Pleistocene, emphasising that our ongoing systematic investigations need to be pursued in-depth and over the whole area.

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### **New OES radiocarbon dates from Lake Besaka: implications for the Later Stone Age of Later Pleistocene Ethiopia**

The Late Quaternary archaeological/paleoenvironmental complex of Lake Besaka in Ethiopia's Main Ethiopian Rift was first investigated in 1974 and 1975 by J. Desmond Clark and Martin Williams. Clark and Williams were able to construct a terminal Pleistocene to late Holocene sequence documenting the activities of LSA hunter/gatherer/fisher groups occupying the western shorelines of a lake fluctuating dramatically as the LGM came to an end and the subsequent African Humid Period waxed and waned. In 1975 Clark's team observed a surface scatter of LSA obsidian artifacts within a fault scarp above the current shoreline. A test excavation of LB4 (now FexJ4) revealed a deeply stratified occupational and environmental sequence composed of two main occupation horizons. The lowest was a buried paleosol over and underlain by thick pumiceous sands laid down by high lake stands. Chronometrically undated but on stratigraphic grounds thought to be late or terminal Pleistocene in age, the Lower Horizon contained an obsidian LSA industry of backed blades, scrapers, burins, and other tools on blanks produced by prismatic and other blade cores. Steven Brandt's dissertation research in 1977 focused on further excavations of FeJx 4. Although severely curtailed by the "Red Terror" and other political events of that year, Brandt's research expanded upon Clark's results, including the obtainment of 4 OES radiocarbon ages dating the Lower Horizon to 27-22 ka, at that time the earliest chronometrically dated LSA site in the Horn of Africa. Over the last decade, researchers have, for various reasons, questioned the accuracy of the Lower Horizon dates as being too old. However, new OES AMS dates using a refined OES preparation process confirms the original dates. We conclude with the implications of these ages toward a better understanding of the tempo and mode of technological change in Late Pleistocene Ethiopia.

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### **Newly recovered primate fossils from the Middle to Late Pleistocene of the middle Atbara River, eastern Sudan**

Recent fieldwork efforts in the middle Atbara valley of Sudan have recovered a diverse faunal assemblage comprising more than 30 species. Among the taxa represented are two primate genera: *Homo* and *Macaca*. *Homo* is represented by three individuals – a partial mandible, postcranium, and clavicle, and *Macaca* by two individuals – a partial maxilla and mandible. The *Homo* fossils represent the first fossil evidence of hominids reported from Sudan since the discovery of the Singa *Homo sapiens* cranium nearly one century ago. The notable corporal robusticity of the mandible combined with the large size of the dentition suggests affinities with pre-modern *Homo*. The partial postcranium presents a mix of derived and ancestral features, combining moderate cortical thickness of the limb bones and a well-developed femoral pilaster with ancestral pelvic features. Taken together, the combination of ancestral and derived features suggests a closer affinity to Middle Pleistocene *Homo* than to modern *Homo sapiens*. At ~180-70 ka, these hominid remains are contemporaneous with early modern *Homo sapiens* from other African and Levantine deposits, possibly suggesting the late persistence of an archaic lineage in the middle Atbara area. The attribution of the two remaining primate specimens to *Macaca sylvanus* significantly expands the known fossil distribution of macaques. These fossils provide the first and only record of *Macaca* in sub-Saharan Africa and indicate the importance of the Nile Valley as a north-south faunal dispersal corridor. The specimens have inferred ages of ~160 ka and ~90 ka, suggesting that this taxon was a persistent inhabitant of the middle Atbara valley during the later Pleistocene. The newly recovered primate fossils described here contribute significantly to the records of *Homo* and *Macaca* and open a new window onto the last quarter million years of their evolution.

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## **The giant dwarf crocodiles that ate our ancestors: crocodylid response to environmental change in the Late Cenozoic of East Africa**

Fossil crocodiles from the East Africa Rift Valley System (EARS) were historically considered to be ancestral (or referable) to the Nile crocodile (*Crocodylus niloticus*) currently dominating the region, and they were thought to preserve little paleoecological information beyond the presence of warm, wet conditions. In fact, Late Cenozoic crocodiles from the Lake Victoria and Turkana Basins of Kenya reveal a complex history of phylogenetic response to environmental change over the past 20 million years (Ma). Early and middle Miocene sites (~19 to ~15 Ma) preserve three or four species in two major clades. Generalized forms with flat, triangular snouts are osteolaemines closely related to the modern West and Central African dwarf crocodiles (*Osteolaemus*). Tube-snouted forms appear to represent an endemic radiation of gharials, though the bizarre osteolaemine *Euthecodon* may also be present. Deposits dated to ~7 Ma also preserve gharials and *Euthecodon*, but the generalized forms include meciostopins related to the West and Central African sharp-nosed crocodile (*Meciostops*) and extinct species of *Crocodylus* unrelated to *C. niloticus*. Some crocodiles from this interval were gigantic, reaching lengths between 8 to 10 m. Diversity diminishes from five species in the late Miocene to three by the mid-Pleistocene. Extant African *Crocodylus* did not appear until less than 200,000 years ago. Temperature is usually thought to be the primary driver of global crocodylian diversity, but the EARS remained within crocodylian thermal tolerances at low altitudes throughout this time. The change from osteolaemine- to crocodyline-dominated faunas may reflect changes in rainfall and vegetation – the forested wetlands preferred by modern *Osteolaemus* gave way during the middle Miocene to grasslands and open savannahs. Loss of diversity during the Pliocene and Pleistocene presumably reflects regional loss of wetland habitats. This suggests that crocodiles can play a more prominent role in paleoecological analyses of human origins in the EARS.

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## **Varied environmental conditions in the Manyara basin (Tanzania, Middle Pleistocene) revealed by phytolith data**

The Manyara Beds have a substantial archaeological record and significant potential for investigating hominin adaptations to environmental variability in the Middle Pleistocene. Previous faunal and stable isotope studies suggest the occurrence of C4 open grasslands. However, palaeobotanical data should be used to examine the relationship between vegetation and hominin activities in the paleo-lake Manyara landscape. We present the first palaeobotanical data for the Manyara Beds with which to explore the relationship between vegetation and hominin activities in the paleo-lake Manyara landscape. We collected fifty sediment samples from both archaeological and non-archaeological sites from the lower Manyara Beds (780,000-633,000). At archaeological site MK 4 is different from other sites; our results indicate the presence of woody vegetation, palms, and abundant C3 and C4 PACMAD grasses, including the dry-adapted C4 Chloridoideae, and a small percentage of the Panicoideae, which prevails in warm and humid areas. Wetland taxa, including sedges and the Commelinaceae, are also present, suggesting periods when the site was well watered. The phytolith assemblages show changes through time; some levels have more forests, palms, woody dicots, woody and herbaceous dicots, grasses, and wetland indicators including sedge, aquatic monocots, Commelinaceae; others have a reduction of these vegetations. All other sites, including non-archaeological and archaeological MK 17, revealed more open grassy conditions with scattered woody vegetation. Our results indicate that the hominins used varied habitats at the Manyara Beds.

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## **New insights on human burial practices at Mumba rock-shelter in northern Tanzania**

Mumba rock-shelter (1030 m) in the Lake Eyasi basin, northern Tanzania is among the few key sites in East Africa that offer important information about the origin, spread and peopling the world. Material culture from this site shed significant insight into the origin and development of ancient human behavior, technological advancements and mutual relationship between culture and nature. The archaeological records of this site provide an opportunity to investigate trends in technological change, past diet, symbolic aspects, and other traits of cognitive thoughts and how it changed over time. The archaeological records of upper layers (Bed I) at Mumba represents Iron Age (IA), characterized by range of ceramics, shell fragments; symbolic revealing artifacts such as ochre and beads; animal bones, microlithic, fireplaces, and metal pieces. Beds II and III of Mumba cultural sequences are characterized by the Later Stone Age (LSA) artifacts and human burials. Human burials were found associated with a wide range of microlithic artefacts, eggshell beads, potsherds, shell fragments, poorly preserved bones, and turtle shell fragments. However, recent studies at Mumba indicates that during the late phased of the Later Pleistocene and Holocene periods, Mumba may have served as a burial place where dead bodies were often buried together with symbolic revealing objects. Geomorphologically, all three layers (Beds I, II, and III) are highly disturbed from natural processes and anthropogenic activities such as human burials. The high density of fragmented human remains revealed in Beds II and III at Mumba suggest that often shelter served as sacred site for burial and other ritual practices rather than for habitations requirements. In this paper we present new results from the recent excavation at Mumba to shed light on future archaeological interpretations regarding the complex behavior of the people who inhabited the site.

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<sup>4</sup>*Museum für Naturkunde* <sup>5</sup>*Al Neelain University*

### **Quaternary paleoenvironments along the middle Atbara River, eastern Sudan**

The Atbara River, the northernmost major tributary of the Nile, has its source in the Ethiopian highlands and is believed to have provided a route for the northern migration of various large mammal communities, including Homo, through the Pleistocene Nile Basin. Along the middle reaches of the Atbara River, Quaternary alluvial sedimentary sequences of up to 40 m thick contain an abundance of fossil mammals and stone tools. To determine the depositional ages and reconstruct the paleolandscape in the region, we conducted sedimentological studies and OSL dating of the sediments. The OSL dating revealed that the sedimentary sequences were deposited between ~250 and ~15 ka. Despite the presence of significant erosional unconformities, the age dates suggest that the sedimentation occurred rather continuously, and periods of major channel incision cannot be easily correlated with humid periods in the headwater regions in Ethiopia and with Mediterranean sapropels. The sedimentary characteristics and river styles of the Pleistocene precursors of the Atbara River, as inferred from the sedimentary architecture, demonstrate that they ranged from braided to meandering, with evidence of highly seasonal semi-arid to subhumid paleoclimates during deposition, similar to the present climatic conditions in the area. During relatively wet climatic conditions, well-developed paleosols formed on stable floodplains that accompanied rather fixed meandering rivers. The discharges of the Pleistocene rivers were generally lower than those of the present-day Atbara River, and changes in the paleoflow directions and in the mineralogy in the fluvial sediments indicate changing provenances and the influence of tectonics. In the late Middle to uppermost Pleistocene, environmental conditions along the middle Atbara appear to have been consistently favourable for the existence of large mammals and possibly also hominins, but particularly in wetter periods, approximately between 140 and 25 ka, when meandering rivers with long-lived floodplains existed.

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### **Limb functional anatomy and behavioural reconstructions of the StW 573 (“Little Foot”) skeleton, and its implications for hominin evolution**

The ca. 3.67 Ma adult skeleton known as ‘Little Foot’ (StW 573), recovered from Sterkfontein Member 2 breccia in the Silberberg Grotto, is remarkable for its morphology and its completeness. It preserves pairs of humeri, radii, ulnae, femora, and tibiae, making it the earliest hominin with extensive representation of appendicular skeletal elements. Cross-sectional geometric (CSG) properties of these long bone diaphyses enable reconstruction of the loads they incurred during inferred habitual locomotor performance. Here, we integrate ongoing work investigating CSG properties from multiple regions of interest (ROIs) along all of these elements and evaluate them relative to estimates of body size. We compare StW 573 proximal and distal limb segment proportions to those of earlier and later hominins and also extant great apes. Femoral-humeral diaphyseal ROIs of StW 573 resemble those of chimpanzees, western lowland gorillas, and other australopiths more than those of modern humans or other *Homo* taxa, while radial and ulnar diaphyseal ROIs corroborate these similarities. Relatively higher strength of the humeral diaphysis than lower limb diaphyses evaluated against estimated body size aligns StW 573 with most other australopiths for which comparable data are available as well as African apes, suggesting more reliance on arboreal locomotor behaviors than typically characterizing modern humans or other *Homo* taxa. Relatively higher strength in forearm elements, particularly the radial diaphysis, corroborates the integral use of arboreal substrates by StW 573. Despite lower limb morphologies of StW 573 indicative of terrestrial bipedal gait, CSG properties from many limb bones conclusively demonstrate that arboreal activities also formed a selectively advantageous part of its locomotor repertoire.

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### **Age estimation of modern humans based on dental eruption and mandibular formation: a geometric morphometric approach**

Dentition can provide an important indication of age, health, and developmental disorders of an organism and thus is widely used in paleo sciences for skeletal identification. However, traditional methods of estimating age based on dental eruption involve subjective assessments of tooth development and can be prone to error. In this study, a geometric morphometric approach has been developed and tested to predict age with greater accuracy than traditional methods. The study focuses on the correlation between the permanent teeth eruption (from crown completion to its eruption) and the modification in the mandible shape. Using two three-dimensional landmark configurations, the osteological features of the mandible and mandibular dentition (incisor, canine, premolar and first molar only) have been tracked on individuals from age 4 years to 14 years separately. Principal component analysis of the morphometric data is used to identify the groups of individuals based on mandibular form variation and dental growth pattern. The covariation between the developing teeth and mandibular form is then observed through linear regression. The main aim of the study is to identify the maximum correlation between phases of dental formation and mandibular alteration. The benefit of this research is to test the protocol in a well-known reference collection (in terms of sex and age-at-death) in order to be able in the future to apply the same protocol to fossil remain and then have better accuracy in age-at-death determination.

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## **Decolonizing paleoanthropology: problems and perspectives from Africa to Asia**

Decolonising paleoanthropology goes beyond merely questioning and revising colonial/historical narratives of human evolution. As others have noted, bias and imbalanced perspectives and research remain inherent at various levels in the discipline. Much of these are manifest as a dichotomy between West-based and White researchers vs. ‘indigenous’ and/or non-West based ones. At a logistical level, the inherent biases are perpetuated by such problems as “helicopter” research, lack of training components and capacity building in countries where paleo-research is conducted, and inappropriate control over intellectual property rights and data access by Western PIs—including unequal authorship and voice in publications. These issues are shared by African and Asian scholars and are most pronounced in—although not exclusive to—former European colonies in both regions. Here, we review these issues with a specific focus on how the legacies of colonialism have falsely dichotomized African vs. Asian research. We discuss the intellectual history of paleoanthropology and the false binary that Europeans and North Americans created between “either” an African “or” an Asian model of human origins. We contextualize this within global policies of “divide and conquer” that persist in post-colonial societies today, demonstrating how this has resulted in the scholars who live and work in Africa and Asia to subconsciously engage in “otherizing” or erasing ideas and data, from the other. This translates to African and Asian institutions overlooking the importance of actively recruiting students to work at each other’s field schools, resulting in an over-representation of White students to benefit from these opportunities—thus perpetuating the colonial legacy of West-based scholars controlling the narrative of human evolution. As a discipline focused on understanding our shared past, paleoanthropology must be studied collaboratively rather than to the exclusion of other. African and Asian institutions also need to enforce stricter directives and actively empower native researchers.

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## **Understanding the daily lifestyle of early pastoralists during the mid-Holocene of West Turkana, Kenya: Nakwaperit 2 as a new habitation site**

Pastoralism, a way of life centered on herding domesticated animals, is highly adaptive in arid ecosystems with limited alternative land utilization options. In Africa, pastoralism was the first mode of food production and it remains an important economic strategy and cultural identity today. After emerging in northern Africa by 8000 BP, pastoralism spread to eastern Africa’s Turkana Basin ~5000BP, with the earliest pastoralists practicing both fishing and herding. However, these groups are primarily known from the megalithic “pillar site” cemeteries they constructed around the lake. Until now, Dongodien on the east side of Lake Turkana has been the only pastoralist habitation site securely affiliated culturally and chronologically with the pillar sites through Nderit pottery, microlithic artifacts, domestic fauna, and parallel radiocarbon dates. Because most archaeological evidence comes from mortuary sites, there is limited knowledge about the daily life of the early pastoralists in the Turkana Basin. To expand knowledge on early pastoralist practices during the mid-Holocene, we excavated at Nakwaperit 2, a newly documented habitation site west of Lake Turkana. Situated on the south bank of the Turkwel River near Lake Turkana’s receding paleoshorelines, Nakwaperit 2 saw mid-Holocene occupation based on the presence of Nderit pottery. This paper presents archeological data from two excavation units (N669-671 and N671-673) analyzed to understand the lifestyle of the early pastoralists. For analysis, the artifacts were divided based on material densities from the excavated levels. Based on this, different horizons of occupations were observed, indicating that the site had different phases of use. Preliminary observations of the artifacts, such as pottery, lithics, and animal bones from Nakwaperit 2, show similarities to

Dongodien. Further surveys and excavations are needed at Nakwaperit 2 to expand the sample size, understand the spatial distribution of activities at the site, and document other sites around Nakwaperit 2.

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### **Plio-Pleistocene eastern African otters, with a new record from Olduvai Gorge**

Fossil otters (Carnivora: Mustelidae: Lutrinae) are very rare in the African record and this determines much uncertainty in their taxonomy and phylogenetic relationships with extant species. Limiting attention to the Plio-Pleistocene, at least five genera are reported. *Sivaonyx* is a giant bunodont otter found throughout the continent (Egypt, Chad, Ethiopia, Uganda, Kenya, South Africa), but also in the Miocene of Asia and Europe; according to some authors, some African species of *Sivaonyx* should be moved to the genus *Enhydriodon* (e.g., *E. omoensis* from the Lower Omo Valley, described as a gigantic terrestrial form). *Aonyx* (or *Aonyxini* indet.) is documented in Laetoli, Olduvai Gorge Beds I–IV, and numerous other sites in Ethiopia, Kenya, and South Africa. The genus *Lutra* is reported in the Pliocene of Ethiopia and the Pleistocene of Morocco, respectively with the species *L. hearsti* and *L. fatimazohrae*, whose validity and phylogenetic relationships remain unclear. *Torolutra* from eastern Africa and Egypt is very similar in size, morphology, and probably ecological adaptations with present-day aquatic piscivorous otters such as *Lutra* and *Hydricetus*. The latter genus, today represented only by *H. maculicollis*, is reported in Koobi Fora and Woranso-Mille. In this context, a new finding from Olduvai contributes to enriching the discussion. It consists in a left P4 found in site FLK Zinj. It is characterized by a prominent parastyle, massive paracone and especially metacone separated by a marked groove on the labial wall, long and wide talon with a curved mesial edge and a distal edge reaching almost the distal end of the trigon, strong and high protocone. In these characters, the P4 resembles that of *Lutrogale*, that is, a genus hitherto not reported in the African fossil record. This discovery leads to a critical review of the lutrine record from Olduvai and eastern Africa in general.

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### **Late Pleistocene-Holocene paleoclimate reconstruction of afro alpine lake archives using biomarker proxies: case study in the Bale Mountains, Ethiopia**

The examination of the nature, distribution, and variability of organic matter in sedimentary records carries significant implications for reconstructing paleoclimate and understanding past dynamics in the biogeosphere. Biomarker proxies such as hemicellulose sugars, n-alkanes, and glycerol dialkyl glycerol tetraether (GDGT) s are often used in tandem with stable isotope to elucidate changes in organic matter source, response of organisms to changes in temperature, moisture and other environmental conditions. The Bale Mountains, situated in southeastern Ethiopian highlands is one of the best climate archives for the afro-alpine ecosystem in Africa. Additionally, it's also home to one of the oldest prehistoric high-altitude residential sites on the continent—the Fincha Habera rock shelter, dating back to 47-31 thousand years before present (ka yr BP). Deglaciation (16.7 ka yr BP) of icecaps around the plateau resulted in the formation of small lacustrine and peat deposits. Wulf Lake (4020 meters above sea level) is one of several lakes formed on the onset of post Last Glacial Maxima (LGM) deglaciation. Within the framework of the Mountain Exile Hypothesis project (DFG research unit 2358), a number of studies have been conducted to gain insight into the paleoclimatic/paleoecologic evolution of the region. These investigations have utilized various proxies, including those mentioned earlier. The current study



serves as a continuation of the aforementioned works, with the objective of comprehensively addressing the Late Pleistocene-Holocene paleoclimate evolution of the region.

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### **Dietary shifts and specialization among fisher-foragers and pastoralists in eastern Africa from 10,000 BP to present**

Today, pastoralists in eastern Africa are known for their specialized herding economies. The region's earliest evidence for livestock appears ~5,000 years ago in Kenya's Turkana Basin amid major environmental and cultural changes, but we have limited knowledge of the timing and tempo of subsistence specialization. Although current zooarchaeological and lipid residue records for the Turkana Basin suggest that early herders in this area had a relatively generalized subsistence base compared to later herders in the Central Rift Valley, direct human dietary data via stable isotopes can give a more nuanced view of dietary changes. We present carbon isotopic values of tooth enamel ( $\delta^{13}\text{C}$  enamel) from 23 early herders associated with Nderit ceramics in the Turkana Basin and compare these to  $\delta^{13}\text{C}$  enamel and  $\delta^{13}\text{C}$  enamel-equivalent values of 78 ancient foragers and herders from elsewhere in Kenya and Tanzania dated to ~9500-600 BP, illustrating dietary shifts among these groups. We further compare the interquartile range (IQR) of these  $\delta^{13}\text{C}$  values as a nonparametric measure of dietary niche breadth. We show that early herder diets were narrower (IQR: 1.4) than those of fisher-foragers (IQR: 3.5), and similar to later pastoralists (IQR: 1.3 to 2.5). However, early herders' diets are isotopically indistinguishable from foragers (Kruskal-Wallis test,  $p < 0.01$ ), despite this dietary narrowing. We further employed a Bayesian-based dietary niche overlap model (nicheROVER) to explore variation in dietary breadth and overlap among later eastern African herders. Bayesian-based estimates of niche width using  $\delta^{13}\text{C}$  collagen and  $\delta^{15}\text{N}$  collagen show that among herders after 3,500 BP, Pastoral Neolithic individuals exhibited the most varied diets, whereas individuals associated with the Pastoral Iron Age have the most specialized diets. Taken altogether, these data decouple dietary shifts from specialization, and reveal multiple, iterative adjustments in eastern African pastoral economies from their inception to today.

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### **Brain size and shape of *Homo naledi***

Brain size increase and associated cognitive and cultural capacities are the hallmarks of human evolution. Contemporary with the earliest *Homo sapiens* over 200,000 years ago, *Homo naledi* from Rising Star Cave, South Africa presents a combination of primitive and derived features: its brain size was similar to early *Homo* but its frontal lobe has modern-human-like neuroanatomy. To gain additional insights into the brain of *Homo naledi*, I used virtual methods to reconstruct and analyze the brain endocast of "LES1," the most complete *H. naledi* skull. I virtually aligned 3D meshes of the different components of the LES1 cranium and isolated the preserved endocast surface. I used geometric morphometrics methods to apply a template of 3D landmarks to the endocast surface, and to estimate the positions of missing landmarks where the endocast was not preserved. I created several virtual reconstructions based on different references including *Australopithecus africanus* and fossil *Homo*, to assess the range of uncertainty in brain size and shape of LES1. I then compared the reconstructed LES1 endocast shape with modern humans and fossil hominins from a published dataset. Virtual estimates of brain size for LES1 are between 600–620 cm<sup>3</sup>, corroborating the originally estimate based on different reconstruction techniques. The overall shape of the endocast is most similar to early *Homo* fossil KNM-ER 1470: the shape difference between these specimens is in the range of within-species variation for

modern humans and *H. erectus*, whereas comparisons between LES1 and all other fossils exceed the range of within-species variability. I argue that this similarity is best interpreted as a result of the spatial relationship between the brain and the face, rather than in terms of cognition.

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### **Early and Middle Miocene research in the Lothidok Formation, Northern Kenya**

The Lothidok Range is located west of Lake Turkana and is best known for its Miocene fossil apes. Paleontologists first visited the area in the 1930s, and short expeditions took place occasionally through to the 1980s. Notably, three new species of fossil apes – *Afropithecus*, *Turkanapithecus*, and *Simiolus* were described from the Early Miocene sites of Moruorot and Kalodirr (~17 Ma). Two middle Miocene sites were also discovered (Esha and Atirr; ~13 Ma), but these were only minimally prospected, and primates were very rare. The West Turkana Miocene Project (WTMP) began in 2008 to explore the Miocene deposits of the Lothidok Range. Our work to date has included paleontological survey, efforts to refine the geochronology of the Lothidok sequence, study of mammalian fossils collected by our team and previous teams, and paleoclimate and paleoenvironmental reconstruction. Of particular importance has been the recovery of new ape fossils. Since 2008, we have found new craniodental and postcranial material of each of the three species of fossil apes at Kalodirr and Moruorot, further documenting metric and morphological variation. The most impressive specimen is a partial skeleton of *Simiolus enjiessi* from Moruorot preserving most of the forelimbs. At the Middle Miocene locality of Esha, we have found remains of several catarrhine primates, including a large mandible, isolated teeth, and a metapodial. We have refined the stratigraphy and geochronology for all four fossil localities, refining previous Early and Middle Miocene age estimates. Our paleoenvironmental data, largely derived from paleosols, strongly indicates warm and humid climates throughout the sections at Moruorot and Kalodirr. Preliminary data from Esha suggests that it was notably drier. Our future goals are to further refine paleoclimate and paleoenvironmental reconstruction, to systematically collect fossils at the Middle Miocene localities of Esha and Atirr, and to survey for new localities within the Lothidok Range.

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### **A high resolution analysis and re-evaluation of the notched artefacts from Ishango (≈ 20 ka, D.R. Congo)**

The Ishango site, located near the mouth of the Semliki River at the edge of Lake Edward, within the Democratic Republic of Congo's portion of the Western Rift, has provided a rich array of archaeological and paleoanthropological evidence spanning from at least 2 million years ago to the early Holocene. This site is renowned for its abundance of Later Stone Age artefacts, early evidence of harpoons, and the presence of heavily mineralised hominin remains. In association, a number of notched bones have also been recovered from layers dating between ≈ 25 to 19 ka, which have interestingly captured the attention of both archaeologists, mathematicians, and mathematics enthusiasts. Among these artefacts, one particular bone has been documented to present over 100 different notches carved into its surface, organised in a series of distinct groups, that have led some to hypothesise that this artefact represents evidence of prehistoric numerical notations and mathematical thinking. The majority of these hypotheses, however, are built from purely formal considerations, with little empirical evidence to support such interpretations. Here we shed new light on such artefacts, using a wealth of recently developed high resolution techniques, including tools provided by spatial statistics, 3D microscopy, and

the morphometric evaluation of archaeological and experimental incisions, produced under increasing neuromotor and visually discriminant constraints. We provide statistical and empirical results supporting the view that one of their purposes were the storage and retrieval of symbolic information, but it is still open to debate as to whether this is numerical, let alone arithmetical or mathematical, in nature. Our re-evaluation highlights new evidence to debate the evolution of cognitive tools for precise quantification and the role they played in human cognitive evolution.

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### **A micro-regional approach to tool-making activities by early Oldowan groups in a lithic-poor environment (Member F of the Shungura Formation, Ethiopia)**

Since the invention of stone tools, hominins have had to efficiently integrate lithic resources into their land-use practices. Typically, early hominin knapping sites are located in resource-rich environments that afford access to a wide range of local raw materials. The Oldowan sites of the Lower Omo Valley in Ethiopia (Shungura Formation, Member F, ~2.32 Ma to 2.27 Ma) appear to be an exception to this pattern. Distributed in a floodplain environment with limited and difficult to access local raw materials, the Shungura assemblages reflect the reduction of small quartz pebbles with poor knapping qualities. These constraints have long been emphasized and generally account for unique characteristics of the Omo Early Oldowan assemblages. These features include high fragmentation rates, numerous angular fragments, and the frequent use of the bipolar technique on anvil. A large-scale mapping of hominin tool-making activities in relation to raw material sources has been carried out during extensive archaeological fieldwork conducted in the Shungura Formation since 2008. This work revealed persistent micro-regional patterns in raw material procurement, transport, and transformation, consistent with a technological system based largely on non-local (> 5 km) raw materials. Our results add a new perspective on the capacity of early Oldowan toolmakers to adapt to resource-poor environments and on the raw material provisioning strategies they developed in different litho-spaces.

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### **Geochemistry of tephra from late Miocene fossil sites in southern Kenya**

Lemudong'o Formation exposures in the Southern Kenya Research Project (SKRP) pose an exciting opportunity to expand paleontological and geological investigations in the late Miocene (around 6 million years ago) to interpret the timing and environmental context of human origins. This formation contains abundant vertebrate fossils, and volcanics interbedded within lacustrine, fluvial, alluvial, colluvial and paleosol beds. Proposed regional stratigraphic ties linking sections are based on lithostratigraphic evidence and previous dating efforts. Despite the abundance of explosive volcanic material in the area, we currently lack geochemical studies of interbedded tephra deposits. Analyzing the geochemical fingerprint of tephra using glass geochemistry to establish marker beds is crucial for broadening and dating paleoenvironmental reconstructions and interpreting paleoecology in the basin. Here we present the first geochemical data from the Lemudong'o Formation. Glass shards and pumice from 20 samples collected at Lemudong'o 2 and 3, Enamankeon, and Siloma sites were analyzed using an electron microprobe. Results show that tephra from Lemudong'o 2 are rhyolite to dacite in composition, while those from Lemudong'o 3, Enamankeon, and Siloma are trachytes. Intra-sample geochemical variability is high for most samples (e.g., Fe<sub>2</sub>O<sub>3</sub> ranges from 6-10 wt%). Correlations between

Enamankeon and Lemudong' o 2 or 3 are not supported by these results, however correlations may exist between Enamankeon and Siloma. A change in eruption sourcing in younger tephra could explain the geochemical differences observed. Trace element work, ongoing radiometric dating of feldspar grains, and geochemical investigations of 2023 samples, will further test proposed stratigraphic correlations ultimately leading to a tephrostratigraphic framework for the Lemudong' o Formation.

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### **Advances and potential of research in the Plio-Pleistocene region of Fejej (South Omo Zone, Ethiopia)**

Northeast Turkana Basin, Fejej region (Ethiopia) offers great potential for understanding human evolution and interactions between hominins and their environments, given the richness of its palaeontological, paleoanthropological and archaeological records. Part the Koobi Fora Formation, Fejej has been the subject of archaeological and paleoanthropological studies by H. de Lumley and Y. Beyene (IPH Foundation/MNHN-Paris/EHA Ethiopia) since 1992. Here we present an overview of the main results obtained since 1992. The years 1992-1999 were devoted to the excavation in the FJ-1 locality of a rich Oldowan archaeological layer (C1) dated by ESR around 1.96 Ma. This archaeological bed (C1) is covered by a volcanic tuff correlated with the Borana tuff of the Upper Burgi Member in Koobi Fora Formation and the G-29 tuff from the upper G Member in the Shungura Formation. The ESR dating on quartz from the archaeological layer is consistent with biochronology of mammal's species yielded by the same level. The years 2002-2009 were devoted to surveys leading to the discovery of 29 new palaeontological and paleoanthropological localities, nine of which yielded hominin remains. All new localities spread over two chronological horizons: the first being contemporary with FJ-1 locality (Upper and Middle Burgi Member) and the second dated to 4 Ma or more, based on the suids and elephantids remains. No tuff has yet been found in the latter horizon, but the reverse magnetic polarities of the sediments indicate that the Hominin Pliocene localities are older than 4.29 Ma or younger than 4.18 Ma, i.e., either in C3n.1r or in C2Ar subchron. In 2023, the resumption of surveys to deepen knowledge of Fejej region will undoubtedly provide important new data to complete the understanding the Koobi Fora Formation, to discuss the origin of the australopithecines and to clarify the environmental context of human evolution in the Turkana Basin.

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### **New Oldowan locality Sare-Abururu (ca. 1.7 Ma) provides evidence of diverse hominin behaviors on the Homa Peninsula, Kenya**

The Homa Peninsula, in southwestern Kenya, continues to yield insights into Oldowan hominin landscape behaviors. The Late Pliocene locality of Nyayanga (~3–2.6 Ma) preserves some of the oldest Oldowan tools. At the Early Pleistocene locality of Kanjera South (~2 Ma) toolmakers procured a

diversity of raw materials from over 10 km away and strategically reduced them in a grassland-dominated ecosystem. Here, we report findings from Sare-Abururu, a younger (~1.7 Ma) Oldowan locality approximately 12 km southeast of Kanjera South and 18 km east of Nyayanga. Sare-Abururu has yielded 1754 artifacts in relatively undisturbed low-energy silts and sands. Stable isotopic analysis of pedogenic carbonates suggests that hominin activities were carried out in a grassland-dominated setting with similar vegetation structure as documented at Kanjera South. The composition of a nearby paleo-conglomerate indicates that high-quality stone raw materials were locally abundant. Toolmakers at Sare-Abururu produced angular waste from quartz pebbles, representing a considerable contrast to the strategies used to reduce high quality raw materials at Kanjera South. Although lithic reduction at Sare-Abururu was technologically simple, toolmakers efficiently produced cutting edges, made few mistakes and exhibited a mastery of platform management, demonstrating that expedient technical strategies do not necessarily indicate a lack of skill or suitable raw materials. Lithic procurement and reduction patterns on the Homa Peninsula appear to reflect variation in local resource contexts rather than large-scale evolutionary changes in mobility, energy budget, or toolmaker cognition.

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### **Evaluating the role of climate and environment in lithic production during the Middle Stone Age-Later Stone Age transition in East Africa**

Technological changes in lithic production are often used as a proxy to understand and identify cultural shifts in prehistoric periods. However, defining transitions in the Palaeolithic is challenging, as they do not occur synchronously across space and time. A good example is the transition between the MSA and the LSA in East Africa, from MIS 4 to 2. During this long period, the African archaeological record shows a gradual and asynchronous decline in MSA features and an increase in LSA characteristics. One possible explanation is linked to climate and environmental factors. However, this region still lacks a model combining cultural and environmental data from a quantitative statistical perspective. In this paper, we examine the role of climate as an influencing factor in technological changes in Late Pleistocene lithic industries. We have integrated data on the technology of blades and bladelets from East African contexts dated between MIS 4–1 with paleoclimate data based on reconstructions from the Had-CM3 (using the R package “pastclim”). We use a principal component analysis (PCA) to characterise the lithic assemblages based on multiple measurements on each artifact. The first PC captured the size and was strongly associated with time, reflecting a progressive reduction in the size of artifacts from the older contexts to the younger ones. The second component captured the shape (Elongation and Flattening) and was shown to be correlated with the annual temperature range. Our results show a correlation between climate factors and stone tool production. Based on this, we can propose new hypotheses regarding the role of vegetation, tree availability, and their influence on hafting and use of lithic artifacts in MIS 4–1 in East Africa. This research marks the first collaborative data analysis from diverse researchers aiming to develop a large-scale quantitative interpretation of the MSA–LSA transition in the region.

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### **Uncovering the environmental legacies of colonialism: a study of Mgao Village, Mtwara, Tanzania**

The East African coast has long and rich colonial environmental record with the evidence of occupation which dates to between the 16th and 19th centuries, these occupations have altered natural coastal environments. During the intrusion of colonial agents, the coast of East Africa witnessed a

significant role in the needs of colonial invaders. The coast of East Africa became significant to colonialists in running their activities such as slave trade due to easy marine transportation. Some of popular slave trade centers in the coast of East Africa include Bagamoyo, Kilwa, and Mikindani, and the rest of Mgao center has not been studied extensively as other centers. As most researchers have put their effort in documenting and even protecting the popular centers, this makes Mgao remain colonial environmentally uncovered. This paper aims to uncover the evidence of environmental legacies left by colonialists in Mgao village Mtwara region Tanzania; which were obtained through physical observation, surveys, ethnographic inquiries, archives and historical documentation. These methodologies revealed colonial environmental legacies dating to between the 16th and 19th centuries, these environmental data include Mgao ruins, Arabic graves yards, Arabic potsherd and Chinese porcelains both of which illustrate colonial environmental legacies. The paper will include figures as well as a map to locate and illustrate the environmental evidence of colonialism at Mgao. Additionally, the use of this least known site as a case study which is neither under private nor government protection will be a contribution to historic archaeology of Tanzania in terms of conservation strategies, research, and knowledge dissemination.

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### **Handaxe accumulation and cleaver production: new perspectives on Acheulean diversity in West Turkana**

The Nachukui formation in West-Turkana holds a significant place in the study of the Acheulean, as it is one of the earliest examples of handaxe production, setting the emergence of this techno-complex at approximately 1.76 million years ago (Lepre et al. 2011). However, a striking absence of such artifacts in more recent sites within the same formation, where core-and-flake technology predominates, has sparked crucial debates regarding the diversity of this techno-complex in the region and beyond. This paper introduces a newly identified archaeological site, Kamilikol, with the potential to yield valuable insights into the diversity and evolution of this technological complex within the area. An extensive survey conducted in the south-west of the basin by the Trans-Evol project has unveiled a substantial accumulation of handaxes and cleavers. This accumulation represents the first large collection of handaxes in the region—a defining characteristic of the East African Acheulean postdating 1 million years ago, which was hitherto undocumented in this particular area. Furthermore, detailed technological analyses of these artifacts reveal a considerable technical investment in their production. There are indications suggesting the likely use of soft organic percussion and highly predetermined flaking methods employed in cleaver's production. Both these features are characteristic of the late or final stages of the Acheulean period. The initial excavation at this site has unearthed materials technologically consistent with those found on the surface, signifying the immense potential of this location to enhance our understanding of the middle and late Acheulean techno-complexes prevalent in the region.

Marina Gallinaro<sup>1</sup>, Makarius Peter Itambu<sup>2</sup>, Tadele Bekele Solomon<sup>3</sup>

<sup>1</sup>Sapienza Università di Roma <sup>2</sup>University of Dar es Salaam <sup>3</sup>Ethiopian Heritage Authority

### **Rock art between research, conservation, and local engagement: a new collaborative project between Ethiopia and Tanzania**

Thousands of rock art sites are spread across Africa as a residual visual archive of past societies. This heritage has been recognized for its outstanding value by the international community, resulting in

several sites being included in the UNESCO World Heritage List. However, the role of rock art remains challenging in archaeological and anthropological debate and cultural heritage management. This is due to the many factors that can somehow be synthesized into two: conservation and the awareness of the local communities. Every year, numerous sites are lost to both natural and human-driven actions. Meanwhile, a significant number of these sites remain undiscovered, unexplored, or poorly documented due to inadequate recording in the past. In several regions, rock art is viewed as a colonial legacy and is often ignored or vandalized, resulting in a lack of interest in preserving and protecting it as an indigenous heritage. The paper aims to present the current state of rock art study in two areas of Eastern Africa: the Borana zone in southern Ethiopia and the Singida region in central Tanzania. We will introduce the initial steps of a community-based approach project with a partnership between African and non-African scholars, as well as local and national institutions. This partnership aims to address the critical issues that limit a sound archaeological and anthropological study and the proper management of rock art sites.

Hadgu Zeru Gebregergis<sup>1</sup>

<sup>1</sup>*Aksum University*

### **New archaeological sites from the southern side of Middle Mereb Basin, northern Ethiopia**

This archaeological research was carried out in Mereb Leke wereda, north of Aksum, south of the River Mereb. Previous archaeological research did not reach this area in contrast to the work done at Aksum town and its environs. The primary objective of this work is to document potential archaeological sites, to review the current condition of their management, to suggest ideas on the possible settlement period and finally to indicate the way how to protect and save the described heritage sites. Systematic archaeological survey, repeated field observation and interviewing local communities were carried out. As a result, five new archaeological sites were identified. The major archaeological features of the sites include the following: a concentration of small stelae, bricks, potsherds, schematic human figurines, grinding stones, obsidian tools, and an accumulation of iron slags. All of the archaeological sites were located with GPS and the observed artifacts were qualitatively analyzed. Based on the surface archaeological evidence, most of the sites are possibly dated back to early Aksumite period, while few of them are tentatively dated to the pre-Aksumite period. Their possible function ranges from ancient settlements to workshop and ceremonial centers. Land degradation, flooding, looting, and developmental activities are identified as the major potential cultural and natural challenges to the preservation of these archaeological sites. Thus, the concerned bodies, local and regional tourism offices, the ARCCCH, Aksum University, and other stakeholders should take urgent measure to secure these endangered archaeological sites. This can be done through public archaeology and awareness creation to the local people.

Kibrom Legesse Gebremeskel<sup>1</sup>, Dan Palcu<sup>2</sup>, Amanda McGrosky<sup>3</sup>, Sharon Kuo<sup>4</sup>, Sahleselasie Melaku<sup>5</sup>, Frances Forrest<sup>6</sup>, David R. Braun<sup>7</sup>, Emmanuel Ndiema<sup>8</sup>

<sup>1</sup>*Addis Ababa University* <sup>2</sup>*Utrecht University* <sup>3</sup>*Duke University* <sup>4</sup>*University of Minnesota Duluth* <sup>5</sup>*National Museum of Ethiopia* <sup>6</sup>*Fairfield University* <sup>7</sup>*The George Washington University* <sup>8</sup>*National Museums of Kenya*

### **Hominin localities of the Koobi Fora Formation: geological and ecological context of Plio-Pleistocene hominins**

The long history of research in the Turkana Basin has provided one of the richest records of hominin evolution for the Plio-Pleistocene. The Koobi Fora Formation (KFF) provides examples of more than 70% of the known hominin species in the world. As such, the KFF offers critical insights into the biological and environmental contexts of our Plio-Pleistocene hominin ancestors. Although numerous KFF hominins have been recovered, not all of them have detailed contextual information. This study aims to contextualize hominins discovered in the KFF within the broader scope of faunal and geological evidence particularly within the Upper Burgi (1.98-1.87 Ma), KBS (1.87-1.56 Ma), and Okote (1.56-1.38 Ma) Members. These stratigraphic intervals have yielded a rich fossil record, including notable hominin

species including *Paranthropus boisei*, *Homo habilis*, *Homo rudolfensis*, and *Homo erectus*. Varying environmental conditions, such as climate and vegetation, undoubtedly played a significant role in shaping the physical and behavioral adaptations of these early humans. We conducted standardized surface surveys to identify the palaeoecological context of the areas where hominins were recovered. We compared the faunal abundance of different taxa between localities to assess differences. This was compared with geological observations that provided detailed palaeogeographical information as well as age estimations. We integrated these datasets that account for the variability in the fossiliferous nature of localities. Results reveal significant variations in faunal abundance across different localities. Localities with comparable paleoenvironmental reconstructions often exhibit analogous preservation and taphonomic characteristics. Hominin fossils were predominantly found near aquatic environments like channels and rivers, suggesting these well-watered habitats not only favored fossil preservation but also potentially provided essential resources for hominins. This study underscores the importance of integrating paleoenvironmental, geological, and paleoecological data to understand the complex interplay between early hominins and their habitats. The KFF, with its diverse climate and habitats provides a critical window into the story of human evolution and adaptation.

Yonas Beyene Gebremichael<sup>1</sup>, Anne Delagnes<sup>2</sup>, Gen Suwa<sup>3</sup>, Shigehiro Katoh<sup>4</sup>, Berhane Asfaw<sup>5</sup>  
<sup>1</sup>French Center for Ethiopian Studies (CFEE) <sup>2</sup>PACEA - CNRS/University of Bordeaux <sup>3</sup>University of Tokyo <sup>4</sup>Hyogo Natural History Museum <sup>5</sup>Rift Valley Research Service

### **Progress and prospect of paleoanthropological research at Konso-Gardula**

Multiple years of field and laboratory research in Konso Gardula have resulted in establishing the area as one of the most important research areas for the period between 1.9 Ma and 0.8 Ma. At the Konso-Gardula sites, archaeological materials attributed to the Acheulean techno-complex were found and documented since 1992 from levels dated to between ~1.75 Ma and 0.85 Ma, providing a continuous technological record for the techno-complex. Older sediments that produced Oldowan-like assemblages have also been found and reported from earlier levels. Recent field research in the area has confirmed that these older archaeological levels, that are radiometrically dated to >1.75 Ma comprise a number of archaeological assemblages devoid of Large Cutting Tools and Heavy Duty Tools. Recently, we have renewed research of these levels, aiming to address the technological transition between the Oldowan and the Acheulean technologies at Konso-Gardula. This research is critical for addressing changes, both in terms of rupture and continuity, which will make it possible to clarify the processes of technological filiation between the two techno-complexes during this critical period. This presentation will review the previous and newer findings of our research at Konso-Gardula.

Christopher C. Gilbert<sup>1</sup>, Stephen R. Frost<sup>2</sup>, Dipuo W. Kgotleng<sup>3</sup>, Biren A. Patel<sup>4</sup>, Christine Steininger<sup>5</sup>

<sup>1</sup>Hunter College of the City University of New York <sup>2</sup>University of Oregon <sup>3</sup>University of Johannesburg <sup>4</sup>University of Southern California <sup>5</sup>University of Witwatersrand

### **New fossil Cercopithecidae from Kromdraai, South Africa**

Deposits at Kromdraai have been intermittently excavated since the discovery of *Paranthropus robustus* in 1938. They have traditionally been recognized as two separate deposits: Kromdraai A (KA) or “faunal” site and Kromdraai B (KB) or “hominid” site. Cercopithecoid primates are abundant at KB and are represented by an unusually large proportion of subadults. The most recent assessment of the pre-1990 KB collections identified at least two cercopithecoid taxa: *Papio* cf. *robinsoni* and *Cercopithecoides coronatus*. Here, we studied all available KB cercopithecoids, including ~380 catalogued specimens and ~490 undescribed specimens from recent excavations in the new extension area, including Unit P. We identified the same three taxa in both the old KB and new Unit P collections: *P. robinsoni*, *C. coronatus*, and *Theropithecus oswaldi oswaldi*. An additional large papionin is possibly present. The identification of *T. o. oswaldi* is based on craniodental material from Unit P and a complete metacarpus



with an elongated pollex from old KB collections corresponding to Units Q-R. The Unit P and old collections also share a distinctively high proportion of subadults. The shared taxonomic and demographic profiles of the old KB and new Unit P collections suggest they represent a single, broadly contemporaneous assemblage across geological units and perhaps have the same accumulating agent. *Theropithecus o. oswaldi* teeth from Unit P are similar in size and enamel complexity to those at Swartkrans Member 1 (SK1) and provide a mean age estimate of ~1.8 Ma. Additionally, all cercopithecids known at KB and Unit P are found in combination at SK1, suggesting they are broadly similar in geological age.

Jeremias Glöggler<sup>1</sup>, Rebecca M. Muriuki<sup>2</sup>, Rahab N. Kinyanjui<sup>2</sup>, Indrè Žliobaitė<sup>1</sup>

<sup>1</sup>*University of Helsinki* <sup>2</sup>*National Museums of Kenya*

### **Associations between mammalian and plant communities through the Plio-Pleistocene of the Omo-Turkana Basin and their evolution through time**

Our predictions of past and future ecological processes are based on inferences from current ecosystems, applying certain association rules to link ecological components. Conventional premises are, for instance, the systematic association of morphological traits in animals with the host ecosystem and the method of uniformitarian deduction, i.e., that processes in past ecosystems can be inferred from present-day ecosystems. Our study investigates functional relationships between mammal communities and their paleoenvironment and their potential change over geological time. The Omo-Turkana Basin is a well-studied region of immense paleontological, paleoanthropological, and geological interest and is marked by considerable environmental variation over its long geological time span from the Oligocene until today. These environmental changes entailed major faunal composition changes through migration and speciation. Despite the plethora of data, no uniformly synthesized account of preserved mammalian fossils and their localities exists. We present a revision and compilation of localities, species occurrence, and morphological traits of the mammal record from the Plio-Pleistocene Omo Group in the northern Omo-Turkana Basin, which is based on the extensive NOW database and supplied by literature reviews. We use these data to conduct spatially and temporally resolved ecometric analysis of morphological traits including hypsodonty and body mass in large herbivorous mammals to infer paleoenvironmental features and detect potential changes in associations between mammal and plant communities. This allows understanding ecosystem dynamics in a historically unscathed setting and exploring whether the modern ecosystems, which are impacted by anthropogenic activity and ecologically impoverished, are functionally isolated and thus unsuited for ecological inferences.

Juan José González-Quiñones<sup>1</sup>, Juan Francisco Reinoso-Gordo<sup>1</sup>, Pedro Matias<sup>2</sup>, Vítor Santos<sup>3</sup>, Hugues-Alexandre Blain<sup>4</sup>, Juan Manuel Jiménez-Arenas<sup>1</sup>

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### **All roads lead to Orce? Evaluating possible corridors related to the earliest hominin settlement of the Iberian Peninsula**

The Iberian Peninsula, placed in the extreme west of Eurasia, presents a peculiar location because of its proximity to North Africa (currently the minimum distance is 14.4 km) and because a mountain range, the Pyrenees, separates it to the north from the rest of the continent. Different authors have proposed that the first human settlement in that part of the world could have come both from northern Maghreb or from southern France (~1.5 Ma). Here, we propose to evaluate whether there are preferential corridors (paths) that could have been used by the first settlers of the Iberian Peninsula. For this purpose, ecological and topographic variables have been used, and a self-developed algorithm based on the well-known Tabu Search (TS) and A\* algorithms has been implemented. Our results show: 1) that hominins could have reached the northernmost part of the Maghreb Mediterranean coastline; 2) that within the

interior corridors of the Iberian Peninsula, the most probable ones include two archaeological complexes with pre-Jaramillo human presence (Orce, southern Iberian Peninsula, and Atapuerca, northern Iberian Peninsula); 3) and, that the probability of reaching Orce from southernmost Iberian Peninsula is similar to those when departing from the Pyrenees. Based on those results, and taking into account aspects such as the chronology of the earliest human settlement in North Africa, the Syrian-Palestinian corridor and the eastern part of Eurasia, the similarities between faunal assemblages and technocultural similarities, we discuss the routes of arrival of humans to the Iberian Peninsula in the Early Pleistocene.

Tegenu Gossa<sup>1</sup>, <sup>2</sup>Francesco Carotenuto, Giuseppe Briatico<sup>1</sup>, Alex Brittingham<sup>1</sup>, Asfawossen Asrat<sup>3</sup>, Gideon Hartman<sup>4</sup>, Bienvenido Martinez-Navarro<sup>5</sup>, Erella Hovers<sup>1</sup>

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### **Broadening the environmental context of early human evolution: implications of the first and unique fossil of the Ethiopian Wolf from Melka Wakena, Ethiopia**

The first-ever fossil of the Ethiopian wolf (*Canis simensis*) was discovered in 2017 within the stratigraphically-controlled and securely dated sequence of the Melka Wakena (MW) paleoanthropological site-complex on the South-central Ethiopian highlands. The fossil provides the first empirical evidence of the species' presence in Africa since the Early Pleistocene, suggesting that by 1.6 - 1.4 Ma, this currently endemic and highly endangered animal had arrived in Africa and specifically on the Ethiopian highlands, where it existed in the MW area at an elevation of ~ 2300 m above sea level (a.s.l.). Bioclimate niche modeling suggests that throughout its long history in Ethiopia, populations of the Ethiopian wolf faced cycles of drastic geographic range contractions during warmer periods of the Pleistocene. Such modeling results will be tested using carbon and oxygen isotopes from animal teeth and biomarkers from sediments as paleoclimatic and environmental proxies. Additionally, this scenario highlights the importance of conservation efforts for this biological deep-rooted legacy. The *C. simensis* fossil is the first clear indication of endemism in the Ethiopian highlands, in high elevations that supported an Afromontane vegetation that differed from the African savannah-like environments typical of lower elevations. Thus, the discovery of the Ethiopian wolf at Melka Wakena underscores the importance of paleoanthropological and paleontological research outside the East African Rift System in attempts to better understand the ecological conditions and biodiversity that served as the arena for early human biocultural evolution and behavioral innovations.

Behailu Habte<sup>1</sup>, Clément Ménard<sup>2</sup>, François Bon<sup>3</sup>

<sup>1</sup>National Museum of Ethiopia <sup>2</sup>EPCC Centre européen de recherches préhistoriques de Tautavel <sup>3</sup>Université Toulouse II Jean Jaurès

### **The Later Stone Age lithic industries from the Main Ethiopian Rift: en route to culture-chronology of the Later Stone Age in Ethiopia**

Our understanding on the Later Stone Age (LSA) lithic technology from Ethiopia is tempting, when available are contrasting among sites. Traditionally, this period encompasses Marine Isotope Stage (MIS) 3-1 in the Horn of Africa, an interval often overlapping with multiple culture-chronology referring as Middle Stone Age (MSA) and LSA as well as Neolithic cultures. To date, we possess insufficient knowledge about this culture chronology in the Horn mainly for the lack of long stratified context thus restricting us to establish longer culture-stratigraphic information between MIS 3-1. To tackle this problem, we opted for the former and recent LSA excavated contexts from Main Ethiopian Rift (MER) in order to get better insight into the lithic behaviour within the MIS 3-1 and to generate relatively longer culture-chronology. This paper, therefore, highlights the work, mainly made by the first author (BH) as part of his doctoral research, on lithic technological analysis from five LSA sites of MER: two sites from old excavations and three sites from recent excavations. These different assemblages came from sites

relatively close to each other in space but cover a very long time interval of at least 20,000 years. We characterized the technical behavior through lithic analysis and comparative perspective, and then organize them into five chrono-cultural phases: Formative (ca. 31-27 ka), Evolved (ca. 27-22 ka), Refugia? (ca. 22-15 ka), Developed (ca. 14-13 ka) and Specialized (after ca. 13 ka), each phase to be distinguished by the presence and prominence of certain lithic techno-typological features, as reflected by (1) the mixed nature of MSA and LSA lithic features between ca.31-27 ka cal BP. (2) the gradual abandonment of MSA toolkits (3) the disappearance of MSA toolkits in the Developed stage (4) the proliferation of segments in Specialized stages heralding new socio-economic changes.

Tamrat Kahsay Habtu<sup>1</sup>, Tamara Dogandzic<sup>1</sup>, Erella Hovers<sup>2</sup>, Tegenu Gossa<sup>2</sup>, Margherita Mussi<sup>3</sup>, Eduardo Méndez-Quintas<sup>4</sup>, Patricia Bello-Alonso<sup>5</sup>, Joao Marreiros<sup>1</sup>

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### **The use of Early Stone Age tools: an integrative approach to edge damage analysis to study the emergence of Acheulean industries in Ethiopian highlands**

Stone tools offer valuable insights into humans' behaviour and their ability to adapt to the environment. Archaeological records reveal when early humans changed their lithic tools, but connecting tool use with specific hominin behaviours is challenging. Examining artefact edges can shed light on interactions between hominins and their material culture. The study analyses edge damage in stone tools and their relation to raw material variability and tool use through experimental archaeology and data analysis. The research focuses on two Early Pleistocene Acheulean lithic assemblages from the Ethiopian Highlands, Melka Kunture and Melka Wakena, dated ~1.95 to 0.6 Mya. The Lithic assemblages are characterized by bifacial Large Cutting Tools (LCTs), including hand axes and cleavers. The investigation will explore the influence of raw material variability at these sites (including obsidian, ignimbrite, dacite, Trachyte, scoria, and basalt) and of tool categories of Large Cutting Tools (LCTs) on edge damage frequencies, seeking to discern patterns and reasons for its occurrences. Ultimately, this research will contribute to a more nuanced understanding of edge damage patterns, offering insights into the diverse variables and reasons underlying such occurrences, which can help assess differences in decision-making behaviours related to raw material selection and their uses by early human tool makers and tool users. A comprehensive reference collection will be constructed comprising replicas of stone tools from these ESA site complexes. The selected sites have good preservation, a variety of raw materials and techno-typological classes, and similar geochronological ages. The study will also advance current methodologies by combining controlled experiments, macroscopic observations, and different image analysis scales to understand the function of stone tools.

Martin Haeusler<sup>1</sup>, Shanel Müller<sup>1</sup>, Guillermo Bravo Morante<sup>1</sup>, Megan Malherbe<sup>1</sup>, Nicole Torres Tamayo<sup>2</sup>, Tea Jashashvili<sup>3</sup>, Christopher Ruff<sup>4</sup>

<sup>1</sup>University of Zürich <sup>2</sup>University College London <sup>3</sup>University of Southern California, Los Angeles <sup>4</sup>Johns Hopkins University

### **Anatomical stature reconstruction of KNM-WT 15000 (*Homo erectus*)**

*Homo erectus* is thought to be the first hominin with modern human-like body proportions and a modern gait, suggesting that humans evolved to the ecological niche of endurance walkers/runners. However, most of what we know of *H. erectus* body proportions is based on a single male specimen, the 1.5 Ma old KNM-WT 15000 skeleton from Nariokotome, Kenya, whose age estimates vary widely. While dental microanatomy suggested a chronological age of 7.6–8.8 years, the epiphyseal fusion pattern of the elbow implied a skeletal age of 13–13.5 years relative to modern human standards. Similarly, reconstructions of his body proportions and stature-at-death estimates diverge significantly, with predictions based on lower limb length converging on 157 cm, while a body size of only 141–146 cm is

suggested when vertebral dimensions are also considered. Part of this discrepancy may be due to the paucity of similarly aged juveniles in the modern human reference samples, as well as the divergent age estimates of KNM-WT 15000. Here, we performed a virtual anatomical reconstruction of the entire KNM-WT 15000 skeleton using high-resolution 3D surface scans of the original fossil. The vertebral column was reconstructed by comparing the KNM-WT 15000 vertebrae to an age series of 40 CT-generated 3D models of 8–20-year-old modern human subadults, using 3D landmarks. We found that the dimensions of the vertebral bodies and articular processes of KNM-WT 15000 are very similar to those of 9–10-year-old boys but not to those of older individuals. In contrast, limb skeleton size corresponded best to 14-year-old modern adolescents. Our resulting stature-at-death reconstruction of KNM-WT 15000 was intermediate between previous estimates. Further research is needed to determine whether heterochronic growth between the axial and the limb skeleton in *Homo erectus* might explain the observed differences in body proportions compared to modern humans.

Haregwin Belete Hailu<sup>1</sup>, Alemseged Beldados<sup>1</sup>, Blade Engda Redae<sup>2</sup>,

<sup>1</sup>Addis Ababa University <sup>2</sup>Arizona State University

### **Zooarchaeological study from the Early Stone Age site of Gadeb (~1.4 Ma), south central Ethiopia**

Despite the long history of archaeological research at Gadeb, no faunal studies have been conducted from this site. Thus, its context and the functional associations between the bone remains and Acheulean lithic artefacts is far from being understood. This presentation aims at addressing these critical issues through zooarchaeological methods. We examined taphonomy analysis and taxonomic composition of the faunal assemblages from two excavation localities, i.e., Gadeb 2 and Gadeb 8. Both localities yielded diverse range of taxa including significant presence of water-dependent species such as Hippopotamidae among other ungulates. The overall taxonomic composition, however, suggests the presence of multiple micro-environments within the Gadeb area. Taphonomy results shows that despite the high abrasion of bone surfaces, the Gadeb faunal assemblage showed hominid induced marks indicated by the presence of cut and percussion marks. Furthermore, no carnivore specimen as well as carnivore-modified specimens were identified in the assemblage. Based on these, we conclude that hydraulic sorting and hominid activity as major accumulating agents. The study contributes to our understanding of ecological background, hominid behaviour and site formation of the Gadeb landscape during the Pleo-Pleistocene period.

Raphaël Hanon<sup>1</sup>, Christine Steininger<sup>1</sup>, José Braga<sup>2</sup>

<sup>1</sup>University of the Witwatersrand <sup>2</sup>Université Paul Sabatier Toulouse III

### **Early animal hard tissue tool technology from Kromdraai Units O-P, South Africa and its emergence during the Early Pleistocene in Africa**

Tools made of animal hard tissues (i.e. dental, keratin or bone tissues) are well known during the Eurasian and African Upper Palaeolithic. Evidence for the existence of such tools has also been found at Middle Palaeolithic African sites, but more rarely. The use of animal hard tissues that were minimally modified as tools during the Lower Palaeolithic is more contentious. Here, we report the presence tools made from bone and dentition from the Plio-Pleistocene deposits of Kromdraai Unit P and O. Since 2014, more than 10,000 bone specimens have been found at Kromdraai, mainly from Unit P, including at least 51 cranial and postcranial hominin remains, most of them attributed to *Paranthropus. robustus*. Of these specimens, thirty have been identified as potential bone tools, exhibiting the typical shape of a long bone splinter associated with a polished point. Of the 30 original potential bone tools, only 12 present the criteria to identify them as definitive bone tools. Ten of them are bone flakes with abraded tips, with the presence of the micro-striation pattern observed. The two other specimens are identified as teeth. The first is identified as a tooth because no blood vessels, foramens, or spongy bones are observed. Additionally,

the combination of cementum, dentin and enamel can be clearly seen. The second specimen was identified as a suid tusk, based on its rounded outer surface and characteristic longitudinal grooves. The presence of locally constrained micro-striation associated with a non-extensive polished area on of the tips indicate their potential use as tools. The description of tools made out of bones and teeth allow us to discuss the relevance of the osteodontokeratic culture hypothesis as well as the diversity of early Pleistocene hominin subsistence behaviours.

Jason J. Head<sup>1</sup>, A. Michelle Lawing<sup>2</sup>, Fredrick Kyalo Manthi<sup>3</sup>, Johannes Müller<sup>4</sup>, Susanne Cote<sup>5</sup>, Daniel J. Peppe<sup>6</sup>, Kieran P. McNulty<sup>7</sup>

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<sup>5</sup>University of Calgary <sup>6</sup>Baylor University <sup>7</sup>University of Minnesota

### **Neotropical snake lineages from the Early and Middle Miocene of equatorial Africa indicate complex dispersal biogeographic histories and wet-forest paleoenvironments**

The highest species richness and ecological diversity of extant snakes are in the tropics, primarily in South Asia and Central and South America. Tropical Africa has relatively lower richness and less diversity, but the evolution of tropical herpetofaunas, and the factors governing diversification through time at continental scales are poorly understood due to an understudied fossil record. The ecologies and geographic distributions of aniliid and uropeltoid snakes are examples. Modern species constitute either a grade or clade of fossorial, primarily wet forest taxa from South America and South Asia. Their distributions have historically been interpreted as Gondwanan vicariance following the isolation of Africa in the Early Cretaceous, but a definitive fossil record for these snakes is depauperate. Field research in the early Miocene (approx. 19 Mya) Tinderet sequence of western Kenya has produced precloacal vertebrae of an aniliid snake from multiple localities. Specimens possess vertebral apomorphies shared with extant South American *Anilius scytale*, including the morphology of the neural spine and prezygapophyseal angle. Combined with additional fossils from the Eocene of North Africa and Middle Miocene of Kenya, the Tinderet records demonstrate an unambiguous past record of an extant neotropical snake lineage in Africa and falsify previous vicariance hypotheses. Recent stable isotopic and palynological studies of Neogene eastern African fossil localities have indicated heterogeneous environments, including C4 grasses and wood- to scrubland, associated with vertebrate faunas. Comparing climate parameters of habitats for extant *Anilius* and uropeltoid snakes as ecological analogues to the Tinderet snake with modern ecosystems equivalent to those reconstructed for the eastern African early Miocene demonstrates only limited overlap in precipitation and temperature values. This discord indicates either greater environmental heterogeneity than reconstructed for the early Miocene of eastern Africa, or a greater range of habitat variability in aniliid snakes than observed in extant *Anilius*.

Leslea J. Hlusko<sup>1</sup>, Franck Guy<sup>2</sup>, Marina Martínez de Pinillos<sup>1</sup>, Mario Modesto-Mata<sup>1</sup>, Ian Towle<sup>1</sup>, Marianne F. Brasil<sup>3</sup>, Arthur Thiebaut<sup>1</sup>, Blade Engda Redae<sup>4</sup>

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CNRS/University of Poitiers <sup>3</sup>Western Washington University <sup>4</sup>Arizona State University

### **A multi-faceted approach for identifying the taxonomy of isolated hominin teeth from the Omo, Ethiopia**

One of the richest paleoanthropological sites recording human evolution between 3 and 1 million years ago is exposed by the Omo River in southwestern Ethiopia. These sediments have yielded an abundant fossil record of terrestrial faunas. This time period is particularly relevant to human evolution because it documents the first appearance of the genus *Homo* alongside the evolution of the eastern African robust hominids. The Omo Group Research Expedition (OGRE)'s fieldwork since 2006 has recovered dozens of new dental specimens that add to those already known. Many of the hominin fossils recovered are isolated teeth. We developed a four-pronged approach to infer the most-likely taxonomic

identification for the postcanine teeth based on the external crown morphology. First, we ran linear discriminant analyses of linear crown dimensions on a comparative dataset of 464 hominid teeth (with well-established taxonomic identifications) that were then used to predict the classification of 95 complete crowns from the Omo. For the second and third components, we ran a cluster analysis on the morphological scores and on the 2-dimensional cusp areas for these same teeth. The fourth part of our approach compared the three quantitative methods to reach a final decision on taxonomic identification. Our results reveal a significant amount of overlap in size and morphology between the isolated postcanine teeth of *Au. afarensis* and *H. habilis*. This *afarensis/habilis* group dominates the dental assemblage in the earliest part of the Omo stratigraphic sequence, with the robust lineage gradually increasing in proportion. By 2.27 million years ago, we see clear evidence of teeth from genus *Homo* alongside those from the robust lineage. Near the top of the sequence, between 1.38 and 1.05 million years ago, we only find isolated teeth of *Homo*.

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<sup>1</sup>The Hebrew University of Jerusalem <sup>2</sup>National Museum of Bloemfontein <sup>3</sup>University of the Free State <sup>4</sup>McGregor Museum

### **Slow but steady: a 2-million-year tortoise record from Wonderwerk Cave (South Africa)**

To fulfill their protein needs, people worldwide exploit a wide range of animals, including small-sized reptiles (e.g. lizards, snakes, turtles). Terrestrial tortoises are one of the most common reptiles exploited as they are relatively sessile and not aggressive. Furthermore, they can serve as a ‘living larder’, kept alive for long periods without needing food or water. and so slaughtered as needed. We present an overview of a unique 2 million-year long record of tortoise exploitation from Wonderwerk Cave, a site located in the arid interior of South Africa. The remains derive from levels in the cave associated with artefacts of Later Stone Age, Middle Stone Age, Earlier Stone Age and Oldowan material culture. Points to be reviewed are tortoise species identification and the application of measures of tortoise body mass and body size as a means of assessing paleoclimate. In order to provide information on anthropogenic and animal modifications, as well as natural agencies we also report on bone taphonomy including skeletal element representation and evidence of surface marks, breakage and colouration. Based on these data we are able to conclude that most of the tortoise remains at Wonderwerk Cave were initially introduced by hominins, but were later modified by other agents.

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### **ZooMs and isotopic analysis of El Hammar and El Hattab II caves**

The identification of fossil taxa is the main goal of palaeontology. Knowing the composition of communities is fundamental to characterising past ecosystems and understanding changes in environment and climate. However, taxonomic identification of animal remains is not always straightforward due to the high degree of fragmentation that bones tend to present. Recently, a technique of molecular biology (proteomics) has been developed for the identification of bone fragments, through the collagen peptide fingerprinting by mass spectrometry (ZooMS). This requires the collagen to be removed from the bones and that this collagen maintains a good degree of preservation. Breaking the collagen molecule between specific amino acids with trypsin, the obtained set of peptides can be identified by MALDI-TOF (Matrix-Assisted Laser desorption/ionization, time of flight). Some of them are characteristic of a certain taxon, and their presence or absence will allow us to differentiate the taxon from which they come, working as true markers. In those two sites, the bone sample is usually fragmented and therefore taxonomic identification was only possible in a low percentage of the remains. However, the results obtained allowed us to broaden the faunal spectrum and the number of remains identified, including ursids, felines and several ungulates. Not only that, but also we make an isotopic analysis for our samples to reconstruct the

ecology of our species by extracting the collagen, and then analysing the carbon and nitrogen isotopic ratio. In this work we applied those techniques to animal bones remains from the cave sites of el Hammar and Hattab II, both located in northern Morocco. In addition to reporting on the type of diet of the organisms, they reflect environmental variables such as the degree of tree cover temperature, humidity of the environment or the altitude and orographic conditions of the area where they lived.

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<sup>1</sup>Tacoma Community College <sup>2</sup>Science Museum of Minnesota <sup>3</sup>National Museums of Kenya <sup>4</sup>Senckenberg Research Institute and Natural History Museum <sup>5</sup>Baylor University <sup>6</sup>University of Minnesota <sup>7</sup>Hostos Community College

### **Site formation and paleoecology of the Early Miocene Nyang Rise bonebed, Rusinga Island, Kenya**

The Early Miocene Kaswanga fossil locality (R5) on Rusinga Island, Kenya, has been a touchstone for understanding the evolution of African ecosystems in part due to its history of systematic excavations, rather than surface collections alone. These excavations and their floral and faunal fossil assemblages comprise a series of very well-dated snapshots into the African Early Miocene and thus have contributed to historic paradigm-shifting paleontological research on fossil primates and paleo-community analyses. In 2011 and 2023 our team lead archaeological-style excavations at an R5 sub-locality, Nyang Rise. Nyang Rise is a dense bonebed that continues to yield numerous crocodilian remains intertwined with both large and small mammalian taxa. In 2023, we expanded our excavation by 16m<sup>2</sup> and continued to work five of the original 2011 units for a total of 21m<sup>2</sup>. This new work yielded relatively rare taxa, including two new primate specimens, a small lizard, and a partial hyaenodontid cranium. Taphonomic analyses suggest that Nyang Rise represents a complex depositional environment within a fluvial system. This bonebed further yields evidence of ancient behaviors, such as predator-prey relationships and conspecific aggression among crocodiles, through observed surface modifications and healed breaks. Past excavations throughout the broader R5 locality have been framed as evidence of changing ecosystems based on recovered fauna; but our new excavations suggest that previously excavated samples may have captured only a portion of the faunal community present at Nyang Rise, perhaps due to variable taphonomic processes at different sub-localities throughout the site. Importantly, thoughtful community collaboration and outreach has been crucial to preserving this important and still productive excavation site.

Alexander Titan Kabelindde<sup>†</sup>

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### **Technological behaviour of *Homo erectus* in Beds II, III, and IV, Olduvai Gorge (Tanzania)**

Technological behaviours of *Homo erectus* are discussed following a comprehensive technological analysis of stone tool assemblages from FC East, JK, and WK sites at Olduvai Gorge, Tanzania. A first-hand reanalysis of the Leakey and OGAP previously excavated lithic collections provides evidence of hominin technological behaviour in Beds II, III, and IV, a crucial time period for the existence of the Acheulean technology at Olduvai Gorge. A technological analysis shows occurrence of reduction sequence that indicates that hominins aimed at producing small flakes and cores. Exploitation of cores appears to be expedient and low to medium intensity. Retouched tools are mostly notches, alongside other retouched tool types such as denticulates and sidescrapers. A comparison of technological aspects between sites reveals a well-defined and standardised procedure, ranging from raw material selection, tool-making, maintenance and discarding. This technological organisation of the Acheulean sites of Olduvai is indicative of a remarkable technological advancement and organisational skills. This strongly suggests the existence of technical procedures that were systematically executed by hominins at

these sites and underscores the organised technological behaviour of the Acheulean hominins at Olduvai Gorge.

Johanes Kakoki<sup>1</sup>

<sup>1</sup>Tanzania Petroleum Development Corporation (TPDC)

### **Palynological investigation of the upper Jurassic to Cenozoic sediments from offshore, southern Tanzania**

Thirty cutting sediment samples from boreholes Kiliwani North and Kiliwani-1 of the same basin, located in the shallow continental shelf of southern Tanzania were palynologically processed and studied, to assess the chronostratigraphy, depositional environments, thermal maturity, and the correlation of bio events. Dinoflagellate cysts were used for assigning the geologic age, whereby, the oldest interval in Kiliwani North well was Oxfordian, marked by *Wanaea fimbriata*, *Wanaea clathrata* and *Gonyaulocysta jurassica* while *Homotryblum tenuispinosum* marked the youngest Messinian section. In Kiliwani-1 well, the oldest Hauterivian section was indicated by *Coronifera oceanica* while the youngest Rupelian horizon was marked by *Glaphyrocysta semitecta* and *Stoveracysta ornata*. The depositional environments ranged from proximal shelf to deep basin with oxygen levels varying from oxic, dysoxic to anoxic conditions while type III gas-prone kerogen dominated most of the samples. The abundance of fungal spore and hyphae indicated a humid climate, the presence of *Apectodinium homomorphum* was a hot climate signature, *Pediastrum* sp. signified a freshwater input, while plant pollen indicated a terrestrial influence. Thermal maturity varied from mature to over-mature for hydrocarbon generation. The correlation of six bio-events common in both wells showed changing sedimentation rates at some intervals and breaks in sedimentation in others, caused by variations in creation of accommodation space within the basin, due to changing sea levels and tectonic uplift and subsidence.

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<sup>1</sup>National Museums of Kenya <sup>2</sup>American Museum of Natural History <sup>3</sup>Pennsylvania State University <sup>4</sup>University of Illinois Urbana-Champaign

### **Vegetation reconstruction of the late Miocene Lemudong'o Formation, southern Kenya**

The Lemudong'o Formation, located approximately 100 km west of Nairobi on the western margin of the Kenya Rift System, is one of the only known late Miocene sites in Southern Kenya. The Lemudong'o paleolake basin sequence comprises a ~135meter-thick sequence of lacustrine and terrestrial sediments and volcanics spanning more than 9km across the paleolandscape, dating to ca. 5.8-6.1 Ma. This sequence provides a window into the paleoenvironmental contexts and climatic dynamics that may have influenced early hominin evolution. Previous palaeobotanical data derived from analysis of phytoliths from 11 sediment samples indicated habitats ranging from closed forest to woodlands and bushlands across the paleolandscapes. Riparian and swampy environments were also present. In this paper we present new palaeobotanical data. A total of 66 sediment samples were processed and analyzed for both phytoliths and pollen. Phytoliths are preserved in all samples. Few pollen grains have been identified so far. However, the additional information provided by the pollen data helps us understand the composition of the wooded taxa indicated by phytoliths, hence improves our reconstruction of the vegetation history for the Lemudong'o Locality. The current pollen and phytolith data help draw a more accurate picture of the paleohabitats in Lemudong'o Fm and the environmental contexts of the faunal communities identified. Phytolith and pollen evidence coupled with ecometric and isotopic data derived from faunal assemblages and paleosols will contribute to more detailed reconstructions of the late Miocene environments of the Lemudong'o Formation.



Sarah Kassim<sup>1</sup>

<sup>1</sup>*National Museums of Kenya*

### **Culture, identity, and symbolism of Maasai beadwork**

Beads in Africa can be traced back at least 12,000 years. Earlier beads were made of eggshell, clay, twigs, stones, ivory, and bone while glass beads were introduced later by traders from Europe, India, and the Middle East. The Maasai people did not use glass beads in any significant way until the start of the 20th century. The research objective is to explore the external influences on the meaning and identity of Maasai beads. The study aims to establish whether Maasai beadwork is primarily created for aesthetic purposes or if it holds deeper cultural meaning. To achieve this, the research will focus on several specific objectives. Firstly, the study aims to explore the meanings of Maasai beads within the culture of the Maasai people. Secondly, the research seeks to determine whether modernity have had any influence on the design and structure of Maasai beadwork. In addition, the study will investigate the attitudes of the Maasai community towards modern-day beadwork. Maasai beadwork designs reflect the contrasting light and dark patterns that can be found in nature, with names of the patterns reminiscent of those found on their livestock and landscape, Maasai additionally use specific ornaments and patterns to define gender, clan as well as affiliations such as age set, marital status, motherhood, and social position. The research aims to investigate the cultural and aesthetic significance of Maasai beadwork. The research hopes to provide answers to these questions and shed light on the values attached to beads as well as adding to the general information reserve on beadwork. Overall, the research hopes to provide a comprehensive understanding of the cultural significance of African traditional beadwork and its place in modern society. The study will be carried out in Narok county at Narok north constituency in Kenya.

Philbert Katto<sup>1</sup>

<sup>1</sup>*University of Alberta*

### **Settlement variabilities during Iron Age in the Iringa region, southern highlands of Tanzania**

The Iron Age (IA) of Iringa Region is less studied compared to the Stone Age. The previous research conducted by the Iringa Region Archaeological Project (IRAP) has established the cultural chronology of the region that spans from Early Stone Age (ESA) to the recent historic period. The Iron Age has been dated from 3,000 ya to the recent historic period at the major sites such as Magubike and Mlambalasi rockshelters. However, the current study conducted on the IA period of the region has noted the variabilities in settlement history. Using the chronometric dating results generated from charcoal and ceramic samples and the secondary data from the previous studies, the study noted the differences in sites occupations that can be traced from Stone Age. Thus, while the Iron Age of some sites such as Magubike rockshelter dates back from 2,055 BP/105 BC, Mlambalasi rockshelter lacks the Early Iron Age (EIA) but contains Later Iron Age (LIA) material dating from 1,200 AD. Combining data from the previous archaeological research and those of current study it come to the conclusion that the Magubike rockshelter site was continuously settled earlier from ESA-Later Stone Age (LSA)-Pastoral Neolithic (PN)-EIA and historic period whereas Mlambalasi settlement history traces from LSA-LIA-historic. Such variabilities inform issues related to site occupations and re-occupations overtime that could be influenced by various factors such as trade, interactions, resource scarcity/abundance, and many others.

Temesgen Leta Kelecha<sup>1</sup>

<sup>1</sup>*Ethiopian Heritage Authority*

### **Characterizing an archaeological assemblage from Oulen Dorwa, Middle Awash study area, Afar Rift, Ethiopia**

This poster presentation focuses on the archaeological assemblage and associated evidence from the Oulen-Dorwa (OUD-A1) locality near Namey Koma, located in the Middle Awash study area of the

Afar Rift, Ethiopia. The Oulen-Dorwa area contains Late Stone Age occurrences first noted by Kalb et al. during survey in the 1970s (Kalb, 1982). Localities contain lithic artifacts, manuports, and ground stones. Perhaps most notable are the substantial quantity of ostrich eggshell beads (complete and fragmentary) recovered. This presentation highlights the significance of Oulen-Dorwa, which is not only one of the few areas in the Afar region where ostrich eggshell beads have been recorded, but crucially was also a site of ostrich eggshell bead production. The archaeological methods used in the study of the locality and the artefact collection strategy are outlined and the results of the research and the associated assemblage of lithics and ostrich eggshell beads and bead fragments is presented. The significance of the raw material selection is discussed, as is the reduction sequence for the lithics, and the production process for the beads. The OUD-A1 assemblage is situated within its environmental and cultural context, both regionally and in the wider context of the African Late Stone Age. This research is, therefore, innovative in its attempts to collect significant data with which to investigate the Late Stone Age in the Afar region.

Madeleine Kelly<sup>1</sup>, Sahleselasie Melaku<sup>2</sup>, Maryse Biernat<sup>3</sup>, Amanda McGrosky<sup>4</sup>, W. Andrew Barr<sup>5</sup>, Frances Forrest<sup>6</sup>, David R. Braun<sup>5</sup>, Emmanuel Ndiema<sup>7</sup>

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### **Reconstructing hominin paleoenvironments in the upper Burgi Member (Koobi Fora Formation, Kenya) using Bayesian modeling and 3D shape variation of the bovid astragalus**

It is widely accepted that hominins evolved in a complex, variable paleoecological context. Many existing paleoenvironmental reconstructions conclude that hominins inhabited heterogeneous, mosaic habitats composed of woodlands and grasslands. However, this mosaic generalization makes it challenging to tie changes in specific aspects of the environment to behavioral and morphological shifts along the hominin lineage. Therefore, more nuanced reconstructions of hominin paleoenvironments are needed to develop more precise and testable hypotheses regarding the role of environmental variability as a catalyst of hominin evolution. Here, we present a novel method for reconstructing tree cover across diverse hominin paleoenvironments, using ecomorphological traits of bovids. As a case study, we apply this method to the fossil record of the upper Burgi Member (~2.0-1.88 million years ago) of the Koobi Fora Formation, which encompasses a transitional period in hominin evolution, including the first appearance of *Homo erectus* in the Turkana Basin. To achieve this, shape variation in extant and fossil bovid astragali is examined using 3D geometric morphometrics and quantified through a principal components (PC) analysis. PC scores of extant astragali are subsequently used as predictor variables in a Bayesian multi-level regression model to reconstruct percent woody cover in modern African habitats. The model is then applied to fossil astragali (n = 19) from five upper Burgi Member collecting areas to reconstruct percent woody cover variation across space. By doing so, this project explores the degree of habitat variability during the upper Burgi Member, thereby providing more detailed insight into the range of habitats which hominins inhabited during this important transitional period.

Osman Khaleel<sup>1</sup>, Jonathan Haws<sup>2</sup>, Sol Sánchez-Dehesa Galán<sup>1</sup>, Célia Gonçalves<sup>1</sup>, Nuno Bicho<sup>1</sup>

<sup>1</sup>ICArEHB/University of Algarve <sup>2</sup>University of Louisville

### **The Paleolithic record of Sudan: past, present, and future perspectives**

Paleolithic research in the Sudan has broadened its range not only geographically but also temporally: it now includes investigations in previously little-studied areas such as Khasm El-Girba, the Eastern Desert and the Nile Valley, and it covers sites from the Early Stone Age to the Later stages of the Paleolithic. However, the Paleolithic evidence in Sudan is highly fragmented and sporadic in both spatial and temporal terms. Using the mosaic Paleolithic landscapes of the Sudan, this study aims to review and reassess current understanding of the Paleolithic occupation of the Sudan and its important contexts by bringing them together in one place for the first time. By describing and analyzing the primary Paleolithic

data in both local and regional geomorphological, palaeoecological, and chronological contexts, this article reviews the present data and explores the hypotheses of Sudan as a glacial refugium.

Jackson Stanley Kimambo<sup>1</sup>, Beatrice Azzarà<sup>2</sup>, Giovanni Boschian<sup>3</sup>, Sofia Menconero<sup>4</sup>, Giorgio Manzi<sup>1</sup>, Marco Cherin<sup>2</sup>

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### **A new paleontological assemblage with evidence of hyena activity from the Side Gorge at Olduvai (Tanzania)**

Although research in Olduvai Gorge (Tanzania) has been ongoing for over a century, not all the Beds that form the stratigraphic sequence have been studied in detail. In particular, the younger units, namely the Ndutu Beds (NB) and Naisiusiu Beds (NaB), have been subject to much less intensive investigation than the older ones. This work is part of recent efforts by THOR (Tanzania Human Origins Research) project to investigate the NB-NaB even in little explored areas of the Gorge. We discovered an interesting site on the left bank of the Side Gorge near the Kelogi Hills. Approximately located in front of Richard Hay's Geolocality 99, the site is preliminarily named as Geolocality 99 North. Surveys at the site allowed the collection of numerous vertebrate remains and MSA and LSA stone tools. Whilst most of the stone tools were found on the surface, the fossils were almost all in situ and can be divided into two assemblages. The first is made up of bones unearthed from a compact siltstone in the lower part of the succession referable to the NB. Among this material, a cranial fragment of Procaviidae with complete cheektooth row, stands out. The second assemblage comes from a loose siltstone in the upper part of the succession, whose stratigraphic relationships with the aforementioned NB deposits are still unclear. This assemblage is composed of bones with clear evidence of hyena activity (e.g., bite and gnaw marks). As a matter of fact, the majority of this assemblage -including an almost complete zebra cranium- was retrieved within a burrow-like feature interpreted as a fossil hyena den. The systematic excavation of this burrow was accompanied by the making of multiple 3D models. Today, thanks to Augmented Reality, the excavation phases can be digitally relived step by step.

Rahab N. Kinyanjui<sup>1</sup>

<sup>1</sup>*National Museums of Kenya*

### **Paleobotanical research in Kenya: opportunities, challenges, and way forward**

East Africa has rich heritage remarkably preserved in the paleontological and archaeological sites across the region. For more than five decades, numerous paleontological, paleoanthropological, and archaeological research focused on faunal assemblages discovered in these sites and their geological context especially within the rift valley systems, have yielded numerous collections which include human remains. One of the key research objectives is to determine and understand the role of environment in shaping the evolution trajectories of mammals, especially genus *Homo*. Most environmental interpretations are derived from ecometrics and isotope datasets. The study of paleobotanical remains to reconstruct paleoenvironment has been hindered by the scarcity of well-preserved plants remains particularly of organic nature. Most previous studies focused on pollen analyses and their preservation statuses unfortunately is dependent on specific abiotic and biotic factors that are not popular across Kenyan landscapes. Until recently the study of phytoliths-plant silica cells- that preserve well in most of the depositional context and present a unique opportunity to reconstruct past vegetation history with an added advantage of understanding grasslands dynamics which are critical component of the vegetation cover. This paper presents the opportunities, challenges, and way forward for paleobotanical research in Kenya.

Mitchelle Wanjiru Kioko<sup>1</sup>, Susanne Cote<sup>2</sup>, Emmanuel Ndiema<sup>1</sup>,

<sup>1</sup>National Museums of Kenya <sup>2</sup>University of Calgary

### **Fossil preparation in Kenya**

Fossil preparation is a crucial component in the preservation and study of fossils. The role of fossil preparators encompasses the intricate tasks of identifying, preparing, and cleaning fossils specimens, including delicate fossils like micro-mammals, apes, birds, and hominin. This presentation explores the journey of a Kenyan woman trying to fit into this professional field, which has traditionally been dominated by men. The preparator has principally worked at a Miocene site located in Nyanza-Kenya called Tonde Bridge, that dates to ~23Ma. Her work includes hardening of the fossils, plastering, and fossil exhumation in the field. She has mainly focused on the fossil teeth of hominoids, carnivores, and elephant bones, using an air scribe. She has also been involved in other subsequent fossils preparation in paleo- lab National Museums of Kenya. This presentation sheds light on the role of fossil preparators in inspiring a new generation of women in the paleo-sciences.

Movin Kiprotich<sup>1</sup>, David R. Braun<sup>2</sup>, Joyce Waithira Waweru<sup>2</sup>, Niguss Gitaw Baraki<sup>2</sup>, Habiba Mohammed<sup>1</sup>, Matt Douglass<sup>3</sup>

<sup>1</sup>University of Nairobi <sup>2</sup>The George Washington University <sup>3</sup>University of Nebraska-Lincoln

### **Harnessing the use of machine learning in the identification of reduction sequences: application to Oldowan technology**

Stone artifact assemblages represent the longest continuous record of human behavior currently known. The reductive nature of these assemblages allows archaeologists to explore the sequence of decisions that are made when making stone tools. Sequence information can help us understand the procurement, use, and discard of stone tools. Currently our understanding of decisions made during stone tool production are largely driven by studies of refits. However, there have been some advances in predicting the sequence of removals using attribute analysis. Traditionally, technological flake categories have been used for understanding reduction sequences in many Earlier Stone Age assemblages. Recently alternative methods have been explored to understand the sequence of removals. We present a novel application of machine learning methods (random forest) to predict the reduction sequences of flakes from Oldowan sequences. Flakes were knapped by skilled knappers in an attempt to simulate sequences used by Oldowan knappers. Machine learning models were then used to predict the sequence of removals. The combination of a series of variables provides high accuracy for flakes of known sequence. In particular, variables that are traditionally used to understand sequence (e.g., flake scar count) contribute significantly to machine learning models. The efficacy of machine learning models in sequence prediction is rooted in the complex interactions between individual variables. The aggregate predictive strength of multiple variables is superior to the predictive power of a single variables in anticipating the sequence of removals. Importantly the machine learning model appears to predict sequence accurately in cores of varying sizes. Previous attempts to understand sequences that focused on the percentage of cortex are plagued by the impact of varying surface area to volume ratios in cobbles of diverse sizes. This will enable us to better interpret stone tool assemblages and understand the decision-making processes of the hominins that created them.

Francis M. Kirera<sup>1</sup>, Nasser Malit<sup>2</sup>, Rahab N. Kinyanjui<sup>3</sup>, Christine Omuombo<sup>4</sup>, Francis Muchemi<sup>3</sup>, Veronica Waweru<sup>5</sup>, Aryeh Grossman<sup>6</sup>, Steven Muge<sup>3</sup>

<sup>1</sup>Mercer University <sup>2</sup>SUNY - Potsdam University <sup>3</sup>National Museums of Kenya <sup>4</sup>Technical University of Kenya <sup>5</sup>Yale University <sup>6</sup>Midwestern University

### **New fossiliferous and archaeological sites in central highlands of Kenya**

Recent paleontological and archeological investigation of Plio-Pleistocene sediments in the Central Highlands of Kenya (CHK) has yielded abundant vertebrate fossils and archeological artifacts.

Close to 20 sites spanning the latest Miocene through the Holocene have been documented in the region. The sites, with an elevation of >1800m asl, are sandwiched between the Aberdare Ranges to the east, Mt. Kenya to the west and Mathews Range to the north. We have documented over 400 fossil specimens representing different vertebrate faunae including proboscideans, perissodactyls, carnivorans, cetartiodactyls, primates, reptiles, and rodents. The artifacts are represented by diverse tools kits that represent all technical phases of the Stone Age assemblages, which show evidence of long-term and/or continuous occupation. These fossil faunae and stone tools have been recovered associated with Mid-Pleistocene and Holocene hominins. The least known CHK sites represent one of the richest extrabasinal Plio-Pleistocene localities in East Africa. The presence of fossils and numerous archaeological sites in the region affords us a rich spatial and temporal archive of past biodiversity in high-altitude ecosystems and sheds light on high-altitude habitation, speciation, and endemism during the Plio-Pleistocene. We hypothesize that the CHK high-altitude ecosystems acted as a fundamental modulator of regional climate and local hydrology during periods of environmental instability.

Emanuel Thomas Kessy<sup>1</sup>

<sup>1</sup>*University of Dar es Salaam*

### **Revisiting the archaeology of Dar es Salaam**

In the 1950s to late 1970s, the Dar es Salaam Region witnessed a number of cultural heritage investigations in sites such as Mbweni, Ukutani, Kunduchi, Msasani, Mjimwema, Mbuamaji and Kimbiji. The investigations were in the form of brief reports following site's visits, however without excavation work, indicating that such sites date back to the Medieval/Swahili period. In relative terms, although since the 1930s the Dar es Salaam Region has been a hub of heritage institutions in Tanzania, only handful of detailed archaeological research projects have been done in the region. It is unfortunate that the majorities of the sites in Dar es Salaam are facing rapid destruction following the soaring industrialization and need for settlements to accommodate the growing population. A recent archaeology site's rescue strategy indicates that the Dar es Salaam Region consists of many Iron Age sites; rich of information; some demonstrating pre-contact cultures including non-Islamic burial practices.

Bernard Flavian Kitoha<sup>1</sup>, Isaac Onoka<sup>2</sup>, David Mrisho<sup>3</sup>, Omary Rusuby<sup>4</sup>, Kayla Genord<sup>5</sup>, Mariha Corbin<sup>5</sup>,

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### **The use of photogrammetry on conservation and preservation of the 3.56 million years old non hominin ichnofossils at Laetoli, Tanzania**

Although the discovery of hominin and non-hominin footprint trackways at Laetoli in 1978 made the site world famous, the conservation and preservation of the trackways caught the paleoanthropological community unprepared. As part of the conservation strategy (P1) the hominin footprints are currently buried and inaccessible. Apart, from the renowned hominin footprints the site is also endowed with other animal, insect, and bird's footprints preserved in the 3.56 million years old solidified tuffaceous layers exposed throughout the landscape. The non-hominin prints were not on a high priority conservation list. They are currently deteriorating and fast disappearing. This paper highlights the potential of photogrammetry in the conservation preservation efforts of Laetoli ancient trackways for present use and for the future generation. 2D images of the footprints were captured using Unmanned Aerial Vehicle UAV complemented with normal SRL camera. Using photogrammetry software, the captured images were used to generate 3D models of the footprints. The implementation of this project made it possible to monitor the deterioration rate of the non-hominin footprints at Locality 7 and made them digitally accessible to the broader public.

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### **Fossil white rhinoceros (*Ceratotherium simum*) from the later Pleistocene of Sudan**

Paleontological, geological, and archeological exploration in the middle Atbara area in eastern Sudan between 2018 and 2022 has revealed a diverse ecological and cultural assemblage from the later Pleistocene. Our team has collected fossil cranial material of white rhinoceros (*Ceratotherium simum*) from three localities in our study area, representing three juveniles and one adult individual. The adult comprises a skull with a nearly complete dentition. New high-density OSL and 14C dating indicates an overall chronology spanning ~250 to ~15 ka for the middle Atbara sediments, with the white rhinoceros material dated from ~160 to ~60 ka. Like other faunal elements in our study, this material represents a northern extension of the geographic range of the modern species. The age and geographic location of the new specimens suggest they might belong to the critically endangered northern white rhinoceros. Though previous research has identified dental and cranial characters that might distinguish the northern and southern white rhinoceroses, the character states in these fossil specimens do not permit confident referral to either subspecies. The new middle Atbara material provides confirmation of the prehistoric range of *Ceratotherium simum* in the Sahelian region, and represents an important Pleistocene occurrence outside the better-studied East African Rift Valley.

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### **Examining the isotopic niche space of Serengeti insectivores and the implications for hominin diet reconstruction**

Hominin paleoecological studies are increasingly incorporating nitrogen (N) and zinc (Zn) isotopes to examine the evolution of the human diet. N and Zn isotope ratios correlate to trophic level and can be used to estimate the frequency of meat consumption in prehistoric animals. While results obtained from these studies can demonstrate animal consumption, we are largely unable to specify with certainty what specific forms of carnivory were employed. Understanding the finer dynamics of these isotope systems is imperative to their application to the terrestrial fossil record and the interpretation of the animal ecology in the past. Invertebrates may have been a major component of early hominin diets, but we presently lack a means to explicitly test for insectivory. To evaluate the contribution of insects to hominin diets, robust metrics for the insectivore isotopic niche space will be needed. Given the small size of most obligate insectivores, sampling insectivore teeth for isotopic analysis is often infeasible. However, the Serengeti ecosystem hosts two myrmecophagous insectivores large enough to sample for N and Zn isotopes: the aardwolf (*Proteles cristata*) and the armadillo (*Orycteropus afer*). We examine diet correlated isotopes, recovered from both tooth bioapatite and collagen, in these insectivores as well as sympatric species of various dietary categories, including flesh-specialized carnivores, osteophagous carnivores, and omnivores. We compare  $\delta^{15}\text{N}$  and  $\delta^{66}\text{Zn}$  values for these taxa and evaluate differences in the trophic signal. We demonstrate that the unequal fractionation of these isotope systems leads to observable differences in isotopic niche space, allowing for the differentiation of specialized carnivore diets. Future investigations will examine additional omnivorous taxa to evaluate the relationship between the frequency of insect consumption and the offset we observe in N and Zn isotopes.

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## Human palaeobiology in the late Quaternary of West Turkana, Kenya

The climatic oscillations following the Last Glacial Maximum resulted in major shifts in lake levels and riverine drainage patterns in Africa north of the equator. Human populations would have been strongly influenced by these fluctuations, in terms of resource availability, geographical distributions, connectivity and isolation, and social and subsistence patterns. In this paper, we report on the results of field investigations in the lower reaches of the Kerio River in south-west Turkana. Sixteen years of fieldwork have yielded a large sample (N> 1200 isolated fossil elements or fragments, and 40 partial articulated skeletons) of human skeletal remains, covering a period from ca. 12,000 to 4,000 BP, and from both hunter-gatherer-fisher communities and pastoralists. The archaeological and geological contexts for most of these consist of fluvial, deltaic, and lacustrine deposits, with little evidence for explicit mortuary practices prior to the arrival of pastoralist economies. We present evidence on the palaeobiology of the late Quaternary populations derived from these samples, and discuss the high level of variation present, the demographic structure represented, and the observed palaeopathology, including evidence for violence-related trauma as well as the taphonomic nature of the sample. In addition, we discuss how the morphological variation in this large sample from West Turkana may throw light on broader patterns of human population diversity during the later Pleistocene and early Holocene. Finally, we consider the significance of this large collection of human remains for understanding the populational dynamics in Africa at the end of the last glaciation.

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### Lucy's piglets: suid fossils from Hadar and their relevance in eastern African paleoanthropology

The Hadar site in Ethiopia's Afar Region is renowned for its abundant fossil remains of the hominin *Australopithecus afarensis*, highlighted by the discovery of "Lucy" 50 years ago. However, the site has also yielded a rich array of fossils from a variety of faunal groups, constituting one of the most extensive Late Pliocene archives between 3.45 and 2.95 million years ago (Ma). Among these, the Suidae is exceptionally well-represented, with over 1,500 specimens documented. Due to their relatively rapid evolutionary rates, African suids serve as excellent biochronological markers and indicators of ancient environmental conditions. Previous studies had identified three distinct species of suids at Hadar: *Kolpochoerus afarensis*, a relatively small member of the modern subfamily Suinae with bunodont molars; and two representatives of the extinct Tetraconodontinae, including *Nyanzachoerus kanamensis*, characterized by relatively short, brachyodont molars and large premolars; and *Notochoerus euilus*, noted for its elongated, hypsodont molars, smaller premolars, and reduced incisors. Here, we revise Hadar's Suidae collection and examine morphological trends throughout Hadar's well-documented stratigraphic sequence. Early in the sequence (Basal Member ca. 3.45 Ma) the presence of large, narrow premolars suggests the co-occurrence of *Notochoerus jaegeri* and its likely descendant, *No. euilus*. The later Kada Hadar Member (ca. 3.0 Ma) reveals dental remains attributable to *Kolpochoerus phillipi*, an early ancestor of the modern Giant Forest Hog (*Hylochoerus*) together with early Metridiochoerus, the lineage of modern warthogs (*Phacochoerus*). Additionally, a third molar from the Sidi Hakoma Member (ca. 3.35 Ma) may constitute the earliest *Metridiochoerus* found in the Afar. These findings indicate greater suid diversity at Hadar than previously recognized, prompting further questions about the evolutionary trajectories and biogeography of these suid lineages and the paleoenvironments of *Au. afarensis*.

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### The Hadar Carnivora: implications for hominin behavior and ecology

The Hadar Carnivora provide a unique glimpse into the ecological framework surrounding hominin evolution. Taxa include various species of sabertooths *Homotherium* and *Dinofelis*, bear otters *Enhydriodon*, hyaenids *Crocota* and *Chasmaporthetes*, and other small and large-bodied carnivorans. In this study, we discuss the inferred behavior of Hadar carnivorans and discuss shifts in the carnivore guild through time. These shifts include the appearance and disappearance of key taxa, including a new large-bodied mustelid known only from the member in which Lucy was found, the Kada Hadar Member. Both mustelids and felids are represented by a greater diversity of forms than exist in Eastern Africa today. While relatively rare, even canids and smaller taxa are present at Hadar. Changes in body size, robusticity, and morphology within genera are discussed (e.g., *Homotherium*, *Enhydriodon*, *Crocota*). Shifts in body size within taxa are particularly marked. Carnivorans are not as well-represented in the Kada Hadar Member as in earlier members both in taxonomic diversity and body part representation; what is present almost certainly underrepresents the diversity of Carnivora at the time. Hyaenids are underrepresented in the Kada Hadar, although that is likely a taphonomic issue and reflective of the lower representation of Carnivora rather than a lack of hyaenids. Nonetheless, the Kadar Hadar, like the older Hadar Formation members, include a greater diversity of Size Class 4 predators than present (albeit poorly represented) and thus was a time of both greater threats to hominins and greater scavenging opportunities than present.

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### **Evolution of language: a correlation between auditory and phonation capabilities through virtual anatomy analysis in the Hominidae family**

Audition plays an essential role in mammal communication, particularly in primates. There is a correlation between audible frequencies and those produced during phonation. If fossils don't allow direct inferences about behavior, as they don't fossilize, however, the absence of proper anatomical support indicates the lack of a specific biological function. Considering this relationship, this research describes and compares the anatomy of the external ear and the skull base, associated with the integration and conformation of cranial modules in the Hominidae family, including the genera *Australopithecus*, *Homo*, *Pan*, *Gorilla*, and *Pongo*. In the initial stage, osteometry analysis was conducted using CT scans detailing the morphology of each genus. Subsequently, the results of the otic module were compared with the skull base through Spearman correlations and principal component analysis. These results were further compared with the *Macaca* genus. Identifying significant morphological differences in the skull base of modern humans, contrasting with great apes and macaques, and demonstrating an intermediate stage in the analyzed fossils (*Australopithecus africanus* and *Homo erectus*). These differences are less pronounced in the morphology of the ear, which exhibits traces of a primitive feature. All analyzed genera show a positive relationship between the ear and the skull base, confirming morphological variation in the anatomical structures necessary for phonation and audition. From the sample of fossil hominids, only *H. heidelbergensis* exhibits the same morphology as present-day humans, indicating that the essential anatomical structures for speech have been present for approximately 400,000 years.

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### **New insights on feeding habits of *Kolpochoerus* from the Shungura Formation (Lower Omo Valley, Ethiopia) using dental microwear textures**

During the Neogene and the Quaternary, African suids displayed dental morphological changes regarded as reflecting adaptations to increasingly graminivorous diets, such as in the genus *Kolpochoerus*. However, their most significant morphological changes are not synchronous with increases in consumption of C4 plants such as grasses, as indicated by comparisons between dental enamel contents in



stable carbon isotopes and dental morphological evolution. To date, only a few studies have applied Dental Microwear Texture Analysis (DMTA), which informs about the mechanical properties of the diet, on *Kolpochoerus* specimens. Moreover, none has yet focused on specimens from the Shungura Formation (Lower Omo Valley, Ethiopia), which is the most complete Late Pliocene to Early Pleistocene record in eastern Africa. In the present study, we investigated dental microwear textures (DMT) in four genera of extant suids with different diets: the herbivores *Phacochoerus* and *Hylochoerus*, and the omnivores *Potamochoerus* and *Sus*. We show that extant suid DMT respond to their different dietary habits. We then studied the DMT of 68 specimens of *Kolpochoerus* from the Shungura Formation dating from about 2.9 Ma to ca. 1.0 Ma. The microwear pattern of *Kolpochoerus* differs from that of extant suids by its overall low anisotropy, complexity, and heterogeneity values. Some similarities with *Phacochoerus* are observed (low values of complexity and heterogeneity). The stratigraphic variations within the Shungura Formation are relatively weak, indicating no particular long-term temporal trend in dietary changes. In line with previous studies, we suggest that microwear patterns of *Kolpochoerus* likely reflect a highly herbivorous diet (including both graminoids and non-graminoids plants) with preferences on young and low-abrasive grasses.

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### ***Australopithecus* in South Africa: analysis of the internal morphology of hominin distal femora**

*Australopithecus sediba* displays a unique combination of features in the limb skeleton that are distinct from earlier species of *Australopithecus*, suggesting that this species moved differently within its environment. The nearly complete right distal femur (U.W. 88-63) of *A. sediba* (1.98 Ma) has condyles that morphologically resemble other australopith species in combination with *Homo*-like anatomy of the patellar surface. Here we analyse the internal morphology of the MH2 right distal femur to further assess the functional morphology and locomotor kinematics of the knee in *A. sediba*. Using high resolution micro-CT scans of comparative sample of *Homo sapiens* (N = 15), *Gorilla gorilla* (N=14), *Pan troglodytes verus* (N = 15), *Pongo* spp. (N = 9) and *Australopithecus africanus* (N = 3), we conducted a canonical holistic morphometric analysis (cHMA) of trabecular bone distribution in the distal femur [7]. As only the lateral condyles were sufficiently preserved in *A. africanus*, trabecular analysis was limited to this region for this species. Due to taphonomic factors analysis of *A. sediba* was limited to patellar region and lateral condyle. Trabecular structure reflects habitual use of extended knee postures during bipedalism in *Homo* and habitual use of flexed knee posture during terrestrial and arboreal locomotion in *Pan* and *Gorilla*. Trabecular architecture in *Pongo* is consistent with a knee joint used in postures varying from extension to full flexion. Trabecular structure of the *A. africanus* lateral femoral condyle exhibits signs of extended and flexed knee postures, suggesting regular bouts of both climbing and terrestrial bipedalism. *A. sediba* shows *Homo*-like trabecular concentrations at the patellar region while the lateral condyle indicates loading the knee joint with a degree of flexion that differs from *A. africanus* and extant apes. The results highlight the diversity of locomotor behaviours in South African hominins around 2 million years ago.

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### **Seasonal environmental signals from high-resolution intra-tooth isotopic analyses of herbivores: application to palaeodatasets**

There is an increasing interest in serial sampling of equid and bovid teeth to gain insights into seasonal variations in carbon and oxygen isotope values. Equids are particularly well-suited for this

purpose owing to their hypsodont dentition and an extended tooth formation period lasting over a year, allowing them to capture one or more seasonal cycles. This poster will provide an overview of serial sampling, and its implications for palaeoenvironmental reconstruction. Recent findings from contemporary specimens will be showcased, alongside analyses conducted at the middle Pleistocene site of Elandsfontein. Notably, Elandsfontein provides high-resolution intra-tooth analyses of enamel  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  on the same teeth where  $\delta^{87}\text{Sr}$  measurements have been previously recorded. Strontium isotope analyses indicate that these large herbivores never moved off the local marine sands, thus confirming that the carbon and oxygen isotope values left in teeth reflect local signals.  $\delta^{13}\text{C}$  values in these teeth remained consistent over the period of mineralization, but  $\delta^{18}\text{O}$  varied considerably – up to 8.6 parts per mille (0/00) in *Equus capensis*. This approach holds considerable promise, but it will be important to ensure a more comprehensive understanding of the factors contributing to the documented patterns.

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### **Comparative palaeoproteomic insights from southern African hominins**

Southern Africa has produced a rich and taxonomically diverse collection of Plio-Pleistocene hominin fossils, including *Australopithecus africanus*, *Paranthropus robustus*, *A. sediba*, *A. prometheus*, *Homo erectus*, *H. naledi* and early *H. sapiens*. Phylogenetic relationships among many of these taxa are unresolved. A recent study on the palaeoproteomics of southern African *Paranthropus* demonstrated the feasibility of recovering ancient protein traces and determining the biological sex of Pleistocene hominin fossils in Africa. Here, we share a preliminary comparative palaeoproteomic analysis of the previously studied specimens of *P. robustus* and a specimen identified as belonging to *A. africanus* from Sterkfontein caves Member 4, from the Cradle of Humankind. We also identify the *A. africanus* specimen as a male individual and further identify single amino acid polymorphisms. We discuss the implications of this work within an African context, including its potential for: (1) determining whether morphological variation is due to sexual dimorphism versus taxonomic diversity, (2) resolving evolutionary relationships, and (3) expanding investigation to other Plio-Pleistocene hominins on the continent.

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### **Reflections on reconstructing the dietary niches of Plio-Pleistocene hominins**

Between 4.2-3.5 Ma early hominins began to broaden their dietary niches to incorporate substantial amounts of C4 foods, which are abundant but considered low quality. Notwithstanding their low nutritional value *Paranthropus boisei* and *A. bahrelghazali* subsisted mainly on these foods but, owing to their different dento-cranial morphologies, they likely ate foods with different material properties or, alternatively, masticated the same foods in a different manner in accord with their masticatory capabilities. In contrast, South African *P. robustus*, widely considered phylogenetically related to East African *Paranthropus* and broadly comparable to the latter in dento-cranial morphology, did not feed predominantly on C4 foods. Instead, the C4 composition of its dental tissue suggests a diet comparable to that of *A. africanus*. These observations raise a number of questions: First, how could large-brained/large-bodied early hominins have subsisted on a low-quality diet? Second, why/how could hominins with similar dento-cranial morphologies (*Paranthropus*) occupy different niches, whilst those with very different morphologies seemingly exploited the same niche. Third, are there “reliable” or “best” approaches for determining the dietary niche(s) of early hominins? Here I review and analyse different lines of enquiry and demonstrate that only a multidisciplinary approach can elucidate early hominin

feeding ecology. As a case in point, not all C4 foods are low quality, but for a large-bodied/large-brained hominin to meet its nutritional/energetic requirements for growth, maintenance, and reproduction a selective feeding strategy needs to be employed. The choice of strategy (and foods selected) will depend on the species' masticatory capabilities and the environment in which it lived. This is illustrated for *Paranthropus boisei* and *A. bahrelghazali*. Regarding *P. boisei* and *P. robustus*, micro-anatomical details indicate kinematic differences in mastication (despite similarities in gross morphology) and point towards the habitual consumption of hard/brittle foods (*P. boisei*) and tough foods (*P. robustus*), respectively.

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### **The Omo-Turkana Basin hominin fossil record: historical bearing to the study of hominin evolution and a focus on the origin of the genus *Homo***

When an exhaustive hominin catalog is considered as an object of study, the analysis of its characteristics can make significant contributions to the study of hominin evolutionary history. Based on 115 bibliographical references, we illustrate this using the hominin record from the Omo-Turkana Basin (Kenya-Ethiopia), where intensive palaeoanthropological research began in 1967. To date, the hominin fossil record contains 1,231 published remains. The analysis of this record provides an historical perspective highlighting the considerable historical importance played by the Omo-Turkana Basin in our knowledge of hominin evolution. We can thus highlight the dynamics of discoveries and compare them between the three main parts of the basin (east, north, and west). Publication strategies for hominin fossils show disparities that do not hide the need for the long time often required to study fossils. We also highlight the considerable contribution made by native African including the Leakeys to the accumulation of this invaluable fossil record. We also show that the three main parts of the basin document different chronological ranges, producing a rather continuous record at the scale of the whole basin. With such an analysis, we can also demonstrate that the relative abundance of *Paranthropus* and *Homo* genus remains (2/3 and 1/3 respectively) during their long period of coexistence. We will also show that, illustrated by a significant number of remains, and contrary to the prevailing view, the genus *Homo* was significantly present in the Omo-Turkana basin between 2.7 and 2 Ma. Finally, we show that the fossil record of the Upper Burgi Member, and to a lesser extent the KBS Member, is atypical, both in terms of anatomical representation and taxonomy, which cannot be fully explained by neither palaeoenvironments nor taphonomic or collecting biases.

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### **Developed Oldowan or a bizarre stone industry**

Archaeological research in the North Mbulu Plateau Landscape has produced a wealth of industries traversing the ESA-LSA continuum. Of particular interest is an industry suggestive of Developed Oldowan (DO) with an occurrence restricted to the lower reaches of the northeastern escarpment of L. Eyasi basin (35.50-35.55E-3.40-3.43S) Developed Oldowan" was originally coined by M. Leakey to describe a technologically "advanced Oldowan" artifact tradition, that preceded the Acheulian Industry at Olduvai Bed I and II. M. Leakey further identified three stages of the DO which she labeled as the DOA, DOB and DOC. The assemblages at hand from the North Mbulu sites show a preponderance of heavy-duty types such as spheroids and subspheroids, polyhedrons, choppers, discoids and minimally worked bifaces, etc., used for assigning assemblages into the DO. While most of sites are surface scatters, some are in sealed stratigraphic sequence though the stratification is less than 1m deep. Unlike in the rest of the plateau where the raw material is dominated by quartzite, phonolite reminiscent of the phenocryst free Olduvai type is the dominant material in the occurrences from the escarpment. The DO has been generally recognized as transitional to the Acheulian though it lacks clarity in terms of classification. Like at Olduvai the assemblage at hand will be found to suffer from a lack of secure

~~radiometric dates due to lack of associated radiometric deposits. At Olduvai MD considers the DO tools as belonging to stage 5 and coming from the junction of Bed II and III. Unfortunately, the stratigraphy at Durugeda is not that distinct. Nevertheless, more fieldwork should settle the question of stratigraphy and artifact composition.~~

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### **High-resolution reconstruction of vegetation distribution through phytolith assemblages in the Kisese II Rockshelter, Dodoma region**

This research demonstrates a high-resolution reconstruction of the distribution of vegetation using phytolith assemblages in the Kisese II rock shelter, Dodoma region. Kisese II is located in the UNESCO World Heritage Kondoa Rock-Art Site in Kondoa District, Eastern Africa, with a rich history dating from the Pleistocene (50,000 years ago) to the Holocene (Iron Age 1000 years ago). Phytoliths are plant silica cells that preserve for a long period, even when plants are dead. The main goal of this study is to understand how vegetation cover changes over time. Relating these changes with archaeological and geological data published from the region, preliminary inferences of the key drivers contributing to these changes are presented. Our objective in using phytolith assemblages was to comprehensively understand the past plant communities in the region. Phytolith analysis offers a unique perspective, as these microscopic plant silicas remain to provide a robust record of past vegetation. We sampled and analyzed phytolith assemblages from the excavation conducted at the rock shelter in a systematic approach. Our findings present an intricate narrative of vegetation dynamics that enables us to identify changes in plant species distribution and ecological variables throughout time—a better micro-botanical understanding of how vegetation distribution is affected by human activities and climate. Also, human activity influences micronutrients in the soil, particularly climate change. This approach contributes to a better understanding of the region's biological history by highlighting the connections between human populations and the local environment. The results contribute to the growing body of knowledge regarding paleoenvironmental reconstructions and demonstrate the usefulness of phytolith analysis in clarifying fine features of past ecosystems.

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### **Core-axes and other heavy-duty tools in the MSA from Equatorial Guinea and the relationship to humid forested environments at the end of the Pleistocene**

The Sangoan and Lupemban industries have been considered, since their original definition, as a Middle Stone Age (MSA) adaptation to the forest environments of Central Africa, in part due to the use of large format tools such as core-axes, hand axes, cleavers, and other tools for heavy-duty tasks. Although this association makes sense, because these types of tools are suitable for working on wood, it has rarely been possible to test it because there are few sites in central Africa where the association between rainforest and Lupemban industry is perfectly documented. Here we present the results of the techno-functional analysis of a set of tools that include core-axes, big discoidals, trihedral picks, tranchets, and other large format tools, all of them made by Façonnage techniques, from the MSA site of Mabewe I in Equatorial Guinea, with an age of >12.57-12.24 ka Cal BP years in which the existence of a rain forest similar to the one preserved today has been documented. The results of the analysis suggest that

Mabewe's heavy-duty tools could be used for the processing of plant materials that include blunt cutting of wood, as well as sawing it. But it also seems that some tools were used to obtain and process tubers and other soft parts of plants. The analysis also demonstrates a careful selection of the raw material for the knapping of these tools. These results suggest that the specializations of the Lupemban industry, at the end of the Pleistocene, were more complex than simple hardwood working. The exploitation of plant resources was diverse and complex, which is manifested in the diversity of tools that were used for this purpose.

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### **An anthracological study at Jubilee Shelter: woody recollection economy, fire use, and past landscape during the final Later Stone Age in Magaliesberg mountain, South Africa**

The final results of a doctoral research project to further paleoethnobotanical and palaeoecological knowledge using archaeological charcoals is presented. Charcoals from distinct occupation levels at Jubilee Shelter (Magaliesberg, near Johannesburg, South Africa) were identified and used to understand human adaptations to their environment in the studied area during the Holocene period. We will present the anthracological results of all strata preserved (ca. 8500 BP to 1350 BP), associated with several lithic industries, ranging from Oakhurst until Post-Wilton techno-complexes. 1643 charcoal fragments were analysed and standard anthracology procedures were applied in this qualitative and quantitative study. The following topics will be discussed: 1) the woody species present in the layers, 2) similarities/differences between the layers, 3) their association with other artefacts in the same layer, and 4) reconstruction of past climate by using specific charcoal indexes. More than 12 species of woods were identified and there were some differences in species composition between the layers. The most common species were *Acacia burkei*, *Acacia karoo*, *Acacia* types, *Brachylaena rotundata*, *Croton* cf. *gratissimus*, *Protea* cf. *rouPELLIAE*, *Searsia lancea* and *Searsia* cf. *pyroides/leptodictya*. Applying anthracological analysis can help to bring information on changes in survival strategies of hunter-gatherers, and consequent impacts on social organization, and technology during the Holocene period in this area, that remain poorly explored.

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### **Examining social influence on primate learning and social networks in rhesus macaque (*Macaca mulatta*)**

Primates form long-term social bonds that are mostly maintained through social behaviors, like affiliation or proximity. Primates are also adept at learning from one another, and their social relationships influence who they learn from. To address the potential influence of learning on network centrality, we designed an experimental study in captive groups of rhesus macaques (*Macaca mulatta*). We selected four groups (mean group size = 11.5) housed at the California National Primate Research Center at the University of California, Davis, that had never previously been exposed to any kind of puzzle box solving experiment. We gave each group access to a novel puzzle box containing a preferred food reward to determine whether network position influenced macaques' success with the task and, in turn, whether success with the task impacted an individual's position in their group's social network. The total study hours are as follows: baseline = 60 hours, experiment = 54 hours, follow-up = 72 hours. Across all four groups, the macaques solved the task 1608 times. Comparing social networks before and after the learning experiment revealed that the macaques who frequently solved the puzzle box did not receive more affiliative behaviors than they did before, however we found key differences between the four groups. It is therefore unlikely that knowledgeable individuals increased their centrality. In the presence

of a strong hierarchy, a change in centrality is unlikely mediated by the introduction of a novel food source.

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### **Proboscidean post-cranial morphometrics and ecomorphology and their utility in reconstructing past environments**

We explore key post-cranial features that can be used to differentiate and identify new bones, podials, and metapodials of proboscideans, in particular true elephants of genera *Elephas*, *Loxodonta*, *Mammuthus*, and *Palaeoloxodon*. Understanding of the post-cranial differences in morphology and morphometrics between recent and fossil proboscidean taxa is currently lacking. Therefore, expansion of ecometric analyses of limb bones for proboscideans will be very important. This process will involve establishing morphometric criteria from extant and skeletal fossils collections in Africa and Europe for the post-cranial differences of these genera, which could be applied to identifying partial skeletons and isolated post-cranial bone specimens. Ultimately, understanding the post-cranial differences between proboscidean taxa serves as an important starting point for understanding how such post-cranial traits in proboscideans can be used in paleo-environmental reconstruction and how such traits serve as adaptations to move in different environments (e.g., forest elephants moving in closed environments vs “savanna” elephants moving in open environments). This project will also involve description of a very important complete skeleton of c.f. *Elephas recki* from Koobi Fora Area 123, stored at Turkana Basin Institute facilities, in a comparative framework with other elephant fossils from Koobi Fora, Ileret, West Turkana, and Omo (Ethiopia). This study will be highly valuable because it will lay out a foundation for future work on potential ecometric value of proboscidean post-cranial bones. Additionally, this project could also inform us about habitat needs of extant elephants for conservation efforts.

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### **New surveys at the Tinderet fossil complex, Nyanza Rift, Kenya**

The first fossil apes published from Africa were discovered in the 1920s at the Tinderet site of Koru, Kenya. Since that time, the entire Tinderet fossil complex has produced thousands of fossil mammals, reptiles, and plants, including some of the most important early ape and stem catarrhine specimens. Here, we report results from geological, paleoecological, and paleontological surveys and samples conducted by our team between 2013-2023. A major part of our work has been to rediscover old but sometimes poorly documented fossil sites and to assess their potential for future research. One such site, Tonde Bridge, was thought to have no remaining fossil deposits but we report here the discovery of many new specimens. We have also discovered new fossil sites that may sample poorly known depositional and/or ecological settings. Our stratigraphic and geochronological results help to better ordinate major fossil outcrops with respect to each other. We have also specifically targeted the smallest microfauna as well as understudied taxonomic groups such as reptiles and amphibians. This work combined with other paleoecological analyses confirm closed habitats at many of the Tinderet sites. One site in particular has benefitted from extensive multi-proxy paleoecological reconstruction, allowing us to place some fossil apes within a dense forested environment. Finally, the discovery of important new primate specimens helps clarify some of the anatomical variation represented in historic collections but also extends the taxonomic variation from Tinderet. In particular, the discovery of a large-bodied

nyanzapithecine from Koru suggests that size variation in this clade may have been similar to that found in proconsulids.

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<sup>1</sup>Smithsonian Institution, <sup>2</sup>National Museums of Kenya

### **Collaborative learning: co-development of an interactive paleoanthropology school program by the Smithsonian Institution and the National Museums of Kenya**

Here we present the processes of planning, developing, testing, and executing a collaboratively built paleoanthropology museum school program by The National Museums of Kenya, Nairobi (NMK), the Smithsonian National Museum of Natural History (NMNH) Human Origins Program (HOP), and the Smithsonian Office of Governmental Affairs (OGA) - together, the Smithsonian Institution (SI). Based on SI and HOP's expertise and the NMK collections and Kenyan curriculum, the team created a paleoanthropology-centered school program. Centered on the *Homo erectus* fossil KNM-WT 15000, nicknamed "Turkana Boy," this program includes five stations exploring different lines of evidence in human evolution. Pilot testing of the first station, "Human Family Tree," at NMNH in October 2019 resulted in positive feedback with 80-100% of participants (n=17 teen volunteers) reporting the activity to be fun, clear, and understandable. Engagement with the scientific process was rated at 4.3 out of 5 on a Likert scale. Pilot testing of the same station at NMK in January 2020 resulted in similar feedback with participants expressing engagement in the scientific process at an average of 4.9 out of 5 on a Likert scale (n=14 museum educators). Subsequently developed stations include "Bipedalism," "Diet and Environment," "Stone Tools," and "Social Life and Intelligence." This program introduces a new type of inquiry-based learning to NMK, expanding the types of visitor engagement and experiences offered. The skills and confidence acquired by the NMK Education team during our collaborative program development inspired their first online program during COVID, which was further adapted for a new online school program at NMNH. After SI secured funding for casts and materials for full in-person implementation at NMK, NMK planned to launch the program in spring 2024. Formal evaluation of the program performance with perspectives from student learners, teachers, and program helpers is the next step.

Sahleselasie Melaku<sup>1</sup>

<sup>1</sup>National Museum of Ethiopia

### **Unraveling Plio-Pleistocene faunal evolution and paleoecological dynamics in the Awash, Omo, and Turkana Basins: insights into hominin evolution in eastern Africa**

The vibrant tectonic and volcanic activities within the rift zones of the Awash and Omo basins in Ethiopia, as well as the Turkana Basin in Kenya, have yielded multiple layers of continuous depositional records providing a unique opportunity to trace the link between biological evolution, climatic variability, and environmental constraints during the Plio-Pleistocene. Years of fieldwork in these regions has led to discoveries of significant fossil remains of various vertebrates, including hominins. While these basins contain a continuous record of hominins, including *Ar. ramidus*, *Au. anamensis*, *Au. afarensis*, *Au. aethiopicus*, *Au. boisei*, *H. habilis*, *H. erectus*, and *H. sapiens*, there has been a considerable lack of inter- and intra-basinal comparison exploring faunal and ecological patterns associated with transitional changes. Here, I have integrated multiple lines of evidence from preexisting paleoclimatic and paleoecological datasets to present a comprehensive assessment of the environmental dynamics in these regions. Preliminary findings reveal a discernible pattern of increased environmental variability and hominin diversity throughout the Plio-Pleistocene. As such, there is a growing need for robust inter- and intra-basinal comparisons of faunal, paleoclimatic, and paleoenvironmental data across different sites to

unravel the implications of large-scale ecological and environmental changes and understanding their connections to hominin evolution.

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### **The emergence of Acheulean in East Africa: the Melka Kunture record (Upper Awash, Ethiopia)**

The emergence of the Acheulean is a milestone in human evolution, when many characteristics associated to a new human species (i.e., to *Homo erectus/ergaster*) appear, including technological advances and changes in foraging strategies. The initial stage of this process was established at ~1.8 Ma ago at sites of the East African Rift. The Melka Kunture record, at 2000m asl in the Ethiopian highlands, dates this process further back to ~1.95 Ma, in an environment different from the savanna of lower elevations. Two sites of Melka Kunture, Garba IV and Gombore I, yielded a rich and complex archaeological record with lithic industry, faunal remains and hominin fossils, which allow to better understand key factors related to the emergence of the new technocomplex. We will discuss the main technological innovations observed in the stone tool assemblages, and the notable changes when compared to the Oldowan. The segmentation and increased complexity of the operational chain, the acquisition of the skills needed to detach large flakes, the increased artefact retouching and the emergence of true large cutting tools (including handaxes) are some of the hallmarks.

Gildas Merceron<sup>1</sup>, Margot Louail<sup>1</sup>, Kevin Uno<sup>2</sup>, Morgan Brown<sup>3</sup>, Blade Engda Redae<sup>4</sup>, Arthur Francisco<sup>5</sup>, Franck Guy<sup>1</sup>, Leslea Hlusko<sup>6</sup>, Antoine Souron<sup>7</sup>, Ghislain Thiery<sup>1</sup>, Jean-Renaud Boisserie<sup>1</sup>

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### **Niche partitioning among primates in the Shungura Formation: insights from dental proxies**

Extant baboons and geladas have been proposed as ecological models for early hominids. These two genera (*Papio* and *Theropithecus*) are known in the fossil record and were possibly competitors of early hominids. The Shungura Formation, Ethiopia, provides an appropriate context to test the hypothesis of ecological overlapping between cercopithecids and hominids. As diet is an essential ecological parameter, we calculated the Levins' niche breadth and the ecological overlapping between extinct primates by combining molar enamel stable carbon isotope and molar microwear texture (DMT) on shearing and crushing facets. We focused on the period from ~2.4 Ma to 1.9 Ma. In complement with *Theropithecus* and *Papio*, fossil specimens assigned to *Paranthropus* and *Homo* were also included. Using stable carbon isotopes, extant baboons from eastern Africa (N=22) show a slightly wider niche breadth than extant gelada (n=12). Their values display a lesser overlap than the one between their extinct relatives. *Paranthropus* (n=18) and *Homo* (n=11) have greater overlap with extinct theropithecids (n=23, with higher  $\delta^{13}C$  values) than with extinct *Papio* (N=11). Using the software "trident" (which extracts the most discriminant microwear parameters), we built a PCA-ecospace based on extant species of monkeys with contrasting diets, including extant gelada (n=21) and baboons (n=27). Extinct data were secondarily inserted as supplementary observations. Based on PC1 (largely explained by texture directionality on shearing facets) and PC4 (mainly defined by roughness parameters on crushing facets), the DMT indexes of niche breadth display lower values for hominins than for cercopithecids. *Paranthropus* (n=10) and *Homo* (n=5) have greater ecological overlapping with extinct theropithecids (n=44) than with extinct *Papio* (n=42). Our study demonstrates that, with a spatially constrained sample, extant and extinct baboons appear as ecologically dissimilar from hominids. Instead, we highlight the ecological similarities of theropithecids with early hominids.



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## **Vegetation cover and structure of Kalodirr and Loperot Early Miocene sites, west Turkana, using phytolith data**

Evolutionary studies have sought to understand past vegetation cover and composition, their dynamic nature through time, and their influence on faunal communities. In eastern Africa, the Turkana Basin is critical for understanding these dynamics in evolutionary history. More recent work using stable isotopes, plant biomarkers, ecometrics and phytolith analyses of some early Miocene sites have produced evidence of abundant C4 grasses. This paper presents phytolith data analysed to reconstruct vegetation cover of the Kalodirr, Moruorot, and Loperot paleo-landscapes. Phytolith counts from 14 sediment samples from Loperot (n=10,395 counts) and 4 from Kalodirr and Moruorot (n=2,381 counts) indicate woody dicots are more common than grasses at Loperot (woody dicots: n=3942 (38%); grasses: n=2570 (25%)). Of the remaining phytoliths, 30% are non-diagnostic, 6% are indeterminate and 1% are sedges. Woody dicots also dominate at Kalodirr and Moruorot (woody dicots: n=1570 (66%); grasses: n=270 (12%)). Of the remaining phytoliths, 18% are non-diagnostic, 4% are indeterminate and 0.1% are sedges. These findings indicate that woody dicot dominated at these sites in the early Miocene with occasional grasses in the vicinity. This provides further insight into the habitat of hominoids found at both sites. The hominoids might have used forest resources such as fruits and leaves for their survival. However, detailed vegetation reconstruction can provide critical information for understanding how the environment influences primate adaptations. Finally, we also recovered pollen and diatoms from some samples and through ongoing work we anticipate additional paleoecological information from these proxies.

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## **Quaternary alluvial paleosols of the Atbara River, eastern Sudan: description and paleoenvironments**

Quaternary climatic changes in the Nile Basin and their impacts on the evolution of African mammals and vegetation are poorly understood, particularly for the last 1 Ma. Pleistocene (~230 to <17 ka) alluvial sediments exposed along the middle stretches of the Atbara River in eastern Sudan contain paleosols and are rich in stone tools and fossil vertebrates, including hominins, making them ideal for paleoenvironmental reconstruction during this time interval. We performed petrographic, mineralogical, geochemical, and isotopic analyses on middle Atbara paleosols to reconstruct the paleoclimate and paleolandscape. We describe Aridisols/Calcisols characterized by a calcrete profile which consists of nodular and laminar horizons containing calcite, gypsum, and halite, and Vertisols with a relatively large amount of smectite and vertic features such as pedogenic slickensides. The paleosols indicate that the study area transitioned from an arid to a semi-arid climate during Marine Isotope Stage (MIS) 7/6, changed to a more humid climate during MIS 5 to MIS 3, and then returned to drier conditions during MIS 2. The studied paleosols likely supported a range of grassland and wooded grassland savanna habitats with estimated precipitation greater than 350 mm-1, nearly similar to the present-day. Our study confirms that the Atbara River Valley provided favorable living conditions for Pleistocene large mammal communities, including *Homo*, potentially facilitating dispersals out of Africa through the Nile corridor.

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### **Review of the Selachian fauna of the As-Sahabi area, NE Libya**

The study of D'Erasmus (1951), on the collected ichthyofauna from the As-Sahabi site by the pioneer Italian scientists has been revisited in this review study. The inspected data of the concerned Petrocchi's localities were traced and matched with the corresponding localities used in the East Libya Neogene Research Project (ELNRP) of the As-Sahabi area. Ten Selachian species in D'Erasmus's study have been recognized and assigned to seven main families (Odontaspidae; Carachariidae; Otodontidae; Lamnidae; Sphyrnidae; Myliobatidae, and Rhinopteridae) as we updated the systematics done by him. The first Petrocchi's locality "No. 12", which is adjacent to locality P8, where the middle part of Qarat Makada Formation "a synonym for Sahabi Formation, Member U2" has been excavated and the following taxa are identified, *Spyrna prisca* of family Sphyrnidae and *Aetobatus arcuatus* of family Myliobatidae. Meanwhile, the second Petrocchi's locality "the gare of Dor el Fuacher" which is corresponding to locality P12, and also corresponds to locality 9 by Stefanini (1935); and localities (No.1, 2 and 3) by Petrocchi and Marchetti (1952, 1955). This study confirmed D'Erasmus's recognized species, however, the classification of the families has been updated as follows: *Odontaspis* (*Synodontaspis*) *acutissima*, and *Odontaspis* (*Synodontaspis*) *cuspidata* are assigned to the family Odontaspidae; *Isurus* (*Oxyrhina*) *nova* is assigned to the family Lamnidae; *Otodus* (*Megaselachus*) *megalodon* is assigned to the family Otodontidae; *Carcharhinus* (*Carcharias*) *egertoni* and *Carcharhinus* (*Carcharias*) *acanthodon* are assigned to the family Carachariidae; *Spyrna prisca* is assigned to the family Sphyrnidae; *Rhinoptera studei* is assigned to the family Rhinopteridae; *Myliobatis* sp. is assigned to the family Myliobatidae. Most of the recognized Selachian taxa are indicative of a shallow marine environment of characteristic muddy substrate and mostly adopted tropical or subtropical climatic conditions.

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### **The ecological context of modern human evolution in Central Rift Valley, Kenya, during the Late Quaternary**

Our ability to explore modern human origins in East Africa had been severely impeded by the small and incomplete record of well-dated archaeological sequences and associated high-resolution paleoenvironmental proxy evidence spanning the (Middle Stone Age) MSA to the beginning of the Later Stone Age (LSA) (~320–30 ka). While scholars working across Africa generally agree that changing environmental conditions represent one of the likely explanations for technological change and innovation, a diversity of opinions exists on how exactly such mechanisms operate. My dissertation research project seeks to improve our understanding of the ecological contexts of modern human evolution in the Central Rift Valley, Kenya. Specifically, it proposes to test hypotheses about whether and how changes in lithic technology, ranging patterns, and social connectivity articulate with environmental shifts during the Late Quaternary. To answer these questions, I excavated four MSA sites with long sequences between July and December 2021. Efforts are underway to develop a chronostratigraphic history of the region through chemical fingerprinting of the volcanic ashes and 40Ar/39Ar dating. Preliminary results from lithic analysis indicate that obsidian was used nearly exclusively for all flaked artifacts from the four sites. Hierarchical and nonhierarchical cores, awls/borers, denticulate, different kinds of scrapers, foliate points, triangular flakes, and retouch flakes have been identified from the four sites. One site further away from the obsidian raw materials source has the smallest artifacts and cortex ratios compared to the other three. Faceted platforms have been recorded on all the sites. Plant leaf waxes ( $\delta^{13}\text{C}_{\text{wax}}$ ), bulk organic matter ( $\delta^{13}\text{C}_{\text{COM}}$ ), and carbonate nodules will be used to develop a high-resolution paleoenvironmental reconstruction. On the other hand, obsidian sourcing studies will be carried

out using portable handheld X-ray fluorescence (pXRF). Funds are being sought through this application to take care of related costs.

Venanzio Munyaka<sup>1</sup>, Kennedy Oginga<sup>1</sup>, Susanne Cote<sup>2</sup>, Jason J. Head<sup>3</sup>, William Lukens<sup>4</sup>, James Lutz<sup>5</sup>, Rahab N. Kinyanjui<sup>6</sup>, Fredrick Kyalo Manthi<sup>6</sup>

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### **Reconstructing the climate and ecology of an early Miocene tropical forest on the flanks of the Tinderet Volcano, Nyanza Province, Western Kenya**

Tectonically driven physiographic evolution in early Miocene of eastern Africa significantly shaped landscapes, climates, and vegetation, resulting in habitat heterogeneity. Early hominoids inhabited these landscapes, and their evolutionary history was likely influenced by these heterogeneous environments. In western Kenya, around the extinct Tinderet Volcano (ca. 19-21Ma), fossil-rich exposures offer crucial insights into this history with evidence of early hominoids. Here we use analyses of sedimentology, paleosol paleoclimate proxies, fossil leaves, and forestry metrics, to reconstruct the paleoclimate and paleoecological reconstruction of the Koru-16 fossil site. Sedimentological and stratigraphic analyses at Koru-16 reveal a landscape marked disturbance created by periodic volcanic eruptions and stable intervals marked by moderately to poorly developed paleosols. Paleoclimate reconstructions based on paleosol geochemistry indicates warm and wet conditions. Over 1000 fossil leaves were collected from the Koru-16 site, representing 17 morphotypes across two stratigraphic intervals. Mean annual precipitation estimates based on leaf size of shape indicate >2000mm/yr. Leaf lifespan reconstructions reveal predominantly evergreen taxa with a distribution leaf lifespan, similar to modern equatorial African rainforests. Fossil tree stump casts suggest an open forest, similar to contemporary tropical forests supporting large-bodied primates. Importantly, fossil leaves, the tree stump casts, a medium-sized pythonid, and multiple specimens of large-bodied primates occur in the same stratigraphic layer demonstrating their cooccurrence in the Koru-16 ecosystem. The multi-proxy paleoclimate and paleoecological reconstructions for Koru-16 converge on a very wet and warm climate supporting a closed, tropical seasonal forest to rainforest biome. This environment likely provided an ideal habitat for early hominoids, emphasizing the role of forested habitats in their early Miocene evolution. Additional work is ongoing on refining the paleosol paleoclimate estimates with a more recent model and  $\delta^{13}\text{C}$  analysis of soil organic matter will help to further refine these reconstructions.

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### **Renewed research at the Early Miocene locality Chamtwara 34, Kenya**

The Tinderet volcanic complex includes many rich fossil sites (Koru, Legetet, Chamtwara, Songhor). Chamtwara Locality #34 is one of the most prolific of these sites. The locality lies on a laterally discontinuous horizon of calcified with intercalated red marls. Thousands of fossils were collected in the 1970s and early 1980s, but not since. Most fossils are highly fragmented (e.g., isolated teeth), but include abundant microfauna and primate remains, largely found through surface collection and limited excavation. As part of a larger field project at Tinderet, the Koru Paleontological Project team has re-initiated research at Chamtwara #34. Traditional surface prospecting for fossils is infeasible because the site is continuously wet, making fossil recovery challenging. We subdivided the site into four sub-sections to optimize prospecting efficiency and crawled transects collecting all fossils with identifiable surfaces. We used a portable GPS unit to record specimen provenience. Prospecting was repeated multiple times during the season as new fossils were exposed periodically by rain. We then 'dry' and wet screened the

most fossiliferous exposures. The dried sediment was hand-picked in camp, packed to the NMK for a second round of washing, and picked under a microscope. Work is underway to identify all specimens to part and taxonomic unit. Among the identified species include gastropods, birds, reptiles, amphibians, and mammals. Reptiles include agamid, chameleonid, amphisbaenid, and varanid lizards as well as pythonid and elapoid. Mammals include catarrhine primates, abundant thryonomyoid rodents, other small mammals (Macroscelidea, Anomaluridae, Euliptophyla), ruminants, suids, hyaenodonts, and carnivorans. We have recovered a lot of fossils, including a much better sampling of very small taxa. We document higher diversity, particularly for amphibians and reptiles. The detailed faunal lists and abundance data we collect will augment previous studies and provide a basis for comparison of the Chamtwara 34 locality with other Early Miocene sites.

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<sup>1</sup>National Museums of Kenya <sup>2</sup>University of Nairobi

### **Assessment of vegetation changes in Kilombe caldera, Baringo County, Kenya: inferences from micro-botanical remains and current vegetation**

Human interactions with landscape and climate changes played roles in shaping paleo-vegetation and impacting paleo-environments. This study explores effects of climate change and anthropogenic activities on paleo and current vegetation in Kilombe caldera, Baringo County, Kenya. Multiproxy analysis using plants micro-botanical remains (pollen, phytoliths, and charcoal) was adopted to reconstruct past vegetation. 42 sediments samples collected in a pit were processed using specific acids /alkali, paleo data obtained was analysed using Tilia program and Cluster analysis. Current vegetation was sampled from 9 transects using stratified random sampling method. Identification, tallying and recording of all plants species was done. Species abundance, frequencies, density, and structural composition into lifeforms was calculated to determine species variation in composition. Spatial distribution along environmental gradient was also determined. Paleo data results indicated existence of dry montane forest represented by *Juniperus* and *Podocarpus*, shrubs and herbaceous represented by *Amaranthaceae*, while aquatics by *Typha*. Current vegetation data showed gradual succession from primary to secondary vegetation. Some plant species documented in paleo data were not found in current vegetation, similarly, few plant species represented in current vegetation were not represented in paleo data e.g., *Diospyros abyssinica*. Consequently, some species were over-represented in current vegetation e.g., *Dodonaea viscosa*. Paleo-data analysis indicated prior to human settlements, was existence of relatively open woodland with abundant assemblages of grass phytoliths which indicated cool /warm temperate past environment. Human activities were reflected in paleodata by presence of cereals in phytoliths data, and pollen grains e.g., *Zea mays*. Main drivers of changes were past patterns of climate variability and human activities, like livestock keeping, fire and agriculture. This research demonstrated existence of long-term human-mediated changes and climate driven changes. A more detailed study is required to establish full impacts of anthropogenic activities on ecologically and economically important plant species that have disappeared from Kilombe caldera.

Sylvester Musembi Musyoka<sup>1</sup>, Job Kibii<sup>2</sup>

<sup>1</sup>National Museums of Kenya <sup>2</sup>Turkana Basin Institute

### **Consolidants and adhesives: a fossil preservation and conservation dilemma at the National Museums of Kenya**

Fossils are our direct link with past ecosystems. The nature of retrieval from the ground, preparation and curation can determine the nature, quality and quantity of information that may be generated from these fossils. As one of Africa's premier fossil repositories, the Palaeontology Section at the National Museums of Kenya houses fossils that provide unique insights of evolutionary histories of different taxa extending back to millions of years. This unique collection has been gathered through

varied means in over seven decades. The preservation status of fossil specimens in the field is often less than ideal necessitating the use of consolidants and adhesives to impart sufficient strength and facilitate their transportation, accessioning and curation. However, the short-term and long-term impacts of various consolidants and adhesives on the specimens at differing environmental and laboratory conditions and the implications for fossil preservation and conservation have not been adequately investigated. Experimental studies, conducted at the National Museums of Kenya, using thermoplastic resins-polyvinyl butyral (Butvar B-76 and B-98), acrylic resin-Acryloid B-72, epoxy resin-UHU and Hot Stuff revealed that depending on the environmental and/or laboratory conditions, some consolidants are reversible while others are not. In addition, consolidants and glues had varying short-term to long-term impacts on fossils compromising their scientific value as well as curatorial management practices. In some cases, surfaces of fossils were scarred, others developed multiple fractures while integrity in others was so much affected that they fell apart.

Martin Kiriinya Muthuri<sup>1</sup>, Alan Zdinak<sup>2</sup>, William J. Sanders<sup>3</sup>, Louise N. Leakey<sup>1</sup>

<sup>1</sup>Turkana Basin Institute <sup>2</sup>Natural History Museum of Los Angeles County <sup>3</sup>University of Michigan

### **Archival jackets and clam shells and their role in conserving African vertebrate fossil collections**

The use of archival jackets facilitates the handling, storage and exhibition of fossil specimens in museum collections. Large fossils are usually fragile, often heavy, and need support during all stages of excavation, preparation, or storage. Over the years, museum workers have developed support structures for the long-term storage of prepared fossils. Many of these involve variations on the use of gypsum cement, fiberglass cloth, polyethylene foam, and polyester felt. These materials are regarded as “archival” because they are long-lasting and will not damage specimens during extended contact. The clamshell storage jacket, developed at the Smithsonian's National Museum of Natural History, is an especially innovative approach that has been widely adopted by North American museums. By fully enclosing the specimen in a rigid, padded shell, the clamshell jacket protects the fossil from both environmental factors and mishandling, and makes it easy to flip the specimen over securely for study. While African museums have been battling issues of conservation, storage, and exhibition of vertebrate fossils, few institutions have embraced these techniques. The Turkana Basin Institute, Kenya, has taken initial steps to incorporate these methods in the conservation of their collections. The necessary materials can be sourced in Africa, though cost can be an issue. Training is also a challenge, as most of the experts in these techniques reside overseas. But by bringing these methodologies to the attention of East African collections managers and conservators and fostering discussion and strategic planning, these challenges can certainly be overcome in the foreseeable future.

Christina Wandia Mutinda<sup>1</sup>, Makarius Peter Itambu<sup>1</sup>, Pastory Makagaye Bushozi<sup>1</sup>, Rahab N. Kinyanjui<sup>2</sup>, Fredrick Kyalo Manthi<sup>2</sup>

<sup>1</sup>University of Dar es Salaam <sup>2</sup>National Museums of Kenya

### **Reconstructing early Pleistocene bovids' diet and by extension hominin environments using bovids' dental calculus: a case of the Nariokotome Member, Turkana Basin, Kenya**

Environments have for long been thought to have played a key role in shaping the evolution of early hominins. Paleoanthropologists have thus employed qualitative and quantitative approaches to determine the paleoenvironments in which early humans evolved. The Turkana Basin in northern Kenya is a prolific source of most hominin fossils in Kenya, and the Basin has provided a platform for a wide range of paleontological, archeological, and geological investigations aimed at reconstructing the evolution of hominin and non-hominin species and the environments in which they inhabited. The Pleistocene is a key epoch associated with the first appearance of the genus *Homo*. This study aims at reconstructing Pleistocene environments and contributing to understanding the role environments played

in influencing the evolution of the genus *Homo*. The environmental data is derived from dental calculus from fossil bovids' teeth from Todenyang in the Turkana Basin, dating ~1.3 - 0.7 Mya., and is aimed at unraveling the dietary patterns of the bovids with a view to inferring hominins environments. We present 11,340 phytolith morphotypes identified and counted from 21 grazers, 1 mixed, feeder and 2 browsers. The results show that the Todenyang bovids were not specialists but rather generalists. This suggests that the bovids exploited heterogeneous habitats, which the Pleistocene hominins most likely interacted with. It is therefore plausible to assume that the hominins needed to adapt versatile strategies to the different resources in the mosaic habitats.

Giuseppina Mutri<sup>1</sup>, Hareguin Belete<sup>2</sup>, Giancarlo Ruta<sup>3</sup>

<sup>1</sup>University of Firenze <sup>2</sup>ICArEHB/University of Algarve <sup>3</sup>Italo-Spanish Archaeological Mission at Melka Kunture and Balchit

### **Microliths production, use, and discard at the Middle Holocene site of Beefa Cave**

Beefa Cave is part of the archaeological site of Melka Kunture, with a well-known documentation of the lower and middle Pleistocene. It opens on the right bank of the Awash River, at 2000 m s.l. on the Ethiopian plateau. The cave opens on an ignimbrite layer about 3 meters thick from the surface of the deposit to the entrance of the cave. The entrance is about 7 meters wide, with converging walls and the length is about 12 meters. The cave is located on a steep slope, covered by dense vegetation. So far, 5 levels of occupation have been exposed, revealing a sequence of overlapping combustion features dating back to the Mid-Holocene. The archaeological records show a significant number of lithic artifacts, all of them made of obsidian, with a strong microlithic characterization. In levels 1 to 3, the most common retouched tool is the lunate, for which it was possible to describe all the production stages. Moreover, the presence of a few clear impact fractures is evidence of the use and discard of the artefact and cutting marks on faunal remains may be related to hunting practices. This paper aims to establish a correlation between these elements in order to achieve an exhaustive interpretation of the available data.

Innocent Raymond Mvamba<sup>1</sup>

<sup>1</sup>Tanzania Petroleum Development Corporation (TPDC)

### **Palynology and paleoenvironmental interpretation of the Eyasi-Wembere rift basins: implications for palynofacies analysis and hydrocarbon potential**

This study presents first palynological records of the core samples from three stratigraphic boreholes from the Eyasi-Wembere Basin. The palynological analysis was carried out in order to estimate age, comment on the depositional environment, thermal maturation of the palynomorphs, and hydrocarbon potential of the Basin. Forty-three (43) core samples from the three stratigraphic boreholes (Kining'inila-1, Nyalanja-1 and Luono-1) have been analyzed for Palynological content. The sample yielded fair to well preserved terrestrial palynomorphs while other samples were barren. The reported palynological assembly is dominated by mainly pollen grains, fungal spores, fungal hyphae, phytoclasts materials and very few trilete spores. Pollen analysis results establish informal palynological intervals in the studied stratigraphic boreholes with an age not older than Miocene. Fungal spores were highly abundant and diverse in Kining'inila-1 stratigraphic borehole and rare in both Nyalanja-1 and Luono-1. Palynomorphs recovered from the three stratigraphic boreholes are not evenly distributed. The Palynomorphs in biozones in Nyalanja-1 and Luono-1 boreholes evidence Pliocene to Holocene age while in the Kining'inila-1 borehole was difficult to assign the precise age due to the wide range of species observed and barren sample to some depth. Based on the miospores, a detailed palynostratigraphic correlation was established, showing almost non-continuous deposition with minor stratigraphical gaps observed in the Kining'inila-1 borehole. Palynofacies and lithological analysis show a good correlation in Nyalanja-1 and Luono-1 boreholes compared to Kining'inila-1 borehole. Palynofacies in Nyalanja-1 and Luono-1 suggests the depositional environment to be low-energy dysoxic-anoxic terrestrial deposits

with a good preservation potential while Kining'inila-1–borehole show the high energy deposition environment. The hydrocarbon potential assessment was conducted and evident that the high abundance of Amorphous Organic Matter (AOM) is an indicative of Kerogen type I/II capable of producing oil.

Victoria Godfrey Mwakasege<sup>1</sup>

<sup>1</sup>*Tanzania Petroleum Development Corporation (TPDC)*

### **Laboratory services**

Tanzania Petroleum Development Corporation (TPDC) Laboratory was established in 1988 through Norwegian Agency for Development Cooperation (NORAD) funds. It is operated in accordance with good oilfield industry practices. The Laboratory provides services to the Corporation and other clients while constantly adapting to new technologies for delivery of quality services. Currently, the Laboratory is in the certification process for International Standard Organization (ISO). Since its establishment, the Laboratory has offered various analytical services to different International Oil Companies, neighboring Countries and Research Institutions in collaboration with various local and International Universities. TPDC Laboratory offers a range of analytical services from an outcrop scale, single well, data analyses and interpretations. Currently, the Laboratory comprises four sections namely Geochemistry, Micropaleontology, Palynology and Petrology. The services provided include Total Organic Carbon (TOC) analysis & Pyrolysis, relative age determination, paleoenvironmental settings, thermal maturity, and petrographic analysis. TPDC invites all stakeholders in the industry, research institutions, various entities, and individuals to use our Laboratory facilities and services.

Ahazi John Mwambuchi<sup>1</sup>

<sup>1</sup>*University of Dar es Salaam*

### **The role of women in the construction of the ancient societies in Njombe southern highland of Tanzania**

Women played a big role in the construction of the ancient societies through performing different activities like hunting, gathering, basketry, and weaving. On the other hand, they are doing very fruitful tasks in the reconstruction of the past through collection of data in archaeological research either directly or indirectly. Most researchers and scholars turned their concentration to highlight the domination of men in the past construction, but they forget the role of women in ancient development of their societies because until today the role of women has not yet been sufficiently academic studied. The ancient women in Njombe societies engaged in contributing the development of their societies through making potteries, weaving, iron making, hunting, gathering, and family development through doing reproduction activities. The different types of evidence discovered in Njombe societies through methodologies like survey, archival sources, and interviews will prove the role of women to the construction and reconstruction of ancient societies in Njombe southern highland of Tanzania.

Thierra K. Nalley<sup>1</sup>, Lucas K. Delezene<sup>2</sup>, Joseph Museba<sup>3</sup>, Marie Vergamini<sup>4</sup>, Amelia Villaseñor<sup>2</sup>, Amy L. Rector<sup>4</sup>

<sup>1</sup>*Western University of Health Sciences* <sup>2</sup>*University of Arkansas* <sup>3</sup>*Zambian National Heritage Conservation Commission* <sup>4</sup>*Virginia Commonwealth University*

### **Taphonomy of a seasonal riverine habitat: the first year of the Zambia Rift Valley Research Project**

The Luangwa River in Zambia is one of the last major undammed rivers in Africa. For more than 700 km, it flows unimpeded through a northeast–southwest oriented valley that is a southern extension of the Eastern African Rift System. Major central African river valleys would have provided biogeographical connections for ancient hominins and other mammalian groups, offering dispersal corridors into and

across regions with variable environments. The Luangwa Valley is thus an important potential analogue for understanding ecosystems associated with human evolution. Here, we report the results of taphonomic investigations of the Luangwa mammalian community in South Luangwa National Park by the Zambia Rift Valley Research Project (ZRVRP). Following the skeletal survey methods of Behrensmeyer, in 2023 the ZRVRP initiated the first systematic taphonomy/bone walk survey sampling a seasonal riverine habitat in Africa. We also initiated an isotopic investigation of modern and ancient mammals living in South Luangwa. During our initial season, we surveyed floodplain, woodland, and grassland habitats and collected both fossil and modern materials. Preliminary results suggest that across habitats, skeletal elements were most often preserved from large taxa (size III or IV). In habitats with less tree cover, skeletal elements from size II animals were recovered, perhaps reflecting selective predation by smaller-bodied predators. Across size classes and habitats, we most often recovered dense elements that are likely to be preserved, such as vertebral bodies, horncores, pelves, carpals, and tarsals. These data suggest that taphonomic analyses of South Luangwa communities will contribute to hypotheses about how hominins and other mammals used different habitats within a seasonal riverine environment through time.

Emmanuel Ndiema<sup>1</sup>, Rahab Kinyanjui<sup>1</sup>

<sup>1</sup>*National Museums of Kenya*

### **Navigating climate change: pastoralism, foraging, and cultural evolution in the southeastern Lake Turkana basin**

This research explores the intersection of pastoralism and foraging in the southeastern Lake Turkana basin, Kenya, a region where nearly half of the households depend on herding. The study investigates the adaptive strategies employed by early herders and foragers during significant environmental transformations about 5000 years ago, a period marked by climatic shifts and the introduction of domesticated animals like cattle, sheep, and goats. The project builds on previous research, extending the archaeological inquiry to the southeastern shores of Lake Turkana. Through a combination of survey, excavation, and comprehensive analysis of archaeological artifacts, this study aims to provide insights into the socio-economic and cultural dynamics of early pastoral communities and their interaction with indigenous fisher-foragers. This understanding is critical for contextualizing the long-term resilience of pastoralist strategies in the face of environmental changes and offers valuable lessons for addressing contemporary challenges posed by climate change. This research is pivotal in filling the existing knowledge gaps in the Holocene record of the Turkana basin. It contributes significantly to understanding the early socio-cultural developments in the region, including the origins of pastoralism, settlement strategies, and the impact of climatic shifts on subsistence practices.

Tewabe Negash<sup>1</sup>, Michael Pante<sup>1</sup>, Edward W. Herrmann<sup>2</sup>, Connie D. Fellmann<sup>1</sup>, Alex Pelissero<sup>1</sup>

<sup>1</sup>*Colorado State University* <sup>2</sup>*Indiana University*

### **A quantitative analysis of the micromorphology of marks on bone retouchers used to sharpen lithics**

Bone retouchers, commonly found in the middle and upper Paleolithic of Europe, are claimed to be a toolkit for post-Acheulean hominins. Nevertheless, uncertainties persist regarding when and where this technology flourished, leading to debates on whether it was deliberately selected for resharpener and shaping stone tools or opportunistically utilized. While traditionally associated with middle to upper Paleolithic behavior, some suggest a connection with early Pleistocene hominins implicating the origins of the technology as having great antiquity. Even though bone tool technology is known from the Early Stone Age of Africa, evidence for bone retouchers has not been reported. This may be in part due to similarity between the morphology of marks found on bone retouchers and those produced by other



processes including carnivore chewing and hominin butchery. Identifying the origin of this technology is important because it signifies a significant behavioral change in hominin evolution, but the qualitative approaches currently in use limit our ability to do so. Here, we report the results of an actualistic experiment where partially weathered equid bones were used to sharpen raw materials from Olduvai Gorge, Tanzania. The resulting damage to the bones was molded and subsequently scanned with an S-Neox non-contact profiler to create high-resolution 3-D models of individual marks, which were measured and compared with actualistic samples of carnivore tooth marks and human butchery marks. Results show that quantitative methods can effectively distinguish between the compared mark types.

Christine F. Ngereza<sup>1</sup>

<sup>1</sup>*National Museum of Tanzania*

### **Elephants are awesome teaching tools**

Elephants are more than the largest existing land mammal on the planet as well as one of our planet's greatest ecosystem engineers. Elephant evolution is one of the most interesting stories in the history of Earth. They evolved over a period of millions of years. It took 60 million years for elephants to evolve their long tusks and trunks. The earliest ancestors of elephants looked nothing like elephants. As time went by, the bodies of the animals became larger, the trunks of the animals became longer, and the teeth of the animals turned into tusks. The world is changing, and new researchers suggest while the evolution of animals is often thought of as something that takes millions of years, it can also happen much faster as seen in African elephants *Loxodonta Africana*. Whether they be catastrophic or gradual, elephants provide us with context and perspective when attempting to understand the possible ecological consequences of human-made and natural changes that our world is facing today. Through evolution of elephants, it possible to educate the public about, science, history, art, civics as well as the necessity of conservation. National Museum of Tanzania is constructing a new exhibition, "Save the Elephants" in one of its museums. Elephant conservation is a national priority in Tanzania and this exhibition is part of the national efforts to raise public awareness on why it is important to conserve African elephants. In this talk, I will give highlights of the exhibition on the section of elephant evolution.

Happiness Nyambo<sup>1</sup>

<sup>1</sup>*Ministry of Natural Resources and Tourism*

### **Bridging a gap between researchers and policy makers**

Research-based policy has become rhetoric for many East African governments across a broad range of palaeanthropological sciences. However, the application of academic research in policy making has frequently been problematic. Academics have frequently claimed that policy makers ignore their research, while policy makers claim that academic researchers only partially involve them in research activities, because most research remains expert driven. Research collaborations and relationships can be viewed as important strategies for introducing research into policy contexts. In fact, they help researchers understand policy issues as well as design and implement policy initiatives. This paper discusses the challenges that both researchers and policymakers face, as well as what can be done to bridge the gap between the two. It explores the relevant research practices and the relationships between researchers and policy makers. It outlines obstacles and suggest solutions. It concludes that researchers and policymakers should collaborate to address factors that impede linkages between researchers and policymakers, and to develop more realistic initiatives to address the research/policy gap.

Susan Akinyi Ongoro<sup>1</sup>

<sup>1</sup>*University of Dar es Salaam*

## **Geo-positioning early hominin sites to explore technological trends in Area 1A in Ileret, northern Kenya**

The investigation of early hominin behavior and adaptations remains a fundamental aspect within the field of archaeology, edifying our knowledge about the capabilities and interactions of our ancient ancestors within their environments. *Homo erectus*, one of the early hominin groups, demonstrated significant advancements in the production of tools, patterns of migration, and adaptation to the environment. Ileret is one of the largest excavated regions in northern Kenya providing convincing evidences of the existence of this species in the area. Nevertheless, despite the abundance of remains such as handbones, footprints, and evidence of food acquisition in Area 1A, the absence of stone artifacts raises intriguing questions about technological omissions. This study employs a comprehensive approach to spatial modeling in order to delve into this paradox. By utilizing digital modeling techniques, the objective of this study was to map the geographic positions of the archaeological and faunal sites in Area 1A, which in turn analyzed the spatial relationships between these sites to enhance our understanding of trends in resource distribution and technological strategies. The integration of historical aerial photographs assisted in identifying areas that were frequented by early populations. Through the use of Geographical Information Systems (GIS) methods, a detailed distribution map was created to unveil correlations between geographical parameters and the site occurrences. The findings of this study reveal that landscape dynamics play a major significant role in shaping distinct clusters of site occurrence, thus challenging conventional expectations regarding tool use in such settings. Map illustrations exemplify how specific characteristics of the landscape influenced the manufacturing, use, and preservation of tools. This identification provides an additional understanding of the interaction between environmental conditions and the technological choices made by *Homo erectus* populations. Future research should place emphasis on macro-scale analysis to comprehend the behavioral and technological strategies of ancient populations.

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<sup>1</sup>*Ministry of Tourism and Heritage*

## **Conservation of slave trade memories in Zanzibar with their significance in the tourism industry**

Zanzibar has diverse cultural heritage assets such as ancient monuments, historic buildings, and archaeological sites, and has also a lot of intangible cultural heritage. This heritage is found in Pemba and Unguja, among them are slave trade memories as part of cultural heritage. Conservation activities of this heritage begun in early 20th century after the establishment of government entity that was assigned to conserve and manage the heritage of the country. Since 1920s, the main purpose of doing conservation of these heritage was to pass to the next generation so as to make the history alive. For more than century Zanzibar economy was depending on cloves economy to gain its economic prosperity before it collapsed in 1990s. The collapse of this economy influenced the country to think about tourism, whereby the main tourist's attractions were beaches, spice farms, marine resources, and Jozani National Parks. Having these thoughts, the government introduced the Ministry of Tourism and Heritage which was then directed to merge those conserved slaved trade memories and other conserved cultural heritage into the tourism industry. This paper seeks to explore these government efforts and strategies on conservation of the slave trade memories and their implications in the tourism industry. Methodologies for this study will be archival sources, interviews, government, and private sectors reports, together with desktop survey. Nevertheless, the study will help to shed lights significance and challenges of incorporating the slave trade memories in tourism industry in Zanzibar.

Abigail K. Parker<sup>1</sup>, Jason J. Head<sup>2</sup>

<sup>1</sup>*University of Helsinki* <sup>2</sup>*University of Cambridge*

## **Body size histories of reptiles from the Plio-Pleistocene Shungura Formation of Ethiopia: biotic and abiotic habitat correlates**

To investigate reptile body size as a paleo-ecological indicator and the relationships between size and environmental variables through time, we compare patterns of maximum size in non-avian taxa from the Plio-Pleistocene Shungura Formation of Ethiopia. We estimated body mass for aquatic pelomedusid and trionychid turtles, terrestrial tortoises (Testudinidae), and crocodylians including *Crocodylus*, *Mecistops*, and the longirostrine genus *Euthecodon*, as well as investigating size records for the more sparsely sampled squamate record, including *Varanus* and *Python*. Body size maxima in aquatic taxa correspond to lake level: crocodylian body size increased concurrent with rising lake levels around 2.3 and 1.5 Ma, and trionychid size maxima also occur in large lake environments. Terrestrial tortoises from the Shungura Formation include specimens with reconstructed carapace lengths in excess of 1m; however, their maximum body sizes were smaller between 2.3-2.0 Ma, during a period of increased wooded vegetation cover. This size decrease is consistent with the association of the largest body sizes in modern tortoises with open habitats. Squamates show a general trend of increasing body size through time, but without correspondence to a particular environmental proxy. We tested for correlation between reptile maximum sizes, mammal maximum sizes and faunal metrics, and  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  records across members of the Shungura Formation. After correction for multiple comparisons, no significant correlation was observed between reptile size and paleoenvironment or mammal metrics. However, high correlation coefficients between size maxima in semi-aquatic taxa and paleosol  $\delta^{18}\text{O}$  values suggest temporal coincidence between size change and shifts in hydrological regimes and intensity of evaporation in the environment. These results identify links between maximum size in reptiles and local habitat availability that, if confirmed by histories of body sizes and habitat change in other settings, could be utilized as paleoenvironmental proxies for aquatic and terrestrial habitats in future studies.

Alex Pelissero<sup>1</sup>, Edward Herrmann<sup>2</sup>, Jackson K. Njau<sup>2</sup>, Tewabe Negash<sup>1</sup>, Danielle Peltier<sup>2</sup>, Michael Pante<sup>1</sup>

<sup>1</sup>Colorado State University <sup>2</sup>Indiana University

## **Using drone survey to map hominin activity patterns at Olduvai Gorge**

Almost 100 years since it was first excavated, Olduvai Gorge, Tanzania has continued to provide a wealth of paleontological, archaeological, and geological information crucial to understanding the evolution of our lineage. The geographically and temporally extensive deposits sample almost two million years of human evolution, allowing for large-scale questions to be investigated regarding hominin behavioral ecology, land-use, and response to environmental changes. New research methods have been able to expand our current knowledge and allow for new approaches to existing datasets. Our team recently conducted an extensive unmanned aerial vehicle (“drone”) photogrammetry survey of Olduvai. The goal of this survey is the creation of high-resolution imagery of the site to be used for mapping the geology and analyzing the distribution of hominin activities in the area through time. We present preliminary results demonstrating how drone-based imagery and geographic information systems (GIS) can be used to analyze and compare the availability of fossiliferous exposures, excavation locations, and the pattern of hominin activities.

Marta Pina<sup>1</sup>, Masato Nakatsukasa<sup>2</sup>

<sup>1</sup>London South Bank University <sup>2</sup>Kyoto University

## **The elbow of *Nacholapithecus kerioi*: a new quantitative approach to the proximal end of the ulna**

*Nacholapithecus kerioi* (family Afropithecidae, subfamily Equatorinae) is an early Middle Miocene extinct hominoid found in the Aka Aitheputh Formation (Samburu County, Kenya). Although the elbow has been extensively described qualitatively, quantitative analysis of the proximal ulna has not

been done up to date. Here, we analysed the proximal ulnar morphology of *Nacholapithecus* and compared it with a sample of extant and extinct anthropoids through PCA analysis and agglomerative hierarchical cluster analysis (UPGMA algorithm). We also calculated the Cophenetic Correlation Coefficient, the phylogenetic signal in the variables used, and checked for group differences through MANOVA and pairwise post-hoc comparisons. The ulna of *Nacholapithecus* shows a moderately long and relatively narrow olecranon, a relatively wide trochlear surface-radial notch width, and a relatively thin sigmoid notch depth. Overall, these features resemble those of large papionins and chimpanzees, and some extinct taxa, mainly *Equatorius*. Our results are in accordance with previous inferences about *Nacholapithecus* elbow's functional morphology, which is related to general quadrupedal behaviours. Other derived (extant hominoid-like) traits (e.g., a relatively wide trochlear surface) are probably associated with the ape-like features found at its distal humerus (e.g., wide trochlear groove). As a common trend in many Miocene hominoids, the ulna of *Nacholapithecus* shows a combination of primitive and derived features. Furthermore, *Nacholapithecus* ulnar morphology shows affinities with large papionins, which are associated with the enhancement of the muscle triceps brachii leverage and the loading transmission through the elbow joint, suggesting the presence of some (semi)terrestrial habits. Nonetheless, there is no such evidence in the rest of the skeletal elements recovered so far, refraining us to conclusively suggest terrestrial affinities in this taxon.

Amy L. Rector<sup>1</sup>, Irene E. Smail<sup>2</sup>, Christopher J. Campisano<sup>3</sup>, Alan L. Deino<sup>4</sup>, Erin N. DiMaggio<sup>5</sup>, David A. Feary<sup>3</sup>, Dominique Garello<sup>3</sup>, Thierra Nalley<sup>7</sup>, Joshua R. Robinson<sup>8</sup>, J. Ramon Arrowsmith<sup>3</sup>, Kaye E. Reed<sup>3</sup>

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<sup>4</sup>Berkeley Geochronology Center <sup>5</sup>Pennsylvania State University <sup>6</sup>Louisiana State University <sup>7</sup>Western University of Health Sciences <sup>8</sup>Boston University

### **Paleoecology and faunal diversity between ~3 and 2.5 Ma in the Ledi-Geraru Research Project area, Afar Regional State, Ethiopia**

The period in hominin evolution between ~3 and 2.5 Ma in eastern Africa is critically underrepresented in the fossil record. The Ledi-Geraru Research Project (LGRP) area in the Afar region, Ethiopia, preserves these fossiliferous exposures in the Lee Adoyta and Asboli regions. There are four major fault-bounded blocks comprising several sedimentary packages spanning this interval, dated by a) the  $2.782 \pm 0.006$  Ma Gurumaha Tuff; b) the  $2.631 \pm 0.011$  Ma Lee Adoyta Tuffs; and c) the  $2.593 \pm 0.006$  Ma Golden Sands Tuff. A rich fossil sample is distributed both temporally and spatially within these sedimentary packages, providing a rare opportunity to study faunal turnover and paleoecological diversity during this important time frame. We build on previous results with new assemblages to explore spatial, temporal, and ecological trends associated with LGRP hominin diversity using several lines of data and mammalian community analysis. Results suggest that habitat diversity, seasonality, and heterogeneity on localized scales were important aspects of the landscape ecology during this time interval. While a broad pattern of more open and wet habitats characterizes some of the fossil deposits, it is clear from enamel isotopes that mammals that were browsing before this time interval are grazing at 2.78 Myr. Despite the hypotheses of increased African continental aridity after 3 Ma which is somewhat evident here, smaller scale spatial analyses suggest that some closed and intermediate habitats also existed in key areas on the LGRP landscape through time and across space. These results have implications for the adaptive context of the earliest *Homo* and hominin diversity during the 3-2.5 Ma interval.

Weldeyared H. Reda<sup>1</sup>, Phillip Gunz<sup>2</sup>, Zeresenay Alemseged<sup>1</sup>

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### **Facial development and variation in *Australopithecus afarensis*: new evidence and reevaluation fifty years after Lucy**

After the discovery of Lucy and the naming of *Australopithecus afarensis* in the 1970s, the Pliocene hominin fossils discovered at Hadar, Ethiopia, and Laetoli, Tanzania were assigned to a single but highly variable and sexually dimorphic species. As more fossils are discovered, morphological evidence shows that *A. afarensis* (ca. 3.7-3.0 Ma) evolved from *A. anamensis* (4.2-3.8 Ma), anagenetically, and *A. afarensis* is potentially ancestral to both the robust australopith and *Homo* clades owing to its generalized craniodental morphology and temporal placement. Yet, the extent and patterns of variation in this long-lived species remain highly debated. Fortunately, new fossils coupled with the employment of virtual reconstruction and new analytical techniques allow us to explore intraspecific variations in-depth. Here, we reexamined the intraspecific variability of the diagnostic facial traits of *A. afarensis* and their distribution across ontogeny. Using linear measurements, we quantified the extent of variation in facial forms, and using 3D geometric morphometrics, we explored shape variation and the role of allometric scaling within the context of great apes. We found that some of the taxonomically diagnostic facial traits are intraspecifically variable, and most of the diagnostic features are established at the juvenile stage, but with the presence of intraspecific variability mirroring the pattern noted in adults. Furthermore, the coefficient of variation we noted in *A. afarensis* is comparable to that seen in gorillas but exceeds that of chimpanzees—all subspecies included. Shape variation within the *A. afarensis* is mainly explainable by allometric scaling, but there are some non-allometric shape differences, both within the adults and juveniles. This multipronged approach will offer new insight into the taxonomic significance of facial features and intends to disentangle how the observed patterns of variation relate to temporal depth, ontogeny, and sexual dimorphism.

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### **New Early Pleistocene zooarchaeological data from the Shungura Formation (ca. 3.7 Ma to 1.1 Ma), Lower Omo Valley, Ethiopia**

The Shungura Formation deposits provide one of the richest faunal assemblages for the African Plio-Pleistocene, including hominid remains. In addition to the famous Oldowan occurrences dated to ~2.3 Ma, the Shungura continues to produce new late Early Pleistocene lithic artifacts. Although the fossil fauna assemblages have been subjected to extensive paleontological studies, no zooarchaeological work have been conducted until now. In addition, previous taphonomic reports are limited to the general depositional context of assemblages, without evaluating bone surface modifications (BSM). Thus, the trophic relationships among species, and notably the role of hominids within the ecosystem (their interactions with the rest of the fauna) are not fully understood. This study attempted to address these crucial zooarchaeological questions. To achieve that, we focused on recording BSMs throughout the Shungura Formation with special emphasis on members bearing lithic production. The main objective was to identify the taphonomic agents responsible for BSMs and characterize the anthropogenic signatures at Shungura. Results show that crocodylians and carnivorans were active agents in all members of the formation, the former being particularly abundant in members C and G. Hominid butchery activities are present in members F, G, and L. In addition, possible bone tools dated to ~2.3 Ma are documented, although to be confirmed through further excavations. At Member L, BSMs show various activities of carcass processing from medium to large size mammals, as well as fish and turtles, indicating exploitation of aquatic resources at ~1.2 Ma.

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### **New hominin dental remains from Olduvai Gorge (Tanzania)**

In 2019 and 2022, collaborators of the Tanzania Human Origins Research (THOR) project made significant discoveries at Olduvai Gorge (Tanzania), recovering two hominin lower molar teeth. The first tooth represents a new individual labelled as OH90, found at the bottom of a hill east of the BK (Bell's Korongo) main outcrop, where Upper Bed II, Bed III and the Ndutu Beds crop out. The second is designated as OH30X since it represents the antimer of the lower left first molar of OH30. It was recovered from Maiko Gully at the FLK (Frida Leakey Korongo) site. The stratigraphic position of OH30X aligns with previous interpretations suggesting an age of about 1.8–1.7 Ma (Lower Bed II). Both teeth underwent digitization using synchrotron microtomography. The investigation involved analyses of both external and internal morphology using linear dimensions, relative cusp areas, enamel thickness, and geometric morphometrics of the enamel-dentine junction (EDJ). This approach aimed at determining the teeth's placement in the dental arch and their taxonomic identification. Both specimens are identified as lower right molars, with OH30X representing a first molar and OH90 identified as either a second or third molar. The morphological differences between the two teeth are evident in both the outer enamel surface and the EDJ. OH90 exhibits a complex occlusal surface characterized by a bulged crown and inwardly protruding cusp tips, while OH30X displays a simpler occlusal surface with straight crown walls and upward-pointing cusp tips. Despite these differences, quantitative analyses consistently point toward an attribution of both specimens to the genus *Paranthropus*. The differences in the morphology of the two specimens possibly stem from metamer variation. This discovery effectively almost doubles the sample of *Paranthropus* lower molars from Olduvai Gorge. The specimen OH 30X adds to the other isolated teeth belonging to this subadult individual.

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### **The late Middle Stone Age at Gona, Afar, Ethiopia: the Awash River as an Out-of-Africa corridor**

While it appears likely that *Homo sapiens* spread across and beyond Africa at various times between 300-100,000 years ago (300-100 ka), the most consequential expansion and dispersal event(s) occurred 70-50 ka, leading eventually to the peopling of the entire globe. However, we know very little about the group or groups of *Homo sapiens* on the cusp of this expansion living in northeast Africa, since well-dated fossil and archaeological sites are scarce. Here we present archaeological material found at the Ya'alu South 1 site (YAS1) in the Gona study area, Afar, Ethiopia, dated to MIS 5, that reveals a late Middle Stone Age technology. The stone tool assemblage, comprised mostly of obsidian obtained from at least one source 23 km away, demonstrates flexible, prepared core technologies that emphasized the creation of points of multiple target sizes, the smallest of which were likely tip armatures for complex projectiles. Blades were also a significant component of tool production, some of which were retouched into tools such as burins, notches, denticulates and perforators. Well-preserved fossil fauna with extensive anthropogenic bone modifications from a variety of prey species suggests that YAS1 modern humans were adept hunter-foragers, drawing from a varied ecosystem adjacent to a perennial river. Overall, the material culture at YAS1 is similar to that seen at other nearby Middle Stone Age sites such as Aduma and Porc Epic, reflecting regional shared traditions, but with an unusually high diversity of techno-cultural markers, some of which are found at contemporaneous and younger sites in Arabia and the Nile Valley, and even further afield. The people who lived at YAS1 were likely closely related—biologically and

culturally—to those who initiated the seminal Out-of-Africa *Homo sapiens* dispersal(s), migrating through riparian corridors along various routes around and across the Red Sea.

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### **Meet the Chibanians**

What would it take to move the field of palaeoanthropology from the proverbial “Muddle in the Middle” towards a more optimistic “Solving of a Chibanian Puzzle”? During a recent (May 2023) workshop in Novi Sad, Serbia the group of invited participants who are active in the research on the Chibanian (Middle Pleistocene) hominins endeavoured to come up with a roadmap that will: 1) help coherently talk among each other to understand the complexity of human evolution in the Chibanian; 2) help communicate this complex picture in a way that will dispel some myths and be better understood by non-specialists and the general public. We sought to identify concepts and perceptions that underlie the intensive current debate, viewing that as the key to future efforts to resolve related questions. Much discussion cantered particularly around two long-standing Chibanian hominin species: *Homo heidelbergensis* and *H. rhodesiensis*. With respect to the former species, questions were raised about the varying ways the taxon name has been used (i.e., to encompass either a very restricted group – only the holotype – or a very wide group of fossils). With respect to the latter, the meeting’s participants discussed the ethics of continuing to use taxonomic names that were created as honorifics for individuals who, given their racist and/or genocidal actions, are identified as a blight on the history and dignity of humanity. Here we present the most salient moments of the workshop and the conclusions – as we see them – as organizers of the whole endeavour. We present the way forward identified at the AABA meeting in Los Angeles by a group of panelists related to the second, ethically problematic Chibanian hominin species.

Nancy Rushohora<sup>1</sup>

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### **Imagining the future of teaching and learning about human evolution**

Tanzania is acknowledged as the cradle of mankind due to the discoveries of hominid remains dating more than 3 million years ago. The knowledge of human evolution with evidence from Tanzania has contributed to the scientific investigation and theories of human evolution. In Tanzania however, human evolution is still treated as an elite discipline not known to the public and not well taught in schools where the topic has flourished since independence. This paper highlights the areas of misconceptions in human evolution that have stood the taste of time in pedagogy as an attempt to involve the academic community to translate the scientific knowledge to reach the public and schools that can benefit from the knowledge. It is also about the trends of teaching and learning about human evolution at the tertiary level where the discipline is prominent and questioning the future of the discipline in Tanzania archaeologies.

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<sup>1</sup>University of Dodoma

### **Subsistence strategies and exchange contacts during the early to late Iron Age in central Tanzania: field report**

In October-November 2023, we conducted a reconnaissance archaeological survey within five districts of the Dodoma region, namely Dodoma Urban, Chamwino, Kongwa, Chemba, and Kondoa. The aim was to explore subsistence strategies and exchange networks between Iron Age communities not only in Dodoma but also with communities outside the region. Research strategies adopted include

unsystematic pedestrian surveys and test excavations at some selected sites, including a few previously studied sites. Dozens of Iron Age sites across the five districts largely included cultural materials such as pottery, ground stones, daubs, iron working remains such as tuyeres and slags. The Iron Age remains, particularly pottery, characteristically span from the early to the late Iron Age periods although dating is on progress. The study also recorded several sites with lithic artifacts belonging to the Middle and Later Stone Age traditions.

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### **Niche partitioning in fossil bovids near the Mio-Pliocene boundary at Lothagam, Turkana Basin, Kenya**

The spread of C4-dominated environments constituted a major shift in eastern African terrestrial ecosystems during the late Miocene to Pliocene periods. While previous work has shown that many families of eastern African herbivores adopted C4 diets during this time, we know little about how dietary resource partitioning was structured at finer, taxonomic scales, such as within the speciose and diverse bovid tribes. The Lothagam sequence (Turkana Basin, Kenya) spans the late Miocene to Pliocene (~7.5 to 3.5 Ma) and has produced an abundant mammal fauna that is ideal for investigating how increasing abundance of C4 grasses influenced niche partitioning within the large herbivore guild. Here, we report new  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  isotope data from tooth enamel ( $n = 120$ ) and body mass estimates from tooth measurements ( $n = 93$ ) for nine bovid tribes from Lothagam. Linear models predicting  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values and estimated body mass by time revealed no significant shifts, which implies that most tribes were characterized by static dietary and body mass niches. Alcelaphines and bovines were both C4 specialists but differed in average mass (~65 versus > 100 kg, respectively). Tragelaphines were relatively large-bodied (~80 kg on average) and had the lowest average  $\delta^{13}\text{C}$  values (-6.6 ‰), suggesting mixed-feeding with a preference for browse. Other taxa seem to have been mixed feeders varying only by mass. We concluded that Lothagam bovids may have differentiated their niches in other ways (e.g., microhabitat use and migratory behavior) that are common among extant taxa today.

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### **New excavations at Lothagam Lokam, Kenya, reveal fisher-forager mortuary complexity during the African Humid Period**

First excavated in the 1960s, Lothagam Lokam (AKA the Lothagam Harpoon Site) near Lake Turkana, Kenya has one of the largest concentrations of human skeletal remains from eastern Africa and is key to understanding fisher-forager lifeways during the African Humid Period (~15,000-5500 BP). However, because only a small portion of the >100,000 m<sup>2</sup> site was systematically studied, and initial radiocarbon dating efforts yielded ambiguous results, many questions remain unresolved. In 2017 and 2022, we conducted new surveys and excavations at Lothagam Lokam with the goal of establishing the site's chronology and documenting the spatial distribution of mortuary and habitation deposits. We found human remains in the process of eroding across much of the site, with the extent and diversity of mortuary deposits far greater than initially reported. We recovered 16 new individuals, most from primary in situ burials as well as isolated remains, bringing the minimum number of individuals at the site to ~45. Direct dates on tooth enamel from four of the individuals show at least two periods of mortuary activity ~7500 cal BP and ~9500 cal BP (95% CI, IntCal 20); to our knowledge, these are among the oldest



directly dated human remains in eastern Africa. Most of the individuals were in single burials spaced far apart, likely reflecting isolated mortuary events. However, one area with a higher density may have been a cemetery. Skeletal analyses indicate the presence of men, women, and at least two children, and provide insights into their lived experiences. Interpreted alongside other archaeological and palaeoenvironmental evidence, these results challenge assumptions of stability around Lake Turkana during the AHP. This case study also illustrates the changing nature of bioarchaeology in light of contemporary climate change, raising questions about our evolving professional responsibilities as sites like Lothagam Lokam become increasingly threatened.

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### **1000 years of mid-late Holocene lithic technical traditions from two Neolithic sites in the Central Afar (Ethiopia, ca. 4.3-3.3 ka)**

In the framework of research activities carried out since 2014 by the Volcanological and Archaeological Program for Obsidian Research (VAPOR-Afar) team, several Holocene sites dating from ~11-3 ka have been documented in the Ethiopian Central Afar. During the Holocene African Humid Period (~15-4.5 ka), the region experienced the alternation of humid and arid phases that affected the hydrology of the Awash River and Lake Abhe as well as surrounding paleoenvironments. The sites document long-term human lakeside adaptation and the transition from Later Stone Age (LSA) hunter-gathering-fishing to the first Neolithic societies (ca. 4.3 ka) that integrated pottery production and herding with hunting, fishing, and foraging practices. Two of the Neolithic sites excavated and dated by the VAPOR-Afar program, namely Kurub-07 NE (4300-4000 cal. BP) and Kurub-07 (3900-3300 cal. BP), have provided 1000 years of semi-continuous occupation and lithic production along with the presence of domesticated fauna and pottery production. Recent analysis of the lithics highlights the reliance of populations on obsidian for technologies oriented towards the production of flakes of very reduced size. The use of the bipolar percussion on anvil technique was used by these populations for the production of mainly small blanks that were occasionally turned into shaped tools (mainly scrapers, denticulates, notches, and burins). Backed artifacts (shaped only on obsidian blanks) including backed geometric microliths, were produced at both sites with slight differences, and have parallels with lithic assemblages from contemporary neighboring Neolithic sites. This poster will focus on presenting the main characteristics of the lithic technologies and assemblages from the Neolithic sites of Kurub-07 NE and Kurub-07 in the Ethiopian Afar.

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### **Mode 1 and 2 stone tool assemblages associated with *Homo erectus* ca. 1.5 and 1.2 Ma from Gona, Ethiopia**

The Gona study area has produced two *Homo erectus* crania associated with both Mode 1 and Mode 2 stone assemblages: a nearly complete cranium from Dana Aoule North (DAN5) estimated to 1.5-1.6 Ma, and a more robust partial cranium recovered from Busidima North (BSN12) dated to 1.26 Ma. Years of field survey and excavations at Gona and nearby sites have shown that the Mode 1 technology remained ubiquitous throughout the Paleolithic. A test excavation at BSN12 yielded only Mode 1 stone artifacts, while DAN5 produced a few Mode 1 stone tools in stratigraphic context. The evidence from

Gona indicates that Mode 1 technology was a component of the Acheulian, implying *H. erectus* had behavioral plasticity and cultural complexity. Stone cobbles accessed from nearby ancient streams were used by *H. erectus* at Gona. Despite abundant fossil fauna, cutmarks or hammerstone-percussed bones were not identified at BSN12. At DAN5, stone tool cutmarks were identified on an elephant phalanx and a percussion notch on a small antelope leg bone, suggesting that *H. erectus* butchered both large and small mammals. The few modified bones from DAN5 show disarticulation and defleshing from a large range of animal sizes with evidence of hominin animal consumption. The DAN5 cranium has a strikingly close resemblance to the smaller crania known from Dmanisi (Republic of Georgia) in the Caucasus, dated to 1.8 Ma. With a cranial capacity of ca. 598 cm<sup>3</sup>, DAN5 is among the smallest *H. erectus* in Africa. The archaeological evidence strongly suggests that the *H. erectus* population that evolved in Africa invented the Acheulian. Further investigations are critical for understanding the mobility patterns of *H. erectus* and cultural spread of Mode 2 technologies across Africa and Eurasia.

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### **Leveraging digital archaeology for conservation and planning in Kenyan museums**

This research explores the transformative potential of digital archaeology in revolutionizing conservation and planning strategies within Kenyan museums. In focusing on the rich cultural heritage and archaeological wealth of Kenya, the study aims to assess the efficacy of advanced digital technologies, including 3D scanning, GIS, and virtual reconstruction, in preserving, cataloguing artifacts, optimizing resource allocation, and enhancing public engagement. By capturing intricate details and dimensions digitally, we aim to transcend the limitations of traditional conservation methods, ensuring a more comprehensive, understanding and preservation of Kenya's rich cultural tapestry. Working with Kenyan museums, archaeologists, and conservationists, the research aims to provide comprehensive guidelines for integrating digital archaeology into existing conservation practices. The expected outcomes include improved artifact preservation, streamlined museum management through the digital database, and the potential for virtual exhibits, ultimately contributing to a more sustainable and accessible approach to cultural heritage management in Kenya. A mixed-methods approach engages museum staff, archaeologists, and stakeholders. This study contributes to academic knowledge and positions Kenyan museums at the forefront of international best practices by filling gaps in existing literature. The findings are expected to influence not only local conservation efforts but also contribute to a broader understanding of leveraging digital archaeology in cultural heritage preservation globally.

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### **Ancient DNA from Tuto Fela attests to a male-centered megalithic funerary tradition**

Much of the archaeological scholarship on Ethiopia's Medieval Period focuses on the Christian and Islamic societies in the temperate highlands who are associated with indigenous written sources of the period as well as a robust archaeological record. Monumental and megalithic traditions dating to this period are much more poorly understood. Archaeological and ethnographic research suggests megaliths were often used as grave markers by groups engaged in local religions (i.e., people who were not following Christianity). Here we present the first genome-wide ancient DNA data for 15 individuals buried at the site of Tuto Fela in the Gedeo Zone of southwest Ethiopia, shedding light on the community that created and used these monuments. Results show 13 out of 15 individuals are male, and that ten of these individuals had one or more male relatives in our dataset. By contrast two females buried at Tuto Fela had no relatives, suggestive of a system of patrilocality where women married in from other communities. Genetic evidence of a male-centered funerary tradition is notable in light of the phallic and anthropomorphic stelae at the site whose cultural and religious significance is not yet fully understood.

The Tuto Fela individuals are also informative of broader connections and population history in Africa. We observe a high frequency of the rare east African-specific EV2403 Y chromosome haplogroup, connecting Tuto Fela males to foragers who lived in the region for thousands of years. Analysis of genome-wide data reveals that the Tuto Fela individuals fall at an extreme position on the spectrum of genetic variation of present-day Ethiopians despite their recent radiocarbon dates (16th-17th centuries CE), sharing affinity with a forager individual who lived 4500 BP from the nearby Mota Cave. Here, we explore these data and discuss some of their implications.

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### **2D geometric morphometric analysis of hominin mandibular molars from Woranso-Mille, Afar State, Ethiopia**

Over the past two decades of extensive fieldwork at the Woranso-Mille (WORMIL) site, a wealth of hominin fossils has significantly contributed to our understanding of the fossil record spanning the period between 3.8 and 3.2 million years ago. However, the taxonomic identification of hominin specimens, particularly isolated teeth, from this site faces two critical challenges. There are multiple contemporaneous hominin species from 3.5-3.3 Ma and a paucity of morphological traits that differentiate their dental specimens and from 3.7-3.6 Ma the mosaic morphology of *Australopithecus anamensis* and *Australopithecus afarensis* traits present in many of the specimens complicates taxonomic identification. Addressing these challenges, this study employs 2D geometric morphometric (GM) analyses, a method previously successful in differentiating dental specimens of other hominin taxa. 2D GM analyses were performed on a sample of WORMIL hominin mandibular molars based on 8 fixed and 30 semilandmarks. A comparative sample of *Ardipithecus ramidus*, *A. anamensis*, and *A. afarensis* was also included. Preliminary results of the 2D GM analyses indicate that the WORMIL specimens generally overlap with *A. afarensis* and *A. anamensis* specimens. This research contributes to the refinement of hominin taxonomic identification at the Woranso-Mille site.

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### **Collaborative research approaches and capacity building for Uganda's archaeology, palaeontology and heritage: views from Napak GeoPark and fossil site**

Collaborative research at fossil hominoid sites in Africa is paramount for student training and expanding local heritage knowledge capacity. Researchers drive this by carrying out long-term research projects in these sites. For example, at Napak fossil site collaborative research teams from France, the United States and Uganda have worked with students and local people in prospecting, excavation, identifying and studying rich fossiliferous localities that yield large apes and other primates dated 15-20 million years ago. For example, the recently discovered almost complete femur of a large *Anthropothis*, *Rusingameryx aequatorialis* found at NAP XIX by the local people of Iriri village Napak District, part of a team we worked with at the site. Such empowerment inspires the people to move from prospecting for fossils to safeguarding the site for future discoveries. Such an important site needs concerted efforts to ensure its protection and the continuity of research. Napak is a great candidate for an Open-Air Museum not only for promoting the fossil sites and the nearby ancient volcano but also to conserve and manage this important site. The local people, being at the center as key stakeholders and playing a great part in the studies at these sites, need to own the process, being trained to manage their own heritage rather than letting others manage it for them. This includes providing employment opportunities based on site conservation, education, and research. In that way the state will spend less on material needs to safeguard the site as the community takes charge in safeguarding their heritage for national posterity.

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### **Phalangeal cortical bone morphology suggests diversity in hominin hand use**

Hand use in the hominin lineage represents a transition from a hand used for locomotion towards a hand capable of forceful, dexterous manipulation. This transition likely occurred alongside the emergence of bipedalism as well as stone tool use, but when and how the hominin hand ceased to be used for locomotion remains unresolved. Here we investigate cortical bone morphology of manual proximal and intermediate phalanges (digits 2–5) of fossil hominins, as variation in phalangeal cortical bone distribution in extant hominids has been shown to reflect differences in manual behaviours. Cortical bone distribution patterns and thickness are assessed in the phalangeal shafts of *Australopithecus afarensis*, *Australopithecus africanus*, *Australopithecus sediba*, *Homo habilis*, and *Homo naledi* alongside a comparative sample of *Pongo* spp. (N=12 individuals), *Gorilla gorilla* (N=27), *Pan* spp. (N=29), and *H. sapiens* (N=40). We use surfaces created from high-resolution micro-CT data to analyse cortical bone morphology in R package Morphomap. Results reveal extant great apes have thick cortices on the palmar flexor sheath ridges (FSRs) with a low-to-intermediately thick shaft, whereas extant human cortex is thickest distodorsally in the phalangeal shaft. Australopithecids and *H. habilis* show the thickest cortex on the palmar FSRs and intermediately thick dorsal surfaces, which is most similar to great apes. This suggests that these early hominins used their digits for locomotion, loads of which may ‘override’ any signals of manipulation. *H. naledi* shows a pattern of thick FSRs combined with human-like thick cortices of the dorsal shaft, suggesting a functional signal for manipulation, despite external morphology of the fingers and upper limb that would facilitate climbing. Variation in external morphology coupled with the variation in cortical bone distribution patterns indicate that the fossil hominins included in our study were using their hands in ways that were distinct from each other and from extant hominids.

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### **Acheulean raw material usage by Early-Mid Pleistocene hominins from east and south African sites**

Cores and large cutting tools from Acheulean assemblages from the Early-Mid Pleistocene sites of Canteen Kopje and Rietputs 15 have been technologically analyzed in the context of a PhD project. The project focuses particularly on the role of raw materials in technological variation. The preliminary results show that there are differences in the selection of raw materials in the two studied assemblages, perhaps due to the different geological settings of the regions. The size and shape of the raw materials will be described. It has been recorded that there are also differences in reduction intensity that may relate to raw material qualities. The reduction techniques from the sites studied thus far show the presence of prepared core technology among Early Acheulean assemblages from Canteen Kopje and discoidal cores among Rietputs 15 collections. This data will be integrated and compared with new analyses from Ethiopian Early-Mid Pleistocene sites in order to better understand hominins technological variation throughout regions, hominins landscape foraging strategies, raw material transportation, and discardation. So far, the preceding analyses show that the availability and abundance of raw materials on the sites under study have influenced core exploitation, which has mostly resulted in few flake removals. On the other hand, LCT preparation and flaking techniques appear to be influenced by the quality of the raw materials. The next step in the study (in the coming couple of months) would be to analyze Acheulean assemblages from Gadeb and the Middle Awash. This wide chronological and geographical framework will shed light on the Acheulean hominins’ technological adaptations and specializations in two geographical areas.

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### **Maxillary fragment with dentition of a juvenile fossil hominin from Shungura (Ethiopia) : new insights into robust hominin ontogeny**

Early hominin juveniles are required for understanding the developmental basis of adult phenotypic variations and for defining new characters useful to the resolution of hominin phylogenetic relationships. Since the discovery of the Taung child a century ago, numerous findings of juvenile specimens have expanded our knowledge concerning craniodental ontogeny of *Australopithecus africanus* and *A. afarensis*, and more recently, of *Paranthropus robustus*. However, less is known about the early development stages of eastern African robust australopiths, despite their highly documented derived adult morphology. In this study, we present a fragmentary juvenile maxilla (OMO 362-10001) discovered by the Omo Group Research Expedition in the Shungura Formation in Ethiopia (Member K, at ca. 1.5 Ma). Both qualitative and quantitative analyses were conducted for the taxonomic assessment of this specimen, including tooth size, enamel thickness, and discrete anatomical characters, in comparison with a sample of Plio-Pleistocene African hominins. In order to identify the age at death of this specimen, its dental developmental stage was studied and compared to those of known infants of *Paranthropus robustus*. Finally, we analyzed both derived and shared morphological traits of australopithecines in this specimen to determine if it exhibits ontogenetic similarities with known forms of Plio-Pleistocene hominins. Our results showed that OMO 362-10001 has strong affinities with *Paranthropus boisei* both in metrics and permanent dentition morphology. Age at death has been estimated to ca. 3.5 to 5 years old, i.e., the youngest known specimen for this species. Finally, maxilla morphology indicates that some of the derived features shared by species of *Paranthropus* were already present at this early stage of development.

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### **Leadership and coordination in transforming the story of human origins in Tanzania**

Tanzania, a country rich in archaeological and palaeoanthropological evidence, has played a pivotal role in transforming our understanding of human origins. This abstract explores essential elements of leadership and coordination that have contributed to this transformative journey. Tanzania's significance in the study of human evolution is exemplified by the discovery of key archaeological and paleoanthropological sites, including Olduvai Gorge, Laetoli, Peninj, just to mention a few. These discoveries have reshaped our understanding of how early hominins lived, evolved, and migrated across the African continent and beyond. Additionally, archaeological data increased our understanding of evolutionary changes in human form and stone tool technology. Leadership has been a driving force in this transformation. Tanzanian and international researchers, guided by visionary leaders in the fields of palaeoanthropology, archaeology, and geology, have formed collaborative partnerships. These leaders have united teams of scientists, local communities, and government agencies (NCAA, COSTECH, Antiquities Division, NMT, and UDSM, UDOM) to facilitate groundbreaking research and the preservation of invaluable heritage of our past. Coordination has been equally crucial. Effective communication and cooperation among multidisciplinary teams and local community have resulted in the successful excavation and analysis of fossils, ancient stone tools, and environmental data. Effective leadership has fostered relationships with local communities, respecting their cultural heritage and involving them in the scientific process. This collaborative approach has enriched research and contributes to the sustainable preservation of these invaluable sites. In conclusion, leadership and coordination have been fundamental in transforming the story of human origins in Tanzania. The collaborative efforts of visionary leaders, multidisciplinary teams, and local communities' engagement have paved the way for a deeper understanding of our evolutionary history.

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### **Reconstructing incomplete hominin ossa coxae based on the covariation between pelvic traits**

The shape of the human pelvis is influenced by important evolutionary selective pressures relating to locomotion, obstetrics, and thermoregulation. Reconstructing the pelvis in hominins is an intricate process because key areas, such as the auricular surface and the pubic symphysis, are often not preserved. With a few exceptions (e.g., *Australopithecus afarensis* A.L 288-1, 3.2 Ma; the Neanderthal Kebara 2, 60 ka; or the early *Homo sapiens* Ohalo 2, 23–19 ka), the most commonly preserved areas of the hominin pelvis are the ilium and/or the body of the ischium, whereas remains associated with the pubis are rarely recovered (e.g., A.L. 288-1, Sts 14, StW 431, MH2, KNM-WT 15000). Here we assess the applicability of the Statistical Shape Modelling (SSM) combined with 3D geometric morphometrics to validate the statistical prediction of the pubis/ischium from the ilium. We tested our method on two virtually complete hominin ossa coxae, the early human Ohalo 2 and the Neanderthal Kebara 2. We digitized 219 landmarks and semilandmarks on the right hipbone of 113 *H. sapiens* and 79 *Pan* individuals. These points were used to define the variability of a *H. sapiens* statistical shape model and of a pooled *H. sapiens*–*Pan* statistical shape model that captured a broader range of hipbone shape variation. Preliminary results show that the pooled model predicted the original ischiopubic regions more accurately than the *H.sapiens*-only model in both Ohalo 2 and Kebara 2. This is despite the fact that Kebara 2 preserves an unusually long and slender pubic ramus compared to Ohalo 2. These results have implications for the applicability of this method for reconstructing less complete fossil ossa coxae.

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### **Reduction sequence and Toth analysis of the Ledi-Geraru Oldowan lithics from Bokol Dora 1 (BD1) assemblage**

The Bokol Dora 1 (BD1) assemblage is one of the oldest Oldowan record in East Africa and in the world that contributed the earliest material culture of our ancestors. Until the discovery of oldest Oldowan dated to 3.032 to 2.581 Ma from Nyayanga, Kenya, BD1 is known for its well described oldest Oldowan artifacts in the world. The BD1 artifacts were made from various raw materials, mainly from locally available rhyolites, as investigated from the ancient landscape. These artifacts were discovered by the 2013 and 2015 field works conducted by the Ledi-Geraru Research Project (LGRP). All of the 295 lithic artifacts collected from the surface and in situ that are currently housed in Ethiopian Heritage Authority (EHA) were included in this study. The main objective of this study was to investigate the reduction intensity of BD1 Oldowan artifacts. We applied multiple methods, including attribute analysis to get a better understanding of reduction sequence and techniques. Reduction intensity and raw material comparisons were made with contemporaneous early Oldowan assemblages from Gona dated to 2.5 Ma and Nyayanga dated to ~ 2.581 – 3.03Ma. The results indicate the Gona materials were more reduced than BD1 and NY1 materials. The older site was less reduced than the younger sites; however the BD1 and NY1 assemblages shared many results indicating related reduction intensity regardless of their chronological difference. In addition, raw material preferences were appeared in the BD1 and Gona assemblage, although it is not clearly reported for the NY1 assemblage.

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### **Emerging rock art assemblage on the verge of Blue Nile Valley of Gojjam, Ethiopia**

Being surrounded by one of the world's largest river Blue Nile, Gojjam has recently explored with plenty of new rock art sites along the great valley of this river. The Blue Nile River appeared to have been provided a fertile ground for the development of early pastoralism and foraging practices in the region. During the preliminary survey works conducted so far, about five rock art sites have been discovered and some are documented. As far as the previous documented rock art sites concerned, based on the parameters of regional variations and geographical proximity, in Ethiopia there were three established northern, south-central and eastern rock art assemblages. The recent archaeological reconnaissance at the Blue Nile Valley has revealed a new additional rock art assemblage which geographically situated on the pocket area of northwestern Ethiopia which is out of the horizons of the established assemblages. Based on the depictions executed on the rock surfaces, the rock shelter inhabitants of this region seem to have been utilized the Blue Nile river as a reliable source of subsistence. One of the sites called Jiru Serit found adjacent to the river, has rendered a pre-historic record of aquatic lives like fish, hippo, and the water body itself which were not reported in the previous studies. This study has mainly reconstructed the dynamic natures of the paintings of Jiru Serit executed both in abstract and semi-naturalistic perspectives. Geometric features are most dominant followed by wild animals, birds, and trees. Tree and aqua lives are rare scenes in the rock art traditions.

Amelia Villaseñor<sup>1</sup>, Lucas K. Delezene<sup>1</sup>, Rahab N. Kinyanjui<sup>2</sup>, Enquye W. Negash<sup>3</sup>, Joshua Porter<sup>1</sup>, Anna K. Behrensmeyer<sup>4</sup>

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### **The (semi)arid ape: how the rift valley defined our niche**

Hypotheses about drivers of human evolution often address how hominins are ecologically distinct from closely related apes. These hypotheses have common ingredients, and many suggest that the topography and vegetation of the Eastern African Rift Valley System (EARS) contributed unique selective pressures in hominin speciation events. We suggest a new semi-arid ape hypothesis that centers on the environment as a force in early hominin evolution and combines ideas from previous hypotheses and recent research. Early hominins (7–3 Ma) likely had species ranges that extend from mesic forests (found today on the rift highlands and extend into central and western Africa) to semi-arid regions, such as the lower parts (floor) of the EARS. This range of habitats is their fundamental niche. Semi-arid regions include the low elevation regions along the rift floor that are generally more arid than the regions surrounding them, in part due to higher temperatures, higher evaporation, and wind cycles. The semi-arid ape hypothesis proposes that drier components of the hominin range (the realized niche) separated hominins from non-hominin apes in the Mio-Pliocene. Chimpanzees today do not exploit the same type of semi-arid habitats as reconstructed for Pliocene hominins, nor are their fossils usually found in the same regions. We suggest that an early exploitation of semi-arid habitats, outside of the central-western African rainforest belt, resulted in a biogeographic separation between hominins and other apes. Adaptations to a broad range of environments and climates are fundamental for the human ability to survive in extreme environments today and may help us survive in more extreme future environments.

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## **Trophic food web structures of Plio-Pleistocene faunal communities from Sterkfontein's Jacovec Cavern and Member 5**

Nitrogen ( $\delta^{15}\text{N}$ ) and carbon ( $\delta^{13}\text{C}$ ) stable isotopes are important geochemical tools for reconstructing past diet and food webs. The oxidation-denitrification method enables the assessment of  $\delta^{15}\text{N}$  in diagenetically robust tooth enamel, finally permitting trophic level reconstructions of specimens that are millions of years old. Employing this technique alongside cryofocusing high-precision mass spectrometry allows for nitrogen, carbon, and oxygen stable isotope to be measured in a single (<5 mg) aliquot of tooth enamel. This study focuses on the hominin-bearing fossil locality of Sterkfontein Cave, South Africa. Previously, fauna including *Australopithecus* sp. from Member 4 have been analysed (Lüdecke et al., in revision at Nature), and show a clear separation between herbivores and carnivores in  $\delta^{15}\text{N}$  values, as well as between browsers and grazers in  $\delta^{13}\text{C}$  values. Large variation in  $\delta^{15}\text{N}$  among *Australopithecus* individuals is observed, but always with lower values than sympatric carnivores, suggesting a variable, but largely plant-based diet for these hominins. We aim to extend our understanding of the trophic structure at Sterkfontein by analysing faunal communities from older (Jacovec Cavern, ~3.6 Ma) and younger (Member 5, ~2.2 to 1.4 Ma) deposits at this locality. The Jacovec Cavern 'orange' breccias contain *Australopithecus*, but no stone artefacts, while Member 5 contain *Paranthropus robustus* and Oldowan tools, and *Homo* and Early Acheulean tools. Sterkfontein presents a unique opportunity to assess potential changes in ancient food webs of Plio-Pleistocene fauna over time in a single locality. The faunal assemblage presented here comprises taxa coexisting with our early ancestors, and thus represents potential competitors and/or food sources. This expanded trophic level reconstruction of the food web at Sterkfontein will serve as the basis for planned future research incorporating primate (non-hominin and hominin) isotope data with a focus on the onset and intensification of animal resource consumption in our early ancestors across the Plio-Pleistocene.

Caroline VanSickle<sup>1</sup>, Zach Cofran<sup>2</sup>

<sup>1</sup>Des Moines University <sup>2</sup>Vassar College

### **Revisiting the taxonomic affiliation of the SK 3155b isolated hominin hip**

In the 1970s, a block from Swartkrans in the Cradle of Humankind, South Africa, yielded an isolated, relatively complete hominin os coxae, SK 3155b. At the time, only two species were known from Swartkrans: *Paranthropus robustus* and an early *Homo* species that had not yet yielded a pelvis. SK 3155b was assumed to represent one of these species; crucially, support for this important fossil belonging to *Homo* stemmed from John Robinson's unique view that Sterkfontein australopiths were in genus *Homo*, which is not supported today. Our knowledge of the hominin diversity in this region of South Africa ~2 Ma now know includes multiple contemporaneous species beyond those originally known from Swartkrans. These additional species expand the possible taxonomic attributions for SK 3155b. Here, we repeated the original metric and non-metric analyses used to assess the taxonomy of this fossil in the 1970s, using an expanded comparative sample that included fossils attributed to *Australopithecus africanus*, *P. robustus*, *A. sediba*, and early genus *Homo*. Our findings showed no clear pattern of metric or non-metric traits aligning with particular taxa. These results demonstrate the issues with trying to distinguish hominin taxa based on isolated pelvic fossils. The hominin pelvis evolved to be well-adapted for bipedal locomotion by 2 Ma, and so perhaps it is no surprise that there were morphological similarities between species. These results have implications for interpreting other isolated hominin pelvic remains, such as the BSN 49/P27 hominin pelvis from Gona, Ethiopia.

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<sup>1</sup>University of Oregon

### **Climate seasonality in the Turkana Basin, Kenya from 4-1 Ma: isotopic records from equid teeth**



In the tropics today climate seasonality plays an important role in determining the distribution of plant and animal communities, and has been proposed as an important environmental driver of hominin evolution over the past 6 million years. Increasing climatic seasonality is often thought to characterize climate change from the late Miocene to Pleistocene in eastern Africa. The  $\delta^{18}\text{O}$  compositions of paleosol carbonate horizons and leaf wax biomarkers that are preserved in deep sea and lake sediment cores provide highly spatially and temporally averaged signals, and do not record seasonal-scale precipitation changes. We use oxygen isotope variation within mammal teeth to investigate environmental changes over seasonal scales. Extant equids are water-dependent grazers, and oxygen isotope variation within teeth of modern zebra in eastern Africa correlates with intra-annual ranges of fluctuations in the  $\delta^{18}\text{O}$  of local precipitation. We present oxygen isotopic profiles of fossil equid teeth ranging in age from ca. 4-1 Ma from hominin fossil sites in the Turkana Basin, Kenya. Initial results indicate that intra-tooth  $\delta^{18}\text{O}$  ranges are lower among Pliocene compared to Early Pleistocene equids, which have intra-tooth  $\delta^{18}\text{O}$  ranges within the range observed among modern equids. These results indicate greater isotopic seasonality of precipitation in Early Pleistocene environments in the Turkana Basin compared to preceding periods, likely reflecting increasing seasonality in precipitation amount or source. A shift in environmental seasonality may have played a role in ecological changes such as the expansion of C4 grasses and faunal population dynamics, which may have influenced selective pressures experienced by hominins.

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### **Three-dimensional analysis of dental topography in catarrhine primates: morphofunctional study of fossil hominoids from the Shungura Formation, Lower Omo Valley, Ethiopia**

Catarrhine primates, both extant and fossil, exhibit dental variations, including distinct features such as crests or crenulations, possibly associated with feeding functions like leaf/grass consumption, food gripping, or force dissipation during occlusion. Our goal is to identify and evaluate the correlation between these features and potential adaptations to specific functions, possibly related to food fragmentation. For this, we used the fossil record of the Shungura Formation, located in the Lower Omo Valley, which is the most complete for the Plio-Pleistocene in eastern Africa. Within this formation, three genera of fossil hominins (*Australopithecus*, *Paranthropus*, and *Homo*) exhibit dental trait variability. We compared the Shungura hominin molars to those of extant catarrhines for understanding the evolution of their occlusal patterns. The sample included 70 upper molars from 34 catarrhine species, representing a large part of the extant diversity, and nine upper molars (six M1 and three M2) of Shungura hominins. Our 3D dental topography method allows for the identification and characterization of overall dental morphology without relying on reference points. Topographic indices, including occlusal relief, occlusal complexity, and dental curvature, reveal morphological differences between the two catarrhine clades (cercopithecoids and hominoids), indicating diverse masticatory specializations. To capture the functionality of dental traits, particularly sharpness, an index based on subsampling the most curved surfaces was developed, associating high curvature values with their expression surface area. The results highlight differences between extant and fossil hominins, providing insights into the evolutionary path of these dental traits and their adaptive features. This approach quantifies dental traits not only in terms of curvature and complexity but also considers their evolution in response to functional or structural demands. Using the Shungura Formation as a case study, this method examines the functional capacities of hominin teeth over time, comparing them with other primates.

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### **Mobility patterns of hominins during the Early Pleistocene of the early Okote Member, Koobi Fora Formation, east of Lake Turkana**

There exist debates by contemporary archaeologists on uniformity within the Oldowan industry and what this may mean for an understanding of hominid cultural and adaptive abilities. This study investigated commonalities and variations at intra and inter-site scale, to understand hominin behaviors and lifeways. We present the analysis of stone tools from four localities from the Koobi Fora Formation (KFF) (FxJj23, FxJj20E, FxJj18 IHS and FxJj50) dating to (1.6-1.38 Ma). Data was collected on artifact attributes including artifact types (cores, flakes, angular fragments, and cobbles), proportion of cortex, flake scars, platform types, size, bulb types, termination types, Toth types and weathering stages. Results indicated a direct correlation between assemblage variation and local contextual variables (water, food, raw materials). Sites located close to raw material sources had longer and wider whole flakes with a mean length of 65mm at FxJj23. In contrast, assemblages that were more distal to raw material sources were relatively smaller. Whole flakes from FxJj18IHS and FxJj20E had mean lengths of 30.67 mm and 33.86mm respectively. Assemblages that were in the axial part of the basin tend to have greater diversity of raw material types, due to the availability of certain rock types in the center of the basin. Further, FxJj50 had the highest frequency of exotic raw material, 1% compared to other sites that had less than <1% as well as the highest cortex percentage. These findings indicate that stone tool making is a complex adaptation. Early hominins modified the production of stone tools based on the procurement and use of resources on the ancient landscape. This study expands the breadth of knowledge on hominid behavior and mobility patterns, during the early Pleistocene.

Veronica Waweru<sup>1</sup>, Aryeh Grossman<sup>2</sup>, Rahab Kinyanjui<sup>3</sup>, Nasser Malit<sup>4</sup>, Christine Omuombo<sup>5</sup>, Francis Muchemi<sup>3</sup>, Richard Kinyua<sup>6</sup>

<sup>1</sup>Yale University <sup>2</sup>Midwestern University <sup>3</sup>National Museums of Kenya <sup>4</sup>SUNY - Potsdam University <sup>5</sup>Technical University of Kenya <sup>6</sup>Community based researcher, CHK project

### **Geodiversity and hominin evolution in the central highlands of Kenya: a knowledge co-production research approach**

There is increasing scholarship on the role of the world's mountain systems as hubs of biotic evolution, speciation, and migration. Such studies have not been applied to African contexts of hominin evolution. In East Africa, the Rift Basin, often dubbed "the cradle of humanity," has produced considerable fossil and archaeological evidence for hominin bio-cultural evolution. High-elevation localities outside this basin have however not been a focus of paleoanthropological investigations despite technological and fossil evidence of their colonization by hominins in the last 2my. The work presented here takes a landscape approach to understanding the role of tropical mountain geodiversity in hominin evolution in the Quaternary at the Central Highlands of Kenya (CHK). We hypothesize that the geodiversity found at the CHK produced heterogeneous microclimates that were sometimes asynchronous to regional and global climatic regimes, resulting in temporally variable but continuously viable pockets of habitats in the Quaternary. The CHK constitutes highlands ranging from 1800m to 5199m asl with a high density of mountain-fed river networks but variable topography, vegetation, temperature, and rainfall. Using a knowledge co-production model where locals are actively involved in prehistory research, the area has yielded ~ 30 sites spanning all phases of the Stone Age, mid-Pleistocene and Holocene hominins, and multiple faunal taxa, including new species. We argue here that high tropical mountains were important centers of hominin evolution, likely sheltering hominins during adverse climatic regimes. Additionally, incorporating non-expert locals in paleoanthropology research facilitates quicker discovery of sites, increases the uptake of science research products, and promotes pride in the ancient heritage found at the CHK.

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### **Zooarchaeology and taphonomy of the Pastoral Neolithic site of Luxmanda, northern Tanzania**

Pastoralism has sustained eastern African populations for more than five thousand years and has proven to be a resilient way of life amid increasingly variable climates. Previous research on ancient pastoral lifeways has often emphasized economic responses to climatic variability. But scholars have also shown that ancient pastoralists' resource exploitation was dictated not only by the environment and available resources, but also by cultural norms that may have guided their interactions with one another, different animals, and the general environment. For instance, ethnoarchaeological and archaeological research in East Africa has shed light on gender roles, exchange relationships, and burial practices that demonstrate the complexity of pastoral social lives. Additionally, studies of pottery through lipid residue analysis have informed past culinary practices. It has remained challenging, however, to use zooarchaeological data to make such social interpretations. This study focuses on patterns of animal procurement, preparation, and consumption at Luxmanda in Tanzania, a site occupied ca. 3000 BP during the Pastoral Neolithic era. We present preliminary results of a zooarchaeological study of faunal material recovered in 2023 excavations, including taxonomic identification and taphonomic analysis, and we compare our results against selected previously collected data. By employing a social zooarchaeological approach, we hope this dataset will advance the understanding of the more studied cultural responses to climatic variability and offer more insights into the social factors that shaped human decisions during the Pastoral Neolithic.

Andualem Girma Wersa<sup>1</sup>, Enza Elena Spinapolice<sup>2</sup>, Worku Derara<sup>1</sup>, Marinna Fusco<sup>2</sup>, Seminew Asrat<sup>2</sup>, Caterina Aureli<sup>2</sup>

<sup>1</sup>Addis Ababa University <sup>2</sup>Università Roma La Sapienza

### **Techno-typological analysis of Middle Stone Age assemblages from Gotera, southern Ethiopia**

The Middle Stone Age (MSA) techno-complexes in African archaeological record are currently linked to the emergence and the early representatives of *Homo sapiens* in the continent. Gotera is one of the MSA stratified sites in East Africa, in an area and it is dense in evidence of human occupation. It offers a testing ground for understanding environmental and technological dynamisms. As result, in this work we were present the analysis of an important part of the surface material (Cluster A). This study also applied common techno-typological analysis which is chaîne opératoire approaches, including different attribute analysis and, to get a better understanding of production techniques. The technological and typological examination of MSA lithic materials leads to the understanding of the reduction sequence employed for the lithic production. GOT10 (cluster A) MSA lithic assemblage, demonstrates advanced human technological, typological, and behavioural developmental markers, through different lithic production techniques including Levallois, blade, bladelet and other technologies. Although it is difficult to determine whether these were specifically used for specific purpose, it can be assumed that they could be used to cut, scrape and butcher animal meat. Stone Age hunters utilized animal carcasses as their targets. The lithic assemblages suggest production techniques involving different reduction sequence, including hard and soft hammer percussion. This research offers some preliminary comparisons between the artifacts from GOT10 and those from three different MSA sites, namely Mochena Borago, Goda Buticha, and Porc Epic. The Levallois and opportunistic flaking reduction techniques are used more on quartz raw materials than at these three sites. Despite of this, there are similarities between these sites in terms of cultural preference and variations in technology and morphological characteristics. However, due to a variety of circumstances, such as typological classification, contexts, and differences in raw

materials, it is difficult to identify meaningful comparisons. Therefore, future studies could be able to disprove some of these viewpoints.

Giday WoldeGabriel<sup>1</sup>, Tim White<sup>2</sup>

<sup>1</sup>*Santa Fe, NM* <sup>2</sup>*University of California, Berkeley*

### **Middle Awash geoscience**

Italian geologists explored the Middle Awash region in 1938, reporting nothing of paleoanthropological interest. In contrast, geologist Maurice Taieb recognized the paleoanthropological potential of the study area years before the 1974 Lucy discovery. Taieb initially led Johanson and Coppens in exploration and collections of lower Awash basin study areas today known as Ah'Dar, Gona, Ledi-Geraru, Woranso-Mille, Dikika, Mille-Logya, and others. All these were first discovered and brought to the attention of science by Taieb. The discovery of Pliocene hominids at “Hadar” in 1973 then focused that group’s work there, but led Jon Kalb to form the “RVRME” and to begin separate intermittent work to the south, on “Middle Awash” outcrops first logged as the “Formation D’Urugus” by Taieb; and in adjacent catchments including Bodo D’Ar where Alemayehu Asfaw found the first and only RVRME hominid fossil in 1976. Archaeologist Desmond Clark was invited by RVRME archaeologist Fred Wendorf to extend that work. In 1981 Clark began excavations and associated detailed multidisciplinary research on both sides of the Awash River. His Middle Awash research project continues today and has generated >33,000 identified vertebrates from >400 localities (including 485 hominid individuals); 312 archaeological localities (>12,000 collected artifacts); and >1,800 geological samples spanning ~1km vertical thickness, accumulated during >6 million years. A total of >1,000 personnel have conducted the fieldwork. More than 175 papers/chapters comprising >7,000 published pages have resulted. Assembly of the complex stratigraphic record of Neogene sedimentation—including abundant radiometrically calibrated volcanics—has been a foundational and constant objective involving long-term field and laboratory studies necessitated by the tectonic and consequent geographic and geomorphological complexity of the study area. Here we present a revised stratigraphic nomenclature and the current working chronostratigraphy of the study area, with special attention to the latter’s paleoanthropological implications.

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### **Morpho-volumetric shifts in the Middle Stone Age (MSA) pointed tools from Gademotta and Kulkuletti site complexes (280-180 ka), Main Ethiopian Rift, Ethiopia**

Pointed tools are one of the most characteristic end-products of the MSA and highlight major transformations from the late Acheulean to the MSA, in particular in terms of production systems. They are prominent tool types in many eastern African MSA assemblages and are often used to illustrate inter-site variability and regional cultural diversity. However, our current understandings of these specific tool types are limited due to a lack of standard approaches to establish robust comparative analysis in geographically and chronologically distinct sites. This study aims at overcoming such methodological limitations and to investigate morpho-volumetric evolution of pointed tools in two securely dated early MSA sites in the Main Ethiopian Rift; at Gademotta and Kulkuletti site complexes dated between ~280 ka and 180 ka. Here, we introduced an innovative methodological approach that combined a technological analysis focused on blank types and modification patterns with classical morphometric and 3D geometric morphometric analyses. Our results display the feasibility of our methodological approach and shed light on the gradual shift in the production strategy of the pointed tools without a significant change in their final morphology.

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## **Faunal composition among the three fossil collection phases of the Lemudong'o Formation, SW Kenya**

Paleontological and geological fieldwork at the late Miocene localities of the Lemudong'o Formation (~6 Ma) in the southern Kenyan Rift Valley, can contribute to understanding of ape and early hominin evolution and paleoecology. The primary fossiliferous localities of the Lemudong'o Formation are Lemudong'o 1 (LEM1) and Enemankeon (ENK), which are ~5 km apart. Fossil collecting efforts can be grouped into three phases over the past 28 years, each associated with its own constraints on resources and methodology. We investigated whether taxonomic compositions of vertebrate fauna changed among the phases and between localities, as indicators of any shift in collecting efforts. Specimens of the Lemudong'o Formation (N = 2123) were counted at the family (e.g., bovids and hippos) or the order level (e.g., primates and carnivores). Specimen counts and relative abundance of taxonomic groups at both localities were summarized for each collection phase. Most fossils come from LEM1 (N = 1895). Faunal assemblage composition at both localities is dominated by bovids (~35%). ENK differs from LEM1 by having more large-bodied taxa (e.g., hippos and perissodactyls) and fewer small-bodied taxa (e.g., primates and hyraxes). Within LEM1, there is little change in faunal composition among the three phases (except for suids), indicating relatively consistent collecting efforts through time. We found higher percentages of specimens collected at ENK (from <5% to ~25%) for Phase II and III, which suggests increased collecting efforts after Phase I. The later collecting phases now document the presence of *Cainochoerus* (Suidae) and a more diverse primate fauna, including a galago. Analyses of tuff, biomarker, paleosol, phytolith and enamel samples in progress will provide more comprehensive paleoenvironmental reconstructions of the Lemudong'o Formation.

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## **Reconstructing the dietary preference and the paleoecology of the fossil family Rhinocerotidae (Mammalia: Perissodactyla) from the hominid-bearing Pliocene Hadar Formation of Ethiopia using extended dental mesowear analysis**

Rhinos are the largest, taxonomically diverse, and the most successful perissodactyl group on earth. The fossiliferous Pliocene Hadar Formation has yielded abundant fossil faunal specimens including two rhino lineages and hominins like the famous *Australopithecus afarensis*. The two rhino lineages are the browsing *Diceros* and the grazing *Ceratotherium*. Dental mesowear analysis is a method used to infer the dietary category of herbivore mammals as browser, grazer, or mixed feeder, recorded over a long time based on the facet developed due to attrition (tooth on tooth contact) and abrasion (tooth on exogenous materials, mostly food contact) on the ectoloph occlusal surface of the tooth. By analyzing the fossil tooth specimens, it is possible to reconstruct the Paleodietary ecology of specific group of individuals as well as paleocommunities in that ecosystem. In this study, the maxillary P2-M2 of *Diceros praecox* and *Ceratotherium mauritanicum* were analyzed using the extended mesowear method of rhinos with the objective of reconstructing the paleodietary adaptation of the Family Rhinocerotidae to study and understand their paleoecology. The mesowear result indicate that *Diceros praecox* is a browser probably feeds on varieties of leaves, shoots, tree bark, or fruits whereas *Ceratotherium mauritanicum* is grazer that feed on grasses and other low-growing vegetation. A wide range research conducted on the extant representative of the two lineages, *Diceros bicornis* (the African black rhino) and *Ceratotherium simum* (the African white rhino) found similar result with the present study indicate their feeding behavior is still preserved. *Australopithecus afarensis* that inhabited in a similar environment with other contemporaneous

mammalian groups is believed to have experienced the same climatic and environmental conditions. Therefore, the inferred paleoenvironmental condition of the two lineages also define other mammals including hominins that lived the same environment and similar time period.

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### **A palaeobiological reappraisal of the "*Elephas recki*" complex**

The *Elephas recki* complex of Plio-Pleistocene Africa has long been held as an anagenetic transitional series from an *Elephas*-type ancestor to the immediate precursor of Eurasian *Palaeoloxodon*, comprised of five successive chronosubspecies best known from the Omo-Turkana Basin (*E. recki brumpti*→*E. r. shungurensis*→*E. r. atavus*→*E. r. ileretensis*→*E. r. recki*). However, this model recently came under contention as ancient DNA highlighted the apparent phylogenetic closeness of *Palaeoloxodon* to *Loxodonta*, rather than to *Elephas*. Extensive re-examination of cranial materials from Ethiopia and Kenya reveals that, whereas the nominotypical form of this supposed lineage is morphologically consistent with *Palaeoloxodon* (thus *Palaeoloxodon recki*), other earlier remains attributed to *recki* exhibit far greater cranial disparity than can be explained by anagenesis. The Late Pliocene skull from southern Ethiopia attributed to *brumpti* is most morphologically similar to the contemporary "*Elephas*" *planifrons* of the Siwaliks and *Phanagoroloxodon* from southeastern European Russia; whereas the Early Pleistocene *atavus* shares substantial similarities with the contemporary Siwalik *E. hysudricus*. A pattern of intra-lineage 'relay' in ratcheted diet-driven convergent dental evolution in African elephantids is revealed, by reconciling a novel cladistic analysis arising from these morphological observations with dental mesowear-based records of dietary shifts in East African proboscideans. The replacement of *Palaeoloxodon* by *Loxodonta* across the Middle and Late Pleistocene accentuates major ecological and faunal changes which underpinned the emergence of modern African savannah community.

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### **New age constraints for the Singa hominid**

The Singa cranium, found on the western bank of the Blue Nile in 1924, shows a combination of modern and archaic features of *Homo sapiens*. Electron spin resonance dating on two associated mammal teeth previously indicated an age within Marine Isotope Stage 5 or 6, while U-Th dating of calcrete deposits around the cranium implied a minimum age of  $133 \pm 2$  ka. However, the exact age of the calvaria, and the deposits from which it originated, remains uncertain. To provide more detailed age constraints for the Singa cranium, this study applies optically stimulated luminescence (OSL) and radiocarbon dating to Blue Nile River sediment sequences at Singa, where the fossil was found, and at Abu Hugar, located ~30 km to the south, and from which a diverse fossil assemblage was previously described. OSL dating of sediments was conducted using both quartz blue-stimulated OSL and K-feldspar post-infrared infrared stimulated luminescence (post-IR IRSL; pIRIR). The stratigraphy and new ages determined in this study are compared to those of the middle Atbara sequences, where fossils of Middle Pleistocene *Homo* have recently been found. Our new age constraints will shed important insights into the evolution of *Homo* in the Nile Basin.