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**Did *Australopithecus afarensis* include climbing in its locomotor repertoire?**

One of the most conspicuous adaptations in early hominins is their mode of locomotion. In fact, the emergence of bipedalism after the human clade separated from the apes, c.a. 6 to 7 Ma, is often used as a key morpho-functional adaptation to establish the beginning of our lineage. Subsequent to the advent of this novel adaptation, the genus *Australopithecus* became a habitual biped by ca. 4 Ma; there is ample evidence to support this claim. Yet, the longstanding debate relating to whether *Australopithecus* had fully abandoned an earlier arboreal life style continues in a polarized fashion. In this presentation, an attempt will be made to integrate data from fossil and living hominoid morphology and ontogeny and link them to muscle function and observed locomotor adaptation in apes. This approach allows the documentation of character plasticity during ontogeny and how that plasticity relates to observed shifts in mode of locomotion across taxa, providing an interpretive context to explore locomotor adaptation in fossil species. It is argued here that such integrative approaches will pave the way for paleoanthropologists to interpret function in early hominins by more objectively examining whether the so-called “primitive or ape-like” features encountered in *Australopithecus* had survival values – or were just part of the taxon’s evolutionary baggage.

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**Niche separation of large-bodied Cercopithecidae at Koobi Fora, Upper Burgi Member**

In the Upper Burgi Member of Koobi Fora there is evidence for the sympatry of at least four large-bodied sympatric colobine species and to multiple similarly-sized hominin and papionin taxa, a situation unmatched in modern East African habitats. This study examines niche overlap among large-bodied cercopithecids known the Upper Burgi Member of the Koobi-Fora Formation using estimates of body mass, fruit/leaves dietary composition, and percent time terrestrial as environmental variables. We compared *Cercopithecoides williamsi*, *Paracolobus mutiwa*, and *Rhinocolobus turkanensis*, along with the large cercopithecine *Theropithecus oswaldi*: the only taxa complete enough for inclusion. Estimates for body mass and diet composition of the extant and fossil taxa were compiled from the literature where available. To estimate percent time on ground 5 forelimb indices from 292 extant and fossil cercopithecid specimens including 11 colobine (*P. mutiwa* from West Turkana) and 17 cercopithecine taxa were selected. These indices were chosen for being practical to calculate in fragmentary fossil elements and for being significantly correlated ( $p < 0.05$ ) with terrestriality in extant taxa. These include indices for relative humeral medial epicondyle breadth, humeral trochlea length, humeral capitulum depth, radial neck length, and the shape of the olecranon process of the ulna. The three fossil colobines are all estimated to be more terrestrial than extant colobines, with *P. mutiwa* more so than the other fossil colobines. The fossil taxa also separate out in other variables: *P. mutiwa* and *C. williamsi* overlap in size and terrestriality, but not diet; *C. williamsi* and *R. turkanensis* overlap in body mass but not terrestriality or diet; and *P. mutiwa* and *T. oswaldi* overlap in size but not diet. Further analyses with more environmental variables are necessary, but niche separation may have contributed to the diversity of large-bodied primates in the Upper Burgi Member of Koobi Fora.

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### **JA-53, a big fossilized isolated lower incisor from Sangiran, Indonesia**

JA-53 is an isolated fossilized tooth which was found accidentally by a local inhabitant somewhere around Sangiran. Therefore, its location and stratigraphic position is unclear. JA-53 maintains the crown and root and looks like the lower first or second incisor (LI1 or LI2). Furthermore, in terms of its crown and root colors that is dark grey and black, it seems that JA-53 might come from the upper part of the Pucangan (Sangiran) formation which in the context of faunal succession on Java, this specimen can be included as a member of Trinil H.K (ca. 0.9 mya) or Cisaat faunas (ca. 1-1.2 mya). Its crown size is the biggest when compared to the size of lower first and second incisors of *Pongo pygmaeus palaeosumatensis*, *Pongo pygmaeus pygmaeus* [Hoppius] and *Pongo pygmaeus* from Vietnam. So, if JA-53 could be a representative of a *Pongo* tooth and if its age is really very old it would be the important data for reviewing the existence of lower-middle Pleistocene *Pongo* in Java (Sangiran) and the origin of *Pongo* in Southeast Asia. In this paper, the application of REE (rare earth element analysis) to solve the stratigraphic problem of JA-53 will be discussed, including the importance of this specimen.

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### **The early Acheulean and paleoenvironments at Konso, southern Ethiopia**

The Early Pleistocene Konso Formation sequence is chronostratigraphically well-calibrated and yields fossils and artifact assemblages that span the ~1.95 to ~0.8 Ma time period. At Konso, the earliest documented Acheulean occurs at ~1.75 Ma, and is represented by crudely made handaxes, cleavers and trihedral picks. These are associated with a fauna that is apparently continuous from the ~1.9 Ma time period. This timing corresponds broadly with the emergence of *Homo erectus sensu lato*, supporting an African origin of the species lineage accompanied by subsistence and technological changes. Thereafter, at Konso, typical early Acheulean assemblages occur at ~1.6 Ma, while some significant technological advances are seen in the handaxe and cleaver tool categories of the ~1.45 to 1.25 Ma time period. The latter include biface production via blank predetermination technology and handaxes with better formed edges and tips (despite still being thick and sinuous-edged). The Konso large mammalian fauna of this time period was characterized by new appearances and increased abundances of dry grassland adapted bovids and suids. Such a biotic change might have led to the above stated technological development. Finally, the ~0.85 Ma Konso Acheulean tools were considerably more advanced, suggesting further technological innovation that postdated 1 Ma. This includes a preference for thinner blanks, more intensive flaking (greater flake scar counts) and routine use of soft hammer technology. This development included the production of handaxes with refined “three-dimensional symmetry” and may have occurred broadly concurrently with the *Homo erectus* (such as Daka) to *Homo rhodesiensis/heidelbergensis sensu lato* transition.

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### **Paleoecology and dietary adaptation of Plio-Pleistocene giraffes from Shungura Formation**

Dental scores of the mesial and distal surfaces of enamel band of the upper second molars of fossil of *Giraffa gracilis*, *Giraffa pygmaea* and *Sivatherium maurusium* were analyzed using Mesowear III. This material was found in five members (B, C, D, E-F, and G) of the Shungura Formation, which covers a time span between 3.6 Ma and 1.05 Ma. Results indicate that the taxa *G. gracilis* and *G. pygmaea* experienced gradual changes in their dietary adaptation in accordance with the changes in habitat from that of closed to open habitats. The specimens of *G. gracilis* were predominantly browsers, with a broader dietary dispersion during the deposition of Members E and F. The specimens

of *G. pygmaea* changed from a full browsing diet to a diet incorporating browses and grazes. Unlike *G. gracilis*, *G. pygmaea* was adapted to a dominantly grazing diet during the deposition of Member G. According to the different lines of evidences from this study and other works, the possible habitats of *G. gracilis* & *G. pygmaea* was presumably a mixture between woodland, bushland and open wooded grasslands. *Sivatherium maurusium*, sampled only in member F, was a full grazer and its habitat was probably grassland, in line with a maximum expansion of grasses in this member.

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### **Revealing the Middle Stone Age of the Middle Awash**

The Middle Awash research area has produced archaeological findings that have helped to elucidate the behaviors of emerging humans. Abundant Early Stone Age (ESA) and Middle Stone Age (MSA) occurrences have been discovered, documented, and, for many localities, excavated. Placing these occurrences into ecological and geochronological contexts represents a core, long-term activity of the research project, and is continuing in both the field and the laboratory. Middle Stone Age occupation is now known from familiar localities such as upper Herto, upper and lower Aduma, and several Halibee horizons. Additional occurrences have now been mapped from north to south and from east to west across the study area. These are consistently found stratigraphically atop Acheulean-bearing sediments that also contain the remains of more archaic hominids in large vertebrate fossil assemblages. At the upper Herto locality, typical Acheulean bifaces have now been recovered in situ from 155-160 Kyr occupation loci. These sediments also yield in situ flakes and cores more typical of MSA assemblages. Even younger assemblages from Halibee and Aduma have proven more resistant to precise geochronological placement, but recently excavated assemblages and geochronological samples are currently under analysis with the aim of radioisotopic age controls for these important paleontological and archaeological occurrences. The spatial breadth and temporal depth of the Acheulean and Middle Stone Age occurrences of the Middle Awash study area therefore represent a unique opportunity to understand technological, anatomical, behavioral, and ecological changes surrounding the emergence of anatomically modern humans in northeastern Africa.

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### **Ongoing investigation of prehistoric sites on the Kilwa Basin, Coastal Tanzania**

There exists a major gap in our knowledge of the extent to which early human biogeography included the eastern African coastal landscapes along the Indian Ocean because most previous Paleolithic and paleoanthropological studies in the region have remained focused on the hinterlands, mainly in the vicinity of the Great Rift Valley. A recent archaeological reconnaissance survey in the Kilwa Basin (coastal Tanzania) has recorded prehistoric sites featuring Middle Stone Age lithic entities, predominantly discoidal and prepared core products. Some of these sites were previously recorded but were not published. In this paper, we discuss the geological and archaeological contexts of the sites, highlighting the diagnostic features of the lithic entities recorded at the sites. At the outset, the seascape and terrestrial terrains characterizing the Kilwa basin appear to be ideal for sustained human adaptation, and the discovery of such Paleolithic sites from the region is unsurprising and serves as a promising starting point for future research.

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### **Long-term and seasonal diet change in eastern African primates**

The well-documented expansion of C<sup>4</sup> vegetation in eastern Africa since the Pliocene is accompanied by increasing consumption of C<sup>4</sup>-based resources by members of at least four orders of mammals, including Artiodactyla, Perissodactyla, Proboscidea, and Primates. However, the prevalence and variability of C<sup>4</sup> foods in the diets of African primates remains poorly understood. We address long-term diet change among primates in eastern Africa since the Pliocene using the carbon isotope composition of fossil tooth enamel. Next, we evaluate the range of C<sup>4</sup> consumption among modern African primates using the carbon isotope composition of tooth enamel and hair sampled from field and museum collections. Further, we explore the biological significance of C<sup>4</sup> feeding, including seasonal variability, using the carbon isotope composition of feces repeatedly collected from well-studied savanna baboons in Kenya. Finally, we introduce a new project focused on investigating the role of intra-annual variability in the evolution of primate and hominin diets in eastern Africa using laser ablation stable isotope analysis.

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### **The lower Omo Valley as an ecological refugium during the Pliocene and Early Pleistocene**

Several paleontological studies focused on the Plio-Pleistocene of eastern Africa have highlighted periods of significant faunal and environmental change. But the fossil record also shows periods of remarkable faunal and ecological stability over scales of many hundreds of thousands of years. Here we analyze geochemical and paleontological data from the lower Omo Valley of southern Ethiopia, with updated versions of the Omo databases that include more than 20,000 records of fossil vertebrates. Analyses of faunal turnover and abundance in relation to paleoenvironmental indicators show that the Mursi, Usno, and Shungura formations, spanning from about 4 Ma to nearly 1 Ma, reflect prolonged periods of ecological stability even though faunal changes are readily apparent elsewhere in the region. These data indicate that the proportions of key mammalian families (e.g., Suidae, Bovidae, Cercopithecidae) change gradually over 3 million years, while previously published pedogenic stable isotopes show the persistence of mixed C<sub>3</sub>-C<sub>4</sub> vegetation even as C<sub>4</sub> vegetation was becoming rapidly dominant elsewhere in the Omo-Turkana Basin and elsewhere in Africa. The congruent signal from faunal abundance data and pedogenic stable isotopes shows that the lower Omo Valley remained a refugium for woodland adapted faunas in the face of important climate and environmental change in the African Plio-Pleistocene.

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### **Investigating faunal evolution in the Shungura Formation, Turkana Basin, south-western Ethiopia**

Thanks to its relatively continuous deposition over a long time period (3.6 Ma-1 Ma), the Shungura Formation offers a unique opportunity to follow step by step the interactions between biological evolution and environmental constraints during the Plio-Pleistocene. The Omo Group Research Expedition is pursuing this goal by analyzing a wide diversity of taxonomic groups collected in the Shungura Formation (including bovids, cercopithecids, equids, herpetofauna, hippopotamids, hominids, ichthyofauna, ostracods, proboscideans, suids, etc.) through, in most cases, a multiproxy approach (including diversity, phylogenetic signals, stable isotopes, dental wear, functional morphology). Taking as fully as possible the actual paleodiversity into account is important, because different groups from the same site may bear different signals in relation with their ecological specificities. A real understanding of paleoecosystem dynamics will not be achieved by focusing on a small fraction of the diversity and of the biomass only. An example will be provided with the on-going revision of the Omo hippopotamids, showing the importance of recent taxonomic assessment for paleoecological and paleobiogeographical interpretations. The ultimate goal of the Omo Group Research Expedition is to compare this ecosystem-wide data with new results being obtained on Omo environments in order to understand what factors were really at play at the local scale.

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**Through a volcanic glass darkly: viewing modern human origins with the lens of raw material transport**

Long-distance transport (>50 km) of raw materials is a feature of human behavior inextricably linked to increased intergroup interactions through higher mobility and/or exchange. However, evidence of long-distance raw material transport in Africa is mostly known from after 70 ka. A synthesis of new obsidian data with a previously compiled geochemical database demonstrates early and consistent presence of long-distance obsidian transport in East Africa between ~50–400 ka, the period of *Homo sapiens* evolution and dispersals out of Africa. Obsidian artifacts (25 analyses on 5 artifacts) from five sites in the Lake Victoria basin dating between >50–100 ka show transport distances of 145 km to 250 km from Naivasha basin sources. In the Baringo basin the Sibilo School Road Site, dated to 222.5 ka, shows transport of obsidians (160 analyses on 28 artifacts) from three sources located 25 km, 140 km and 166 km from the site with 95% of the obsidian deriving from the most distant source. New analyses of obsidian artifacts (149 analyses on 31 artifacts) from two Middle Pleistocene sites: Kapthurin site 'A' and Rorop Lingop, recently dated >395.8 ka, demonstrate seven compositions from at least three sources ranging distances between ~60–140 km from these sites. The evidence suggests long-distance raw material transport is older than previously appreciated and predates technological innovations of the Middle Stone Age by ~100 kyr as well as the first appearance of *H. sapiens* by ~180 kyr. By antedating important technological and biological features in human evolution, increases in intergroup interactions attested by long-distance raw material transport constitute significant selective pressures on the development of modern human behavior and biology. A focus on raw material transport and its impacts on technology, biology and human-environmental interactions can provide new insights into modern human origins in Middle and Late Pleistocene Africa.

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**Filling in the gaps: virtual reconstruction of the Kabua I cranium**

Our current knowledge of the emergence of anatomically modern humans, and the human lineage in general, is limited, in large part because of the lack of a well preserved and well dated fossil record from the relevant time periods in Africa. Thus, the primary aim of this research is to partly relieve this problem by virtually reconstructing and analyzing the fragmentary hominin cranial remains of Kabua I, found in Kenya west of Lake Turkana in the 1950s. Most scholars have argued that Kabua I represents an anatomically modern *Homo sapiens*, although the fragmentary nature of the cranium hinders robust phylogenetic and taxonomic assessment. Moreover, Kabua I is assigned by some scholars to the Mid/Late-Pleistocene and thus might represent a significant stage in the evolution of anatomically modern humans. However, this is debated due to the lack of a secure chronometric date. In order to analyze the overall shape of this potentially critical cranium, we used micro-CT scans and computational palaeontological techniques to virtually remove any adhering sediment and subsequently created several virtual anatomical reconstructions of Kabua I. These reconstructions were then subjected to a suite of geometric morphometric procedures and analyzed with comparative fossil and modern human samples. Our results confirm Kabua I's affinities to anatomically modern fossil specimens and extant human populations. Notably, the virtual reconstruction of the Kabua I cranium also increases the number of fossils available for study in East Africa.

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**Pre MIS 4 (>59 ka) archaeological deposits from Mochena Borago Rockshelter: implications for testing the highland SW Ethiopia OIS 4 refugium theory**

Since 2015, archaeological research at Mochena Borago Rockshelter, SW Ethiopia has focused exclusively upon the excavation of Late Pleistocene deposits in the central area of the site. Prior to 2015 excavations were concentrated in the northern "BXA" area of the ~ 70m wide rockshelter where three major artifact-bearing litho-stratigraphic units have

been securely dated by over 40 charcoal radiocarbon ages to >50-36ka. Attempts to reach deeper deposits >50ka were unsuccessful due to an impenetrable basal volcanic stratum. In the Central Area only ~ 30 cm of truncated aeolian, roof-fall, fluvial and volcanic deposits separate the surface from a distinct dark brown stratum whose uppermost layers are dated by four charcoal AMS ages to >50ka. Another 2+ meters of stratified archaeological deposits lie below these dated deposits. The lithics are >80% obsidian and defy simplistic MSA/LSA designations as they reveal a remarkably diverse array of small core reduction technologies in the same horizons that include tabular and volumetric flake/blade/bladelet cores, preferential and recurrent centripetal Levallois flake, classic Levallois point, Nubian point types 1, 2, and 1/2 (and possibly a third type) and discoidal cores, cores-on-flakes, bipolar and angular core technologies. Levallois, Nubian and parti-unifacial to fully bifacial points dominate the shaped tools, but drills, burins, and scrapers are also present. A “heavy-duty” component of large basalt and other volcanic artifacts including various core types, naturally backed “knives”, and ground, pecked and rubbing stones, some of which are ochre-stained, is found throughout the sequence but is more plentiful in the lower levels. These deposits remain undated although experimental Obsidian Hydration dating has yielded ages of ~100-60 ka. We conclude with a discussion of how the Central Area lithics relate temporally and spatially to regional assemblages, and how they contribute to the testing of our “Highland SW Ethiopia OIS 4 refugium theory.

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#### **New data on paleoenvironment and carnivory at Lokalalei 1 (ca. 2.4 My, West Turkana, Kenya)**

Despite considerable interest and debate, relatively little is known about the behavioral ecology of Oldowan hominins prior to ca. 2.0 Myr due to the paucity of sites for this time period. What habitats did they frequent? Did they acquire meat and use animal products in abundance? Can we integrate studies of tool-use and diet (with the aim of better understanding the evolution of both)? And how might the answers to these questions compare to the later records from Olduvai and elsewhere? All these issues are essential but still need more surveys and pluridisciplinary analysis. This paper presents new archaeofaunal data from recent analysis of bone assemblages from Lokalalei 1 (LA1). The site is located in the Nachukui Formation (West Turkana, Kenya) and is dated between 2.4-2.3 Myr (e.g., Roche et al, 1999; Brugal et al., 2003; Prat et al 2005; Tiercelin et al, 2010). Excavations revealed a rich assortment of lithic and faunal materials densely distributed across a well-defined archaeological layer. Here we give a full report of the stratigraphic context and taphonomical conditions of these materials as well as provide a first glimpse at the results of archaeofaunal studies. The latter include: a detailed species list, inferences of paleoenvironmental setting, skeletal element analyses, ungulate age profiles, and bone modification studies. Our results bear on issues of Oldowan hominin subsistence, and habitat utilization, with potentially broader implications for the emergence and evolution of key morphological and behavioral adaptations. Some comparisons are made with other faunal lists from sites within the Omo-Turkana Basin, especially to infer paleoenvironment and paleoclimate variations through time (ca. 2.5 - 1.6 Myr) (Brugal et Roche, 2017). A first preliminary version of this paper was given at the EAQUA 2013 (Naynuki, Kenya). Acknowledgments: Special thanks to M. Kibunja and H. Roche, and their institutions in Kenya and France.

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#### **Meet the Siuyu minds: local people values and meaning of cultural heritage assets**

Siuyu ward is very rich in both tangible and intangible cultural heritage assets. The ward is found in Ikungi district, Singida region in central Tanzania. In terms of archaeological occurrences, Siuyu sites range from Later Stone Age (LSA) to Iron Age (IA) approximately 45,000 BP to 10,000 - 2000 years old. Moreover, Siuyu ward has massive granite outcrops containing prehistoric rock painting sites made by hunter-foragers and Bantu-speaking communities. Our investigations aimed at examining the value of heritage in local people's perspectives, and more significantly meaning that local people Siuyu place on cultural heritage assets within their vicinity. The study employed a case study strategy of inquiry in which in-depth interviews with the respondents in Siuyu ward were done. The collected data were subjected to qualitative analysis and interpretation. Findings show that a significant number of respondents do not know the significance of the cultural heritage assets of Siuyu and the values of such assets attached to the

local community. Importantly, results from this study showed that the reported and newly discovered Heritage treasures of Siuyu have great potential of refuting the long prevailing notion that LSA and rock art sites are only found in Kondoa Irangi. This bias has evidently been perpetuated by the teaching syllabus of Tanzanian primary and secondary schools. Additionally, the study recommends having on-going campaigns and programs promoting local communities' awareness on a regular basis.

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#### **The endostructural bony organization at the distal humerus: do *Paranthropus* and early *Homo* differ?**

The distal humerus in *Paranthropus*, compared to humans, is commonly reported to exhibit a mediolaterally elongated articular surface, a prominent coronoid area between the trochlea and the capitulum, a medially positioned capitulum, a lateral epicondyle aligned to the upper edge of the capitulum, and a mediolaterally broad and anteroposteriorly flat distal shaft outline. However, despite their relative abundance in the Plio-Pleistocene African fossil record, the taxonomic attribution of some isolated hominin distal humeri remains a matter of controversy. Radiation based imaging techniques were used to explore and tentatively characterize the still unreported inner structural organization of five adult distal humeri from South Africa (TM 1517g, SK 24600, SKX 10924, SKX 34805) and Ethiopia (Gombore IB) which have been variably attributed to *Paranthropus* or *Homo* based on their outer features. All specimens, except SK 24600 from Swartkrans, revealed a degree of endostructural preservation allowing the reliable quantification of their geometric properties at the most distant cross-sectional level (%CA, Ix/Iy, I<sub>max</sub>/I<sub>min</sub>) and the measure of bone thickness topographic variation across their preserved shaft portion by means of a 2-3D index of relative cortical thickness. As a comparative extant human reference sample, we used six adult humeri of both sexes. Our results indicate two main endostructural morphotypes: the first includes the nonetheless slightly variable signatures of the specimens TM 1517g, SKX 10924 and SKX 34805, while the second clearly sets apart the *Homo aff. erectus* Gombore IB, which more closely relates to the extant human condition. Marked differences in the amount and pattern of proximodistal cortical bone distribution across the distal shaft have been detected in the case of Gombore IB and SKX 34805. Given the heterogeneous polarity of its outer and inner morphostructural features, we conclude that the taxonomic status of SKX 34805 deserves further investigations.

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#### **New bipedal footprints from Laetoli support marked body size variation in early hominins**

The study of fossil footprints is of great interest in paleontology. Their physical features can help to identify their makers but can also be used to infer much more biological and ecological information. Hominin footprints are very rare. Nearly all the hominin tracks discovered so far are ascribed to distinct species of the genus *Homo*, with the only

exception of those discovered in the 1970s by Mary Leakey and co-workers at Laetoli Site G. These tracks were presumably left about 3.66 million years ago by three *Australopithecus afarensis* individuals walking on a fresh volcanic ash layer that was subsequently cemented. The extent of body size variation within the *Au. afarensis* species has long been the subject of debate among researchers, also in terms of sexual dimorphism. Based on the skeletal remains found so far in East Africa, some scholars believe that individuals only varied moderately, as in modern humans, while others state that the variability was pronounced, as in some extant great apes. At Laetoli Site S, we have now unearthed new bipedal footprints of two individuals who were moving on the same paleosurface, in the same direction and at the same speed as the three found in Site G. The estimated body mass of one of the new individuals (about 45 kg) exceeds the estimates for those from Site G. This evidence supports marked intraspecific morphological variation. Considering the new footprints as a whole with the 1970s ones, we hypothesize that the largest individual may have been a male, whereas the others were smaller females and/or juveniles. It may be concluded that considerable differences existed between sexes in *Au. afarensis*, more similarly to extant gorillas than to chimpanzees or humans.

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#### **New research on the Kohl-Larsen Collections from Mumba Rockshelter, Tanzania**

The Kohl-Larsen excavations at Mumba Rockshelter between 1934 and 1938 provide an important reference for studying the Middle and Later Stone Ages of East Africa. The excavation team removed nearly 1,000 m<sup>3</sup> of sediment from the site both following natural strata and digging in 20 cm spits. Despite the large scale of work, the crew proceeded carefully, recovering many classes of material and screening some portions of the sequence. In addition to the vast assemblages of lithic artifacts and faunal remains from Mumba, the excavation directed by Margit Kohl-Larsen yielded large collections of ostrich eggshell (OES) artifacts and examples of worked ochre. So far we have examined 94 pieces of ochre (70 in bed V and 24 in bed VI) spanning the stratigraphic deposits between VIe and Vc and corresponding to much of the Late Pleistocene. The collection includes both hematite and goethite with hues from deep red to yellow. The finds preserve examples of pieces of ochre with ground and faceted surfaces. Some artifacts including grinding and hammer stones bear clear traces of ground ochre. The OES beads represent one of the earliest expressions of this kind of personal ornament in Africa. The OES assemblage from Mumba includes more than 3,600 artifacts, two-thirds of which are complete beads. We analyzed the production chain of the beads and dated the OES artifacts from the entire stratigraphic sequence. Like the ground and chipped lithics artifacts, the OES assemblage provides evidence for a degree of technological continuity. While most of the radiometric dates cluster between 29,000 and 33,000 BP, the oldest result yielded a minimum age of ca. 47,000 BP. These data further illustrate the difficulty in identifying a clear shift between the Middle and Later Stone Ages.

Anne Delagnes<sup>1</sup>, Tiphaine Maurin<sup>2</sup>, Pascal Bertran<sup>3</sup>, Jean-Renaud Boisserie<sup>4</sup>

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The archaeological investigations carried out since 2008 as part of the OGRE project in the Shungura Formation (Lower Omo Valley, Southern Nations, Nationalities and People Regions, Ethiopia) have adopted a strategy based on large-scale surveys combined with a taphonomic reassessment of the existing record (IORE and OGRE sites and collections) prior to any new intrusive field operation. They result in the inventory of more than 100 geo-referenced archeological occurrences in the lower part of Member F, grouped into 9 main site complexes dated to ca. 2.3 Ma, and more than 50 geo-referenced occurrences in Lower G Member, grouped into at least 4 site complexes dated to between 2.2 and 2.0 Ma. The high inter-assemblage variability in terms of artifact density, size composition, spatial and stratigraphic distribution is indicative of a variety of post-depositional contexts, ranging from primary or sub-

primary occurrences to secondary occurrences heavily disturbed by water flow. The set of data collected during this first phase of investigations will greatly contribute to targeting a number of operational objectives for the forthcoming field phase, related to the land-use patterns and environmental preferences developed by the early Oldowan hominins in a context of meandering river valley system.

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### **The technological context of LCT emergence: a preliminary comparison of non-LCT lithics from Kokiselei 6 and Kokiselei 4, West Turkana, Kenya**

The eastern African Early Pleistocene witnessed critical shifts in climate, environment, hominin anatomy and behavior. Hominin habitats became drier and more open and habitually bipedal hominin species, such as *Homo erectus/ergaster*, emerged. Such changes in the environment and hominin anatomy likely resulted in their expanding mobility patterns. The hominin lithic record shows change within this broader context, particularly between 2 and 1.5 Ma. Before 2 Ma, cores, flakes, and other percussive tools were most common in archaeological lithic assemblages. After 1.8 Ma, Large Cutting Tools (LCTs) such as handaxes and picks became part of the hominin lithic repertoire. The earliest known occurrences of LCTs have been found in eastern Africa. Among knapping strategies, many archaeologists theorize a dichotomy between “flaking” and “shaping”. Yet, little empirical evidence supports these concepts’ usefulness for archaeological research. LCTs after 1.8 Ma are widely viewed as the first evidence of lithic shaping and the Early Acheulean, but how this capacity evolved remains unclear. Further, we have little holistic information about non-LCT components in Early Acheulean lithic assemblages. Early LCTs occur in the Kokiselei Site Complex (KS) in West Turkana, Kenya with sites ranging from 1.8 - 1.76 Ma, and preserve both LCT and non-LCT components. Kokiselei is an ideal location for conducting technological comparisons during this period of critical change within a single geographic location.

This research takes a holistic perspective on technological change by focusing on both LCT and non-LCT components of Kokiselei lithic assemblages. The data presented here are preliminary comparisons of the non-LCT lithic components from two KS sites (Kokiselei 6 and Kokiselei 4). The Kokiselei lithics will eventually be compared to data from an ongoing experimental program that will quantify differences between the archaeological artifacts and controlled products of flaking strategies.

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### **New insights into the paleoenvironments of *Australopithecus anamensis* in the Omo-Turkana Basin, eastern Africa**

*Australopithecus anamensis* lived in eastern Africa around 4 million years ago. Three main fossil sites in the Omo-Turkana Basin (Kanapoi, Allia Bay and Mursi) preserve sediments from c. 4 Ma. Preliminary paleoecological analyses suggest that there were differences in the environments of these three sites. In addition, the abundance of hominin fossils at these sites is extremely variable; the majority of the fossils attributed to *A. anamensis* have been found at Kanapoi (c. 70%), some have been discovered at Allia Bay (c. 30%) and no hominin remains have been found so far at Mursi. Can the differences in the relative abundance of *Australopithecus anamensis* in the Omo-Turkana Basin be attributed to ecological differences between the sites? The analysis of the faunal material is in progress. The analysis of the remains thus far reveals that the site of Kanapoi was the most open, the site of Allia Bay was more of a mosaic environment, and the environment was more closed at Mursi. The bovid community composition differs accordingly and is significantly different between the three sites. Browsers are more common at Mursi than at the other sites and grazers are the most common at Kanapoi. Similarly, carbon isotopic ratios are generally more depleted at Mursi, intermediate at Allia Bay and less depleted at Kanapoi. Allia Bay mesowear scores and ecomorphologic analyses are also indicative of a mosaic habitat at Allia Bay. Analysis of the complete fauna will provide further insights into the preferred habitats of *Australopithecus anamensis*.

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### **Low-level aerial imaging of outcrops and their application to hominin fossil sites**

Low-level aerial imaging trials in the Ledi-Geraru area of the Afar during the 2015 field season provided extremely high-resolution 3-dimensional models of the land surface that are being used for an array of paleoanthropological, paleontological, and geological purposes. Aerial imaging tests focused on two main regions within the permit area, involving the collection of 1300 low-level digital aerial photographs in the 0.04 km<sup>2</sup> Ali Toyta area adjacent to an archeological excavation, and 15000 images in the approximately 2.6 km<sup>2</sup> Lee Adoyta sedimentary basin where the earliest *Homo* mandible was discovered in 2013. A fairly rudimentary, gimbaled 14 megapixel DJI FC200 5mm camera, attached to a 4-rotor platform, was flown by remote control to capture the images. This basic camera, combined with sophisticated photogrammetric (Agisoft Photoscan Pro) and mapping (Global Mapper) software packages, provided us with extremely high-resolution digital elevation models and orthomosaic composite images. One aspect contributing to the usefulness of these models was the minimal vegetation in both test areas, so that correction for tree height was not necessary. In addition, the paucity of vegetation makes it relatively easy to accurately trace individual geological horizons around the landscape, complementing initial ground observations. GPS-located ground control points distributed around the area further enhance geo-location and permit the overlay of accurate contour lines. The creation of these models allowed for fine-scale geological analysis, including identification of possible faults, and more detailed understanding of the overall location of fossils in 3-dimensional space.

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### **Fossilized starch shows Acheulean harvesting of yams 1.7 million years ago at Olduvai Gorge**

Hominin dietary ecologists study the impact of food extractive capabilities and subsistence adaptations in human evolution. The long standing hypothesis that plant underground storage organs (USOs) drove an essential transformation towards dietary savanization has traditionally encountered an empirical void partly filled through indirect data from bone chemistry, tooth wear, masticatory features, and the influence of food mechanical properties on predicted diet trends among primitive and archaic hominins. However, the fossil record contains no direct evidence of USO exploitation that could speak to the selective ecological processes underscoring the emergence of the genus *Homo*, mixed plant and prey diet, and multifunctional extractive tools embodied by the invention of the Acheulean handaxe. Here, we investigate exceptionally preserved plant fossils on the oldest Acheulean biface from Olduvai Gorge. Fossilized starch granules are abundant and document the utilization of tubers from *Dioscorea*, a forest climber. This is the only direct indication to date of hominin reliance on USOs and constitutes the first and earliest example of fossilized starches in the archaeological record. The preservation pathway was silica permineralization. The analytical methods deployed represent an advance over previous ancient starch research, and provide a broader perspective on diets where carbohydrate extraction from calorie-rich, predictable food sources now correct a meat-based view of dietary ecology during the early Pleistocene.

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### **Morphological reinterpretation of MH2 *Australopithecus sediba* pelvis based on a new virtual reconstruction**

The MH2 *Australopithecus sediba* pelvis is incomplete and fragmentary and consists of a right ilium missing the anterior superior and inferior iliac spines, two fragments of the right pubis, and a partial left pubis. The sacrum lacks its right ala and most of its left side. We virtually reconstructed the MH2 pelvis based on high-resolution 3D surface models. First, a large fracture in the antero-inferior iliac region was reduced. The fracture line was used as a reference to confidently realign the right hipbone fragments. The preservation of the symphyseal surfaces allowed a good fit of the right and left pubic fragments, which matched without interplay probably owing to an age-related reduction of the symphyseal fibrocartilage thickness. The hipbone was completed by morphing the A.L. 288-1 *A. afarensis* hipbone based on a dense configuration of landmarks and semilandmarks. The mid-sagittal plane for the entire pelvis was set at the best-fit plane of the symphyseal articular surface and coincided with the midsagittal plane of the right hemi-sacrum. The position of the sacrum was further adjusted with respect to the sacroiliac joint until the profile of the greater sciatic notch, the wall of the pelvic inlet and the arcuate line were continuous and harmonious. The missing sacral auricular surface was reconstructed based on the iliac auricular surface using a 2-mm gap at the sacroiliac joint. The StW 431 (*A. africanus*) sacrum was used to reconstruct the missing ala. Finally, we performed an additional reconstruction of the MH2 hipbone and sacrum using a female modern human pelvis for the missing parts, which did not change substantially the outcome. Differently from what previously thought, we found that *A. sediba* possessed an australopithecine-like pelvic morphology. We could not confirm the presence of modern features indicative of a derived mode of locomotion and birth process.

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### **Potential hominin affinities of *Graecopithecus* from the late Miocene of Europe**

The divergence of our own clade from the Panini is undocumented in the fossil record. To fill this gap we investigated the dentognathic morphology of *Graecopithecus freybergi* from Pyrgos Vassilissis (Greece) and *cf. Graecopithecus* sp. from Azmaka (Bulgaria), using new  $\mu$ CT and 3D visualizations of the two known specimens. Pyrgos Vassilissis and Azmaka are currently dated to the early Messinian at 7.175 Ma and 7.24 Ma. Mainly based on its external preservation and the previously vague dating, *Graecopithecus* is often referred to as nomen dubium. The examination of its previously unknown dental root and pulp canal morphology confirms the taxonomic distinction from the significantly older northern Greek hominid *Ouranopithecus*. Furthermore, it shows features that point to a phylogenetic affinity with hominins. *G. freybergi* uniquely shares p4 partial root fusion and a possible canine root reduction with this tribe and therefore provides potential evidence of the oldest hominin.

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### **Homogeneity and variability in the Acheulean: preliminary results from the Garba I assemblage (Melka Kunture)**

The 1960s and 1970s witnessed new quantitative and morpho-metrical approaches to the study of Acheulean stone tools that were strongly tied to typological concepts and the definition of “biface” technologies. While the presence of distinctive bifacially-flaked, ovate and teardrop-shaped tools still dominates understanding of Acheulean assemblages, it is increasingly clear that traditional approaches frequently fail to account for the true complexity and variability seen within this technocomplex. The classical archaeological complexes are now being revisited from a renewed perspective in order to bring some modern information to bear on these debates and to explore the true diversity of Acheulean toolkits. In this context, Garba I, composed of more than 12,000 lithic artifacts constitutes the perfect corpus for this dialogue. Excavated between 1965 and 1975, it constitutes the richest and most unknown site of the Melka Kunture complex. Dated on the basis of typological criteria between 600,000 and 400,000 ky, it is with Isenya and level 7 of Olorgesailie, one of the greatest sites of a handaxe accumulation characteristics of the African Acheulean. Old data and new research have been put together to explore an old discussion from a new point of view.

The main goal of this project is to arrive, through the study of lithic material, at an understanding the human behavior during this period from the individual to the group and from local to the regional scale.

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### **Role of remembrance in the origin and growth of trade in northeastern Africa: the place of Ethiopia**

Ethiopia is well known for having a diverse array of commemorative monuments. Perhaps the most widely used of these monuments are standing stones and Fatichaas. The main objective of this paper is to examine the possible interrelationships between commemorative monoliths and Fatichaa erection practices which give away for trade in Northeastern Africa in general and Ethiopia in particular. This study makes use of evidence provided by historical and archaeological records, ethno and oral history, as well as symbolic and pictorial depictions. Standing stones are not exclusively used as funeral markers for valor (a prehistoric person with multiple merit), but also are used to venerate sacred centers or temples. Despite the fact that the erection of monoliths and Fatichaas have a long history in Northeastern Africa in general and Ethiopia in particular, no researchers have attempted to discover and make association between the erection of these monuments and the beginning of trade exchange in this region and the adjacent Gulf zones. The findings of our recent fieldwork suggest that these monuments and Fatichaas were erected for commemoration of hunters who possibly commence collecting a global trade commodity during the Late Prehistoric Period. This in turn, created a conducive situation and helped us to present a possible and a plausible deliberation as how the Northeastern African valor makes trade commodities accessible and initiates global trade transactions.

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### **New data on morphological and dietary evolution of *Elephas recki* from the Shungura Formation (Lower Omo, Ethiopia)**

The Shungura Formation is a Plio-Pleistocene paleontological site found in Southern Ethiopia, in the Lower Omo Basin. It is one of the best sites which is radiometrically well dated. It yielded abundant mammalian fossils, among which proboscideans (elephants and relatives) were common elements; at Shungura there were seven proboscidean species that went extinct during the Pleistocene. Given their size and this diversity, proboscideans are important for the reconstruction of paleoenvironments. I present a study of both diversity and paleoecology of these animals, more specifically on the species *Elephas recki*, very abundant at Shungura. Dental metric measurements were conducted on the original materials of Shungura. They were compared with morphological observations made on published and unpublished materials. Results from the biometric analysis indicate that different subspecies of *Elephas recki* show statistically significant evolutionary changes in terms of the biometric traits. Generally, the results show that there is no clear progressive increase in crown height. Instead, some sudden changes in morphological features and no progressive trends in the lineage of *Elephas recki* were observed throughout the Plio-Pleistocene of Shungura.

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### **Cranial Variation in *Theropithecus oswaldi*: A 3D Geometric Morphometric Analysis**

Species of *Theropithecus* are the most widely distributed group of non-human primates during the Plio-Pleistocene (Pickford, 1993; in N. Jablonski, ed. *Theropithecus*). Fossils of this genus have been found in Southern, East, and North Africa, the Middle East, Spain, and even India (Delson, 1993; in N. Jablonski, ed. *Theropithecus*). As a result, taxonomy of fossil *Theropithecus* species has been a topic of contention for several decades. Previous studies have mostly utilized qualitative features and standard 2D metrics. Here I examined one of the three lineages of *Theropithecus*, *Theropithecus oswaldi*, using 3D geometric morphometric methods to analyze cranial shape diversity within this lineage. *T. oswaldi* is generally thought to consist of three chrono-subspecies: *T. o. darti*, *T. o. oswaldi* and *T. o. leakeyi*, each of which has been debatably considered to be a distinct species in its own right. Therefore, I tested whether the different subspecies of *Theropithecus* can be differentiated based on shape data alone. A recently

described specimen of *Theropithecus oswaldi darti* (Seyoum and Alemseged, 2015; abstract, Amer. J. Phys. Anthropol., S60:284) was then used to test the validity of this method. Results strongly support the use of 3D GM methods in elucidating the taxonomy of this group. Furthermore, the amount of variation within the different subspecies of *Theropithecus oswaldi* was analyzed by comparing the morphological distance among them with that of two populations of the extant *Theropithecus gelada*.

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### **The newly discovered Early Stone Age site of Melka Wakena, Ethiopia**

The earliest (~1.7 Ma) Acheulian assemblages present a mosaic of lithic technological characteristics that bridge the Oldowan and Acheulian technological systems. The newly discovered site complex of Melka Wakena (MW) contains a series of assemblages that pertain to questions of the evolution, situational contexts and chronology of Early Pleistocene lithic technological variability. Situated at an elevation of >2300 m above sea level, ~8 km south of the Gadeb site, MW, along with Melka Kunture, is among the earliest hominin occupations located at the rift - plateau margin. Ten localities were found along a 2 km stretch of the Wabe–Shebele riverbank. Surveys and test excavations in 2014-2016 revealed paleontological and Early Stone Age assemblages. These occur in fluvial overbank conglomerates, sands, and silts interbedded with pyroclastic deposits. Three stratified localities were test-excavated. At MW1, two currently known dense archaeological horizons, containing well-made handaxes and cleavers are older than  $0.696 \pm 0.002$  Ma, based on  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of single sanidine crystals. In locality MW2, the four artefact-bearing horizons are constrained by  $^{40}\text{Ar}/^{39}\text{Ar}$  (sanidine single-crystal) dates to between  $1.617 \pm 0.003$  and  $\sim 1.337 \pm 0.003$  Ma. The two lower horizons contain mainly flakes, few large flakes and biface preforms, hammerstones and giant cores. Bifaces collected from the two top layers are roughly made compared to the MW1 artifacts. MW5 containing well-made bifaces, cores and flakes, is not yet dated. The small faunal collection derives from in situ archaeological localities and stratigraphically-equivalent exposures on the landscape, and represents a mixture of water and terrestrial environments.

Ongoing geological investigations in the site along with tephrochronology will help to constrain the depositional history of the site. Here we present the site and preliminary observations on the lithic assemblages, as well as their possible implications for understanding technological change at the MW site complex.

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### **A new reconstruction of the juvenile *Homo erectus* pelvis KNM-WT 15000 from Nariokotome, Kenya**

The Nariokotome boy skeleton KNM-WT 15000 is one of the most complete early hominin fossils ever found and is key for understanding *Homo erectus* biology. Nevertheless, the interpretation of its morphology is contentious. A reanalysis of the KNM-WT 15000 vertebral column revealed evidence for juvenile disc herniation rather than a congenital pathology, and alleged asymmetries in the rib cage could be resolved by a rearrangement of the rib fragments. The KNM-WT 15000 pelvis has been described as mediolaterally narrow with short superior pubic rami and modern human-like, vertically oriented iliac blades. However, these features are not observed in the recently discovered adult female *H. erectus* pelvis from Gona, Ethiopia, which presents a surprisingly wide biacetabular distance, long superior pubic rami and laterally flaring iliac blades. Part of this discrepancy might be attributable to the incompleteness of the KNM-WT 15000 pelvis. Moreover, these two pelvic specimens are not comparable in terms of developmental age, where KNM-WT 15000's triradiate suture is still unfused and the apophyses are missing. Here, we present a new reconstruction of the KNM-WT 15000 pelvic girdle performed using virtual techniques. The ilium and ischium were repaired by merging surface scanner-generated 3D-models of the right and left sides, which are differently broken. The remaining missing areas were integrated by morphing early hominin remains and modern

human pelves of the same developmental age. The head of the femur served as reference for reconstructing the acetabulum. In parallel, we realized a manual restoration using 3D-prints of the pelvis to assist our virtual reconstruction. Our outcomes show that a mediolaterally wider pelvis and more flaring ilia are well possible in KNM-WT 15000. This has implications for *Homo erectus* locomotion and body shape. Furthermore, it is compatible with KNM-WT 15000's long femoral neck as well as with recent suggestions for a wider inferior thorax.

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#### **Dental microwear texture analysis of the Middle Pleistocene hominin Eyasi 1 from Lake Eyasi, Tanzania**

The Eyasi 1 hominin from Lake Eyasi, Northern Tanzania, is believed to be associated with Middle Stone Age Industry and date to the Middle Pleistocene. We analyzed the dental microwear signature of the Eyasi 1 molar (LM2) to shed light on its diet. Scans of an area of 255 x 191 µm of the crushing, grinding facet 9 of the occlusal surface were taken at 100x magnification (with 0.17 µm lateral sampling interval and <0.002 µm vertical resolution) using the Sensofar Plu Neox confocal imaging (Paleoanthropology Imaging Laboratory, Tübingen University), following established protocols. The surface textures were characterized by 30 ISO-25178-2 texture parameters generated using SensoMap software. Microwear data were also collected for five recent human groups with diverse diets: 1) Chumash (Santa Cruz, California), predominantly consuming marine animal meat supplemented by terrestrial plant / animal resources, 2) Fuegians (Yamana Tribe, Tierra del Fuego), almost exclusively relying on terrestrial animal meat, 3) Arikara (Mobridge Site, South Dakota), predominantly consuming large game supplemented by a mix of wild and cultivated plants, 4) Khoesan (Oakhurst Shelter, South Africa), with a mixed diet of mostly terrestrial animal/plant resources in addition to marine resources, 5) Andaman Islanders (Port Blair, South Andaman), also with a mixed diet. Principal component analysis was used to compare the microwear textures of the samples. Results show clear separation of the comparative groups analyzed. Eyasi 1 fell outside the clusters of any of the comparative samples, but closest to the Chumash. The implications of these results for the diet of the Eyasi 1 specimen will be discussed in the context of other Middle and Upper Pleistocene remains from western Eurasia previously analyzed (El Zaatari et al., 2016).

El Zaatari, S., Grine, F.E., Ungar, P.S., Hublin, J.J., 2016. Neandertal versus modern human dietary responses to climatic fluctuations. PLoS ONE, 11(4):e0153277

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#### **The ROAD database and the MapModule - new tools to store and evaluate spatiotemporal data in human evolution**

The ROAD database is designed to store and evaluate spatiotemporally organized data related to human evolution and cultural development. The database includes for instance descriptive data on hominid fossils, faunal assemblages, vegetation, and artefacts including the geographical position, geological and stratigraphical background and age, as well as more derived datasets on climate, biome reconstructions, ecology, raw material, typology, and technology of artefact assemblages. At present, the database contains data on over 6,000 assemblages from more than 1,500 localities in Africa, Europe, and Asia with an age between 3 Ma and 20 ka. It therefore represents a valuable tool for research. The ROAD database is accessible via a web interface. A login is required.

In order to simplify access and to include data available in other (web-based) databases, we created a map interface. This MapModule allows running analyses across different databases. A toolbox is presently developed in frame of an INQUA initiative to install a series of tools for evaluation.

Both tools, the ROAD database and the MapModule will be demonstrated.

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**"To have and have not": lithic technology of the 2.4 Ma assemblage from A.L. 894, Hadar, Ethiopia**

It has long been recognized that the earliest Oldowan lithic assemblages (2.6-2.4 Ma) already present an understanding of stone fracture mechanics and of the technical know-how of stone toolmaking, including adherence to constant technical rules. The lithic assemblage from A.L. 894, a ~2.4 Ma archaeological locality in the Hadar research area of Ethiopia, is among the richest assemblages for this time period. The size of the assemblage combined with numerous refits provide an opportunity to further explore the technological abilities of the early stone toolmakers. The attribute and refit analyses of the assemblage show that while the goal of core reduction was the production of a large number of flakes, some of the identified technological behaviors raise questions about level of technological competence of the A.L. 894 toolmakers. Such observations may suggest lack of technological understanding or of technological knowledge. When placed in the context of coeval Oldowan sites, this can also reflect particular information transmission mechanisms that fixated technological behaviors unrelated to their effectiveness for the goal. Following the recent discovery of stone tools older than 3 Ma, such questions are framed within the discussion of the tempo and mode of the evolution of lithic technology.

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**Building public acceptance and interest in fossil hominin heritage in the Cradle of Humankind, Gauteng Province, South Africa**

The unique history of South African apartheid has led to a number of historical circumstances that have militated against broad public acceptance and interest in human evolutionary concepts. For the part of South Africans from historically disadvantaged backgrounds, in addition to limiting the scope of their learning to trade skills, the Bantu Education Act of 1953 did much to create an atmosphere of suspicion surrounding subjects that have been identified with colonialism (palaeoanthropology falling into that category). Between 1998 and 2008, the South African natural sciences curriculum underwent a major overhaul, including the introduction of human evolution into public classrooms. However, despite this and a series of highly publicized recent fossil hominin discoveries within and surrounding the 47,000-hectare Fossil Hominid Sites of South Africa World Heritage Site (informally known as "the Cradle of Humankind" or "the Cradle"), Gauteng Province, South Africa, local penetration of knowledge surrounding fossil hominins remains low. This paper presents and discusses the outcome of a pilot course of the fledgling National Geographic "Umsuka" Public Palaeoanthropology Project produced through the joint auspices of National Geographic and the African Digital Education Trust (ADET). The "Cradle Ambassadors" course pilot integrated knowledge of human evolutionary concepts and fossil hominin heritage with personal development training, meeting twice weekly for three weeks between 23 January and 7 February 2017 within the Cradle itself. While perfect understanding and retention of palaeoanthropological information presented a challenge, acceptance of human evolutionary concepts and interest in our fossil hominin heritage was increased substantially within the pilot sample. Pilot feedback indicates that demonstrating an interest and respect for potentially hostile or indifferent members of the public as human beings can be a vital first step to building the trust necessary to boost acceptance and interest in the science of palaeoanthropology.

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**Handbook of standards: documenting African collections**

Museums all over Africa and indeed all over the world have struggled with the documentation and standardization of their unique scientific and exhibition heritage collections for decades. In every country, private cultural institution, national museum, county and community repositories, documenters have been faced with this challenge. In Africa, since the launch of the 'Handbook of Standards: Documenting African Collections', the exercise to adopt the contents of this manual has been an uphill task. Firstly, because African curators and collection managers are not aware of the standards, and secondly there haven't been any forthcoming finances to implement them. This paper is meant to

bring awareness to the African fraternity, directors, collection managers, collection technicians, and museum lovers, of the standards that already exist. If adopted these standards, can bring better coordination of museums' collections documentation, research activities, and communication of information relating to our heritage research story among scholars and the world at large.

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### **Local people's perceptions of the scientific discoveries at Plio-Pleistocene sites: the case of Olduvai (Olduvai) Gorge and Laetoli, northern Tanzania**

For the past six decades (between the 1950s and 2010s) scientists from across the world have made scientific discoveries at Plio-Pleistocene sites of Olduvai Gorge and Laetoli in north-eastern Tanzania. Among many others, the discoveries included *Zinjanthropus boisei* at Olduvai Gorge (1959) and the hominid footprints (1976) hypothesized to be of *Australopithecus afarensis* at Laetoli. Some of these discoveries did not only shape scientists' understanding of the human evolution but also placed Tanzania in the world's paleo-science studies' map. Arguably, the discoveries were received differently by different people, especially evolutionists and creationists, whose perceptions are documented. While perceptions of scientists and creationists on the discoveries are recognizable, those of local people living at sites of discovery have never been investigated. This is where the current conference paper finds its place by investigating the local people's perceptions and attitudes towards discoveries at some selected Plio-Pleistocene sites in Tanzania. The research conducted between 2008 and 2015 involves personal observations, interviews and reviewing documents. Research results indicate that the local people living close to the sites are divided into two groups: the knowledgeable (simonism/mataloism) and the un-knowledgeable. The former group is aware of the discoveries' whereabouts, ready to learn whenever there is a new discovery, willing and ready to tell about the discoveries within their vicinity and to make sure that the knowledge is transferable to future generations. Hence, they have integrated the discoveries' narratives into their deep engraved history. On the contrary, the latter group looks at the discoveries as curses and interferences in their normal human-environment interactions. The group accuses discoverers of their scientific work and have gone further to destroy some of the establishments aimed at marking locations of the discoveries. These results imply that unless an integrative approach is designed to capture interests of all the stakeholders, Plio-Pleistocene sites and their material remains are likely to be destroyed.

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### **Phytolith reconstructed landscapes during Bed II at Olduvai Gorge (Tanzania)**

Hominin adaptations to changing environments and increasing aridity in East Africa are central to current palaeoanthropological debate, particularly in regards to the Oldowan-Acheulian transition. Reconstructions of past vegetation landscapes require a multi-disciplinary approach that includes paleoethnobotany, archaeology, and geoarchaeology to illustrate long term environmental trends observed in sedimentary sequences. Olduvai Gorge (Tanzania) contains bedded deposits of recognized value to address questions such as the habitat types that existed along paleo-lake Olduvai during the deposition of upper Bed II (1.5-1.3 Ma). Phytoliths are silica bodies that form within and between cells of different plant parts. When preserved, they can be used as a marker of plant family and ecosystem. These silica particles are morphologically distinct, consistent, and resistant to decomposition. In Olduvai Gorge, phytolith analysis has focused on reconstructing the diversity of landscapes that framed hominin evolution during Bed I and lowermost Bed II. However, almost no information exists about the middle to upper part of Bed II. This paper introduces ongoing doctoral phytolith research on three sites: 1) Sam Howard Korongo (SHK) (1.5-1.34

Ma), 2) Bell's Korongo (BK) (1.3-Ma), and 3) Thiongo Korongo (TK) (1.3-1.1 Ma). The lithofacies represented in these sites include both lacustrine, fluvial, and low energy channels and paleosols. Sampling procedures involved both a site specific and landscape approach; horizontally (spatial) and vertically (temporal) to reconstruct paleovegetation at each of the three locations. Sediments were also collected from trenches, according to stratigraphic layering and features. In the laboratory, sediment samples were sieved, dispersed, and treated with acids prior to heavy liquid separation. After phytolith extraction, counting and classification ensued, and morphometric characteristics were recorded as the basis to making ecological inferences and explain the environmental context of upper Bed II.

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#### **A survey of uncertainty in CT scanning of fossils**

CT scanning has become a major tool used to investigate fossil materials in the paleosciences. It has the advantage of being non-destructive whilst producing 3D images of a specimen and its internal structure. This reduces the need for handling and assists in fossil preservation. The resulting CT scan data is sometimes used to take measurements of features such as the diameter of a tooth canal or the density of the trabecular bone in a femur. There are a number of sources of uncertainty in these measurement values obtained from CT scans which emanate from the technique. These sources can be from the X-ray focal spot, the geometry used for scanning such as cone beam artefacts, positioning of the specimen on the rotation stage, or the detector alignment. The combination of all errors in a CT measurement gives an indication of the reliability of dimensional values obtained from the scanned data. As a result, the subject of measurement uncertainty has become a key area of research in computed tomography at the moment because the technique has become widely used in metrology in many different fields. We are investigating the measurement uncertainties involved in CT with the intention of determining the limiting values obtained from the technique which may be comparable to the amount of error. In this paper we give a survey of the sources of uncertainty and present some initial results from experiments where we have investigated the focusing of electrons on the target to produce X-rays. This affects the minimum resolution which can be obtained from the CT scan. In addition, we have investigated the effect of positioning the specimen on the rotation stage.

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#### ***Xenopithecus koruensis*: new insights on an obscure early Miocene catarrhine from Koru, Kenya**

*Xenopithecus koruensis* is among the first fossil catarrhines described from Kenya but the fragmentary nature of the holotype, and only known specimen, has resulted in uncertainty surrounding its validity and affinities. Following its initial description, *Xenopithecus* was quickly synonymized with *Proconsul*; now, it is regarded by some as a relative of the nyanzapithecine *Turkanapithecus*. Here, we present new information concerning the anatomy and systematic position of *Xenopithecus* that supports its distinctive taxonomic status. *Xenopithecus* upper molars show many unusual features relative to other early Miocene catarrhines, including undulating buccal crown margins, a strongly developed prehypocrista, and an extensive lingual cingulum shelf bearing a pericone that is connected to the protocone by an entoprotocrista. Although systematic information is limited by the fragmentary nature of the specimen, we reject an attribution of *Xenopithecus* to the Nyanzapithecinae based its broad crown, extensive lingual cingulum, small protocone, and strongly developed prehypocrista. Instead, we found aspects of this specimen that more closely resemble Oligocene stem catarrhines such as *Aegyptopithecus* and *Saadanius*: development of the lingual cingulum, the closely spaced trigon cusps, and undulating buccal crown margin. These similarities raise the possibility that *Xenopithecus* is one of the most primitive catarrhines from the early Miocene of Kenya, and that our understanding of late Oligocene and early Miocene "transitional" primate faunas in East Africa is still only rudimentary.

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#### **An ethnographic study of hunter-gatherers of India: special reference to Van-Vagris of Rajasthan, India**

This paper aims to shed light on the traditions and lifestyle of Van-Vagris, a hunter-gatherer tribe from Rajasthan, India. The first and only comprehensive study on the Van-Vagris tribe was undertaken in 1985 by V. N. Mishra (Mishra 1985). The author in this paper aims to update the changes that the tribe has undergone since 1985 in terms of adaptation, including their migration patterns. Such ethnographic studies can prove beneficial to understand the way of life of the foraging cultures in the present context and the manner in which they adjust with the local resources within the Indian subcontinent. It also helps us understand the prehistoric Hunter-Gatherer tribes. Key Words: \* Van-Vagris: Also known as Van Vavri and Bagri. Vagris are hunter-Gatherer tribe of Rajasthan, India. They live near by the district of Nagaur and its neighboring regions, Rajasthan (India). \*Adaptation in Thar Desert: Thar desert region in Rajasthan is characterized by the absence of perennial streams, scanty and erratic rainfall, extreme scarcity of portable water, hot, windy and dusty summers, sand-dune covered rocky landscape and sparse population. So, it is important to observe the adaptation patterns followed by these settlements according to various seasons. \* Nomadism: Tribe that has no permanent abode but moves about from place to place, usually seasonally and often following a traditional route or circuit according to the state of the pasturage or food supply. \*Socio-Economic Transition: The sequence of changes which change the face of socio-economic structure of the tribe through the time period. \*Association with neighboring Societies: Interaction of the Bagris with other societies and rate of dependency on their neighboring settlements.

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#### **Mang'ua and Kikole: a forgotten nineteenth century caravan halts in south-western Tanzania**

Cultural heritage in Tanzania has been facing various challenges that affect its longer sustainability. More efforts in conservation have been put towards natural heritage and on the popular cultural heritage sites such as Olduvai Gorge with less consideration to other cultural heritage assets for various reasons. This paper aims to create awareness by various institutions, government, private sector, international communities, as well as local community of the potential cultural heritage assets found in among of nineteenth century caravan halts located in south-western Tanzania. Mang'ua and Kikole caravan halts possess the archaeological evidence of cultural, historical, architectural, educational and economic significance which necessitate their conservation. The current study conducted at those two study sites, yielded both movable and immovable evidence indicative of caravan trade in nineteenth century. Through survey and excavation a lot of European beads, imported pottery, glass bottles and metal objects were obtained at the study sites. Moreover, through survey and direct observation a lot of deteriorating house ruins built during the nineteenth century were recorded. These were built by Arab traders led by Rashid bin Masudi who settled at the study sites before matching to the Indian coast. It was found that, apart from the potential significance they possess, the caravan halts (Mang'ua and Kikole) are in a bad situation in terms of conservation and management. Currently, some standing ruins of 19th century caravan trade at Kikole site are deteriorating at an alarming rate and there are not any conservation measures which are taking place to rescue them, leaving aside socio-economic activities taking place at the site which affect both intrusive and extrusive cultural heritage assets. The study recommends serious actions to be taken over those caravan halts for maintaining their values.

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#### **Excavation of Nunge Salt-work archaeological site: Pre-Kaole town settlement at Bagamoyo**

Bagamoyo area is famously known for its ancient interactions with the outside world (beyond Africa) back to the last few centuries of the first millennium AD. Archaeological reports about Bagamoyo area date back to the 1950s with the works of Chittick (1958-62, 1970) and Mturi (1974) who centered much of their works at the Kaole Ruins. Other works within the vicinity include the Archaeology Unit, University of Dar es Salaam 1988 Field School and Department of Antiquities' field expeditions in the 2000s. The latest major reported excavation works are those of Chami at Kaole (1994, 2002) and finally at Caravan-Serai by the same scholar (2004). Past investigations suggest that the Bagamoyo area was settled by iron working people as far back as 600- 700 AD, but consolidations into town-like centers may have taken place around the 12-13th centuries at Kaole. While most of previous works show Bagamoyo's involvement with the outside world since the last few centuries of the first millennium AD, excavation of the Nunge Salt-works suggests that from 9 to 11th Century AD Bagamoyo somehow lost this international influence. In that time frame, the Nunge Salt-work area seems to have developed into an extensive urban settlement, an

attribute that leads to a suggestion that development to urbanism at Bagamoyo predates the Kaole town, apparently when the area had little evidence of interaction with areas outside the African continent.

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**A collaborative Pan-African approach in support of Palaeoscientific research, training, and public outreach**

During the 3rd East African Association for Paleoanthropology and Paleontology (EAAPP) meeting in Addis Ababa, the Palaeontological Scientific Trust (PAST) spearheaded discussions aimed at strengthening existing partnerships between African institutions that are deeply embedded in the pursuit of palaeoscientific research and its dissemination to the public. Through the support of PAST and DST-NRF Centre of Excellence in Palaeosciences (DST-NRF CoE Pal), the National Museums of Kenya (NMK), in 2016, hosted a workshop drawing participants from Kenya, South Africa and Uganda with the goal of framing a collective strategy for identifying and overcoming challenges as well as facilitating skill exchanges in curation, digitization, casting and public outreach. Triumphs of the initial event include identification and articulation of common as well as unique challenges, exchange and adoption of new approaches to casting, integration of new avenues of public outreach, adjustment of curation practices and facilitation of fieldwork personnel exchange. The successes of this workshop call for expanded future workshops incorporating more institutions that will form a unified voice among palaeoscience institutions across the African continent.

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**Holocene environmental reconstruction from the Galana Boi Formation, East Turkana**

During the Holocene, the East African region experienced rapid climatic events driven principally by orbital forcing and the monsoon insolation. The most prominent event recorded is the African Humid Period (AHP) during the early Holocene (~10ka to 8ka). The mid-Holocene (~8ka to 5ka) was characterized by rapid shifts between wetter and drier climates. Dry climates have so far been consistent since late Holocene to present. Archaeological evidence from the Holocene deposits, the Galana Boi, indicate changes in subsistence activities from hunting, gathering and fishing during the early Holocene wetter period, to pastoralism in the mid-late Holocene period. High mobility and resource exchange is also associated with drier climates. Little is known about the vegetation structure and the response to changing climates. This paper presents phytolith data analyzed from five Holocene sites occupied during different time periods: FxJ108 (~9.6ka~6ka), FxJ27 (~9.3ka to ~4.2ka), GaJ4 (~4.2ka), FwJ25 (~4.2ka to ~1.34ka) and FwJ5 (~0.93ka). Although phytolith counts were low, especially grass short silica cells (GSSCs), it was possible to identify changes in vegetation structure/habitats and their temporal variation using both a general abundance approach and phytolith indices: aridity index (Iph) and tree density (D:P). Our data show that Holocene vegetation structure was generally dominated by woodlands/shrublands with some grasslands. However, early and mid-Holocene assemblages had significant proportions of aquatic indicators: palms, sedges, sponge spicules and diatoms, which suggest the existence of riverine/riparian habitats with fresh/spring water resources and episodes of seasonally high humidity. Late Holocene assemblages indicate grasslands dominated by Chloridoideae arid grasses that have persisted to present. Iph index shows high variation especially during the mid-Holocene period while the D:P indices have shown the tree cover was mostly moderately to highly dense, which resembles present day Sudanian vegetation structure (grassy woodlands/shrublands). The results concur with previous studies, that Holocene climates were highly variable.

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**The systematics, taphonomy and paleoecology of rodents from Plio-Pleistocene Hadar localities A.L. 437 and 327**

Since Maurice Sabatier (1984) first described the rodents of Hadar there has been no systematic review. This presentation describes three new assemblages of fossil micromammals from hominid bearing localities A.L. 437, A.L. 327N and A.L. 327S at Hadar, Ethiopia. The dates for these sites range from approximately 3.4 mya (AL 327 N and S) to 3 mya (AL 437), and represent some of the oldest micromammal accumulations in Ethiopia. We review the systematic status of rodents from these assemblages and summarize the paleo-biodiversity and paleoecological implications of the Hadar faunas. Our analysis is enhanced by an interactive web-based identification key developed for this analysis. We discuss the implications of computer-assisted identification methods for standardizing the process of fossil identification and for understanding character state distributions among rodents. Lastly, we report on a preliminary taphonomic comparison of the three micromammal accumulations, examining patterns of breakage, preservation bias, and gastric etching present at each locality. The taphonomic analysis suggests that the AL 327 N and S assemblages occur as a result of avian predation, while AL 437 does not. The differences in taphonomic history of these 3 localities may provide a unique opportunity to compare taphonomic preservation biases in the fossil record.

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### **Suid remains from two early *Homo* sites: Ledi-Geraru, Gurumaha Fault Block, Lee Adoyta, and Makaamitalu, Busidima Formation (Afar, Ethiopia)**

*Homo* remains prior to 2.0 Ma, other than molars, are not abundant in Ethiopia but from the Lower Awash Valley (LAV) there is a fairly well-preserved maxilla, AL 666-1 (2.35 Ma), found in the Busidima Formation and a left hemimandible, LD 350-1 (2.8 Ma), found in the Gurumaha Fault Block of the Ledi-Geraru Research Area. An important issue surrounding these discoveries is to answer the question of what habitats were occupied by these hominins. Here we present preliminary results on fossil suid fauna from these two sites and describe the possible habitats that they occupied. The suids recovered from deposits of 2.8 Ma are different from those found in the Hadar Formation 3.4-2.95 Ma. These suids include possibly the earliest appearance in the region of more derived species such as *Kolpochoerus phillipi*, *Notochoerus capensis*, *Notochoerus scotti*, and *Metridiochoerus andrewsi*. The Busidima Formation at 2.35 Ma records possibly one the first appearances of *M. modestus*. The lower abundance of suids (7-8% in Ledi-Geraru in comparison with Hadar, 14-15%) and the appearance of taxa adapted to more open environments are an indication that new habitats were present in the latest part of the Pliocene and the Early Pleistocene that may have catalyzed the evolution of early *Homo* or its migration into the region.

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### **Variability of backed pieces in the Horn of Africa during the Late Pleistocene and Holocene**

Classical definitions for the Later Stone Age (LSA) in Eastern Africa often include the presence of microlithic industries. However, what can be considered “microlithic” is hotly debated. “Backed pieces”, on the other hand, is a more inclusive category and corresponds to a type of retouch that can be objectively identified. The use of this broad category thus allows for more comprehensive diachronic comparisons of implements, regardless of their size. Backing is usually associated with a change in hafting solutions and the development of composite tools, which may be in large part linked to projectile technologies. In Late Pleistocene and Holocene assemblages, backing became a widespread technical process, and this is why backed pieces are generally considered a hallmark of the LSA. However, the association of the LSA with backed pieces appears less clear in Eastern Africa than in other regions. Backed pieces are present in assemblages with otherwise distinct Middle Stone Age characteristics and most assemblages attributed to the LSA (ca. 50-2 ka) include a great diversity of backed pieces, along with other, more common types of tools. The homogeneity of the “backing phenomenon” in this region can thus be questioned: does it represent an innovation that subsequently spread? a series of independent innovations? expressions of functional or stylistic variability? Here we present a review of the context in which these backed tools occur, with a focus on the Horn of Africa. We propose a comprehensive set of attributes and statistical methods to discriminate different groups within the backed tool population. Our classification system which is based on objective grounds allows us to get rid

of equivocal terminologies and to make inter-site comparisons more useful in order to discuss some of the hypotheses for the variability of backed pieces in the Late Pleistocene and Holocene.

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### **Dietary versatility in early *Homo* and *Paranthropus* from southeast Africa**

Diet is key to the adaptive evolution of early hominins and is responsible for significant behavioral and ecological differences among humans and other primates that are linked to the development of East African savannas, which range from closed woodland to open grassland. Plio-Pleistocene sediments of the Chiwondo Beds (Karonga Basin, Northern Malawi) contain fossils attributed to *Homo rudolfensis* and *Paranthropus boisei* (~2.4 Ma). The Karonga Basin is situated south of the ITCZ and lies between hominin bearing sites in the Eastern Rift and Southern Africa. We perform stable carbon and oxygen isotope analysis of fossil tooth enamel to draw conclusions about the diet of these early hominins. We supplement  $\delta^{13}\text{C}$  values from pedogenic carbonate with data from fossil enamel of various herbivores (suids, bovids, equids), and we perform  $\Delta 47$  thermometry as a proxy for paleosol temperature. Finally, to explore new approaches to ecosensitivity, we identify how the element composition of modern humans is linked to environmental variability. Consistent  $\delta^{13}\text{C}$  values around  $-9\text{C}^\circ$  from pedogenic carbonate and suidae enamel spanning the last 4.3 Ma indicate a  $\text{C}^3$ -dominated environment. Presence of specialized grazers with more positive  $\delta^{13}\text{C}$  enamel values around  $-1\text{C}^\circ$  is indicative of patches of  $\text{C}^4$ -grassland. The fraction of woody cover (>60%) near Paleolake Malawi reflects higher canopy density in the Malawi Rift than in the Eastern Rift. The discrepancy between the two savanna types increases starting in the Late Pliocene, when the Somali-Masai ecosystem developed to an open,  $\text{C}^4$ -dominated landscape. The appearance of  $\text{C}^4$ -grasses is considered a driver of evolutionary faunal shifts, but despite differences of ecosystem evolution, similar hominins occurred in both landscapes, suggesting habitat flexibility and nutritional versatility. Eastern African *Paranthropus boisei* shows a  $\text{C}^4$  dominated diet, in contrast to known living and fossil hominoids, providing a point of comparison for the Malawi Rift hominins.

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### **Structure and variability in Levallois technology in the Middle Stone Age of Kenya and Ethiopia**

Levallois prepared core technology is a defining component of the African Middle Stone Age (MSA). With its origins in late Acheulian contexts, Levallois technology diversifies in the Middle and Late Pleistocene to become a prominent and widespread feature of the MSA. The diversification of Levallois methods provides some of the earliest evidence for the elaboration of behavioral variability that develops during the MSA and features prominently in debates on cognitive evolution and changing economic and mobility strategies. Despite a long history of research, the spatial-temporal structure of Levallois variability in the East African MSA remains poorly understood. As one of the most ubiquitous and identifiable components of MSA assemblages, Levallois artifacts are an important source of data for studying the behavioral developments of the Middle-to-Late Pleistocene. Establishing how this behavior is patterned is an essential first step. Generalizations about the presence or absence of particular Levallois types and their frequencies are insufficient for this goal. This study presents the results of a quantitative analysis of Levallois cores and flakes from fourteen Middle and Late Pleistocene MSA assemblages across Kenya and Ethiopia. Multivariate analysis of technological attributes representing stages in Levallois knapping behavior (core morphology and management, core exploitation, the exploitation of dorsal convexities, and the management of platforms) is used to identify the structure of Levallois variability in space and time. The resulting “technological clusters” represent the main dimensions of Levallois variability. These clusters are also being explored for relationships with potential causal factors, including raw material, reduction intensity, environment, “interaction ranges” (inferred through raw material transport distances), and the constraints of Levallois geometry, to better understand the drivers behind Levallois lithic behaviors.

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### **Celebrating the heroes of African prehistory**

Palaeontological and archaeological sites scattered across the African continent have yielded an unparalleled record that has contributed significantly to our understanding of the evolutionary history of many faunal species. The human fossil material has, particularly, placed the region as the birth place for humanity. Work to unearth more material to help bridge gaps in the human evolutionary tree continues to date. This work involves Principal Investigator/s (PIs), collaborating researchers, and contingents - a host of research assistants (sometimes referred to as Fossil Hunters). The research assistants who are largely citizens of the countries in which the research work is undertaken play a very significant role in the successful completion of the projects. They are the people who set up research camps, carry-out excavations, and most importantly find the many fossils and artefacts recovered during the field seasons. Some of the research assistants also take-up administrative duties, which include over-seeing field-work. Despite the important role that research assistants play, they are inadequately recognized – including when they make important discoveries. Much of the credit has been accorded to the PIs who, although they are the leaders of the projects, may not have been physically involved in the discovery of the materials. In order to appreciate the many African research assistants who have contributed significantly to our understanding of the evolutionary history of human and non-human fauna, an event to celebrate these important people was held in Nairobi, Kenya between the 28th and 29th July, 2016. It is the intention of this paper to report on this important event.

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### **Reporting on a newly discovered Acheulean and MSA Assemblages in Karatu, Northern Tanzania**

This paper reports the discovery of a rich assemblage of artifacts some 12 km west of Karatu, Northern Tanzania. The artifacts are littered on the surface of a plateau which is flanked to the north by the lower foot hills of the Ngorongoro Crater Highland (NCH) and to the south/southwest by a ridge dominated by two hills locally known as Samaray and Durgeda. Conceivably both the plateau and the southern ridge may have been part of the lower foot hills of the Crater Highlands before subsequent faulting created valleys which separated the area from the southern ridge and formed the main drainage system in the area. Occupying the valleys are two rivers, Qaru and Laja to the east and south respectively, before their confluence to become the Khosi and eventually drain to the Lake Eyasi graben. The area seems to have been eroded, consequently leaving many of the artifacts resting on the surface with little stratification. The artifacts are in such mint condition that they could not have been exposed for more than ten years, perhaps being eroded out during the El Nino rains. Being dominated by bifacial tools which fall into two sizes: large and diminutive (LCT and SCT), the assemblage has been tentatively interpreted as Acheulean/MSA. The prevalent technology, levallois, also suggests Acheulean/MSA attribution. The raw material is predominantly quartzite. The discovery has several implications, including not only widening our knowledge of the distribution of the Acheulean in Tanzania in particular and the East African Rift in general, but also demonstrates the relationship of the Acheulean and the later bifacial-rich industries of the MSA. Extensive future work is necessary in order to eco-stratigraphically contextualize the assemblage and to augment the sample to facilitate techno-typological characterization of the assemblage.

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### **Faunal signal and Oldowan occupation: spatial analysis of faunal composition of Member E and Member F of the Shungura Formation**

The Shungura Formation is a rich fossil-bearing paleontological site in Ethiopia, Eastern Africa. More than 55,000 fossils have been found since the 1960s by two research groups. The International Omo Research Expedition (IORE) worked from 1967 to 1976 and collected around 90% of the known specimens. The remaining part has been collected by the Omo Group Research Expedition (OGRE) since 2006 with a more restrictive protocol especially for fossils with indeterminate taxa. The fossiliferous outcrops are widespread and encompass 12 geological members

from around 3.6 Ma to 1 Ma. The locations of the fossil sampling sites are known with a degree of accuracy and they lend themselves to spatial comparisons of faunal assemblages within and across members. The Shungura Formation is also characterized by an Oldowan occupation limited to Member F and to the lower part of Member G (2.3 Ma to 2 Ma), although hominid remains are continuously present from Member A to Member L (from 3.6 to 1 Ma). We first analyzed the whole IORE and OGRE data corpus to investigate sampling biases. We then focused on Member E and Member F to study the faunal composition at member level and to identify if the Oldowan occupation could be associated to a particular faunal signal.

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### **The Middle Stone Age site of Negus Kabri, Asbole, Ethiopia**

Levallois and point technologies have long been considered a defining aspect of the Middle Stone Age in East Africa. Here we present a Middle Stone Age lithic assemblage from Negus Kabri which was discovered and excavated in 2006 as part of the Asbole Research Project in the Afar region of eastern Ethiopia. The site consists of a single artifact horizon rich in lithics but with poor faunal preservation. Site formation data suggest an intact deposit near the top of the Busidima Formation in Bironita-Duma Ridge. Stratigraphically, the deposits lie approximately 1m above a plateau-forming gravel, which in turn lies just above the widespread Bironita Tuff (0.64 Ma). The artifact horizon also lies 10 meters below a local tephra layer, which we call the Negus Kabri Tuff and which yielded a  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  date of  $144 \pm 23$  ka. The assemblage itself is dominated by centripetal Levallois technology with highly standardized cores. Points are the most common group of retouched artifacts, and these are made preferentially on Levallois flakes. The raw materials consist of locally available, coarse-grained volcanics, some cryptocrystalline silicates, and fewer obsidian artifacts. For the locally available raw material, the complete reduction sequence appears to be present. The other types of stone were imported already reduced. This paper describes the excavation, stratigraphic context, and lithic assemblage of this new Early Middle Stone Site from Negus Kabri.

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### **Archaeological evidence of food production practiced during the nineteenth century ivory and slave trade in southern Tanzania**

Historians working in East Africa seem to agree that the nineteenth century ivory and slave trades had an impact on the human subsistence strategies practiced along the areas where these caravans passed. Based on historical documents, it is argued that the societies had to intensify food production to feed the passing caravans. To determine the validity of this argument, an archaeological study was conducted on one of the caravan routes (southern route) to see whether archaeological evidence would provide a broad picture of this ongoing debate. Two methods for data collection (excavation and flotation) were used to recover the archaeobotanical materials from two sites located in southern Tanzania (Mang'ua and Kikole) which were inhabited during the nineteenth century caravan trade. The archaeobotanical materials were later analyzed using a stereoscopic light microscope. It is apparent from the laboratory analysis that the study provided evidence of crop species produced and consumed during the height of the nineteenth century caravan trade. These crops include: maize, rice, finger millet, pearl millet, coconut, legumes and so on. The results obtained from this study indicate that the society relied on the production of both foreign and local food crops. Asian rice and African crops recovered in the studied sites have implications for the importance of food in the community's diet. Furthermore, the study shows that the community had no choice regarding a single crop for production; rather the production was done to satisfy the rising demand for food in the society.

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### **Using GIS and 3D photogrammetry to understand the formational history of surface lithic assemblages in Koobi Fora, Kenya**

Surface scatters provide a way to investigate hominin behaviors over broad spatial scales. However, the behavioral relevance of such assemblages is heavily dependent on the influence of the post-depositional processes. Continued development of geospatial technology and unmanned aerial systems (i.e. drones) provide new ways to better characterize and describe the role of geomorphic processes on the formation of surface assemblages. In this study, we examined the null hypothesis that the compositions of surface assemblages reflect modern geomorphological processes as opposed to hominin discard patterns. To do so, the formational history of lithic surface assemblages from the Koobi Fora Formation, Kenya were characterized using aerial photography, 3D photogrammetry, and GIS techniques. Subsequently, regression analysis was used to determine the correlation between variables such as artifact condition (i.e. preservation), scatter density, mass, and geomorphic surface characteristics such as slope and erosional potential for two localities from the Okote Member (FxJ 34 and FxJ 46). The lack of significant or strong correlations between artifact variables and present geomorphic conditions suggests that patterning in mapped distributions of stone artifacts reflects hominin discard behaviors rather than the outcome of hydrological processes. These assemblages have likely undergone some processes of winnowing and deflation of surrounding sediments. However, the horizontal association of these artifacts remains relatively undisturbed and therefore reflects past landscape scale behaviors.

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### **Macroscopic investigation of raw material properties: comparisons with mechanical properties tests**

Selection of certain rock types for the production of stone artifacts is a consistent feature of Oldowan technological organization. One of the biggest challenges, however, lies in quantifying the technologically relevant characteristics of stone. Experimental knapping can provide some insights into the qualities of stone, however, given the variability in rock properties it is difficult to relate these to archaeological materials. Insights from knapping experiments are often difficult to quantify because of the difficulty of controlling the numerous independent variables. Visual inspection of rocks has often been used to identify key features related to stone knapping ability. These visual inspections are usually related to the size and variation of crystals, especially in igneous rocks. This is particularly evident in the igneous rocks that make up the majority of Early Stone Age assemblages in East Africa. Visual properties of stones can be quantified using image analysis (ImageJ 4.x). Here we investigate the relationship between mechanical properties of specific raw materials (as measured by Leeb hardness and Young's elastic modulus) and certain visual features related to the size and shape of phenocrysts. To investigate this, 66 sections of 6 raw materials used by Oldowan hominins at the site of Kanjera South (Western Kenya) were prepared and 1,986 microscope images of these sections were analyzed with Image J to document features of the phenocrysts. This size and shape of crystals appear to be directly correlated with the elastic modulus of stones. Leeb hardness has a weaker relationship with visual properties of these rock types. This methodology can be directly applied to archaeological materials and can provide a non-destructive proxy measure of the variation in rock mechanical properties in an archaeological context.

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### **Revisiting the Sirikwa: heritage loss and survival in Kenya's western highlands**

This region of well-watered pastures interspersed with forest is known archaeologically for its vast numbers of saucer-shaped depressions, 10 m or so wide, occurring in groups on slopes overlooking springs or streams. These

hollows and associated mounds, together with stone walling in some localities, were named after a legendary people called Sirikwa. A broad survey in the early 1960s recorded well over a hundred Sirikwa sites containing several thousand such hollows. Excavations revealed their original form as stoutly fenced cattle pens with dung heaps positioned outside the guarded gate and round thatched houses or herd boys' huts attached. Since they date between three and seven centuries ago, they are obviously relevant to the history of the recent people of the region, the Kalenjin and, indirectly, the Maasai. Half a century later the landscape has been transformed, owing to exponential population increase combined with a land-holding revolution with a massive expansion of cultivation across the previously untilled grasslands and bush cover. A revisit in 2015 documented that virtually all sites reported in the 1960s have suffered damage if not complete eradication. There are rare examples of sites, mostly under bush, that have suffered minimal disturbance. We are recommending to the National Museums of Kenya that some of these should be gazetted for permanent protection following negotiations with landowners and district administrations, including the involvement of local communities. Such conservation should serve the dual purposes of heritage awareness and renewed research, since Sirikwa hollows and their surrounds still have enormous potential for understanding the environmental history of the region.

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### **Teaching styles, challenges and best practice for teaching palaeontology and archaeology in Eastern Africa: the experience from undergraduate and postgraduate students in Tanzania**

Generally speaking, the teaching of disciplines such as paleontology and archaeology in Eastern Africa is new when compared to other regions such as those of Europe and America. In the Eastern African region for instance, the teaching of archaeology started about four decades ago and the syllabi have remained a "copy and paste" of American and/or European ones. In a similar vein, teaching styles including fieldwork programs follow a European-American norm – differences in learning background and/or environment notwithstanding. In some exceptions where new syllabi have been developed, the consumers of such planned knowledge have never been listened to due to reasons well known to those European-American trained professors. Consequently, based on the ongoing discussions on social media sites such as Facebook and Twitter, students and graduates feel like they made a wrong choice and wish they had not joined the University. With this summarized situation, questions for inquiry are: a. what are the expectations of undergraduate students while joining universities to pursue their Bachelor's degree in archaeology and the cognate discipline? b. how does the syllabus and practical training meet the students' expectations? c. how does meeting and/or not meeting these students' expectations affect their future professional carrier and, d. in which ways do results of all these affect future enrollment of archaeology students at the department level? Our presentation answers these questions based on our experience as students of Archaeology at the University of Dar es Salaam and outside the University.

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### **Photogrammetric comparisons of footprint morphology of the recently discovered hominin footprints at Laetoli with the G1/G2-3 hominin prints**

The discovery of the 3.6 million year old Laetoli footprints was one of the most significant advances in our understanding of human position behavior and the evolution of bipedalism. In addition to confirming that human ancestors were already fully bipedal 3.7 million years ago, gait patterns and pedal morphology of australopithecines may have varied dramatically as evidenced in *Au. afarensis*. Preserved trackways, like those at Laetoli, provide a snapshot of early hominin mobility and its paleoecological context. The recent discovery of additional, markedly larger, contemporaneous hominin footprints southwest of the Site G hominin footprints provides a critical comparative dataset to test hypotheses about Pliocene hominin locomotion and ichnotaxonomy. Utilizing photogrammetric imagery and modeling, we compare and contrast the qualitative morphology of the two sets of trackways, as well as the gait patterns, directionality, and stature estimates of the individuals responsible for creating the trackways. There are several affinities both morphologically and taphonomically between these two trackways, but footprint size

differences seen between these two sets of trackways can be associated with great differences in body size, which could be indicative of either the presence of more than one hominin species at Laetoli, or a singular species with significant dimorphism.

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### **Fossil footprints at Gombore (Melka Kunture, Upper Awash, Ethiopia): a rare snapshot of Pleistocene environments**

Gombore is a gully of the Melka Kunture archaeological complex, at 2000 m asl in the Upper Awash Valley of Ethiopia. During the last decades, many sites were unearthed along the fluvial incision, revealing a long archaeological record from ~1.7 Ma up to the time of the Middle Pleistocene Transition, i.e. over approximately one million years. In recent years, the research of the Italian Archaeological Mission brought to light layers containing fossil footprints. At Gombore II OAM and Gombore II-1 (0.85 Ma), Gombore II-2 and Gombore X (0.7 Ma), as well as at Gombore III (0.6 Ma), sediments turbated by biogenic structures have been evidenced both during excavations and through the revision of original pictures kept in the archives of the Mission. Overall, ichnosurfaces are quite rare in the Pleistocene record. This is the first time they are reported from Ethiopia. Footprints are a first-hand source to reconstruct past environments. They provide direct evidence of the behavioral patterns of species that happen to be underrepresented or not represented at all in the fossil record, producing a different picture of the prevailing animals in the general environment. We underline that special attention is required to identify and investigate this precious but fragile record, as well as a specific methodology and a documentation protocol supported by modern technology.

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### **Late Quaternary diatom and palynomorph stratigraphies and palaeoenvironments of the Koora Graben and Lake Magadi Basin, Kenya Rift Valley**

Two sets of cores were recovered from the Southern Kenya Rift (Koora and Magadi basins) through the Hominid Sites and Paleolakes Drilling Project and the Ologesailie Drilling Project. These contain a detailed environmental history for the later Quaternary with records of up to 1 million years. This period correlates with much of the Ologesailie Formation record of 1.2 Ma in the Ologesailie Basin. The Magadi cores reached trachyte at ~ 194 and 133 m with this project focused on the longer core, MAG14-2A, which includes limestone, zeolitic laminated and massive clay and silt, massive mud, chert, trona, gravel and sand. The Koora Core (OLO12-1A) extended to depths of 166.14 m, with laminated and massive diatomites, fine to coarse sands; lime and siliclastic muds with pumice-rich gravels. The two cores are particularly important because they provide environmental records that help to fill erosional gaps in the history of the Ologesailie basin, which includes important evidence for changing hominin cultures and evolution. The high-resolution lacustrine-terrestrial stratigraphies of the two basins have shown how landscapes were transformed because of complex interactions between tectonic and climatic processes. Volcanism

also had a significant impact, partially damming lakes at Ologesailie. Diatoms are present in much of the sequence with a variety of planktonic *Aulacoseira*, *Cyclotella* and *Thalassiosira* taxa being very common in both basins. Species comprising these genera and benthonic and epiphytic taxa preserve a detailed record of lakes that fluctuated in depth, extent and chemistry. The data document the presence of freshwater and saline lakes as well as wetlands. Diatom transfer functions from the Koora and Magadi basins indicate that these water bodies fluctuated widely in conductivity between ~200 to >20,000  $\mu\text{S}/\text{cm}$ , with pH changing between about 7.5 and 11.5. The paleolakes also periodically exceeded diatom tolerance limits and intermittently dried out. Pollen are generally lacking in the Koora basin sediments, but deposits in the Magadi core contain common pollen that document a wide range of habitats, including forests, woodlands and grasslands that could have supported the presence of hominins and their activities in the region. Fungal spore data support pollen inferences and indicate periods when large mammals might have been common.

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#### **Understanding vegetation structure in modern ecosystems; implications for hominin landscape dynamics**

Understanding parameters of vegetation structure, such as the degree of woody cover, in contemporary ecosystems is crucial for reconstructing past ecosystems of hominins and other vertebrates in the Neogene of Africa. Although global and regional scale variation in woody cover have been addressed previously, there is a need for high spatial resolution studies that look at habitat-scale variation across latitudinal and altitudinal gradients. As paleosols are well-preserved in the fossil record and are commonly used in reconstructing past ecosystems, a detailed study and a more comprehensive understanding of modern soils at a high spatial resolution is important in establishing a baseline for interpreting paleosols and their associated vegetation structure. Thus, here we report on variation in stable carbon isotopic composition ( $\delta^{13}\text{C}$ ) of soil organic matter recovered from different habitat types with varying canopy cover and height from the Nech Sar National Park, Southwestern Ethiopia. Surface soil samples were collected from four different habitats (riverine forest, woodland, wooded grassland and grasslands) and hemispherical photographs were taken at each sampling location to quantify the associated canopy cover. Stable isotopic analysis was conducted using an EA-IRMS and woody cover was calculated from the hemispherical photographs using GAP light analyzer imaging software. In addition, phytolith samples were extracted and phytolith undulation and proportions were calculated. The results show significant differences in the signals recorded from the four different habitat types. The proportion of woody cover calculated from the hemispherical photographs and aerial photographs also shows significant differences between the four habitat types. More detailed study of differences in vegetation structure from other undisturbed ecosystems in Eastern Africa across climatic and altitudinal gradients will help us to better understand and quantify these habitat level differences and will allow us to make more refined and precise interpretations of hominin ecospace using paleosols.

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#### **High-resolution reconstruction of hominin paleolandscapes: linking sedimentary cores to outcrops at Olduvai Gorge**

The Olduvai Gorge Coring Project (OGCP) recovered 612 m of core from four boreholes drilled at three sites within the Paleolake Olduvai Basin. They maximally intersected lake facies, to provide most continuous and expanded paleoclimatic and paleoenvironmental proxy records. The deepest borehole exceeded the ~110m deep Naabi Ignimbrite base of the exposed Olduvai sequence to 245m without intersecting basement. We present OGCP methods to pinpoint core stratigraphic levels corresponding to paleolandscapes hosting hominin-related assemblages and technological change levels during the Quaternary period. Tephrostratigraphic fingerprinting and dating allow

correlation to Tuff Markers Hay recognized in outcrop, with extra tuff layers revealed within the core. Paleomagnetic reversal analysis should provide further chronostratigraphic constraints, aided by directional information from inclined borehole 3B. Also >18 new pyroclastic events are identified in the ~135m new stratigraphy. For some hominin-related paleolandscapes tephrorrelation fixes their position in the core, e.g. FLK Zinjanthropus level and HWKE Level1 correlate with the surfaces below Tuff IC and on top of Tuff IF, respectively. However other hominin-related sites and technological change levels are not adjacent to a Tuff. We apply Sequence Stratigraphic techniques, adapted from marine studies to these lake sequences, to pinpoint such core levels precisely and to confront the problem of the correlation of lake core to lake margin, fluvio-deltaic and alluvial fan settings. To illustrate our approach, we feature correlation to Borehole 2A- of DK equivalent levels and set within a 3m interval of lake marginal to alluvial fan sediments between the Bed I Basalt and Tuff IB. The equivalent interval is 18m thick in Borehole 2A and precise lithofacies correlation uncertain. However, using Sequence Stratigraphy we correlate five "time-rock" parasequence units at DK, each bound by unconformities and related to individual lake transgression and regression, as far as the lake marginal FLK Fault. We correlate them to dolomite-topped time-rock units in Borehole 2A. By this means the DK paleolandscape surface can be placed to +50 cm within the core succession.

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#### **Faunal remains from Kakapel rock art and archaeological site, Busia County, Kenya**

Kakapel rock art site is situated at the base of Chelelemuk Hills, Busia County, in western Kenya. Rock art at Kakapel has been attributed to pastoralists and to hunter-gatherers by others, due to the unique geometric shaped components, similar to those of Nyero in eastern Uganda. Initial archaeological survey indicated that the site has archaeological deposits, making it a good candidate for interdisciplinary research in rock art and archaeology for understanding of intra-regional cultural connections especially with neighboring eastern Ugandan sites, which have similar rock art characteristics. A study was conducted to determine the authors, antiquity, cultural and environmental context of the rock art at Kakapel using material culture evidence associated with the site and similar sites in the region (both in western Kenya and eastern Uganda). The study involved excavation of the rockshelter deposits, documentation and analysis of rock art panels, new radiocarbon dating and an ethnographic survey of the local Iteso communities of Kenya and Uganda. Large collections of lithic artefacts, pottery and faunal remains were recovered from excavations at the Kakapel rock art site. This paper provides results of analysis of faunal remains to understand the subsistence strategies and the environmental context of the use of the rockshelter.

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#### **Interpretations of Kenya's dry-stone built heritage landscapes**

Kenya's dry-stone built heritage landscapes represent a unique relationship between the people and the lands or environments the society operated upon. Combining historical discourses and information from the different environments exhibiting the presence of the dry-stone built landscapes, this category of heritage allows for the assessment of the values underlying the relationship between the society and environments, therefore providing a means of correctly interpreting the heritage landscapes. This paper focuses on the interpretation of Kenya's dry-stone built heritage landscapes spelling out motivations for their creation, use, and preservation through time. How the processes of creation, development, use, and preservation are understood in the context of current cultural heritage management agenda and how such interpretations fit within the wider picture of cultural preservation and restoration of endangered heritage landscapes.

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#### **The Acheulien in the Atacama Desert, Chile**

The study of instruments in many archaeological sites in the Atacama Desert shows us with absolute certainty that the people who crossed to America from the NE of Asia transported very good stone tools clearly associated to the Acheulien culture, born in Africa and transported from there to the arid desert of Atacama, in northern Chile. It is very difficult to share this reality before a scientific world that uses an extremely drastic paradigm in reference to the first American population, which only accepts the arrival into our continent of the *Homo sapiens*. Nevertheless, the evidence clearly presented by Pascal Pick and Helene Roche in their 2004 book *Les Origines de la culture: Les premiers outils* allows us to present this other possibility because our discoveries clearly counter those accepted officially. When we say that here, in Atacama, we are clearly in the presence of lithic Acheulense industry, we are saying that there was a *Homo* prior to the *Homo sapiens*, one that either arrived earlier than *H. sapiens* or that was a contemporary of *H. sapiens*, which is also a possibility. We are proposing two distinct migratory waves to America, identified by their lithic industries. In the case of *Homo sapiens*, many hominid remains identify them, which is not the case with the migratory wave that brought the Acheulien and the Musterien industries. We hypothesize that this industry was born in Africa and that, after crossing practically the entire planet, it is very well preserved in the Atacama Desert.

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**Rodent-based biochronology of a new Upper Siwalik Locality (Himachal Pradesh, India): Implications for possible connections with East African hominid bearing localities**

In the absence of datable material such as volcanic ash or a continuous sequence for magnetostratigraphic study, rodent biochronology is a useful tool in making intra-regional biostratigraphic correlations and dating isolated Siwalik fossil localities within the Himalayan Foreland Basin. A new fossil locality exposed near the Village Devni Khadri situated close to the Markanada River Valley (District Sirmour, Himachal Pradesh, India) has been discovered. This Upper Siwalik locality belonging to the Tatrot Formation has yielded a diverse fauna and flora including large mammals (*Hipparion*, *Stegodon*, *Gazella*), birds (Pelican and Stork), crocodiles, fishes (channids and bagrids), gastropods, bivalves, ostracods and charophytes, beside dental remains of murid rodents *Golunda kelleri*, *Mus flynni*, *Mus jacobsi* and *Abudhabia* sp. Based on the biostratigraphic ranges of these murid rodents from well dated Siwalik and Karewa localities this richly fossiliferous locality has been placed at ~3 Ma. The new age facilitates regional biostratigraphic correlation and may suggest that the Karewas of Kashmir Valley was connected to the Siwalik Foreland during Pliocene. At the genera level *Golunda*, *Mus* and *Abudhabia* occur in East African Pliocene localities. A PAUP based cladistic analysis of the African taxa *Golunda gurai* and *Pelomys minor*, and Asian *Golunda tatroticus*, *Golunda kelleri*, *Golunda ellioti*, *Parapelomys robertsi*, *Saidomys afghanensis* reveal close relationship and possible inter-continental connections in the Pliocene time.

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**The potential of avifauna as paleoenvironmental indicators**

Birds are useful biological indicators. They are especially suitable for detecting unexpected changes which cannot be observed by measuring and for monitoring biological often cumulative and non-linear consequences of many environmental changes acting simultaneously. However, the potential of birds as paleoenvironmental indicators has not been widely explored. Birds exhibit a wide variety of distinctive ecological and habitat-specific morphologies, and many clades have narrow ecological and habitat preferences and/or requirements. These traits make birds an indispensable tool for reconstructing environments elsewhere. This study reviews ecological requirements of some of the bird fauna characteristic of selected paleoenvironments in Kenya by analyzing the environmental changes that have occurred over the years in relation to their distributions and adaptations to newer environments.

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**Relevance of Kenyan and Ethiopian drill cores to human evolution: the case of the Olorgesailie Drilling Project, Kenya**

Approximately 2000 m of sediments were recovered by the Hominin Sites and Paleolakes Drilling Project and the Olorgesailie Drilling Project in 2012-2014. These drill cores encompass the past 4 million years. They are thus relevant to numerous critical milestones in hominin evolution. Drill cores reaching the local rift basement were obtained in 2012 south of the Olorgesailie Basin, Kenya, ~20 km from excavations that document benchmarks related to the origin of *Homo sapiens*. Sediments totaling 216 m from two drilling locations represent the past 1 million years. The cores help build a detailed environmental record spatially associated with the transition from Acheulean to Middle Stone Age technology and extensive turnover in mammalian species. The project seeks precise tests of how climate dynamics and tectonic events were linked with these transitions. Core lithology (A.K. Behrensmeyer), geochronology (A. Deino), diatoms (R.B. Owen), phytoliths (R. Kinyanjui), stable isotopes (J. Moerman, J. Russell), among other indicators, show evidence of strong environmental variability, in agreement with predicted climate oscillations during the evolutionary transitions. Increase in hominin mobility, elaboration of symbolic behavior, and concurrent turnover in mammalian species indicating heightened adaptability to unpredictable ecosystems point to a direct link between the evolutionary transitions and the landscape dynamics reflected in the Olorgesailie drill cores. Fossil and archeological data offer a rich source of data and of robust environment-evolution explanations that must be integrated into efforts by Earth scientists who seek to examine high-resolution climate records of human evolution.

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#### **What can Dmanisi's variation tell us about *Homo's* origins?**

Over the past decade, a team headed by David Lordkipanidze discovered four complete, mature fossil crania at the 1.8-million-year-old Georgian site of Dmanisi. An examination of the braincase outline of these four specimens reveals a gradual morphological sequence, as, indeed, can be expected from the normal distribution of a trait in a biological population. The polarity of this sequence is determined by the known end product, *Homo sapiens*, and enables us to speculate about the morphologies on our evolutionary journey: the morphology of the population preceding that of Dmanisi and of the population following that of Dmanisi. If this approach is right, we are destined to arrive at some surprising conclusions.

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#### **Online engagement with human origins research: social media data from the Smithsonian Institution's Human Origins Program**

Given the substantial degree of public funding devoted to paleontology and paleoanthropology research - and the ever-present potential threats to this funding - engaging with the public to convey research results and excite interest is crucial. Social media is arguably the most consumed form of media on the planet, and it provides a useful way to analyze public perceptions. In tandem with the opening of the Hall of Human Origins, the Smithsonian Institution's Human Origins Program launched social media initiatives (Facebook and Twitter) in 2010. We mined archived Facebook data in February 2017 to explore our Facebook audience composition, interests, and engagement with our posts. Our >15,500 fans are comprised of about half men and half women and dominated by 25-34 year olds (~25% of total). While the vast majority are from the US, we have fans from 45 countries. Our audience tends to be online evenly across all days of the week and largely between 9am - 6pm EST, especially from 9am-12pm. Using available data on the number of likes, shares, and comments as standard measures of social media engagement, we determined our top performing posts from December 8, 2014 - February 12, 2017. Results suggest that our audience was most interested in ancient DNA and Neanderthals; other top performing posts focused on ancient human butchery evidence, Darwin's birthday, female bonobo coalitionary behavior, and a new exhibit at the Natural History Museum in London. We determined to what extent post type (link, photo, video) affected impact and investigated which themes spurred the most interest, from breaking news in archaeology, fossils, genetics, and primatology, to recognizing well-known scientists' birthdays and anniversaries of famous fossil discoveries. Knowing what topics are most engaging to our social media audience has implications for how paleoanthropologists can tailor their online presence to have the highest impact on the public.

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### **Relative abundances and paleoecology of four suid genera in Turkana Basin, Kenya, during Plio-Pleistocene**

Suids (pigs, family Suidae) are a widespread family omnivorous, forest dwelling and medium sized artiodactyls. However, warthogs (*Phacochoerus*) have special adaptations to grazing and open environments. Similar specializations have been recorded from other Plio-Pleistocene African suids. Four genera, *Nyanzachoerus*, *Notochoerus*, *Kolpochoerus* and *Metridiochoerus*, are found from late Miocene to middle Pleistocene locations around Turkana Basin. This research analyzes the relative abundances of the four suid genera among all other mammals through time intervals from 8 - 0.7 Ma. The data used in the analysis includes most of the mammal specimens collected from locations around the Kenyan side of Turkana Basin area. Species of genus *Nyanzachoerus* dominated before 4 Ma. The relative abundance of *Nyanzachoerus* decreases through time. At the same time, *Notochoerus* starts to increase its relative abundance, followed by *Kolpochoerus* and finally *Metridiochoerus*. Their peak relative abundances do not overlap in the dataset: *Notochoerus* peaks at 3.44–2.53 Ma, *Kolpochoerus* peaks at 2.53–1.87 Ma and *Metridiochoerus* peaks at 1.30–0.7 Ma. The following paleoecology is interpreted from the relative abundance results and formerly published isotope, paleosol and pollen data from other researchers. *Nyanzachoerus* was replaced by its abrasive diet-specialized successor *Notochoerus*. Rapid decrease of forest might have played a part. *Notochoerus* adapted at first to the expanding woodlands and grasslands and then to more arid shrub lands. After the most severe aridness, more variable environments gave *Kolpochoerus* and *Metridiochoerus* change to disperse, while *Notochoerus* disappeared having lost the competitive edge of shrub land specialization. Changes in the climate enhanced the expanse of the grasses over the shrub lands, where *Metridiochoerus* dispersed. *Kolpochoerus* stayed in the more closed areas near the lake and rivers. No real forests were available, and it was possible that *Kolpochoerus* was a dedicated grazer, but consuming more fresh grass than *Metridiochoerus* which was able to live in tougher environment.

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### **Preliminary study of the Cercopithecidae from Leado Dido'a locality, Woranso-Mille (central Afar), Ethiopia**

Leado Dido'a (LDD) is a Pliocene paleontological locality in the Woranso-Mille project area, Ethiopia, dated to 3.47-3.33 Ma. A large sample of cercopithecids has been collected from LDD, representing at least 6 species (*Theropithecus oswaldi* cf. *darti*, two other papionins, and three colobines). Qualitative and quantitative comparison of the dentition of *T. o. cf. darti* from LDD with that from three other localities of similar age: Hadar, Middle Awash (Maka and equivalents) and older localities from Woranso-Mille is made. In overall dental morphology all are similar, except that the older horizons from Woranso-Mille (3.57-3.77 Ma) are more primitive. Measurements of the M3's were analyzed using ANOVA in SAS. The result shows significant variation among samples in M3 dimensions: length, width and notch height. In addition, there is a papionin from LDD that is larger than contemporaneous *Theropithecus* with low crown and thick enamel molars. A smaller papionin comparable in size with *Pp. jonesi* is also described. This smaller papionin shares absence of anteorbital drop and mandibular morphology with *Pp. cf. jonesi* from Hadar but has more developed maxillary fossae and less flaring molar crowns. The largest colobines from LDD are similar in size to cf. *Rhinocolobus turkanaensis* from Hadar, although at least some of them show the presence of a maxillary sinus. There are also some specimens similar in size to *Cercopithecoides meaveae*, and an additional colobine similar in size to extant *Colobus* and Colobinae gen. et sp. indet. from the older Woranso-Mille sites. The taxonomic and paleoecological implications of the LDD cercopithecids are also discussed.

Weldeyared H. Reda<sup>1</sup>, Maryse Biernat<sup>2</sup>, David R. Braun<sup>3,4</sup>, Ashley S. Hammond<sup>3</sup>, David B. Patterson<sup>3,5</sup>, W. Andrew Barr<sup>3</sup>

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## **Pleistocene paleoenvironments of the Koobi Fora Formation based on bovid mesowear and abundance analyses**

Abundant mammalian fossils, including hominins, have been collected from the Koobi Fora Formation at East Turkana over the past five decades. Due to the presence of abundant hominin fossils, the Upper Burgi (1.98-1.87 Ma), KBS (1.87-1.56 Ma), and Okote (1.56-1.38 Ma) members are of particular interest to paleoanthropologists. The spatial and temporal distribution of habitats are believed to have influenced the evolution and adaptations of hominins and other mammals at East Turkana, however, establishing cause and effect relationships has been challenging. Here we investigate Pleistocene paleoenvironments at Koobi Fora using bovid mesowear (n=338) and abundance analyses (n=2,041). Results demonstrate that mesowear scores vary across bovid tribes (Kruskal-Wallis,  $p=0.001$ ). Abundance variation of all bovid tribes across the members is significant (chi-square=104.126; 12 df,  $p<0.001$ ). Similarly, mesowear results for the relatively abundant bovid tribe, Reduncini (n=142), suggest a significant difference between members ( $p=0.016$ ). However, the mesowear results for the other tribes do not show significant variation ( $p=0.34$ ). This could be related to small sample sizes. Many of the bovids, especially Reduncini, were scored as having high occlusal relief with rounded cusp shape, which typically characterizes browse-dominated mixed feeders. Modern fresh-grass grazers like Reduncini also possess high occlusal relief, and it may be that fossil members of the tribe at East Turkana consumed fresh-grass in the floodplain and lake-margin environments. Spatially, the mesowear data presented here does not suggest spatial variation in mesowear score within East Turkana sub-regions ( $p=0.61$ ). This may indicate that bovid taxa with different ecologies tracked shifts in their preferred habitats within the East Turkana ecosystem, instead of altering their diet. With future work to augment sample sizes, these data will contribute to understanding the environments occupied by contemporaneous Pleistocene hominins at East Turkana.

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### **Anatomical affinities of the Mumba X cranium from Tanzania**

The Mumba rock shelter near Lake Eyasi, Tanzania preserves a unique archaeological sequence spanning the Middle to Late Stone Age. Most human remains recovered are considered to be intrusive burials, with the possible exception of the partial Mumba X skeleton. Mumba X was found 60 cm deeper and in different anatomical position than the other human remains from Bed III. In addition, it was overlain by rockfall and exhibits advanced mineralization. It is thus hypothesized that Mumba X could be of Pleistocene antiquity. Previous morphometric studies have compared the Mumba skeletons with recent human populations and only to a limited extent with Pleistocene fossil specimens. Therefore, we apply geometric morphometric methods and multivariate statistical analyses to the Mumba X temporal bone in order to explore the specimen's affinities to other fossils, including the possibly pene-contemporaneous crania of Nazlet Khater (Egypt) and Hofmeyr (South Africa). In addition, a comparative sample of extant human populations from Africa (Zulu, Holocene Khoisan, East African and Iberomaurusian) is included in these analyses. Preliminary results show Mumba X fully within the range of variation of extant populations, in contrast to Nazlet Khater and Hofmeyr. Nevertheless, it is classified as Ibero-Maurusian in a discriminant analysis and is near neighbor to Upper Cave 101 in a minimum spanning tree analysis. This study has important implications for understanding the human remains from Mumba rockshelter and for the anatomical diversification of modern human populations in the Late Pleistocene and Holocene of East Africa.

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### **Walking at Laetoli: speed and behaviour of track-maker hominins**

The 3.66 Ma fossil tracks of Laetoli (Tanzania) represent the more famous walk in the history of humankind. These tracks have been previously the focus of a plenty of research on speed, locomotion capabilities and behavior of the hominins responsible of the footprints. We have used measurements of stride lengths of both the G1 and G2/3 tracks in order to obtain improved speed estimates and to assess speed relations between the different track-maker hominins. Our preliminary results show that the calculated speed ranges for the G1, G2 and G3 maker hominins, at

each point of the tracks, are similar when the uncertainties in stride length-speed regression and high of the hip joint are taken into account. Our results also indicate a similar stride length (and hence speed) relative changes observed along both parallel tracks. On the other hand, the speeds calculated for the “G1 hominin” are more similar to the equivalent speeds calculated for the “G3 hominin” than to those derived for the “G1 hominin”. This could be indicative of that G1 and G3 hominins could have been walking in parallel and following to the larger (and presumably male) G2 hominin. Stepping on “G2 hominin” footprints might have determined the gait and speed of the “G3 hominin” and its companion “G1 hominin”, which in turn could to have implications on the social behaviour of the implied hominin species.

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### **Shellfish and tortoise exploitation during the Oakhurst at Klipdrift Cave, southern Cape, South Africa: human predation pressure and climatic implications**

Klipdrift Cave in the southern Cape, South Africa, provides new insights into shellfish harvesting during the Later Stone Age between cal BP 10,700 and cal BP 13,700, a time period associated with the Oakhurst techno tradition. Two species dominate the sequence, *Turbo sarmaticus* and *Dinoplax gigas*, and an abrupt shift in the relative frequencies of these species occurs in the middle of the sequence, with an almost complete replacement of one species with another. The shift in dominant species is likely due to environmental changes caused by shifting sea levels rather than change in sea surface temperatures. Although the shellfish specimens are smaller at Klipdrift Cave than those from Middle Stone Age localities such as Blombos Cave, there is no robust link to indicate existence of larger human populations at Klipdrift Cave. Environmental or ecological factors could have restrained shellfish growth rates. Tortoise specimens, presumably from *Chersina angulata* species, are rare at Klipdrift Cave indicating that tortoises may not have been systematically gathered.

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### **Plio-Pleistocene bone surface modifications from the Middle Awash (Ethiopia): implication for cut mark studies and claims of early butchery**

Bone surface modifications are increasingly being used to infer when early hominids began to butcher other mammals. However, from carnivores to trampling animals, to hominid butchers, most fossiliferous Plio-Pleistocene deposits in eastern Africa contain several actors and effectors. This renders the attribution of certain bone surface modifications to a specific actor/effector extremely difficult. Some of the marks made during crocodylian feeding, for instance, highly mimic cutmarks inflicted actualistically by stone tools. Analyses of bone surface modifications on fossils from crocodylian-infested depositional contexts therefore must inevitably face the issue of equifinality. This is particularly the case in Pliocene contexts for which evidence of stone tool use is, as yet, inconclusive. Here, we present bone surface modifications on vertebrate fauna and hominid remains from Plio-Pleistocene contexts in the Middle Awash study area. These examples illustrate the ease with which crocodile tooth marks can be easily misidentified as stone-tool-inflicted cutmarks. We employ confocal scanning microscopy and show that the signature criteria currently used in the characterization of the morphology of modification marks has serious limitations. Through comparison with relevant fossil specimens, as well as modified bones from experimental studies, we demonstrate that it is particularly difficult, if not impossible, to avoid equifinality in small, biased samples from Pliocene fossil localities.

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### **Discovery of stone tools and cutmarked bones dated to 2.2-1.95 Ma from Ain Boucherit (Algeria)**

The Ain Hanech research area (Algeria) is significant for documenting the oldest currently known archaeological occurrences in North Africa, estimated to 1.8-1.7 Ma. Recent fieldwork in the nearby deposits at Ain Boucherit has resulted in the discovery of even much older stone tools and cutmarked bones, spanning from 2.2 to 1.95 Ma. The Ain Boucherit occurrences are found in two stratigraphic members: Member P and Member R. Member P, which is the fossil bearing stratum from which both Pomel and Arambourg collected fossil bones previously, is stratigraphically located 15m below the 1.8-1.7 Ma Ain Hanech and El-Kherba Oldowan bearing deposits. In addition to a diverse savanna fauna, within this same unit, we also collected in situ Mode I stone artifacts and cutmarked bones. Excavations in Member R, located 9m above the Ain Boucherit fossiliferous stratum (Member P) and 6m below the Ain Hanech and El-Kherba Oldowan localities (Member T), yielded animal fossils associated with a Mode I lithic assemblage contained in a floodplain context. The fauna preserves several cutmarked and hammerstone-percussed bones. The age of the Ain Boucherit archaeological occurrences is constrained by means of magnetostratigraphy, mammalian biochronology, and Electron Spin Resonance (ESR) dating methods. The magnetostratigraphic study documents both normal and reversed polarities, indicating that Member P dates to the Matuyama Reverse Chron, and Member R to the onset of the Olduvai Normal Subchron. Based on biochronological evidence, the age of Ain Boucherit is estimated to ~2.2 Ma for Member P, and ~1.95 Ma for Member R. Furthermore, ESR dating results on optically bleached quartz grains extracted from sediments, are consistent with the paleomagnetic and biochronological age estimates. Thus, Ain Boucherit preserves the oldest archaeological occurrences outside of the East African Rift, showing that ancestral hominins inhabited the Mediterranean fringe much earlier than previously thought.

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### **Unraveling of the complexity of prehistoric compound adhesive production through an ethnoarchaeological investigation**

Composite tool-making, particularly hafting of tools, is regarded as a hallmark of Paleolithic technological innovations. While hafted implements have been documented extensively in archaeological and ethnographic contexts, limited research has focused on the utilitarian and cognitive implications of adhesives. Most notably, experimental investigations of hafting materials have provided invaluable insights. However, such conditions have to be simulated by novices. By contrast, contemporary hafting traditions provide more authentic opportunities to approach the past with careful relational analogies. The present research documented one of the rare surviving, but quickly vanishing cases of traditional expert knowledge about compound adhesive production for hafting stone tools. The complete sequence of expert thought and action processes amongst Hadiya hide-workers in Ethiopia was recorded, and coded in cognigrams and effective chains. Such direct investigation differs from previous attempts in this line, which had to rely on simplified assumptions. Ultimately, the research assesses implications of the craft tradition to composite tool-making in the past. Our results corroborate previous inferences that compound adhesive production and use is a cognitively demanding process. Furthermore, the hitherto neglected aspect of possible cooperation during the production of such complex technologies is explored here.

This study is particularly interesting for understanding adhesive production in relation to raw material availability or preference. Such contexts may have implications for why hafting is archaeologically not as clearly evidenced in the Eastern African Stone Age in comparison with other regions on the continent. To highlight this scenario, results of a preliminary study of archaeological materials from Porc-Epic Cave are discussed.

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### **Reassessing taxic diversity in South African hominids and how we analyze human fossils**

Although the first-discovered South African hominids were allocated to different species, even genera, Mayr's (1950) idiosyncratic lumping of all into *Homo transvaalensis* demoted assessing their potential taxic diversity to describing their differences as variation. Even when Robinson (1958) argued that morphology demanded retaining *Australopithecus* and *Paranthropus*, Mayr (1963) revived only *Australopithecus* for all-known early hominids which is an undiagnosable concept still in use. Clarke's (1988) recognizing *Au. prometheus* notwithstanding, *Au. africanus* remained the go-to species until Berger et al. (2010) placed all specimens from Malapa in a new species, *Au. sediba*. In 2015, they assigned ~1550 specimens from Dinaledi Chamber to another new species, *H. naledi*. Unfortunately, the post-1970s embrace of newly-named taxa has not provoked a logically-obligatory re-evaluation of specimens assigned to the "accepted" species that inform the taxonomic and phylogenetic interpretations of newly-discovered specimens. Here I revisit the morphological integrity of *Au. africanus* and *P. robustus* and of newly-named taxa. I begin with craniodental morphology, which, if analyzed without systematic presumption, impacts considerations of diversity (relatively uniform taxic differences) versus variation (differences within taxic uniformity): e.g., "*P. Robustus*" TM 1517, SK 48, DNH 7; *Au. africanus* Sts 5, Sts17, Sts71, 52a, StW505. A case for diversity gains support from os coxae: Sts14, Sts65, SK50 and SK3155b are, respectively, morphologically unique, as are Malapa ilia U.W.88-14 and U.W.88-133. (Furthermore, U.W.88-14 is adult, and supposedly-associated ischium U.W.88-102 subadult.) *H. naledi* also fails the "difference-within-uniformity" test. There are two cranial morphs, with holotype DH1 comprising specimens of each, and two (one australopith-like) femoral morphs. Interestingly, all dentognathic specimens can be associated with a (mostly) DH1+DH2 morph. Facts such as these signal the need to reassess not only South African hominids, but how one goes about interpreting human fossils.

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### **The Gona Paleanthropology Research Project: 6 million years of human biological and behavioral evolution**

The Gona Paleanthropology study area, Afar, Ethiopia, is well-known for yielding the earliest Oldowan stone artifacts dated to 2.6 million years ago (Ma). Continuous field and laboratory investigations since 1999 have revealed that Gona contains late Miocene to late Pleistocene deposits with a rich record of fossil fauna, hominins, and archaeology, informing important time intervals in human evolution. The younger Pleistocene sediments preserve a continuous archaeological record with earliest Oldowan, Early and Late Acheulian, and Middle Stone Age assemblages represented. Two decades of archaeological investigations at Gona have allowed a better understanding of the earliest stone technology, hominin raw material selectivity, and human technological/cultural change through time. The recent Gona field and laboratory research has focused on the early and late Acheulian, and the younger deposits with MSA artifacts, all associated with archaeofauna documenting hominin modifications. The Acheulian seems to be technologically drastically different from the Oldowan, but the ecological background and the adaptive significance of this emergent stone technology in the life of *H. erectus* has yet to be fully investigated and appreciated. The Gona MSA research is in its early stages, but shows great potential in illuminating technological, cultural, and behavioral diversity within the Late MSA. A large number of hominin fossils have been discovered at Gona, including *Ardipithecus kadabba* dated to ~6.0 Ma (among the earliest hominins), *Ardipithecus ramidus* (dated to 4.5-4.3 Ma), and a number of Pleistocene *Homo erectus* fossils, which are associated with stone artifacts and fossilized fauna bearing evidence of hominin activity. Since Gona is unique for preserving important Late Miocene to Late Pleistocene fossil hominins, and archaeological materials from the earliest known up to the present,

it is among a small handful of paleoanthropological study areas in Africa ideal for investigating the entire range of human biological and behavioral adaptations and evolution.

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### **New *Kolpochoerus* remains from the Shungura Formation, Lower Omo Valley, Ethiopia: implications for the systematics and paleobiogeography of the genus and its use in biostratigraphy**

Numerous remains of the suid genus *Kolpochoerus* have been collected since 2006 by the Omo Group Research Expedition in the Plio-Pleistocene levels of the Shungura Formation (Lower Omo Valley, Ethiopia). Members H to L are better documented than in earlier collections of the International Omo Research Expedition, which clarifies the morphological changes within *K. limnetes* and the transition to a dentally more derived species (usually called *K. olduvaiensis* in eastern Africa). Between ca. 2.8 Ma and ca. 1.6 Ma, we observed strong morphological change within *K. limnetes*, the most notable characteristic being a progressive increase in length of the third molars. At ca. 1.6 Ma, a relatively sudden increase in third molar crown height marks the transition to a dentally more derived species. This new Shungura material gave us the impetus to conduct a systematic revision of the genus *Kolpochoerus* using samples spanning the whole African continent and the Levant. Based on cranial and dental characteristics, we observed disparity within the eastern African samples younger than ca. 1.6 Ma: specimens of the Turkana Basin are notably more derived dentally (more elongated third molars) than specimens from other areas. Although *K. paiceae* is usually thought to be endemic to southern Africa, the southern African samples are similar to some eastern African samples, notably those coming from Olduvai Gorge (that yielded the holotype of *K. olduvaiensis*). We consider that those samples of *Kolpochoerus* are conspecific, which implies the older name *K. paiceae* would have priority over *K. olduvaiensis*. The dentally derived morphotypes found in the Turkana Basin would also deserve a new specific name. The better understanding of the chronological and geographic framework of *Kolpochoerus* morphological changes has strong implications for biostratigraphy, allowing correlation of sites all across Africa, and even to the Levant.

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### **New investigations in Southern Ethiopia (Yabelo and Gotera): Pleistocene and Holocene archaeological evidences**

We present here the first results from the Italian Archaeological Mission in Southern Ethiopia. This new archaeological project is principally focused on the emergence of modern humans and behavioral modernity in East Africa. Our research is based on one wide region located to the west of the Chew Bahir lake where two archaeological sites have been identified in the past: the Gotera open-air site and the Yabelo rock shelter. Despite the fact that these sites are cited in literature, detailed archaeological, chronostratigraphic, and paleoclimatic reports are currently unavailable. An exhaustive survey of both areas, coupled with geoarchaeological, geochronological, and ethno-archaeological investigations, is still lacking and is the aim of this new project. We are researching the archaeological record linked to the first *Homo sapiens* presence in southern-central Ethiopia, particularly through the recording and the analysis of the MSA evidence. The areas examined consist in two transects of 100 km<sup>2</sup>, located around the main sites. Results include the recovery of old sites (i.e. Yabelo rock shelter) and the discovery of new open-air sites in the Gotera area. Particularly in Gotera, the MSA sites are dense, and lithics are associated with fluvial/alluvial sediments. They are on different raw materials, including basalts, quartz, quartzite, and occasionally chert. Levallois method is present yet associated with other knapping methods. Associated with the MSA lithics, fossilized bones were identified. Furthermore, the whole area is rich in LSA and Pastoral evidence. The overall preliminary results for rock art evidence are more encouraging than expected. Particularly interesting is the rock art evidence in the main Yabelo rock shelter in terms of the density and quality of the artwork. Here, we recognized at least 5 rock art panels, which gave us a new general understanding of the site. Moreover, new rock art sites have

been discovered in the Yabelo area and are under investigation. Globally, the area seems likely to provide important insights on human evolution and behavior during the Pleistocene and the beginning of the Holocene.

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#### **Site formation processes at GaJ17 (East Turkana, Kenya)**

Known evidence of in situ Middle Stone Age localities in the Turkana Basin are rare and may reflect unsuitable depositional environments and/or unconformities caused by lake level fluctuations. GaJ17 in East Turkana was originally reported by Alison Kelly (1995) as a Middle Stone Age paleobeach locale near the shore of a receding Lake Turkana. We re-excavated GaJ17 in 2016 with the specific aim to reconstruct the depositional history of the site and to provide further information about Middle Stone Age behaviors in northern Kenya. The study of site formation processes of GaJ17 focused on recognizing patterns of human activities and potential post-depositional disturbances. Specifically, this project asks the question: can artifact fabric analysis (orientation and dip) and size sorting at the MSA site of GaJ17 provide the critical site formation data to allow us to reconstruct ancient behaviors? We measured three dimensional positions of all finds larger than 2.5cm and recorded dip and orientation on all elongated objects. This facilitated visualization of fabric analysis of artifacts and size sorting. Preferred alignment of small sample of in situ lithic artifacts suggests some level of transport, while micromorphological and granulometric and sedimentary facies analysis revealed that the archaeological deposits accumulated under sustained aeolian conditions. These results have implications for the kinds of behaviors that can be reconstructed from these MSA-bearing deposits in East Turkana. This study is limited by a relatively small sample size, which will be augmented through ongoing excavations.

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#### **Middle Pleistocene hominin adaptive strategies along the southwest coast of South Africa**

It has been suggested that the morphological and behavioural traits that characterize *Homo sapiens* developed as adaptive responses to environmental challenges in Africa over the last million years. Our current understanding of the interplay between early human adaptive strategies and environments however, is based almost entirely on information derived from late Pleistocene contexts. Comparatively little is known about the abilities of earlier, particularly mid-Pleistocene human populations to optimally adapt to their environments - a state of affairs that may be ascribed to the patchy archaeological and environmental records for this time interval. Currently, our limited knowledge of mid-Pleistocene human adaptive responses to environmental conditions derives mainly from East Africa, where relevant archaeological and environmental records tend to be most complete. This is problematic though, given that hominins occupied a variety of environments at the time, and in response, probably exhibited a diversity of adaptations. Duynfontein (DFT) situated along the southwest coast of South Africa, represents a rare mid-Pleistocene site located outside of East Africa that preserves a high-resolution archaeological and environmental record. In conjunction with East African sites, it offers an opportunity to test whether mid-Pleistocene hominins were capable of environmentally specific adaptations or not. I present some pertinent results of new research undertaken at DFT since 2015 that expand on our understanding of the level of adaptability that African Middle Pleistocene hominins were capable of. In particular, I discuss issues around landscape use, raw material sourcing and subsistence strategies of DFT hominins, and compare these with evidence from East Africa and the rest of the continent.

Gen Suwa<sup>1</sup>, Yonas Beyene<sup>2</sup>, Shigehiro Kato<sup>3</sup>, Katsuhiko Sano<sup>1</sup>, Tomohiko Sasaki<sup>1</sup>, Berhane Asfaw<sup>4</sup>

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### **The revised chronology and fauna of the Chorora Formation, Ethiopia**

The Chorora Formation fauna was first reported in the 1970s, and have been thought to be >~10 million years old. We previously reported the discovery of *Chororapithecus abyssinicus* from the Chorora Formation, a probable stem lineage of the modern gorilla clade. Since 2010, we have conducted annual field work spanning the Chorora Formation type locality and surrounding areas and tested the hypothesis that the Chorora Formation sediments are older than ~10 Ma. Our new investigations indicate a complex combination of juxtaposed fault bounded exposures of similar-aged strata and overlying sedimentary patches that differ substantially in age. The major sedimentary sequences, including that of the type locality, overlie volcanics that we newly dated and constrain to an age between 9.1 and 9.65 Ma. The Chorora Fm type locality fauna is best estimated at ~8.5 Ma, and the *Chororapithecus*-bearing Beticha locality fauna at ~8.0 Ma. Some of the upper Chorora fauna is well-dated at 7.1-7.2 Ma, while others are estimated as >6.8 and <7.5 Ma. We have newly recovered several hundred identifiable faunal elements spanning the ~9 Ma to ~7 Ma time period, including primate fossils from five localities. The emerging Chorora mammalian assemblage provides important clues as to the development of sub-Saharan African mammalian communities at the time period thought to coincide with hominid emergence.

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### **Paleolandscape reconstruction of Early Miocene sediments from Loperot, Kenya: Mineralogy and stable isotope geochemistry**

Recent excavations of Miocene deposits near Loperot, Kenya yielded new primate fossils, including species of apes and monkeys. Our study aims to: (a) describe the stratigraphy of the main site (LpM4) to place the primates in geological context, (b) analyze the sedimentology of main fossil bearing units to reconstruct the paleolandscape, and (c) determine whether the apes and monkeys were inhabiting similar or different habitats. Our stratigraphic column includes 30m of sediments. Eleven fining-up cycles are present, each with sand at the base and clay at the top. The sand units are arkosic to quartzose, and the clay units are smectitic and contain rhizoliths, suggesting they are paleosols (Vertisols). We interpret the fining-up cycles as a meandering river that migrated across the landscape producing channel sands and floodplain soils. Rhizoliths collected from three fossil-bearing paleosol units were analyzed for stable isotope geochemistry. Data indicate that unit MS ("monkey site") has a higher average  $\delta^{13}\text{C}$  value (-8.23‰) and a larger range of  $\delta^{18}\text{O}$  values (-6.98 to -1.76‰) compared to other units (CS "crocodile site" and AS "ape site"). Units CS and AS have an average  $\delta^{13}\text{C}$  value of -10.51 and -10.58 and range in  $\delta^{18}\text{O}$  values from -4.81 to -2.29 and -6.02 to -2.67, respectively. Low  $\delta^{13}\text{C}$  values from CS and AS suggest abundant C3 vegetation, but higher MS  $\delta^{13}\text{C}$  values indicate a more open, mixed C3-C4 landscape. Since all three units have a similar range in  $\delta^{18}\text{O}$  values, it seems unlikely that the shift in vegetation resulted from regional changes in rainfall. Instead, we suggest that during formation of CS and AS, the meandering river was close by and the area was dominated by riparian forest, making it attractive to apes. However, during formation of MS, the river was farther away and monkeys inhabited a more open landscape.

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### **Significance of archaeological field schools in Ethiopia and its comprehensive developmental contribution: the case of Melka Kunture prehistoric site**

Archeological Field Schools and local tourism development are two of the main important themes of this paper. This study paper documents the importance of an archeological field school at Melka Kunture prehistoric site and its economic benefit for the community around its contribution to the ongoing development endeavor of the nation at large. The proximity of the archeological site to the capital city as well as the presence of closely located archeological and paleontological sites, with the flourishing living cultural qualities of the Oromo people around the study area and the natural habitat, are taken as the unseen and unaddressed treasures that this study needs to deal with. This study thoroughly discusses issues related to the need to establish field schools in line with educational

tourism development strategy that benefit both the academic world and the local community. The importance of an archeological field school at the Melka Kunture archeological and paleontological site is well rounded and more inclusive. The field school will create broad research opportunities for national and international scholars. The establishment of the field school would help propel the development of rural tourism and cultural industry as well as preserve the indigenous heritage of the local community. Such an institutional development in the locality would provide opportunities for local and international researcher to respond to and to overcome problems associated with the absence of archeological field schools in Ethiopia. Therefore, the result of this study indicate that it would be appropriate to develop heritage sites and cultural sites within the proposed corridor which would bring significant positive impact in the development of the surrounding region.

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**The Mountain Exile Hypothesis: how humans benefited from and re-shaped African high altitude ecosystems during Quaternary climate changes**

The presentation introduces a new interdisciplinary approach for the reconstruction of Quaternary abiotic, biotic and cultural changes in African model highland environments of southern Ethiopia (Sanetti Plateau, Bale Mountains National Park). High altitude ecosystems are still widely perceived as natural and anthropogenic transformation is generally considered to be concentrated on lower elevations and late. However, recent studies challenge this view and for quaternary environmental science and prehistory, the question where humans retreated to during the driest intervals of the last 20 ka when lowlands may have become uninhabitable is still demanding. Scientific goals of our archaeological project are the reconstruction of the settlement history of the Bale Mountains and the diachronic examination of the interplay between humans and their environment during the late Quaternary landscape evolution. Vertical migration of highly mobile hunter-gatherer groups to montane refugia is suggested as a form of adaptation to abrupt arid events. Human agency, i.e. environment independent decisions could account for non-climate migration patterns.

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**Socio-economic development and memorization dynamics: paradoxical relationships in the management of historical architectural heritage along the Kenyan coast**

This study investigated the conservation status historical architectural sites along the coastal region of Kenya. Most of the sites date between the 13th and 19th century AD, when the region was the ultimate hotbed of human integration and power politics. The architectural sites are sampled on the basis of their tourism potential, accessibility and conspicuous location in the coastal landscape. They include Fort Jesus, Rabai, Mnarani, Jumba, Gedi, Vasco-da-Gama Pillar, Takwa, Manda, Shanga and Pate. The coastal area is characterized by intense tourism activities and socio-economic development in response to ever-increasing human populations. The urge for economic development has often negatively impacted legal conservation instruments in favour of robust infrastructural projects. The Lamu Port project (LAPSSSET), which has taken over large swaths of heritage potential areas, is a case in point. Besides socio-economic issues in conservation dynamics, global warming is facilitating the disintegration of coral structures and coastal landscapes irreversibly. The study establishes that ongoing development projects and subsequent conservation efforts do not accommodate memorization and management through public sensitization and stakeholder participation. There is a disconnect between historical architectural sites and the tangible and/or intangible history of the living communities. The study concludes that the past of architectural sites is not properly presented and memorized beyond the objective of scientific curiosity. This leads to unabated destruction and neglect of heritage resources which is complicated by reduced funding and poor sensitization.

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**The migrations and settlements of Pleistocene hominins in China and East Asia**

East Asia is a vast land where early human lived on since early Pleistocene and left rich footprints of abundance material culture and evolutionary history. Archaeological findings from China have particularly witnessed human

adaptation and developmental trajectory in this area. According to the known records, earliest human occupation in East Asia took place at least ca.1.7ma BP. Recent research on Qinghai-Tibet Plateau in terms of its uplifting temporal phases and height provides us with much insight into its corresponding effect on regional environment and global climate. The progress on the study of uplifting history is setting fundamental background for understanding early human evolution and migration in East Asia. This paper aims to provide a review on the above issues and to discuss the environmental effect of Qinghai-Tibet Plateau on regional adaptation pattern and migration of early humans.

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### **Challenges and opportunities in managing and preserving paleoanthropological heritage in the Middle Awash study area**

Maurice Taieb first recognized the paleoanthropological significance of what is now the Middle Awash study area. The Rift Valley Research Mission to Ethiopia (J. Kalb and associates) followed up on Taieb's work during the mid-1970s and invited J. Desmond Clark to join its investigations. The Middle Awash project began further exploration under Clark's leadership in 1981. Our intensive surveys have shown that most of the study area lacks fossils and artifacts because sediments are obscured or buried (e.g., by riverine forest, water, recent alluvium, and/or volcanic rocks). Tectonic processes have severely displaced strata, yielding relatively small outcrop windows into deep time. We have documented an aggregate thickness of >1km and established geochronological control by using various independent techniques in the field and laboratory. The overall sedimentary succession spans >6 million years, and a draft stratigraphic nomenclature will be presented. Our team's intensive surveys of the study area have so far led to the discovery of 382 paleontological localities with ~29,000 collected fossils, and >20,000 artifacts from 208 archaeological localities. Nearly 2,000 geological samples have been collected and analyzed. Our exploratory efforts are effectively complete in several parts of the Middle Awash, resulting in ~7,000 published pages in ~175 refereed contributions. The Middle Awash has so far yielded >400 numbered hominid remains sampled from ~20 different chronostratigraphic horizons. Knowledge is still being generated in the field and laboratory even decades after our team's first discoveries in 1981. Here we will also outline current project efforts at managing and preserving the study area's field resources. The Middle Awash research project has played a pivotal role in the development of Ethiopian person-power and infrastructure for paleoanthropology. The results of these efforts will be evident to all EAAPP participants in Addis Ababa.

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### **Seasonal variation of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ in extant African suid enamel and its implications for fossil suid diets and paleoecology of hominin fossil sites**

Similar to early hominins, fossil suids experienced a delayed dietary response to the expansion of C4 grasslands during the Pliocene in Eastern Africa. By the early Pleistocene, nearly all suid lineages became C4 feeders, suggesting strong interspecific competition. Such competition may extend to some sympatric C4-dependent hominins (such as *Paranthropus boisei*) and cercopithecines (such as *Theropithecus oswaldi*). Therefore, understanding dietary niche partitioning in fossil suids could provide insights for biotic interactions and dietary variability in hominins. Exploring niche partitioning in extant African suids through stable isotope analysis provides an exceptional foundation to understanding fossil suid ecology, including the vegetation and hydroclimate of their habitats. We selected sympatric bushpigs (*Potamochoerus*) and warthogs (*Phacochoerus*) from Malawi and the Democratic Republic of Congo. We investigated their dietary response to seasonality by analyzing  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  of enamel that was sequentially sampled along the growth axis of third molars and canines, with each sequence covering at least one

seasonal cycle. Two out of three individuals showed dietary changes in response to rainfall seasonality. One bushpig consumed more C<sup>4</sup> in the rainy season (C<sup>3</sup>/C<sup>4</sup> mixed feeder) than in the dry season (primarily C<sup>3</sup> feeder). In contrast, one warthog consumed more C<sup>3</sup> in the rainy season (C<sup>3</sup>/C<sup>4</sup> mixed feeder) than in the dry season (primarily C<sup>4</sup> feeder). The preliminary results demonstrate that serial sampling has the ability to detect different patterns of seasonal dietary response among extant suids, which is also applicable to fossil suids. Analysis on more specimens is on-going and results are expected in May, 2017. Once complete, the extant African suid dataset will serve as a guide to the paleodietary interpretations of fossil suids, which will provide a foundation for paleoecological studies at hominin-bearing sites. Similar methods can be extended to other generalist mammals, particularly those with hypsodont or continuously growing teeth/tusks.

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#### **A comparative mesowear analysis on domestic goats from Turkwel and Ileret, Turkana Basin, Kenya**

Reconstructing ungulates' paleodiets based on mesowear analysis is one of the main sources of information that helps us to understand paleoenvironments. The percentage of animals' tooth wear is highly dependent on the type of environment they were living in. To recognize the influence of the environment on the tooth wear, we undertake a comparative analysis of animals which lived in two different environments. This study was conducted on the East in Ileret and on the West in Turkwel of the Lake Turkana Basin, Kenya. These areas have a difference in environment and precipitation due to the geological movements of half-graben. This has led to Ileret being at a lower altitude and having higher precipitation, whilst Turkwel is more arid with dustier conditions and lower precipitation. To understand the role of environmental difference on the teeth wear variation we have employed mesowear analysis which is based on the relative amount of attritive and abrasive wear from diet, reflecting on the occlusal surface of the teeth. Mesowear is recorded by looking at two aspects of the goat teeth; cusp shape and occlusal relief. Cusp shape is measured and classified as "sharp", "round" or "blunt", and the relief is examined as either "high" or "low". We use this method because it is simple and can distinctively show the difference in diets of ungulates, be it browsers, grazers or mix-feeders. Based on the result of our study, we hypothesize that the Turkwel goats have more abrasive wear on their teeth than the goats in Ileret because of the dustier environment and diet of the goats in Turkwel.

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#### **The tooth structural signature(s) of southern African early *Homo*: implications for the assessment of human paleobiodiversity**

Plio-Pleistocene hominin diversity in southern Africa is revealing increasingly wider, with the inferred (co)existence of a number of species representing the three genera *Australopithecus*, *Paranthropus* and *Homo*. For the latter, up to four species have been recognized or suggested as distinct taxa: *H. habilis*, *H. erectus/ergaster*, *H. gautengensis* and, more recently, *H. naledi*, even if its chronological context remains unconstrained. In mammal paleobiology, tooth morphology is considered a highly reliable tool for taxonomic diagnosis, but the outer crown original shape is often altered by occlusal wear and/or taphonomic processes. For this reason, the allocation of some hominin dentognathic remains is still controversial, even at the genus level. This is the case for a number of specimens from the sites of Kromdraai (e.g., KB 5223), Swartkrans (e.g., SK 15, SK 27, SK 45, SKX 257-258, SKX 21204) and Sterkfontein (e.g., Stw 80, Stw 151), variably allocated to *Homo*, but sometimes regarded as representing *Australopithecus* or

*Paranthropus*. Such uncertainty affects the reconstruction of reliable taxon-specific evolutionary trajectories which, in turn, should rely upon solid taxonomic hypotheses. We noninvasively characterized the structural signature of the post-canine dentition of some among the most debated specimens (KB 5223, SK 15, SK 27, SK 45, SKX 257-258, SKX 21204) and compared it with the endostructural features displayed by Early Pleistocene tooth remains from Africa and Asia undoubtedly representing the taxon *Homo*, as well as with the patterns expressed by some non-contentious *Au. africanus* and *P. robustus* representatives. By crossing quantitative information from crown tissue proportions, enamel thickness distribution, enamel-dentine junction shape and root morphology, our results unambiguously discriminate at generic level all investigated specimens and enabled us to assess the probability of taxonomic attribution of some among the most contentious remains, notably of SK 27, which typically exhibits a combination of australopith and *Homo*-like signals.