

## **Desmond Clark, Glynn Isaac, and the Troop-to-Tribe Transition in the Evolution of Modern Human Behaviour**

Stanley H. Ambrose, Department of Anthropology, University of Illinois, Urbana

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J. Desmond Clark's seminal paper titled "Africa in Prehistory: Peripheral or Paramount" (1975) summarized evidence for the African origin of modern human behavior during the Middle Stone Age (MSA). Glynn Isaac's Random Walk model implied a distinctly non-human way of life during the Acheulean. Isaac began research during the early 1970s on the MSA in Kenya, but he was diverted to Plio-Pleistocene research at Koobi Fora. Had Glynn continued his research on the MSA, our present understanding of the emergence of modern human behavior during the MSA would have been surpassed two decades ago.

Our current field research in the Kenya Rift Valley continues Isaac's work, and provides strong support for J.D. Clark's thesis of an African origin of modern human behavior. Results of our current fieldwork, geochronology and tephrastratigraphy of sites in the central Rift Valley will be summarized. We have excavated 15 sites with stratified volcanic ashes and pumices. Including one ESA/MSA transition, several MSA, four MSA/LSA transition, and two early LSA sites. As in southern Africa, the most significant changes in human organization seem to occur at the end of the last interglacial (marine oxygen isotope stage 5). Lithic raw material site-to-source distance data show early Middle Stone Age (MSA) humans obtained most materials within 10-30 km of occupation sites, implying minimal interactions beyond their annual foraging ranges. Long distance (>40 km) movement of lithic artifacts increased significantly during the early last glacial in Kenya, implying the development of systematic exchange of resources, information and individuals between widely separated local bands. Weak macro-regional integration of local foraging groups during the early MSA (and ESA) implies socio-territorial organization more like that of primate *troops* than human *tribes*. Risky environments of the early last glacial may have promoted integration of local foraging troops into tribal social networks.

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## Pliocene vegetation and palaeoenvironment of Laetoli, Tanzania; evidence from fossil woods

Marion K Bamford and Terry Harrison

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Laetoli, a Pliocene site in northern Tanzania, is renowned for its record of early hominins, fauna and footprints. Previous interpretations of the fossil mammals, geology and palynology indicated that the palaeoenvironment was dry savanna, much as it is today. However, new paleobotanical evidence indicates that it was more complex. Noiti 1 and 2, 10 km south of the main localities, have produced an abundance of silicified fossil woods associated with a volcanic debris flow. The precise age of the sediments is uncertain, but they appear to be correlative with the Yellow Marker Tuff of the Upper Laetolil Beds, with an estimated age of 3.0-3.5 Ma. Of the 140 specimens sectioned, eight are described here. They represent six families. The Dichapetalaceae are mostly lianas or shrubs. The subfamily of Euphorbiaceae represented includes the large genera *Euphorbia* and *Croton*, which occur in the region today. The Guttiferae (Clusiaceae) mostly inhabit riverine forest, moist forest margins or dry woodland margins. Several members of the Mimosaceae are represented, including *Acacia tortilis*, a common tree in the area today. Members of the Oleaceae are trees of drier climates, as are the Sterculiaceae. Although the absence of particular taxa in the fossil record is not necessarily an absence in the palaeo-vegetation, it is interesting to note that only the Mimosaceae and Euphorbiaceae are common in both the fossil and modern vegetation. Missing from the fossil record, thus far, are the Burseraceae and Combretaceae. The Noiti fossil woods show that there were several different vegetation types during the Pliocene, i.e., moist, dry and riverine, and that these had a different species composition from the modern assemblages. This provides additional support for recent reinterpretations of the paleoecology at Laetoli that indicate a mosaic of vegetation types, with a greater representation of bushland, woodland and forested habitats.

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Bernard Price Institute For Palaeontological Research, School of Geosciences, University of the Witwatersrand, Private Bag 3, WITS 2050, South Africa.

Center for the Study of Human Origins, Department of Anthropology, New York University, 25 Waverly Place, New York, NY 10003.

## ESR Dating at Pradayrol, Lot, France: Preliminary Dates for a New Middle Pleistocene Hominid Incisor and Middle Paleolithic Artifacts

B.A.B. Blackwell<sup>1,2</sup>, P. Bain<sup>2</sup>, M.R. Seronie-Vivien<sup>3</sup>, M.A. Tillier<sup>4</sup>, J.I.B. Blickstein<sup>2</sup>, A.R. Skinner<sup>1,2</sup>

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In 2002, a hominid tooth was found associated with extinct Middle Pleistocene fauna at Pradayrol, France. <sup>230</sup>Th/<sup>234</sup>U dating was attempted for stalagmitic deposits to determine the age, but the calcite was too altered to give results. ESR (electron spin resonance), however, can date mammalian tooth enamel ranging in age from 10 ka to 5 Ma, with 2-10% precision, by comparing the accumulated radiation dose in the teeth with the total radiation dose rate from the tooth and its environment.

Near Caniac-du-Causse, Lot, France, the Pradayrol site occurs in a large abri with fill reaching 10-15 m. Only two stratigraphic units have been partially excavated. More than 1000 tools have been found at Pradayrol, mostly sidescrapers made from quartzite or flint and flaking debris. The small tool size suggests in situ production and raw material parsimony. This Denticulate Mousterian tool kit is similar to that at La Borde. In Layer 2A, an upper right permanent incisor from an adult hominid was found, which is comparable in size and features with the Neanderthal teeth from La Chaise-de-Vouthon. Also found in Layer 2A were numerous extinct Middle Pleistocene fauna, including *Dicerorhinus mercki*, *Equus mosbachensis*, *Canis etruscus*, and *Ursus deningeri*, all suggesting an age > 150 ka. In order to determine an absolute age, two bovid teeth from Layer 2A were dated by ESR.

Ten independent analyses from two bovid teeth from the layer containing the incisor were dated by standard ESR. Ten associated sediment samples were tested by neutron activation analysis to determine the volumetrically averaged external dose rate. Assuming linear U uptake by the fossil and the uraniumiferous sedimentary components, the preliminary ages averaged  $324 \pm 8$  ka, which corresponds to Oxygen Isotope Stage (OIS) 9. More teeth need to be dated to check for redeposition at the site.

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<sup>1</sup> Dept. of Chemistry, Williams College, Williamstown MA, 01267

<sup>2</sup> RFK Science Research Institute, 7540 Parson Blvd., Flushing, NY, 11366

<sup>3</sup> Institut du Quaternaire, Université de Bordeaux I, Talence, F33405, France.

<sup>4</sup> CNRS, UMR 5409, Université de Bordeaux I, Talence, F33405, France.

## **Middle Stone Age barbed bone points from Katanda (DR Congo): new perspectives on age and association**

Alison S. Brooks (GWU/Smithsonian), James Feathers (University of Washington), Gideon Hartman (Harvard), Clive Trueman, Noreen Tuross (Smithsonian/Harvard), Francesco d'Errico (CNRS, Univ. Bordeaux I), and John Yellen (NSF)

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From 1986-1990, barbed and unbarbed bone points were recovered from deeply buried, stratified deposits at three sites on the eastern bank of the Semiliki River in DR Congo, about 15 km. downstream from the present-day source at Lake Rutanzige (Edward). Preliminary TL and other ages and association with radial core technologies and a few crude lithic points suggested an attribution to the Middle Stone Age (Brooks et. al. 1995, Yellen et al. 1995). Not only were these the first reported finely made bone points from an MSA context but their technological sophistication and association with numerous fish remains of limited size implied considerable techno-economic complexity at an early date. Yet recent articles on African MSA industries including those with other bone points have ignored or dismissed this attribution, due to perceived uncertainties about the date and association with MSA horizons. Here we report on new efforts to examine the age and association of these artifacts, including new OSL ages for the overlying sands, geochemical studies of the bone points themselves and associated fauna, and microscopic examination of their manufacture and use compared to that of later bone harpoons from the same region.

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- Brooks, A.S. *et al.* Dating and context of three Middle Stone Age sites with bone points in upper Semliki Valley, Zaire. *Science* **268**: 548-553
- Yellen, J.E. 1995. A Middle Stone Age worked bone industry from Katanda, Upper Semliki Valley, Zaire. *Science* **268**: 553-556

A05

Tuesday, March 30, 2004

## **The 40,000 BP Crisis in Iberia**

Marta Camps i Calbet - Donald Baden-Powell Quaternary Research Centre, Institute of Archaeology, University of Oxford. 36 Beaumont Street, Oxford OX1 2PG, England, U.K.

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The most common view of the Mid/Upper Paleolithic Transition in the Iberian Peninsula is a rough adaptation of pan-European generalizations that originated in studies carried out elsewhere, mainly in SW France.

A careful look at the different regions of the Peninsula clearly shows that in order to sustain the traditional view, many important aspects of the phenomenon itself and of the different sites that have yielded remains from that period have been overlooked or interpreted in a very liberal way.

The state of affairs at present, when Iberia is regarded as a key area in this field of study, suffers from major problems, and dissenting opinions and long held opposite interpretations have not come at all closer in the past 30 years. This has turned Iberia into an area where not only 'anything goes' but anyone can come up with a theory and brand it a reality, even if a closer look shows a total lack of evidence to support it.

This presentation aims to be a brief look at different examples of some of the problems outlined above, as observed in this particular area, and an attempt to bring them out in the open. It concludes with a list of possible solutions and hopes to entice international scientific debate on the subject.

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## Extracting Spatial Information from Palaeolithic Secondary Context Assemblages

Jenni Chambers, School of Humanities (Archaeology), University of Southampton, Avenue Campus, Highfield, Southampton, SO17 1BJ

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Lithic assemblages recovered from deposits of Pleistocene river gravels dominate the British Lower Paleolithic record. Yet these secondary context assemblages have received comparatively little research attention due to difficulties in determining their spatial and temporal origins. The artifacts typically show evidence of transportation, having been moved from their original discard locations during their incorporation in active river systems.

In recent years the development of Pleistocene river terrace sequences has been successfully linked to glacial/interglacial cycles, and the associated marine isotope stage record. Refinements in Optically Stimulated Luminescence (OSL) dating techniques provide a means of directly dating Pleistocene river terrace sediments. This is greatly improving the chronological frameworks of secondary context Palaeolithic assemblages, providing the ideal research climate within which to re-evaluate the spatial origins of derived assemblages.

It has long been noted that the physical condition of secondary context artefacts can be utilised as an indicator of the degree of fluvial transportation to which they have been subjected. This approach was formalised by Shackley in the 1970s, who employed microscopic measurements of biface arêtes to quantify **average** abrasion damage. However, subsequent analyses of secondary context assemblages have shown that abrasion damage is not limited to arêtes, and does not develop uniformly across artefacts. Therefore average abrasion summaries inevitably mask the processes of artefact transport and damage development.

This paper presents a new, *état physique* recording technique that incorporates the multiple mechanisms of transportation-related damage that are preserved upon lithic artefacts. This damage is reflected in arête widths, edge micro-flaking, and percussion cone development. This technique has been applied to a series of flume-transported replica artefacts, generating a database of distance: damage correlations. Robust patterns of artefact damage have been related to specific transportation types and generic distance categories. These data have been utilised in modelling the spatial origins of British Lower Palaeolithic secondary context assemblages from Broom (Devon/Dorset, UK) and Dunbridge (Hampshire, UK), revealing valuable data with respect to the landscape behaviours of hominid groups.

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## Geological Formation Processes and Faunal Accumulations at Les Pradelles (Charente, France): Preliminary Results

I. Couchoud<sup>1</sup>, J.P. Texier<sup>1</sup>, C. Beauval<sup>1</sup>, S. Costamagno<sup>2</sup>, A. Mann<sup>3</sup>, B. Vandermeersch<sup>4</sup>, J.G. Bordes<sup>1</sup>, L. Bourguignon<sup>5</sup>, Fr. Lacrampe-Cuyaubère<sup>1</sup>, V. Laroulandie<sup>1</sup>, L. Meignen<sup>6</sup>, J.Cl. Marquet<sup>7</sup>, B. Maureille<sup>8</sup>

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The site of Les Pradelles, located near the town of La Rochefoucauld (Charente, France), was excavated from 1967 through 1980 by B. Vandermeersch. This work resulted in the development of a preliminary model of the stratigraphic history of the deposit. Excavations at Les Pradelles resumed in 2001 with a main objective to refine this earlier model of the processes of site formation. The high priority given to furthering our understanding of the geological history of the site results from the need to comprehend the site's depositional history as an integral part of the analysis and contextualization of the lithics as well as the faunal and human fossil bones.

Over the last three field seasons, geological and sedimentological studies have resulted in the establishment of a more precise stratigraphic sequence. This pattern consists of four main evolutionary phases: 1) deposition of karstic alluvia (lithofacies 1); 2) opening of an aven and development of rock fall processes associated with alluvial deposition (lithofacies 2) then with runoff processes (lithofacies 3, 4, 5); 3) formation of stone-banked solifluction sheets (lithofacies 6); 4) collapse of the roof of the aven (lithofacies 7) and final filling up.

It seems clear that the human presence at the site was closely associated with the specific stages in its geomorphological evolution. For example, archaeozoological and paleontological analyses indicate that faunal remains associated with the beginning of the second evolutionary phase (lithofacies 2) were essentially the result of human activities and that carnivores had only a minor role in their accumulation. However, human occupation at the site appears to show a pattern of decreasing presence from lithofacies 5 through lithofacies 7, when the site seems to be mainly a carnivore den visited only sporadically by prehistoric humans.

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<sup>1</sup> UMR 5808 CNRS, IPGQ, Université Bordeaux 1, Talence – France

<sup>2</sup> UMR 5608 CNRS, UTAH, Université Toulouse 2, Toulouse – France

<sup>3</sup> Dpt Anthropology, Princeton University, NJ, USA

<sup>4</sup> Madrid - Espagne

<sup>5</sup> INRAP grand sud-ouest, Bordeaux - France

<sup>6</sup> UMR 6130 CNRS, Centre d'étude de la préhistoire, Valbonne – France

<sup>7</sup> UMR 6575 CNRS, archéologie et territoire, Tours – France

<sup>8</sup> UMR 5809 CNRS, Laboratoire d'Anthropologie, Université Bordeaux 1, Talence – France,

A08

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## **Taphonomy, Site Structure and Social Organization: Late Paleolithic Open-air Sites**

James G. Enloe - Department of Anthropology, University of Iowa, Iowa City IA 52242

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The difficulty of reading the archaeological record of caves and rock shelters is becoming increasingly obvious to Paleolithic researchers. The scale and duration of long-term accumulations in such palimpsest deposits render them inappropriate for most studies of site structure and subsequent interpretations of social organization. Although certain open-air Paleolithic sites are thought to avoid the complications of taphonomically charged site formation processes evident in long-duration cave and rock shelter deposits, the reading of the archaeological record is probably less direct than assumed. A number of post-depositional processes may operate to obscure latent structure in the configurations of features and artifacts. Many techniques recently developed for the excavation and analysis of Paleolithic cave sites can and should be applied to open-air sites previously considered to have undisturbed configurations. It is only after such analyses that spatial patterning can be analyzed and interpreted for inferences about prehistoric social organization. Methodologies for the reconstruction of configurations of feature and artifact distributions are discussed. The use of ethnoarchaeology in the interpretation of such configurations is discussed. Cases from the sites of Pincevent and Verberie of the late Upper Paleolithic of France are used to explore the interrelationships of data, method and theory.

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## **The articular surface in the distal hominid humerus: 3D shape analysis using Elliptic Fourier descriptors**

M. Friess - NYCEP Morphometrics Group, American Museum of Natural History, New York, NY 10024 and Anthrotech Inc. Yellow Springs, OH 45387

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The distal humerus in hominids (hominins and great apes) has been looked at in numerous studies on functional morphology and phylogeny. While the basic morphology of articular surfaces and their variation among primates in general is well known, their quantitative comparison poses a challenge to both traditional and geometric morphometric approaches. Previous work has focused in particular on locomotion as one key element in explaining the observed variability. In order to fully assess the geometry of the distal articular surface, a 3D shape analysis was performed based on Elliptic Fourier descriptors. A series of 32 humeri of living humans and extant great apes (Gorilla, Pan) was used in this study. In addition, casts of several fossil specimens (AL 288-1, TM 1517, KNM-ER 739) were also included in the analysis. The surface geometry was captured using a Cyberware 3D laser scanner with an optical resolution of less than 1mm. Cartesian coordinates along the edge of the distal articular surface were extracted, and after normalization for orientation and scale the extracted 3D curves were used as input to an elliptic Fourier analysis. The resulting coefficients were subjected to multivariate statistical analyses. The results underline clear morphological differences between the 3 extant groups, especially between Gorilla on the one hand and Pan and Homo on the other, and suggest that the early hominin specimens that were included in this study show more affinities to the human than to the ape pattern, regardless of their chronological or phylogenetic position. It can be concluded that the evolution of habitual bipedalism affected the morphology of the elbow joint from a relatively early stage.

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## **Raw materials and economic behaviors of the Plio-Pleistocene hominids in West Turkana (Kenya)**

S. Harmand - Maison de l'Archéologie et de l'Ethnologie, Laboratoire de Préhistoire et Technologie, Nanterre, France

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Since the 90's, the depositional Formation of Nachukui, located on the west bank of the lake Turkana in Kenya, has yielded a series of archaeological sites attributed to the Late Pliocene and the Early Pleistocene. The stone tools productions show a synchronic and diachronic variability along a chronological sequence spanning from 2.34 to 1.6 Myr (Roche *et al.* 2003). The Lokalalei 2c site revealed the rise of unexpected hominids' cognitive capacities and motor skill as early as 2.34 Myr (Roche *et al.* 1999 ; Roche and Delagnes 2003).

This study on lithic raw materials considered from the angle of their provenance and use is currently undertaken on the Nachukui Formation sites (West Turkana) between 2.34 to 1.6 Myr. It has provided new petrographical and technological data contributing to better understand the adaptive strategies of the first hominids and their associated behaviors : acquisition of technical skills, empirical knowledge of rocks and ecological adaptation.

The integrity and the chronological span of the West Turkana archaeological sites offer unparalleled opportunities for the study of lithic-related behaviors of early hominids through time and space. The synchronic viewpoint assesses the variability in raw material exploitation on geographically distant but chronologically close sites, while the diachronic viewpoint focuses on the study of change in the use of different raw materials throughout the Plio-Pleistocene for that particular area.

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## Taxonomic Assignment of Plio-Pleistocene Hominin Femora Via Morphometric Analyses

T.W. HOLLIDAY<sup>1</sup>, V.T. HUTCHINSON<sup>1</sup>, M.M. BANITT<sup>2</sup>, AND G.A. LIVESAY<sup>2</sup>

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Proximal femoral shape differences are clearly manifest between *Homo* and the australopiths (*Australopithecus* or *Paranthropus*). Specifically, the genus *Homo* is characterized by larger femoral heads, shorter femoral necks, and more lateral flare of the greater trochanter. However, these differences have yet to be systematically quantified, and since few associated skeletons are recovered in Plio-Pleistocene contexts, questions may arise as to the taxonomic affinity of isolated fossil hominin femora. In our study, a digitizing arm was used to collect landmark data on recent human femora (n = 10), a single chimpanzee femur, and casts of six fossil hominin femora in order to test whether one can discriminate fossil femora into different taxa using morphometric analyses.

Twenty-one proximal femoral landmarks were chosen to best quantify the shape differences manifest between hominin genera (the positions of some fossil landmarks were estimated by TWH). These data were then subjected to Procrustes analysis using programs developed by MMB with *MATLAB* 6.0. The resultant fitted coordinate values were then subjected to Principal Components Analysis (PCA). A scatter plot of PC1 and PC2 scores reveals five discrete morphological clusters. First, the chimpanzee is separated from all hominins. The recent humans form a single cluster; all fossil specimens fall outside of their 95% confidence ellipse. The fossil hominins fall into three distinct clusters. The first cluster falls closest to recent humans and includes KNM-ER 1481 and KNM-WT 15000. The second cluster, separated from the first primarily along the second principal axis, includes the specimens SK 82, SK 83, and KNM-ER 1472. A.L. 288-1 is separated from all other fossils.

These results suggest that the KNM-ER 1472 femur is that of *Paranthropus boisei*, not *Homo* as is widely assumed. Results also suggest that there may be key functional differences in proximal femoral morphology between *Australopithecus* and *Paranthropus*.

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<sup>1</sup>Department of Anthropology, Tulane University, New Orleans, Louisiana 70118 U.S.A.

<sup>2</sup>Department of Biomedical Engineering, Tulane University, New Orleans, Louisiana 70118 U.S.A.

## **Technological diversity and stability? Long-term evidence from the British Lower Paleolithic**

Dr Robert Hosfield - School of Humanities (Archaeology), University of Southampton, Avenue Campus, Highfield, Southampton, SO17 1BJ, UK

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The British Lower Paleolithic provides a valuable opportunity to explore patterns in tool-making at a range of different chronological scales. Although primary context sites such as Boxgrove have dominated research over the last decade or more, the secondary context archaeological resource forms a large and valuable data-set from which patterns in hominid technology and behavior can be studied across glacial/interglacial cycles and linked to individual marine isotope stages.

The analysis of temporal patterning in derived stone tool data sets is clearly grounded in the chronological resolution of the sedimentary contexts. Unfortunately, investigation of this issue has been limited, reflecting an absence of reliable geochronological dating tools, poorly developed models of fluvial sedimentary behavior, and an absence of archaeological interest in these data. This paper therefore presents newly developed chronological frameworks for the geoarchaeological secondary context resource, building upon extant geomorphological models for both the Middle Pleistocene and the Lateglacial. These frameworks address the chronological resolution of fluvial sedimentary activity and the issue of artifact re-working in the temporal sphere - and propose new analytical scales for the investigation of secondary context stone tool assemblages.

Data are presented for the late Lower Paleolithic site at Broom (Devon, UK), exploring patterns in a derived handaxe assemblage. Comparison of handaxes from three distinct sedimentary units at Broom indicates considerable diversity of handaxe production within each of the sedimentary units, but notable similarity between the units in terms of the overall typological composition. Optically stimulated luminescence (OSL) dating of the site's sediments suggests that these patterns reflect hominin tool-making behavior over a cold-warm-cold climatic cycle (MIS-8/7/6) of approximately 70-80,000 years duration.

In conclusion, the potential of the secondary context archaeological resource is reviewed with respect to the use of new analytical frameworks and stone tool data to explore current research questions in Lower and Middle Paleolithic research.

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## A Hominid's Eye View of Time Averaging

G.J. Hudgell<sup>1</sup>, A.G.M. Sinclair<sup>1</sup>, and J. McNabb<sup>2</sup>

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The interpretation of Palaeolithic archaeological residues has always been problematic, owing to factors inherent in a record affected at the basic level by the weight of the Palaeolithic timescale. Time averaging in the sense of deposit mixing (as in the case of river gravels) and poorly defined or undatable stratigraphy (including surface artefact scatters) has largely been considered from a geological viewpoint, as can be witnessed by studies that present experimentally determined or theoretically modelled taphonomic information. However, such studies consider factors that are essentially post-depositional in nature. It would therefore be valid to consider, in complement, the processes of site and assemblage formation in terms of actual hominid behaviours: 'as they happen'. By going beyond immediate skills in stone knapping, we can take what we know of technology and move up to an understanding of the landscape as it was used by hominids.

This paper presents a model of assemblage formation in the Palaeolithic, which takes the simple concept of the dynamics of stone tool technology and attempts to place artefacts within the landscape as they are manufactured, used, recycled, repaired, and finally discarded. The model takes the form of complementary sets of both linear and non-linear differential equations based on predator-prey mathematics used in ecological studies, which represent the calculation of rates of artefact production, use, and discard. These are then used as the fundamental logarithms within a computer simulation that places these rates into a landscape context.

Using such a model should allow us to gain an understanding of hominid use and transport of tools, and may also aid in answering questions concerning hominid demographics. Such information is exactly that which we are missing from time-averaged residues – a fact that can be demonstrated with reference to material from the environs of Makapansgat, South Africa, as may be seen in the associated poster presentation.

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<sup>1</sup>School of Archaeology, Classics and Egyptology, Hartley Building, University of Liverpool, L69 3GS

<sup>2</sup> Department of Archaeology, University of Southampton, Avenue Campus, Highfield, Southampton, SO17 1BF

## **Bovid ecomorphology: Refining techniques for paleoenvironmental reconstruction**

K. Kovarovic<sup>1</sup>, L. Aiello<sup>1</sup> and P. Andrews<sup>2</sup>

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The use of bovid remains in paleoenvironmental reconstruction has been prevalent since their anatomical sensitivity to habitat exploitation was first recognized. Critics claim that smaller mammals, while taphonomically more biased, are more sensitive to habitat and thus create a more accurate picture of a site's paleoecology. Others argue that entire faunal communities provide a more precise habitat reconstruction. However bovids, which infrequently weigh less than 4kg, are less affected by depositional history than smaller mammals and as such are of great value to paleoecologists. It is clear that we need to increase our understanding of modern bovid ecomorphology so that we may use this knowledge to better analyze the fossil bovid assemblages recovered from important sites. To this end, we studied a large sample (n=224) of modern bovids that represents the diversity for which they are so well known. The sample is comprised of species that are distributed across Africa, Asia, Europe and the Americas, display an average weight range of 2.25 kg (*Neotragus pygmaeus*) to 800kg (*Bos sauveli*), and exploit a variety of habitats. A total of 235 measurements were taken on each individual.

In this analysis, all long bones, phalanges, carpals and tarsals were included. Despite their relative completeness and frequency in the fossil record, many of these elements have never been studied in an ecomorphological context. The influence of body size was reduced by plotting the logged average body weight for each species against each measurement's logged value; the analysis was carried out using the residuals calculated from the resulting reduced major axis (RMA) line. Principal components analyses on individual elements, anatomically logical groups of elements and proximal and distal ends of long bones were conducted. Preliminary results confirm that although femurs and metapodials discriminate well between broad habitat types, other elements relate to both trophic and spatial aspects of niche exploitation.

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<sup>1</sup>Department of Anthropology, University College London, Gower Street, London WC1E 6BT, United Kingdom

<sup>2</sup>Department of Palaeontology, The Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom

## Provenancing, stratigraphy and related studies of the hominid remains at Limeworks, Makapansgat, South Africa.

Latham, A.G.<sup>1</sup>, Herries, A.<sup>1</sup>, Marshall, J.<sup>2</sup>, Hopley, P.<sup>2</sup>, McKee, J.<sup>3</sup>, Kuykendall, J.K.<sup>4</sup>, and Tobias, P.V.<sup>4</sup>.

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The Makapansgat hominid remains came from a relatively restricted area of the western side of the Limeworks. At the instigation of Raymond Dart in 1947, Hughes, J. Kitching, Tobias, and others sorted the dumps outside the Main, and Entrance Quarries into rows of similarly colored and textured material, and attempted to relate these to areas within the western side of the site. Blocks of mottled gray bone-dense matrix, for example, are uniquely related to the remnants of the *in situ* Grey Breccia. Similarly, other varieties of bone-bearing breccia are sufficiently distinctive that they can be related to other strata within the site with reasonable confidence. One outstanding problem has been to reconstruct the different depositional layers into a sequence. New stratigraphic evidence shows that the Grey Breccia, in the Western Repository, was emplaced partway through a Red Silt phase (Member 2) that also contains a breccia in the Main Quarry. The *in situ* MLD37/38 hominid specimen was recovered from breccia that resembles the Central Debris Pile (Member 4). Very few faunal remains predate the Red Silts (Member 2). Regular laminae, magnetic reversals and distinctive marker horizons are used to relate the different bone breccias to each other and to the overall sequence. The evidence so far suggests that the different hominid representations are of similar age despite their different provenances within the site. Further magnetostratigraphic sampling is underway to confirm a current estimated age range for the hominids of between 3.0 and 2.8 Ma. Paleoenvironmental studies show that the much older Member 1 speleothems, of probable Miocene age, show no evidence of C4 plants. A flowstone from nearby Buffalo Cave of 1.6 to 1.0 Ma shows C4 plants and clear Milankovitch cycles in its C and O isotope records. This presentation updates a number of our recent studies in the Makapansgat Valley.

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<sup>1</sup>Department of Archaeology, Liverpool University, Liverpool, L69 3GS. UK

<sup>2</sup> Department of Earth Sciences, Liverpool University, Liverpool, L69 3GS. UK

<sup>3</sup>. Department of Anthropology, Ohio State University, 124W, 17<sup>th</sup> Ave, Columbus. Ohio, USA, 43210-1364.

<sup>4</sup> School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, RSA

## **Paleoclimate during the extinction of *Homo habilis* from Koobi Fora, Kenya: the alluvial stratigraphic evidence**

Christopher J. Lepre - Dept. of Anthropology, Ruth Adams Building, Rutgers, The State University of New Jersey, New Brunswick, NJ 08901-1414

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Many debates in paleoanthropology have focused on the relationship between Plio-Pleistocene patterns of biological evolution and global climate change. A paramount question is whether Early Pleistocene mammalian extinctions in Africa occurred because of fluctuating environmental conditions caused by Northern Hemisphere climate "deterioration". Some hypothesize that *Homo habilis* went extinct in East Africa, approximately 1.8 Ma, because of an expansion of open-habitats during a warm, arid period.

To test this hypothesis I analyzed the alluvial stratigraphy of sediment from the KBS and Okote Members of the Koobi Fora Formation to reconstruct paleoclimatic conditions for the northern Karari between 1.88 and 1.53 Ma. This geological interval from the Karari directly brackets the stratigraphic level of a potential last appearance datum (LAD) for *H. habilis* (KNM-ER 1805) in the Koobi Fora region of the Turkana Basin. A baseline comparative sample of mature paleosols and a high-degree of channel-interconnectivity, obtained from published alluvial stratigraphic models, represents the architecture of a basin experiencing intermittent deposition and aridity.

Data from the KBS Member show trends similar to the baseline proxy data. That is between 1.8 and 1.7 Ma stratigraphic analysis indicates ephemeral and arid paleoclimatic conditions for the Karari. In contrast, the architecture of both younger (1.7-1.5 Ma) and older (1.8-1.9 Ma) sediment indicates wetter conditions.

The potential LAD for *H. habilis* in Koobi Fora falls precisely within the driest interval of the alluvial stratigraphic record of paleoclimate. This interval is synchronic with basin-wide and regional expansions of open-habitats (circa 1.8-1.7 Ma) and Plio-Pleistocene African climate change (circa 1.8-1.6 Ma) towards aridity. Presently it appears that a local extinction of *H. habilis* from Kenya occurred during a period of landscape-scale aridity, which was spatially and temporally congruent with drier conditions in East Africa presumably resulting from African climate change.

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## **Temporal evolution of the Ngorongoro Volcanic Highland (NVH) in relation to Bed I of Olduvai Gorge, Tanzania: A progress report**

G. M. Mollel and L. M. McHenry - Department of Geological Sciences, Rutgers University, Wright Labs, 610 Taylor Road, Piscataway, NJ 08854 U.S.A,

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Landscape evolution models for Olduvai depend on the temporal evolution of the adjacent volcanic highlands. At Olduvai, vertebrate fossils and stone artifacts are preserved in volcanoclastic material erupted and eroded from the highlands. Topographic changes in the highlands could have changed rain shadow effects, seasonal run-off, drainage patterns and the composition of detritus washed into these basins. Preliminary results of ongoing work on NVH evolution, currently centered on the Ngorongoro crater, indicate that Ngorongoro is younger than previously thought. New  $^{40}\text{Ar}/^{39}\text{Ar}$  ages derived from incrementally heating analyses of lavas and total fusion analyses of K-rich feldspars from the Ngorongoro crater-wall indicate that volcanic activity was much shorter in duration (~60 Ka) and approximately 400 Ka younger, (~2.05 Ma) than historically thought from K-Ar data. The reported "classic" Gauss – Matuyama (N-R) geomagnetic polarity transition recorded in crater wall volcanics now correlates best with the upper 2.1 Ma Reunion – Matuyama (N-R) transition.

Geochemical tephra fingerprinting using mineral compositions has correlated the Naabi ignimbrite, a rhyolitic welded tuff at the base of Olduvai, to an ignimbrite proximal to Ngorongoro, confirming this volcano as the source for the Lower Bed I tuffs and ignimbrites. This correlation is supported by our new ages for Ngorongoro Crater and available ages for the Naabi ignimbrite. Rhyolitic compositions at Olduvai persist through Tuff 1A and then switch to trachytic compositions with Tuff 1B. Some Upper Bed I tuffs (Tuff 1B, 1E, 1F) can now be positively identified by tephra fingerprinting of mineral phases in ignimbrites proximal to Olmoti, a correlation supported by new  $^{40}\text{Ar}/^{39}\text{Ar}$  dates from the Olmoti Crater. The catastrophic caldera collapse of Ngorongoro likely took place during the interval between these two phases, lowering the volcano by as much as 3000 meters, significantly affecting the topography of the NVH and lower Bed I geomorphology at Olduvai.

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## Computer simulations of Neandertal hands

W. Niewoehner<sup>1</sup>, A. Bergstrom<sup>2</sup>, D. Eichele<sup>2</sup>, and J. T. Clark<sup>2</sup>

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Morphological analyses of Neandertal hand skeletons (plus their associated archaeological remains) indicate that they were likely capable of the same types of precision grips produced by recent humans despite indications that Neandertals habitually relied more frequently on power grips rather than precision grips for most tasks. Our computer simulation of the La Ferrassie 1 thumb and index finger confirms that Neandertals could have easily produced tip-to-tip contact of the thumb and first finger even with restricted joint mobility (Niewoehner et al., 2003).

A more thorough understanding of the Neandertal hand as an integrated functional unit requires a more complete and functionally realistic hand model. We are currently engaged in producing a more complete three-dimensional virtual Neandertal hand model using the Shanidar 4 hand remains. High-quality epoxy casts of the Shanidar 4 carpals, metacarpals, and phalanges are individually scanned with a Minolta Vivid 900 laser digitizer, which produces 3D polygon mesh models of the object surfaces accurate to  $\pm 20$  microns. Individual meshes are aligned and merged using Polyworks Modeler software. The individual bone models are moved into their anatomical positions to produce an articulated computer model with Maya Unlimited software. The user-defined center of joint rotation and ranges of movement along the x, y, and z axes of the center of rotation are used to simulate bone movements using the Maya animation tools. The interactive nature of the computer simulation will allow us to test the effects of altered ranges and directions of joint movements on the manipulative posture of the entire Neandertal hand.

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<sup>1</sup>Department of Anthropology, California State University - San Bernardino, San Bernardino, CA 92407

<sup>2</sup>Archaeology Technologies Lab, North Dakota State University, Fargo, ND 58105

## **A diagnosis of crocodile damage to larger vertebrate bones, with fossil examples from Olduvai Gorge, Tanzania**

J. K. Njau and R. J. Blumenshine - Center for Human Evolutionary Studies, Department of Anthropology, Rutgers University, 131 George Street, New Brunswick, NJ 08901 U.S.A.

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Taphonomic studies have established the patterns of bone damage created by larger mammalian carnivores when consuming carcass parts. Typically, mammalian carnivores gnaw and break bones to various degrees in order to access marrow, grease, and brain tissue. In contrast, crocodylians attempt to swallow whole carcass parts, inflicting in the process tooth marks to the bones they are unable to ingest. Although crocodylian species are dominant predators of larger mammals along the margins of tropical rivers and lakes, crocodile mastication damage on bones has not received formal attention in neotaphonomic research.

We present diagnostic characteristics of *Crocodylus niloticus* damage on bones resulting from a series of controlled feeding observations of captive crocodiles provisioned with mammalian carcass parts. The resulting bone assemblages are composed of primarily complete elements bearing a high density of shallow to deep, transversely to obliquely oriented tooth scores over the whole bone, along with shallow to deep pits. While many scores and pits are individually similar to those produced by mammalian carnivores, some have a morphology distinctive to crocodiles. Assemblages created by crocodiles are also characterized by the retention of low-density bone portions, an absence of gross gnawing, and minimal fragmentation. These bone damage characteristics allow for the unambiguous distinction of bones modified by crocodiles from those modified by mammalian carnivores.

The diagnostic traces of crocodile feeding are present in modern bone assemblages associated with pools utilized by Nile crocodiles in the Grumeti River, northern Serengeti. Analyses of Plio-Pleistocene bones from Olduvai Gorge also reveal direct evidence of fossil crocodylian involvement in the formation of bone assemblages that occur together with stone artifacts in fluvial and lake margin settings.

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A20

Tuesday, March 30, 2004

## Phylogenetic Analysis of Human Evolution

A. Parent - Département d'Anthropologie, Université de Montréal, C.P. 61128, succursale Centre-Ville, Montréal, Québec, H3C 3J7, Canada.

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Methods of phylogenetic analysis are becoming more widely used in the field of human evolution. This study examines the phylogenetic relationships between Pleistocene and modern hominids using a phenetic distances method on cranial data. The distances between 32 individuals were calculated by using Gower general coefficient of similarity and transforming it into distance values for 24 continuous quantitative characters. To take the ever-present correlation between the different cranial characters into account, we reduced the distance matrix through a principal components analysis, therefore eliminating co-linearity while conserving the information present in the original set of data. This was done to take into account the number of missing values in the original data matrix. We also used a bootstrap method to validate the obtained phylogeny.

Our results show that phenetic distances phylogeny support the multiregional evolution hypothesis by grouping together individuals from the same region but from different temporal windows and that phylogenetic analysis can be a useful tool to study the relationships between spatiotemporally distant hominid groups, in this case modern humans and Pleistocene hominids. Further study will be conducted with phenetic distances analysis using multi-state characters and with parsimony analysis using multi-state characters.

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## The Narmada hominin locality revisited: implications of fresh geological, paleolithic, and paleontological observations

Rajeev Patnaik<sup>1</sup> and Parth R. Chauhan<sup>2</sup>

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The Narmada Valley in Central India is known to be one of the richest source of Pleistocene fossils and stone tools in South Asia. In fact, its Quaternary deposits at Hathnora have yielded the only known early hominid cranium from the Indian Subcontinent. The (*Homo*) cranium was recovered in the early 1980s from a *Boulder Conglomerate* formation. This Formation was always thought to be a wide-spread marker-horizon and of Middle Pleistocene age, primarily based on large-mammal fauna, Lower Palaeolithic artifacts, and its stratigraphic context. Further, the overlying alluvial sediments have generally been considered to be of pedogenic (palaeosols) origin, and also considered to be parts of widespread formations.

However, recent fieldwork (October 2003) has revealed that: 1) the *Boulder Conglomerate* is not a geological formation. Instead, it is a geological artifact (with limited lateral extent and vertical thickness); 2) The palaeontological and archaeological material varies in age and shows taphonomical bias; 3) the soil formations considered to be widespread by earlier workers are now known to be confined to the river banks; 4) we have possibly recovered the oldest-known lithic assemblage in the Narmada region (comprising of quartzite handaxes and cleavers in fresh condition); 5) it is also possible to establish a broad typo-chronological framework for *in situ* Acheulian handaxes occurring in terrace sections; and 6) we have also recovered large vertebrate fossils (in surface and *in situ* contexts) from the Hathnora area. In light of these preliminary observations, the age of the Hathnora cranium is now rendered uncertain and it can now be either older or younger than previously reported. The 2003 field season has shown that the Narmada Basin contains a wealth of palaeoanthropological and geological data critical for studying the evolution of hominid behavior within the Quaternary timeframe.

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This work was funded by the National Geographic Society and is part of an ongoing multidisciplinary project in the Narmada Basin.

<sup>1</sup>Department of Geology, Panjab University, Chandigarh, India

<sup>2</sup>Department of Archaeology, University of Sheffield, Sheffield, U.K.

## **Cave Bear Taphonomy and its Application to the Fossil Hominid Remains in Sima de los Huesos (Atapuerca, Spain)**

Ana C. Pinto Llona - Institute of Human Origins, Department of Anthropology, PO Box 872402, Arizona State University, Tempe AZ 85287-2402 USA

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In limestone caves throughout Europe, cave bear remains are found in Pleistocene sediments that also bear testimony to the presence of hominid activities. The concurrence of cave bear and Mousterian remains prompted in the past notions such as the 'Alpine Palaeolithic' facies and that of the 'Cult of the cave bear', but both of these have since been challenged by research pointing to the juxtaposition of hibernation related deaths of cave bears in caves with episodic Mousterian occupations.

Although it has been suggested that cave bears were mostly vegetarian, their remains are almost in all cases affected by carnivore alterations with tooth punctures consistent in size with that of the cave bear dentition. In order to ascertain the possible existence and patterning of scavenging behaviours in cave bears, we analysed bone surface modifications and breakage from several assemblages: three Pleistocene cave bear-only sites, a fourth cave bear site where hyenas and wolves were also present, and one Holocene brown bear cave site. All of these are in northern Spain and none bore vestiges of human activity. Our results show that cave bears consistently use a patterned and characteristic scavenging method on other cave bear carcasses, and they are therefore an omnivorous species capable of carcass processing and bone modification.

In Sima de los Huesos (Atapuerca, Spain), many remains of the cave bear *Ursus deningeri* appear mixed with the dismembered and scattered but otherwise mostly complete skeletons of some 30 *Homo heidelbergensis*. Our comparison of bone breakage and carnivore modification in cave bear sites with published modification patterns on the hominid remains of Sima de los Huesos offers a new line of evidence on both the formation process of the Sima de los Huesos assemblage and the origin of breakage and bone surface modifications on the hominid remains in that site.

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## **Detecting Age at Weaning in Human Dental Enamel through Incremental Isotopic Analysis**

J. Rabb - Department of Anthropology, University of Utah, Salt Lake City, Utah, 84112, U.S.A.

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Humans wean their offspring at an early age relative to other living great apes. Identifying when this unique feature of our life history pattern emerged may indicate when we first became human. One potential means of determining age at weaning is by stable carbon and oxygen isotopic analysis of human dental enamel. Enamel may be the best source of isotopic data for Plio-Pleistocene hominin remains because it preserves for millions of years and is highly resistant to diagenetic contamination. Furthermore, enamel develops in incremental layers and is not remodeled over an individual's lifetime as is bone. It thus retains a temporal record of the juvenile diet during which the shift from breastmilk to a post-weaning diet occurred. Incrementally sampling individual teeth can provide a serial isotopic record of the individual's diet during the enamel growth period.

Incremental sampling regimes are common in animal tooth enamel studies but not in human studies. This poster will present carbon and oxygen isotopic ratios of incrementally sampled human enamel (canines and M1s) from an archaeological collection from medieval Denmark. Methods emphasize minimal destruction so that they can be used on hominin fossils; each incremental sample weighs less than 2mg. Whether a weaning signal can be detected isotopically in enamel is not yet well-established; data presented here will contribute to the existing body of research.

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## **Understanding behavioral variability in the Uluzzian: New insights from the lithic assemblages of Grotta del Cavallo, Italy**

Julien Riel-Salvatore - Department of Anthropology, Arizona State University, PO Box 872402, Tempe, AZ, 85287-2402, U.S.A.

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Despite the central importance of the earliest Upper Paleolithic industries in helping clarify the behavioral dimensions of the so-called Middle-Upper Paleolithic transition, little is known about the internal variability of most of them. This is problematic since not understanding the internal dynamics of a given industry can force researchers to gloss over some of its potentially most significant and informative characters. In this paper, I seek to correct this unfortunate situation by presenting preliminary results of a re-analysis of the Uluzzian assemblages from Grotta del Cavallo, the type-site of the industry in southeastern Italy. The approach used in this study aims specifically at extracting behavioral variability from lithic assemblages, and proposes a first glimpse of that variability by focusing on the retouched tools of the assemblages. The analysis begins by detailing how, based on a whole assemblage analysis approach, the typologically based tripartite division of the Uluzzian into chronological phases does not appear to directly map onto broad levels of behavioral variability. Subsequently, the analysis of the assemblages from Grotta del Cavallo is presented, focusing on techno-economic aspects including raw material exploitation patterns, the prevalence of bipolar technology, and evidence for tool reduction. Lastly, a discussion of the microlithization characteristic of the Uluzzian is presented, to emphasize the distinctive nature of that technology in the Uluzzian relative to its manifestation in other initial Upper Paleolithic industries.

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## **A Very Early Middle Stone Age Occurrence at Haaskraal Pan in the Upper Karoo region of South Africa**

C. G. Sampson - Department of Anthropology, Southern Methodist University, Dallas, TX , 75275-0336 U.S.A.

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Mechanical trenching in alluvium and playa fills between two stream channels of the upper Seacow River has produced stratified samples of Acheulian and Middle Stone Age artifacts. A very extensive dating program (U-series, T/L, 14C) has produced a rough outline of post-depositional calcrete formation, but only limited correlation of the profiles. One U-series date on a solitary fragment of ostrich eggshell (OES) is associated with a small, undiagnostic sample of bone fragments. The shell dates to 244+38/-40 kyr. This has not been subject to the acid leaching effects that are so prominent in the overlying calcrete dates. The OES fragment comes from 2.23m below the modern pan surface and is in close association with MSA artifacts, including large blades, made of near-mint hornfels. The context of this material is poor. The MSA artifacts and the OES/bone have migrated down mudcracks to their current positions near the base of the profile. Their source is probably an unconformable surface some 30 cm higher in the profile, but none has remained at that elevation so this remains uncertain. Both are now stratified immediately above a weathered Acheulian of refined workmanship, which some researchers might label 'Fauresmith'. Above, on the pan surface is a lag of both MSA and 'Fauresmith' assemblages with different patinas. None of this made much sense until a comparable, fluctuating ESA/MSA sequence was reported from Kapthurin, Kenya in which MSA and 'Fauresmith' assemblages were found to interstratify between two very well dated volcanics in the .25 myr range and older. Haaskraal suggests a similar high antiquity and the same oscillating Acheulian-to-MSA transition in South Africa.

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Fieldwork & analyses were supported by National Science Foundation, National Research Foundation, Pretoria, and Southern Methodist University.

## **Applying a landscape approach to the Paleolithic of the desert interior of Syria**

Bruce Schroeder, Associate Professor - Division of Social Sciences, University of Toronto at Scarborough, Scarborough, Ontario, Canada L0C 1A0

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Landscape archaeology has typically concentrated on the study of cultures during Protohistoric and Historic times. Rarely is it applied to archaeology in the Pleistocene when human behavior is much more remote. Major obstacles for archaeology are the destruction and burial of evidence. While the enormous chronological gap between cultures of the Pleistocene and the archaeological evidence presents a significant challenge for the direct application of a landscape perspective to the Paleolithic, the lack of ethnographic models and ethnohistoric examples, especially for the rich Paleolithic remains of coastal Levant. Fortunately, there are still a few regions of the Levant where development has not yet taken a complete toll on hunting patterns. The steppe-desert of interior Syria is one of those areas.

This paper focuses on Paleolithic evidence from the steppe-desert of the Syrian interior where the landscape has been little disturbed by westernization. It reconstructs regional hunting practices using archaeological evidence in the context of our knowledge of the local topography, water and flint sources and the (recently extirpated) fauna and ethnohistorically described hunting practices. Paleolithic remains in central Syria are found on the surface, stratified in wadis and in multiple occupancy sites buried in fossil spring deposits, as well as in the fill of caves. Fortunately, surface evidence still exists of historic hunting practices such as the use of blinds. Ethnohistoric and traveler's accounts also exist describing hunting practices and groups persisting in the open desert and better-watered highlands into the last century.

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## THE ALTAMIRAN CULTURE: NEW EVIDENCE ON THE EARLY MAGDALENIAN OF CANTABRIAN SPAIN FROM EL MIRON CAVE.

Lawrence Guy Straus<sup>1</sup>, Manuel Gonzalez Morales<sup>2</sup>, Marcos Garcia Diez<sup>3</sup>, John D. Risetto<sup>1</sup>

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One of the first Paleolithic cultures to be discovered in northern Spain was the technocomplex later known as the Lower Cantabrian Magdalenian, uncovered at Altamira between 1876-79 by Sanz de Sautuola. With the classic excavations at Castillo, Valle & Cueto de la Mina early in the 20th century, it became clear that there were two cultural phases between the Solutrean & Azilian periods: a so-called Magdalenian rich in antler points & works of art, but without harpoons, & a later phase with harpoons. So distinctive is the early phase (e.g., scapulae engraved with tripartite animal images; quadrangular-section, geometrically marked antler points; nucleiform endscrapers &/or backed bladelets), that Jesus Carballo-founder of the Santander Prehistory Museum argued that it should be called the "Altamiran" to distinguish it from the early Magdalenian of SW France, with whose makers the prehistoric Cantabrians nevertheless had contacts, as proven by recent discoveries of French Pyrenean contours decoupees in some north Spanish sites. New excavations at such sites as Viesca & Riera (Asturias), Juyo, Rascón & Miron (Cantabria) and Ekain & Erralla (Guipuzcoa) confirm the peculiarities of this period (now dated by dozens of radiocarbon assays between c. 17,000-13,000 BP uncal.), but also reveal important inter-site differences in artifact & faunal assemblage composition. These are probably based in part on site location vis-à-vis flint or non-flint raw material sources & the main foodshlffs (red deer, ibex, molluscs). Striking aspects of this cultural phase are the high number of known sites (59), plus the great thickness, stratigraphic complexity & artifactual, faunal & structural wealth of many of the deposits (e.g., Castillo, Juyo, Altamira, Rascón & Miron, all with multilevel, early Magdalenian horizons => 1 m thick). Many caves have evidence of deep human penetration in this period; in Miron there are not only major early Magdalenian occupations throughout the large vestibule, but also traces of human use of the ramp leading up into the inner cave & even in the dark inner cave itself. In addition to rupestral paintings dated by AMS, rock engravings at Viesca & Miron are stratigraphically attributed also to this period. In Miron, apparently non-figurative engravings (& probably one horse image) can be dated to no older than c.16,000, but no younger than 13,000 BP. Major hub sites like Miron may have been logistically supplied via special-purpose camps within relatively small, altitudinally diverse catchment " territories. This hypothesis is currently being tested by means of petrographic &

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<sup>1</sup> Department of Anthropology, University of New Mexico, Albuquerque, NM 87131 USA.

<sup>2</sup> Grupo de Prehistoria, Universidad de Cantabria, 39005 Santander, SPAIN.

<sup>3</sup> Akademie Ved Cr Archeologicky Ustav Brno, 69129 Do1ni Vestonice 25, CZECH REPUBLIC.

## **Ancient DNA, late Neandertal survival, and modern human and Neandertal admixture**

Timothy D. Weaver- Postdoctoral Fellow, Department of Zoology, University of Wisconsin-Madison, 430 Lincoln Drive, Madison, WI 53706 USA

Charles C. Roseman - Doctoral Candidate, Department of Anthropological Sciences, Stanford University, 450 Serra Mall, Building 360, Stanford, CA 94305-2117 USA

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One of the longest standing questions in paleoanthropology is the place of Neandertals in human evolution. Most researchers now favor a predominately extra-European origin for the earliest modern human successors of Neandertals in Europe. Debate today centers on the degree to which modern humans and Neandertals interbred. Analyses of mitochondrial (mt) DNA extracted from multiple Neandertal fossils have confirmed abundant skeletal evidence that Neandertals were distinct relative to recent humans. The distinctiveness of Neandertal mtDNA also shows that either modern humans and Neandertals diverged deep in the past or that human mtDNA diversity was much greater in the past. However, Neandertal mtDNA may tell us little about admixture between modern humans and Neandertals, because Neandertal lineages could have been lost in living humans through random genetic drift. What is not often recognized is that any calculated probability that Neandertal mtDNA lineages would have been lost depends heavily on demographic history and how this history is modeled.

In this study, we examine the likelihood that there could have been both substantial admixture between modern humans and Neandertals and the complete loss of Neandertal mtDNA lineages in living humans by simulating demographic models derived from several models of modern human origins currently being discussed in the paleoanthropological literature. Our preliminary results suggest that for some demographic models derived from archaeological and other genetic evidence, it is unlikely that Neandertals contributed substantially to the modern human gene pool. One model that may allow for both substantial admixture between modern humans and Neandertals and the loss of Neandertal mtDNA lineages is a diffusion wave, but this model does not appear to fit the archaeological record of Europe. Our results stress the importance of fully integrating archaeological, fossil, and genetic evidence in investigations of modern human origins.

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## Cross-sectional geometry and locomotor behavior of habituated chimpanzees from the Tai and Mahale National Parks.

K.J. Carlson<sup>1</sup>, D.M. Doran<sup>2</sup>, K.D. Hunt<sup>3</sup>, T. Nishida<sup>4</sup>, A. Yamanaka<sup>5</sup>, C. Boesch<sup>6</sup>

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Studies of extant primate locomotion use cross-sectional geometry to characterize the limb structure of primates spanning broad locomotor categories. Such studies frequently are the basis for inferring locomotor profiles of extinct primates. However, any response of bone to individual differences in activity profiles is obscured when interpreting the morphology of museum specimens with the observed behavioral profiles of wild populations. Here we present an analysis of cross-sectional geometry and locomotor behavior where the same wild specimens supply morphological and behavioral data. Femora and humeri from several chimpanzees of the Tai National Park (Ivory Coast) and the Mahale National Park (Tanzania) were assessed at three diaphyseal locations using computed tomography and image analysis software. Locomotor profiles were constructed with 3387 instantaneous time-point observations (87.4 hours). Few significant correlations are found between a ratio of maximum and minimum principal moments of area, which quantify maximum and minimum structural rigidities, and locomotor activities. Furthermore, few consistent positive or negative trends are observed between structural rigidity ratios and locomotor activities. This suggests that femoral and humeral cross-sectional geometry is relatively insensitive to differences between individual chimpanzee locomotor behavior profiles, and may be incapable of distinguishing between less than broadly defined locomotor categories (i.e., leapers, brachiators, climbers). This limits the precision with which locomotor behavior of extinct primates can be extrapolated using cross-sectional geometry of long bone diaphyses.

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<sup>1</sup>*Department of Anatomical Sciences, Stony Brook University, Stony Brook, NY 11794-8081 U.S.A.*

<sup>2</sup>*Department of Anatomical Sciences and Interdepartmental Program in Anthropological Sciences, Stony Brook University, Stony Brook, NY 11794-8081 U.S.A.*

<sup>3</sup>*Department of Anthropology, Indiana University, Bloomington, IN 47501 U.S.A.*

<sup>4</sup>*Department of Zoology, Kyoto University, Kyoto, Japan.*

<sup>5</sup>*Department of Oral Anatomy 1, Kagoshima University Dental School, Kagoshima, Japan.*

<sup>6</sup>*Max-Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

## **The influence of lower limb length and proportions on locomotor style in humans: implications for reconstructing locomotion in extinct hominins**

Laura Tobias Gruss - Dept. of Biological Anthropology & Anatomy, Duke University, Durham, NC 27708, U.S.A.

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Dramatic differences exist in lower limb proportions among modern and extinct hominins. *Homo ergaster* had long limbs and long tibiae relative to femora, whereas Neandertals had short limbs and relatively short tibiae. Modern humans are largely intermediate, though they vary widely. Researchers have long sought explanations for this diversity in limb proportions, but little research has addressed its potentially important impact on locomotor style. One study (Gruss and Schmitt, 2000) found that modern people with relatively long tibiae (i.e. high crural index) moderate lower limb loading in the sagittal plane by altering limb kinematics.

In this study I tested two new hypotheses. The first suggests that during the stance phase of walking, people with longer tibiae experience higher mediolateral bending moments along the tibia and at the knee. The second hypothesis suggests that people with long legs, or with low crural indices, increase knee flexion during the swing phase of walking in order to reduce the mass moment of inertia of the swinging limb. The goal of this study is to evaluate the probability that differences in limb proportions among extinct hominins imply differences in locomotor style and energetics.

I videotaped 18 adult subjects as they walked across a force plate. Joint angles and bending moments were compared to crural index and limb length. Both hypotheses were rejected. In contrast to the previous study, there was no relationship between crural index and mediolateral bending moments along the leg. Likewise, there was no correlation between limb length or crural index and swing phase knee flexion. These results indicate that limb proportions affect human walking in a complex way, influencing some aspects of locomotion but not others. Data such as these are crucial for reconstructing locomotion in extinct hominins, and are important to functional interpretations of variation in fossil lower limb morphology.

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This research was supported by Duke University Graduate School and the L.S.B. Leakey Foundation.

## **The energetic costs of the relatively short legs characteristic of Australopithecus and Neanderthals.**

K. Steudel and M.C. Tilken - Department of Zoology, University of Wisconsin, Madison, WI 53706 U.S.A.

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The consequences of the relatively short legs characteristic of AL 288-1 have been widely discussed, as have the causes and consequences of the short legs of Neanderthals. Previous studies of the effect of leg length on the energetic cost of locomotion have reported no relationship, however, limb length could have accounted for as much as 19% of the variation in cost and gone undetected (Steudel & Beattie, 1995; Steudel, 1994, 1996). Kramer (1999) and Kramer & Eck (2000) have recently used a theoretical model to predict the effect of the shorter leg of early hominids, concluding that the shorter limbs may actually have been energetically advantageous. Here, we took an experimental approach. Twenty one human subjects, of varying limb lengths, walked on a treadmill at 2.8 and 3.0 mph, while their expired gases were collected and analyzed. The subjects walked for 12 minutes at each speed and their rates of oxygen consumption (VO<sub>2</sub>) over the last four minutes were averaged to estimate VO<sub>2</sub>. We also measured each subject's height, weight and leg length. Lean body mass and %fat were determined using dual-energy x-ray absorptiometry.

ANCOVA with total VO<sub>2</sub> at either speed as the dependent variable and total lean mass, % fat and leg length as covariates resulted in all three covariates having a significant positive effect on VO<sub>2</sub> at  $p < 0.01$ . Subjects with relatively longer legs had lower locomotor costs. Thus the short legs characteristic of some hominid taxa would have resulted in more costly locomotion. The magnitude of this effect is substantial; Neanderthals are estimated to have had locomotor costs 30% (or more) than those of contemporary anatomically modern humans. By contrast the increase in leg length seen in *H. erectus* would have mitigated the increase in locomotor costs produced by the increase in body size.

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## **Stable isotopes and the Savannah hypothesis in South Africa - Orbital-forcing of vegetation change and the latitudinal spread of savannah grasses**

Philip Hopley<sup>1,2</sup>, Jim Marshall<sup>1</sup> and Alf Latham<sup>2</sup>

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Determining the role of climate change in early hominin evolution is a central issue in palaeoanthropology. The competing models such as the Faunal Turnover Pulse hypothesis, Variability Selection, Autocatalysis and the Savannah hypothesis can only be evaluated in the light of a detailed record of palaeoclimatic change. The majority of such studies refer to the marine oxygen isotope record as the template for late Neogene climate change in tropical Africa. However, recent palaeoclimatic data indicates a decoupling of the marine and tropical terrestrial palaeoclimate records. Therefore, to determine the effects of ecological change on early hominin evolution, it is important to develop a high-resolution and continuous record of climate change from early hominin sites.

This study describes the development of a continuous oxygen and carbon isotope record from a 2.4m long flowstone (cave carbonate) from Buffalo Cave, Makapansgat Valley, South Africa. Using a combination of magnetostratigraphy, annual-band measurement and spectral analysis, it has been possible to tune the record to orbital insolation at 2Ma to 1.5Ma. The record shows that temperature/rainfall is varying at the precessional periodicity (19-23ka) whereas the proportion of C<sub>3</sub> and C<sub>4</sub> grasses is varying at both the precessional and the obliquity (40ka) periodicity - this is the first record of orbitally-forced vegetation change at an early hominin site. An increase in the mean proportion of C<sub>4</sub> plants occurs at 1.7Ma, in agreement with faunal and isotopic evidence from across Africa.

A second flowstone from the basal deposits of the Makapansgat Limeworks is dated to the late Miocene / early Pliocene by magnetostratigraphy and based on its carbon isotope composition, was precipitated in a purely C<sub>3</sub> plant environment. Despite the imprecise dating, we suggest that savannah (C<sub>4</sub>) grasses first arrived in South Africa at 4-5Ma, much later than the mid-Miocene (15Ma) origin of C<sub>4</sub> grasses in east Africa. We explain this discrepancy in terms of changes in the latitudinal temperature gradient known to control the distribution of C<sub>4</sub> grasses in the present day. A review of published records of the late Neogene global spread of C<sub>4</sub> grasses provides supporting evidence for this late origin of C<sub>4</sub> grasses at mid-latitudes. Therefore, we show that the latitudinal spread of savannah grasses coincided with the origins of hominin bipedalism, and suggest a possible causal relationship between these two events.

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<sup>1</sup>Department of Earth Sciences, University of Liverpool, Brownlow Street, Liverpool, L69 3GP.

<sup>2</sup>Department of Archaeology, University of Liverpool, Brownlow Street, Liverpool, L69 3GP.



## Laetoli paleoecology reconsidered: Implications for early hominin habitats.

Terry Harrison & Denise F. Su - Center for the Study of Human Origins & NYCEP, Department of Anthropology, New York University, 25 Waverly Place, New York, NY 10003

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The paleoecology of the early hominin site of Laetoli in northern Tanzania has previously been reconstructed as representing an arid to semi-arid grassland with scattered bush and tree cover, and possibly patches of acacia woodland. In addition, the site is unusual in that there were no permanent or large seasonal bodies of water. This contrasts with most contemporary East African hominin sites, which are generally inferred to be more heavily wooded and associated with riverine or lake-margin settings. However, new evidence from the fauna and flora from the Upper Laetolil Beds (~3.5-3.8 Ma) confirms recent reinterpretations of the paleoecology, and suggests a complex mosaic of different vegetation types, with a greater representation of bushland and woodland habitats. Periodic inundations of carbonatite tuffs from Sadiman would have had a catastrophic effect on the local ecology, resulting in extensive tracts of grassland, but these periods of disturbance were of relatively short duration, and the climax vegetation apparently rapidly re-established itself. The fossil faunas are associated with periods of sedimentation when the climax ecosystem was relatively stable, implying that *Australopithecus afarensis* had access to a wide variety of potential habitats, ranging from grassland, through bushland and woodland, to forest. A similar ecology can be reconstructed for the Lower Laetolil Beds (~3.8-4.5 Ma), although there is evidence of permanent sources of water, and possibly more heavily wooded habitats compared with the Upper Beds. No fossil hominins have yet been recovered from the Lower Beds, but their absence from the record may simply be an artifact of sampling. The paleoecology of the Upper Ndolanya Beds (~2.6-2.7 Ma) is reconstructed as being a semi-arid bushland, somewhat drier than the Upper Laetolil Beds. This change in the ecology is associated with a taxonomic turnover in the mammalian fauna, which includes the first appearance of *Paranthropus aethiopicus*.

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## Late Pliocene hominin paleoenvironments of the lower Omo Valley, Ethiopia: new data from bovid ecomorphic studies.

R. Bobe<sup>1</sup>, J. Ferraro<sup>2</sup>, L. Bishop<sup>3</sup>, T. Plummer<sup>4</sup>, and Z. Alemseged<sup>5</sup>

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The paleoenvironmental context of late Pliocene hominin behavior, ecology and evolution is a topic of great importance, but little consensus. As the vertebrate fossil record of the lower Omo Valley, Ethiopia, contains numerous specimens, is well dated, and includes many hominin finds of pertinent geologic age, it currently serves as one of the best sources of data on the subject. Previous research on Omo paleoenvironments strongly suggests a general drying trend through time, coupled with a gradual increase in the presence of relatively open habitats. Studies often differ, however, with regard to the specific timing and magnitude of environmental change, and the degree to which environmental perturbations influenced the abundance and composition of local mammalian communities. One critique of previous studies is that they often derive paleoenvironmental inferences using taxonomic-uniformitarian principles, where habitat preferences of extinct taxa are assumed to be similar to those of related extant taxa. Notable exceptions include a few studies that incorporate some ecomorphic criteria, by which habitat preferences of extinct taxa are inferred from ecologically correlated aspects of their morphology. Nevertheless, the degree to which taxon-based and taxon-free analyses produce congruent results at landscape scales remains an open question. This study employs both ecomorphic and community ecological analyses of antelopes to provide locality-specific inferences of late Pliocene vegetative cover. Specimens were collected by the French and American contingents of the International Omo Research Expedition. For ecomorphic studies, we measured 790 fossil astragali using a scheme that is >90% accurate in assigning complete modern specimens to one of 4 habitat classes. For community ecological analyses, we incorporate over 12,000 fossil specimens in a variety of standard analyses. In addition to addressing methodological concerns, results help refine the paleoenvironmental context of past hominin finds as well as assess the regional biotic effects of climatic change.

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<sup>1</sup> Evolution of Terrestrial Ecosystems Program, Department of Paleobiology, Smithsonian Institution, Washington, D.C. 20560, USA.

<sup>2</sup> Department of Anthropology, University of California Los Angeles, Los Angeles, California 90095, USA.

<sup>3</sup> School of Biological and Earth Sciences, Liverpool John Moores University, Liverpool, UK.

<sup>4</sup> Department of Anthropology, Queens College, City University of New York, Flushing, New York 11367, USA.

<sup>5</sup> Institute of Human Origins, Arizona State University, Tempe, Arizona 85287, USA

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## **High Resolution Paleoenvironmental Comparisons between Hadar and Koobi Fora: Preliminary results of a combined geological and paleontological approach.**

C. J. CAMPISANO, Department of Anthropology, Rutgers University, 131 George St., New Brunswick, NJ 08901-1414

A. K. BEHRENSMEYER and R. BOBE, Department of Paleobiology, Smithsonian Institution, P.O. Box 37012, Washington, D.C. 20013-7012,

N. LEVIN, Department of Geology and Geophysics, University of Utah, Salt Lake City, UT 84112-0111

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Paleoenvironmental comparisons between paleoanthropological localities are usually conducted at broad levels of temporal resolution that may obscure important finer-scale paleoecological information. This study takes an alternative, high-resolution approach to compare the geology and paleontology of fossiliferous deposits associated with the Tulu Bor/Sidi Hakoma Tuff in mid-Pliocene deposits of Hadar, Ethiopia and East Turkana, Kenya.

Both the Sidi Hakoma Member at Hadar and lower half of the Tulu Bor Member (up to the Allia Tuff), dated to between 3.40 and 3.22 Ma, can be subdivided into two units by the base of the Mammoth Sub-Chron (3.33 Ma.). Geological comparisons between these contemporaneous units show significant differences in depositional environments. At Hadar, deposits between 3.40 and 3.33 Ma are primarily fluvial, while those between 3.33 and 3.22 Ma are lacustrine and lake margin. In contrast, this entire 200,000 year sequence in the Tulu Bor Member is fluvial-dominated, particularly in the fossiliferous 3.33-3.22 Ma interval.

Comparisons using abundances of mammalian families and bovid tribes show significant differences among all three faunas. Some of these differences are consistent with inferred depositional environment while others are not. In the lower, fluvial component of the SH Member, Giraffidae and Cercopithecidae are relatively more abundant, while proboscideans increase markedly in the overlying lacustrine deposits. Additionally, the lower SH Member has abundant impala and tragelaphines, while the upper SH member has more reduncines and alcelaphines. The contemporaneous fauna of the fluvial lower Tulu Bor Member is similar to the lower SH fauna but has more bovids, fewer giraffes, and impala and reduncines are common while tragelaphines are rare. Equids are rare to absent in both regions, and hominins are present at Hadar but absent in the lower Tulu Bor sample. The combined evidence suggests considerable local and regional variability in contemporaneous mammalian communities between 3.4 and 3.2 Ma.

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## A Comparison of P<sub>3</sub> Morphology in Early Pliocene Hominins

L. K. Delezene - Department of Anthropology, Arizona State University, Tempe AZ, 85287 U.S.A.

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The morphology the P<sub>3</sub> is analyzed in the hominins *Australopithecus afarensis* (n=16) and *Australopithecus anamensis* (n=6) and is compared to the extant outgroup *Pan troglodytes troglodytes* (n=20). Specimens attributed to *A. afarensis* from Laetoli, Tanzania, and Hadar, Ethiopia, are considered, as are specimens of *A. anamensis* from Kanapoi and Allia Bay, Kenya. Metric features of occlusal morphology are measured from scaled occlusal digital photographs taken of high quality casts. This study demonstrates that relative to *P. troglodytes troglodytes*, *A. afarensis* has a significantly smaller relative area devoted to the portion of the crown mesial to the transverse crest and lingual to the mesial protoconid crest, the area of the anterior fovea. Correlated with the decrease in relative area devoted to the anterior fovea is an increase in the relative area devoted to the posterior fovea. The increase in relative anterior fovea area and decrease in relative posterior fovea area are partially the result of a change in the orientation of the transverse crest in relation to the protoconid crests. The transverse crest is oriented more acutely to the mesial protoconid crest in *A. afarensis* and more obliquely in *P. troglodytes troglodytes*. For these features, *A. anamensis* appears more primitive, i.e. more like the condition in *P. troglodytes troglodytes*. *A. anamensis* has a greater relative area devoted to the anterior fovea, less relative area devoted to the posterior fovea, and a more obliquely oriented transverse crest than *A. afarensis*.

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## **Australopithecine craniodental growth & development: a life history synthesis.**

K.L. KUYKENDALL, School of Anatomical Sciences, University of the Witwatersrand, 7 York Road, Parktown 2193 Johannesburg, South Africa.

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This paper reviews available evidence from dental microstructure, dental development patterns, and facial growth in *Australopithecus*, *Paranthropus*, and early *Homo*, and discusses aspects of interspecific variation in growth and development that are relevant to early hominid life history reconstructions. To date, most research reconstructing aspects of growth and development in fossil hominids has focused on the question of the evolutionary origin of prolonged growth and development in modern humans, which is generally linked to the evolution of increased cranial capacity and body size in the genus *Homo*. The reconstruction and comparison of early hominid ontogeny is valuable in its own right, because it assists in understanding the evolutionary history of growth and development, and is critical for testing and clarifying models of early hominid adaptation and evolution. While it is now widely accepted that small-brained early hominids shared a short ontogenetic trajectory more like modern chimpanzees than humans, the significance of observed differences in tooth development and facial growth between =18gracile=19 and =18robust=19 australopithecines to life history reconstruction has not been established. There are several general patterns of interest: a) *Australopithecus* and *Paranthropus* do not appear to differ substantially in either brain or body size, both of which have strong effects on ontogenetic timing; and b) *Australopithecus* and early *Homo* demonstrate similarities in craniodental growth and development with *Pan*, while *Paranthropus* demonstrates certain similarities with modern humans. In addition, differences in the timing of dental development events have been documented between East and South African *Paranthropus*; and c) documented differences in dental developmental timing =13 and thus of life history =13 reflect differences observed in folivorous vs. frugivorous (i.e., low vs. high quality diet) primates of similar body size. Such information is instructive for future discussions incorporating developmental timing, dietary regime, and life history into early hominid evolutionary models.

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## New perspectives on Late Pliocene hominids' technical skills: the Lokalalei 2c record

Hélène Roche\*, Anne Delagnes\*\*

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Relatively few remains of Late Pliocene hominids' knapping activities have been recovered to date, and these have seldom been studied in terms of manual dexterity and technical achievements. With regard to early hominid technological development, the site of Lokalalei 2c (West Turkana, Kenya), estimated at 2.34 Myr, provides a wealth of new data. Analysis relies mainly on the dynamic reconstruction of entire cobble reduction sequences from particularly informative refitting groups. The Lokalalei 2C knappers had already internalised the notion of planning and foresight in the management of raw material. Whereas the small cobbles were brought to the site in one piece, the larger cobbles were broken up (possibly where the raw material was collected) prior to flaking. Having obviously more than just mastered the basic technical constraints peculiar to stone knapping, they conducted by means of highly controlled percussion gestures a *débitage* of flakes following operational constancies. The flaking surface on the cores, a large and naturally flat face, was exploited for the *débitage* of flakes based on successive and multidirectional series of invasive and subparallel removals, a practice that maintains this surface flat. The productivity resulting from these technical principles was high, with an average of 18 flakes produced per core, and over 50 flakes knapped from the same core. Flakes form an homogeneous category and consist of small to medium-sized, relatively thin products, with sharp cutting edges ; few of them bear evidence of retouch. The level of elaboration evinced by this lithic assemblage is quite unexpected in view of its age, and seemingly more advanced than what can be surmised for other sub-contemporaneous East-African sites, including the nearby site of Lokalalei 1.

The evidence provided by the Lokalalei 2c technological record thus calls into question both the assumption that productions followed a continuous and linear evolutionary trend and the idea that they long remained static.

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\*Directeur de recherche au CNRS

\*\*Chargée de recherche au CNRS

## **KS5, a transitional site between the Oldowan (KS1) and the Early Acheulean (KS4) from the Kokiselei site complex (West Turkana, Kenya)?**

Pierre-Jean Texier\*, H el ene Roche\*\*, Jean-Philip Brugal\*\*\*, Sonia Harmand\*\*

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The stratigraphic sequence from the Nachukui Formation (4 to 1.65 Ma) is now documented by several archaeological site complexes. The Kokiselei complex, located in the Kaitio member (1.90-1.65 Ma), contains 3 major sites located very near one another in space and time: the KS1 Oldowan site, the KS5 and the KS4 early Acheulean sites.

Kokiselei 5 occupies an intermediate position, given its stratigraphic position and the petrographic and technological characteristics of its lithic assemblage.

More than 60m<sup>2</sup> of the only 20cm thick archaeological layer have been excavated in an extensive and exhaustive manner. A scatter plot shows a heterogeneous distribution with almost three concentrations of artefacts. The distribution of the faunal remains, particularly those of an antelope close to *Gazella sp.*, and of an alcelaph (*cf. Damaliscus*), shows a great similarity to the distribution patches of lithic artefacts. Fractures on fresh bones and impact marks can be linked to hominid activities.

The lithic assemblage mainly documents flake *d ebitage* but the module and the workmanship of a unifacially-shaped pebble could announce the neighbouring Kokiselei 4 early Acheulean. The stone-knappers producing the Kokiselei 5 and 4 assemblages exploited different sources of the same raw material. Numerous refits show in detail the geometric organization of the *d ebitage* (sequence?) and give evidence for the conceptual as well as the technical skill level reached at Kokiselei 5. On one hand, the rate of refitting concerning the dominant raw material is low. On the other hand, the refits which are numerically the most representative and from which cores are always missing, always concern flakes made from a specifically coloured, fine-grained raw material. The scatter of the artefacts involved in these refits confirms the low post-depositional disturbance of the archaeological remains. Integrated approaches to lithic and faunal remains in a spatial context, allow us to specify the type of occupation.

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\* CNRS, UMR6130-CEPAM, 250 rue Einstein, 06560 Valbonne, France.

\*\* CNRS, UMR7055-Pr ehistoire et Technologie, 21 all ee de l'Universit e, 92023 Nanterre cedex, France.

\*\*\* CNRS, UMR 6636, 5 rue du ch ateau de l'horloge, 13094 Aix -en-Provence, France.

## **A landscape of Stone Age archaeology: A primary investigation near Hackthorne 1, Limpopo Province, South Africa.**

J.C. Le Baron - University of the Witwatersrand, School of Geography, Archaeology and Environmental Studies, Johannesburg, South Africa

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The Hackthorne 1 site is located on a remnant terrace of the Limpopo River within non-alluvial sands that mantle the terrace. The terrace forms an escarpment over 3km long and has typologically Earlier Stone Age artifacts preserved along its length. Previous geoarchaeological research at Hackthorne revealed that artifacts were not only preserved along the escarpment, but were also present at a number of locations to the south across a sand covered plateau. The aim of this landscape archaeology study was to determine the distribution of the Stone Age artifacts in the Hackthorne area, and to seek potential patterns between artifact distribution and landscape features. To perform this landscape study a series of 1m<sup>2</sup> test excavations were conducted over an area of more than 10km<sup>2</sup>. Excavation sites were situated to explore landscape features such as kopjes (small hills) as well as featureless areas of the plateau. Recovered artifacts were examined to identify tool types diagnostic of the ESA, MSA and LSA industries. The assemblage size distribution from each excavation was compared to data from replication experiments to assess site preservation. Results indicate that the distribution of artifacts is widespread throughout the study area. Comparison of assemblage size distribution data between the excavated sites and published data show that the majority of sites are well preserved; the densest accumulations of artifacts are associated with kopjes. The presence of typologically ESA, MSA and LSA artifacts at these kopjes suggest that these landscape features have been focal points of repeated habitation and/or visitation since the late Acheulean.

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## **Examining early hominid site use patterns on the Kalahari Rim using lithics operations analysis**

Grant S. McCall - Department of Anthropology, University of Iowa, Iowa City, IA 52242, U.S.A.

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Tsoana and its numerous satellite sites are located in the Nhomadom orimumba on the rim of the Kalahari, in the Kaudom National Park, Northeast Namibia. These sites consist of rich lithic assemblages that are typologically Early Stone Age (ESA), sealed by a stratum of calcrete. This paper uses an operations analysis perspective to infer patterns of site use by looking at core reduction sequences. Methodologically, this paper primarily looks at refitting lithics as a way of reconstructing diachronic sequential events. The paper also examines frequencies of flake size, retouch, and patterns of cortex in order to make technological inferences concerning the order of operational sequences between sites. Through reconstruction of lithics production operational sequences, this paper makes inferences concerning the duration of occupation at sites and the technological behavior associated with site use, finding support for the "near-kill" accumulation model of early hominid site use. The operational sequences present at these sites are surprisingly short, with only conjoining flakes present and no true refits, implying concomitantly short durations of occupation. This contradicts the expectations for central place foraging camps, that occupations would be longer and more continuous due to repeated long-term presence. In contrast, these findings support a model of "near-kill" accumulation, where uses of sites would be quite brief and involve little technological activity in terms of the production of lithics.

Stage 3 Climate and the Upper Palaeolithic 'revolution' in Europe: Did the

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A42

Tuesday, March 30, 2004

## **Desmond Clark: a rememberance**

Schick, K. and White, T.

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Abstract not avaiialalbe.

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## Archaeological details, environmental context and the broad view: Desmond Clark's influence on Koobi Fora archaeology

B. L. Pobiner<sup>1</sup>, D. R. Braun<sup>1</sup>, J. W. K. Harris<sup>1</sup>, M. J. Rogers<sup>2</sup>, R. L. Quinn<sup>1</sup>, N. Levin<sup>3</sup>, J. T. McCoy<sup>1</sup>, M. K. Greene<sup>4</sup>, and M. Kibunjia<sup>5</sup>

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More than three decades of archaeological research within the Koobi Fora Formation, Kenya has provided a wealth of behavioral and environmental information, particularly in the 2.2-1.39 Ma time period. We will provide an up-to-date synthesis on what has been learned from this work, which will serve as a launching point for a discussion of recent archaeological, paleoecological, and geological research that has been conducted over the last two years. Our major focus is on the broad temporal trends seen in the archaeological record, combining evidence from hominin-modified bone, stone tools, and paleoecological data to elucidate the ecological niches of hominins during this time period - namely, of early *Homo* and *H. erectus/ergaster*. We will draw upon evidence from the archaeological record to infer dynamics of landscape use and foraging patterns.

Our aim in this paper is to document the changing environmental contexts of hominin behavior through time, from the Upper Burgi (2.2-1.9 Ma) through the KBS (1.9-1.65 Ma) to the Okote (1.65-1.39 Ma) Members, which is possible given the extensive deposits of the Koobi Fora Formation. Within this broad context, we are reporting here on new paleoecological reconstructions based on faunal communities as well as recent sedimentological and geochemical analyses. We will also discuss landscape use patterns through the incorporation of GIS techniques and high-resolution satellite imagery. Additionally, we will review our previous work on FwJj14 and Gaji14 and present new data on paleoenvironments at these sites, using multiple lines of evidence. Finally, we will also discuss preliminary results from new excavations in 2002-3 at FxJj82 and FxJj83 (Karari Region, KBS Member) and surface finds at FwJj20 (Ileret Region, KBS/Upper Burgi Member) and place this recent work within the overall archaeological trends seen between 1.9-1.4 Ma.

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This research is largely a result of an ongoing collaboration between the National Museums of Kenya and Rutgers University. This multidisciplinary collaboration is undertaken in the spirit of Desmond Clark's extensive work of a similar nature in various parts of the African continent

<sup>1</sup>Anthropology Department, Rutgers University, 131 George Street, New Brunswick, NJ 08901

<sup>2</sup>Department of Anthropology, Southern Connecticut State University, 501 Crescent, New Haven CT 06515

<sup>3</sup>Department of Geology and Geophysics, University of Utah, 135 South 1460 East Room 719, Salt Lake City, UT 84112-0111

<sup>4</sup>Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545

<sup>5</sup>Sites and Monuments, National Museums of Kenya, P.O. Box 40658, Nairobi, Kenya

## **The puzzling character of the first dense Oldowan hominid traces in the Olduvai Basin following the ca 1.8 Ma catastrophic eruption of Mt. Olmoti**

R. J. Blumenschine<sup>1</sup>, C. R. Peters<sup>2</sup>, F. T. Masao<sup>3</sup>, J. K. Njau<sup>1</sup>, I. G. Stanistreet<sup>4</sup>, M. Bamford<sup>5</sup>, R. M. Albert<sup>6</sup>, J. I. Ebert<sup>7</sup> and P. Andrews<sup>8</sup>

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The HWKE area of the paleo-Olduvai Basin records the earliest conspicuous presence of vertebrates, including Oldowan hominids, on the eastern lake margin following the catastrophic volcanic eruption that produced Tuff IF. The reoccupation is recorded by the stone artifact and vertebrate fossil assemblages excavated from the basal Bed II paleo-landsurface overlying Tuff IF by M.D. Leakey at HWKE level 1, and by the Olduvai Landscape Paleoanthropology Project at a series of nearby trenches. Examination of this record allows an exploration of the adaptive capabilities of the Oldowan to the marginal landscapes of the post-eruptive, early-successional central Olduvai Basin.

Basal Bed II vertebrate traces in the HWKE area are located on the flood terrace of a shallow braided stream on a westerly declined, gently undulating open and relatively dry landscape. The dense and functionally diverse stone artifacts are associated with abundant skeletal remains of vertebrates preferring open and dry habitats that were drawn to a fresh-water setting supporting hippopotamus and crocodiles. The remains bear modifications inflicted during feeding by crocodiles and a large size-range of mammalian carnivores, but not by Oldowan hominids. This is in marked contrast to expectations based on the "occupation floor" scenario for Bed 1 and Lower Bed II archaeological occurrences.

We examine several competing hypotheses about the nature of hominid activity in the area of HWKE within the broader context of a probable seasonal reoccupation of the east-central Olduvai Basin from the footslopes of the southeastern volcanic highlands.

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1 Center for Human Evolutionary Studies, Department of Anthropology, Rutgers University, 131 George Street, New Brunswick, NJ 08901 U.S.A.

2 Department of Anthropology and Institute of Ecology, Baldwin Hall, University of Georgia, Athens, GA 30602-1619 U.S.A.

3 Paleo-cultural and Environmental Research, P.O. Box 70566, Dar es Salaam, Tanzania.

4 Department of Earth Sciences, University of Liverpool, Brownlow Street, Post Office Box 147, Liverpool, L69 3BX, U.K.

5 Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Private Bag 3, WITS 2050, Johannesburg, S.A.

6 ERAUB/SERP, Department de Prehistòria, Història Antiga i Arqueologia c/Baldiri Reixach, s/n 08028 Barcelona, SPAIN.

7 Ebert & Associates, 3700 Rio Grande Blvd. N.W. Suite 3, Albuquerque, NM

8 Natural History Museum, Cromwell Road, London SW7 5BD U.K

## The Still Bay in context

T. Minichillo - Department of Anthropology, University of Washington, Box 353100, Seattle, WA 98195-3100, USA

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The Still Bay Industry of the Middle Stone Age is an early expression of a regionally restricted “style” on the Cape coast of South Africa. Initially, the artifacts of the Still Bay were thought to mark the arrival of “neolithic man” at the southern end of the continent. Still Bay artifacts were the earliest Stone Age tools from sub-Saharan Africa to be illustrated in publication. However, in recent decades, the significance of the Still Bay Industry waned to the point that some researchers questioned its actual validity. Recently, the industry has been brought back into prominence by the spectacular finds at Blombos Cave. The foliate bifaces that are the most distinctive artifacts of the Still Bay are often associated with other precocious artifacts, like bladelets, worked bone and ochre. This paper presents the results of an examination of a number of Still Bay assemblages, some previously undescribed; from Cape Hanglip, Kleinjüngersfontein, Trappieskop (Eales Cave, Dale Rose Parlour), Blombos Sands, and Hollow Rock Shelter, South Africa. Long assumed to be hafted spear armatures some Still Bay bifaces do exhibit clear evidence for resharpening in a haft. Variability in form of Still Bay bifaces was examined with resharpening and breakage patterns and raw material differences in mind. Variability in form, workmanship, and breakage patterns suggest multiple hafted functions for the bifaces including knives, projectiles, and symbols. Debitage from Still Bay assemblages was also examined; it is significantly more “bifacial” than that of other MSA assemblages, including the Howieson’s Poort Industry. Now firmly dated at greater than 70,000 BP the Still Bay, and the original observations on the technological modernity of the industry, have a renewed resonance in the debate regarding the appearance of behavioral modernity.

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This research was supported by Dissertation Fieldwork Grant 6894 from the Wenner-Gren Foundation for Anthropological Research.

## **Sibudu, a late Middle Stone Age rock shelter in KwaZulu-Natal, South Africa: understanding the transition to the Late Stone Age**

L. Wadley <sup>1</sup>, P. Villa <sup>2</sup>, A. Delagnes <sup>3</sup>, B. Williamson <sup>1</sup>, M Lombard <sup>1</sup>

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This research is part of a larger project to study changes in lithic technologies dating to the transition from the MSA to the LSA and from the Middle to the Upper Paleolithic in South Africa and France. The > 2 m deep stratigraphic sequence of Sibudu, under excavation by one of us (L.W.) extends from Howiesons Poort (HP) at its base to final MSA. OSL dates range from ca 60 to 38 ka for the post-Howiesons Poort, MSA III layers; the uppermost MSA layer has a C14 date of 26 ka. Occupational debris is very dense, there are no sterile layers. We analyzed in detail layer RSP (ca 60 ka, 1 m above the HP levels) which has provided a large MSA III assemblage of several thousand stone artifacts. Compared to other MSA sites this industry is unusual for the very high proportions of retouched pieces (15%). The technology is expedient and lacks stable flaking routines partly as an adaptation to blanks of variable shapes and sizes. There are no flakes of predetermined shapes, retouch is used to modify irregular flakes to obtain desired edges. Soft hammer is used for retouching tools but knapping of flakes and blades is by hard hammer. In contrast the older HP blades were produced on the same raw materials by soft hammer. Raw material (hornfels and dolerite) was procured apparently from distances of less than 20 km but it was introduced into the site partly preformed, occasionally as a product that could be recycled. Unifacial points are the dominant type; there is strong evidence of hafting (with ochre in the mastic) and use as spear armatures. The assemblage presents various points of resemblance to the French Middle Paleolithic (e.g. similar conceptions of core exploitation and similarity in basic tool forms) but unretouched bladelets (blades and bladelets are about one fifth of the flaking products) and the high frequencies of retouched points represent significant differences with coeval Western European assemblages. Supported by NSF and Leakey Foundation grants to P.V.

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<sup>1</sup> Department of Archaeology, University of the Witwatersrand, Wits 2050, South Africa

<sup>2</sup> University of Colorado Museum, UCB 265, Boulder, Colorado 80309-0265, USA

<sup>3</sup> C.N.R.S., Maison de l'archéologie et de l'ethnologie, 21 Allée de l'Université, 92023 Nanterre, France

## The Pleistocene Archaeology of Southwestern Ethiopia: A Dam Approximation

S.A. Brandt<sup>1</sup>, J. Kinahan<sup>2</sup>, A. Desse<sup>3</sup>, E. Fisher<sup>1</sup>, T. Hagos<sup>3</sup>, A. Negash<sup>4</sup>, and H. Said<sup>5</sup>

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One of the least known aspects of Desmond Clark's illustrious career was his concern with the destruction of the archaeological record at the hands of such large infrastructural projects as the Kariba Dam, where in the 1950's he conducted salvage archaeological fieldwork along the Zambezi River. These concerns led him fifty years later to provide advise on the protection of archaeological sites threatened by the 50m high Gilgel Gibe Dam and resulting 80km<sup>2</sup> reservoir in SW Ethiopia ~250 km southwest of Addis Ababa.

The Gilgel Gibe Archaeological Project (GGAP) is an emergency archaeological project aimed at mitigating the deleterious effects of the Gigel Gibe Dam upon the archaeological record. Funded by the World Bank and European Union, GGAP began operations in 1999 with a survey of the dam construction zone. In 2000 and 2001 fieldwork focused on the testing and excavation of significant sites threatened by tunnel and road construction. The 2002 field season concentrated on surveying, testing and excavating sites in the reservoir zone. Over 30,000 artifacts and 50 sites ranging in from Acheulian through Iron Age were discovered.

At some point in the Quaternary, tectonic activity resulted in the drainage of a deep paleolake and subsequent formation of the Gilgel Gibe River Basin. Earliest hominid occupation is in the form of two Acheulian occurrences, followed by MSA and LSA sites scattered along the reservoir's periphery. This includes Liben Bore, an open air site with >2m of continuous occupation spanning the transition from MSA through LSA to Iron Age. The significance of GGAP for providing data on SW Ethiopia, a region previously unknown archaeologically but almost certainly the major environmental refugium for Pleistocene hominid populations circumscribed by the arid conditions of the Pleistocene Horn of Africa, is discussed, along with the critical need to protect Africa's endangered cultural heritage.

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<sup>1</sup> *Department of Anthropology, University of Florida, Gainesville, FL 32611 U.S.A.*

<sup>2</sup> *Quaternary Research Services, P.O. Box 22407, Windhoek, Namibia.*

<sup>3</sup> *Authority for Research and Conservation of the Cultural Heritage, P.O. Box 1907, Addis Ababa, Ethiopia.*

<sup>4</sup> *Department of Integrative Biology, University of California, Berkeley, CA 94720 U.S.A.*

<sup>5</sup> *Ethiopian National Museum, P.O. Box 76, Addis Ababa, Ethiopia.*

## **THE FAUNA FROM ADRAR BOUS: SUBSISTENCE AND CULTURAL ACTIVITY**

Diane Gifford-Gonzalez - Department of Anthropology, Social Sciences 1 Faculty Services, University of California, Santa Cruz, CA 95064 USA

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Desmond Clark actively worked on African research up his final illness. I was privileged to be among those working with him on his final projects. Desmond had a major part in instituting zooarchaeology as a doctoral specialization at UC Berkeley. I was among the earliest encouraged by him, Glynn Isaac, Clark Howell, and Bill Clemens to concentrate on archaeological faunal analysis. This presentation reports on the fauna from Adrar Bous, Niger, the last monographic project of Desmond's career and representative of the great temporal and topical span of Desmond's interests. Especially rich in mid-Holocene remains, the fauna reveals an especially intriguing view of early Saharan pastoralism. The earliest fauna, highly mineralized and largely representing megafauna, is sometimes difficult to link with an industry but does show evidence of butchery. Animal remains from the early Holocene Kiffian is likewise mineralized and nearly exclusively fish or amphibious reptile and mammal, according with the lake high stand in evidence geologically. The mid-Holocene fauna associated with Tenerian lithics and ceramics testifies to a cattle-dominated economy, as well as to special handling of animal meal remains also noted by other researchers on the Tenerian. Taken together, the evidence suggests economic specialization and expression of diacritical behaviors that distinguish this widespread Saharan phenomenon as a social and cultural unit.

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## Oldowan to Acheulean: Quantifying the reasons for change.

S.Hounsell<sup>1</sup>

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Much of Palaeolithic archaeology has been concerned with the form and function of Lower Palaeolithic stone tool traditions. Analysis of these traditions has provided insights into the behaviour and cognitive processes of the producing hominids. This investigation attempts to answer specific questions as to the selective preferences of hominids with regard to their choices in tool form and of appropriate raw materials for these tools. To this end a series of mechanically controlled experiments was undertaken (performed by robot arm), in which selected replicated tools from Oldowan and Acheulean industries made on several different raw materials were subjected to simulated human use motions. The forces required by each tool to perform various "action kinetics" were recorded and analysed to produce a *tool performance index* and a *raw material performance index*.

The data established through these indices were then used to answer hypotheses as to the underlying reasons for the change in technology from the Oldowan to Acheulean, seen in the archaeological record at about 1.5 Ma.

These indices confirm that there are very definite differences in performance between stone tool types. The results indicate that some artefacts common in the Oldowan, such as choppers are, contrary to appearance, relatively specialised. Choppers are able to perform few of the stipulated action kinetics, but at a higher level of the performance index than tools classically associated with the Acheulean, such as hand-axes. Hand-axes are demonstrated objectively to perform as generalised tools, achieving somewhat lower scores on the indices across a wider range of tasks. Flakes and flake scrapers performed well on particular tasks.

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<sup>1</sup> Department of Archaeology, SACE, Hartley Building, University of Liverpool, P.O. Box 147, Liverpool L69 3BX, UK.

## Clustering Approaches to Unravelling Horizontal Variation on an Acheulean Site

J.A.J. Gowlett and S.Hounsell<sup>1</sup>

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In recent years there has been a resurgence of research into the palaeogeography of Acheulean sites (e.g. Olorgesailie, Kalambo Falls, Isampur). At Kilombe in Kenya (a site complex aged ~0.8 Ma) patterning across an extensive area has previously been studied at two conceptual levels: (1) through plotting of artefact morphology in different parts of the site, showing clear local differences, e.g. in thickness/breadth ratio of bifaces, and (2) through cluster analysis of separate assemblages, picking out (e.g.) modes of large and small bifaces which appear to correspond with Acheulean/Developed Oldowan phenomena. This paper reports on a further technique, Wishart's 'Density Analysis', which is used to seek natural clusters. The technique is also good at isolating 'extreme cases', that is, artefacts which are highly distinctive. A surprising result is that, although applied without reference to spatial data, the technique tends to find small 'tight' groups of 5 – 8 bifaces, which are sometimes found to be closely adjacent to one another on the physical surface. We consider whether these groups represent contemporary output of an individual or small group of hominids, and whether the similarities in a biface group might be related to particular functional requirements. In this respect the study echoes Desmond Clark's notion of 'toolkits', which have often been postulated, but which are difficult to confirm by objective criteria. As there is a general 'sameness' in bifaces, similar specimens may indeed be found at opposite ends of a site; nevertheless at Kilombe there is clear evidence of some local patterning. We conclude by analysing the groups in terms of potential performance differences.

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<sup>1</sup>British Academy Centenary Research Centre, *Department of Archaeology, SACE, Hartley Building, University of Liverpool, P.O. Box 147, Liverpool L69 3GS, UK.*

## Missing Links: Refitting Studies at Beeches Pit as an Approach to Understanding Tool Production in the Middle Pleistocene

J. Hallos, J.A.J. Gowlett, V. Brant, S.Hounsell - British Academy Centenary Research Centre, Department of Archaeology, Hartley Building, University of Liverpool, P.O. Box 147, Liverpool L69 3BX, UK.

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Refitting studies have long been employed as a means of lithic analysis to answer questions about site formation processes, technological practice and artefact transport. The refitting studies at Beeches Pit, a Middle Pleistocene site in UK, have been used in conjunction with technological analyses to reconstruct the spatial and temporal dimension of stone tool production. These analyses underline the dynamic nature of Middle Pleistocene lithic technology. The abundance of lithic débitage and the presence of several reduction sequences relating to separate episodes of core reduction and biface manufacture suggest that on-site knapping behaviour was a principal factor in the accumulation of artefacts at this location. However, the refitting sequences are incomplete, and generally record segments of the reduction process, suggesting spatial and temporal disengagement of the *chaînes opératoires*. The 'missing' segments provide links between the archaeological site and the wider landscape, enabling us to gain an insight into how the site was related to the landscape.

The study is based on analyses of approximately 20,000 stone finds defined by coordinates, of which approximately 2500 are artefactual. It identifies patterning in the data suggesting technology was organised around the transport of cores and bifaces. The horizontal overlapping of reduction sequences through a relatively narrow artefact bearing horizon suggests the assemblage is considerably less time-averaged than many comparable East African localities. As such, the site offers an excellent opportunity to investigate variability in the relationships between hominids, their technology and other resources on a local scale. The lithic assemblage suggests a complex and dynamic technological system in which artefacts were not always made, used and discarded in an expedient or opportunistic manner. On-site knapping of local raw material, import and discard of bifaces, and export of knapped components – in particular cores – are responsible for the composition and build-up of lithic material at this location.

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## THE ACHEULO-YABRUDIAN FAUNAS FROM QESEM CAVE (ISRAEL): PRELIMINARY RESULTS

Mary C. Stiner<sup>1</sup>, Ran Barkai<sup>2</sup>, and Avi Gopher<sup>2</sup>

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The faunal associations of the Acheulo-Yabrudian Lower Paleolithic complex in western Asia are largely unknown, because very few bones were found in layer E of Tabun Cave (Garrod & Bate 1937) and those recovered from Yabrud I were lost during World War II (Rust 1950:138). The recently discovered site of Qesem Cave in central Israel contains abundant faunal remains and Acheulo-Yabrudian industries (Barkai et al. 2003, 2004). A pilot study based on a sub-sample of 1780 identified faunal specimens from the 2001 excavation reveals abundant traces of hominid activity, including cut marks (10-19% of ungulate NISP) and burning damage. The orientations and anatomical placements of cut marks—mostly short, scattered, diagonal scars associated with major muscle masses—indicate redundant, simple flesh cutting and removal. Cone fractures occur at rates of 23-38% of NISP and are indicative of marrow extraction from limb bones and mandibles, the two most common element groups in the site. Only one possible case of carnivore gnawing damage was found, and rodent gnawing damage is absent. Evidence of fire activity (burned bones, lithics & sediments) occurs throughout the 7.5 m deposit and promises new information on the early evolution of fire technology in the Levant. Hominid diets at the cave were narrowly focused on fallow deer (*Dama*, a large-bodied form), along with some aurochs (*Bos*), horse (*Equus*, caballine type), wild pig (*Sus*), tortoise (*Testudo*), and rarely red deer (*Cervus*). The clear dominance of fallow deer (over 80% of total NISP) is striking: the faunas are distinctly Holarctic in origin throughout, with no Afro-Arabian types, in marked contrast to early Mousterian faunas from the region (Hayonim Cave, Stiner n.d.), suggesting significant changes in environmental conditions at the Acheulo-Yabrudian to Mousterian transition in the Levant.

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<sup>1</sup>Department of Anthropology, University of Arizona, Tucson, AZ 85721-0030 U.S.A.

<sup>2</sup>Department of Archaeology, Tel Aviv University, P.O.B. 39040, Tel Aviv 61390, Israel

## Early Acheulian in India: A Re-consideration of the Role of Bifacial Flaking/Shaping in Early Mode 2 Industries

Mishra, Sheila<sup>1</sup>; Agrawal, Neetu<sup>2</sup>; Deo, Sushama<sup>1</sup>; Abbas, Riza<sup>1</sup>; Gaillard Claire<sup>3</sup>; & Sonali Naik<sup>1</sup>

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One of the most significant milestones in human evolution was the appearance of *Homo erectus/ergaster* and mode 2 technology at the beginning of the Lower Pleistocene. Although it has been suggested that early mode 2 industries are confined to Africa and a few sites in Western Asia, they are actually common in India. Our studies of artefacts from Morgaon and Bori, re-study of the collection from Lalitpur and comparison with the published description and analysis of Chirki and Hunsgi sites leads us to question the current definition of Mode 2. This definition may be appropriate for later Mode 2 industries but is misleading when applied to Early Mode 2.

The main tools are hand-sized flakes with cutting edges formed by intersecting dorsal and ventral flake scars. There is no real “shaping” by bifacial flaking. The Kombewa technique is extensively utilized but it can only be used in the early stages of core reduction. In the later stages other techniques are used. Secondary flakes removed after the tool was detached from the core are few in number and do not appear to be intended to “shape” or make a cutting edge. They are usually detached from the thick “grip” portion of the flake and are related to improving the grip. A few proper cleavers are made this way.

The second type of tool is the pointed “picks” and “trihedrals”. These are the most common handaxe type. At Bori, Chirki, Morgaon and Lalitpur there are no other types. It could be argued that there is “shaping” in the handaxes, but this is confined to producing a particular type of working edge—a pointed one.

In later Mode 2 the technology of making invasive or covering removals, in order to modify the entire surface and consequently the entire shape of the blank appears. This is absent in the Early Mode 2 industries studied by us. In the absence of a technology to efficiently “shape” tools, flakes with desired size and edges were nevertheless obtained by simple and elegant core reduction techniques.

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<sup>1</sup>Department of Archaeology, Deccan College, Pune 411 006, India

<sup>2</sup>Department of Anthropology, University of Lucknow, Lucknow, India

<sup>3</sup> Institut de Palaeontologie Humaine, 1, Rue Rene Panhard, Paris, France 75013

## Glimpses into the Paleolithic Archaeology of Northwestern Ethiopia

L.C. Todd<sup>1</sup>, J. Kappelman<sup>2</sup>, and M. Glantz<sup>3</sup>

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The record of human activities during the African Paleolithic is heavily biased toward sites located at generally low elevations in the East Rift Valley. To gain a better understanding of the full range of human adaptations, we have begun a combined archaeological and paleontological survey of Ethiopia's Northwestern Plateau and western lowlands. Initial efforts resulted in the discovery of several major localities. Kernet, a rich Lower Paleolithic site is located on the Ethiopian Plateau west of Gondar and is only the third Paleolithic site reported on the northwestern plateau. The site consists of a surface scatter of handaxes covering over 5 ha, with an additional estimated 2 ha of subsurface contemporary deposits. Test excavations exposed 13m<sup>2</sup> with well-preserved fauna and associated artifacts. Kernet's unique combination of plateau setting, rich concentrations of artifacts, and well-preserved fauna promises to add considerable insight into Pleistocene human adaptations within a broader range of environmental and ecological settings.

The second survey area is further west along the Shinfa River, which flows through western Ethiopia's Kolla and Voina Dega plains and into the Blue Nile. While surveying calcrete-indurated hills along the Shinfa drainage, a general scatter of Middle Stone Age (MSA) large basalt flakes and smaller concentrations of chert and chalcedony debitage and artifacts have been documented. This survey, supplemented with test excavations in 2003, has located a group of MSA localities with large numbers of unifacial and bifacial points, debitage (including refitting pieces), well preserved fauna, and indications of hearths (burned bone and heat-crazed lithics) interbedded within a stratigraphic series of paleosols. As with the Kernet site, these Shinfa-Metama localities provide a tantalizing glimpse into the potential for Palaeolithic archaeology and for contributing to our understanding of the factors affecting the human colonization of Africa and adjacent parts of the Old World.

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<sup>1</sup> Laboratory of Human Paleoecology, Colorado State University, Fort Collins, Colorado, 80523-1787 U.S.A.

<sup>2</sup> Department of Anthropology, University of Texas at Austin, Austin Texas, 78712-1086 U.S.A.

<sup>3</sup> Department of Anthropology, Colorado State University, Fort Collins, Colorado, 80523-1787 U.S.A.

## Archaeology of the Kibish Formation, Lower Omo Valley, Ethiopia.

John Shea (Anthropology, Stony Brook University), John G. Fleagle (Anatomical Sciences, Stony Brook University), Frank Brown (School of Mines, Utah), Zelalem Assefa (Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University), Craig Feibel (Anthropology, Rutgers University), Ian McDougall (Geology, Australian National University), with the assistance of Lawrence Bender and Adam Jagich (Stony Brook University).

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This paper reports the results of archaeological, paleoanthropological, and geological reconnaissance in the Kibish Formation of the Lower Omo Valley, southern Ethiopia undertaken in 2002-2003. Our archaeological research focused on Middle Stone Age sites located in Kibish Formation Members 1-3, which date to between 100,000-200,000 BP. One site, KHS (the site of the Kibish 1 hominid) produced a small lithic scatter and a sparse nonhuman fossil assemblage. A second site, BNS, yielded a large lithic assemblage associated with nonhuman fossils, burnt ostrich eggshell and possible combustion features. Both sites feature numerous refitting sets of artifacts. A third site, AHS, preserved hominid remains and a multi-component Middle Stone Age assemblage. All three assemblages share several typological and technological features: intense reduction of high-quality silicates (jasper & chalcedony) procured from local gravels, predominantly radial-centripetal core preparation, overall small artifact sizes, and rare déjeté scrapers. Surveys in the vicinity of these sites recovered numerous small foliate bifaces, larger lanceolate bifaces, as well as cordiform handaxes, though such artifacts are rare in the excavated assemblages. Faunal remains from these sites are primarily of riverine avian, reptilian, and mammalian species. These findings provide the first archaeological and behavioral context for the early *Homo sapiens* fossils recovered from the Kibish Formation. There are similarities between the Kibish assemblages and other Eithopian MSA assemblages (Gademotta, Middle Awash), as well as with assemblages from elsewhere in East Africa.

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## Loiyangalani: Behavioral and Taphonomic Aspects of a Middle Stone Age site in the Serengeti Plain, Tanzania

J.C. Thompson<sup>1</sup>, J.R.F. Bower<sup>2</sup>, E.C. Fisher<sup>3</sup>, A.Z.P. Mabulla<sup>4</sup>, C.W. Marean<sup>1</sup>, K. Stewart<sup>5</sup>, C.F. Vondra<sup>6</sup>

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The Loiyangalani site (HcJd1) is located in the valley of its eponymous river, which drains into Lake Victoria through the Serengeti National Park, Tanzania. This open site has been subjected to test excavations in 1979, 2000 and 2003. The tests have exposed both Middle Stone Age (MSA) and Later Stone Age (LSA) assemblages, but have focused on deposits where the MSA is stratigraphically isolated from LSA debris, and the MSA-related faunal remains are exceptionally well preserved. The MSA occurrences are also noteworthy for including material that is rare or unprecedented in the MSA, such as ochre pencils, bone artifacts, ostrich egg shell beads and abundant fish bone. The significance of such associations for our understanding of the emergence of "modern" human behavior depends heavily on their taphonomic context.

An extensive study of the mammalian fauna from the first two seasons indicates that rapid burial with little re-deposition likely characterized the assemblage. Cut, percussion, and tooth marks indicate a complex taphonomic history of both human and carnivore interactions. Small and large bovids, equids, carnivores, and a wide size range of non-identifiable mammals are all represented. The fish remains are primarily of *Clarias* sp., a catfish that generally spawns up rivers and streams during the rainy season in very shallow floodwaters. They are therefore easy to catch with spears or even bare hands. The turtles, from the family Pelomedusidae, are side-necked semi-aquatic mud turtles that inhabit shallow, slow-moving or marshy freshwaters and estivate in the mud during seasonal drying. The location of the site, preservation of the fauna, and the suite of unusual artifacts at Loiyangalani all offer a unique opportunity to study many poorly known facets of MSA behavioral ecology, technology, and sociality. Loiyangalani also promises to provide important palaeoecological data concerning the Pleistocene Serengeti Plain.

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<sup>1</sup>Department of Anthropology, Arizona State University, Box 872402, Tempe, AZ, 85287-2402, U.S.A.  
<sup>2</sup>3496 Oyster Bay Ave., Davis, CA 95616, U.S.A.

<sup>3</sup>Department of Anthropology, P.O. Box 117305, University of Florida, Gainesville, FL 32611, U.S.A.

<sup>4</sup>Archaeology Unit, University of Dar es Salaam, P.O. Box 35050, Dar es Salaam, Tanzania.

<sup>5</sup>Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, K1P 6P4, Canada.

<sup>6</sup>Department of Geological & Atmospheric Sciences, 253 Science Hall I, Iowa State University, Ames, IA 50011, U.S.A.



## **Blombos Cave, South-Africa: Stone artifacts from the Middle Stone Age levels**

Marie Soressi\* and Christopher Henshilwood\*\*

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Blombos Cave is a key site for the emergence of innovative behaviors prior to 70 ka, for example shaped bone tools and engraved ochres. It is also important because its long stratigraphic sequence makes it a reference site for the evolution of the MSA within southern Africa.

We present here the different behaviors related to stone tool production through the three major phases of Blombos. The upper phase, M1, dated at 77 ka, is characterized by more than 300 bifacial points and a few retouched tools on flakes, mainly end-scrapers and raclettes. The latter were complete or almost complete when brought to the site. The bifacial points were manufactured in situ but from preforms procured away from the cave, suggesting a relatively complex pattern of organization of lithic activities. Two engraved ochre pieces and an engraved bone were recovered from the M1 phase. In contrast the middle phase M2, dated at 85-90 ka, show a less elaborate and more opportunistic production of stone tools, mainly thick flakes. More than twenty shaped bone tools came from M2. The oldest phase, dated to at least 90 ka, is characterized by large quantities of utilized ochre. Irregular and rectangular flakes were produced by the Levallois method. Retouched tools are infrequent and consist mainly of notched pieces and denticulates.

The Blombos Cave assemblages are quite different from broadly contemporaneous assemblages of the neighboring Klasies River Main site, although the coastal context is similar. At Blombos stone tool manufacturing behaviors vary across time with regard to elaboration and organization of lithic activities. Interestingly these behaviors do not seem to co-vary with the appearance of innovative complex behaviors such as engraving ochre or manufacturing bone points and awls.

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\* Institut de Préhistoire et de Géologie du Quaternaire, UMR 5808 du CNRS, Université Bordeaux I, Avenue des Facultés, Bat. B 18, 33405 Talence cedex, France.

\*\* Centre for Development Studies, University of Bergen, Norway Postal address:  
African Heritage Research Institute, 167, Buitenkant Street, Gardens, 8001, South Africa

## **The Ysterfontein 1 Middle Stone Age site, South Africa, and early human exploitation of coastal resources**

Teresa Steele <sup>1</sup>, Richard G. Klein <sup>2</sup>, Thomas P. Volman <sup>3</sup>, David Halkett <sup>4</sup>, Royden Yates <sup>5</sup>, Graham Avery <sup>6</sup>, and John E. Parkington <sup>7</sup>

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Ysterfontein 1 (YFT1) is a deeply stratified, coastal Middle Stone Age (MSA) rockshelter located about 70 km NNW of Cape Town, South Africa. Excavations have revealed 3-3.5 m of stratified sands containing classic MSA stone artifacts, abundant mussel and limpet shells, numerous fragments of ostrich eggshell, and somewhat rarer bones from mammals, birds, tortoises, and snakes. YFT1 also contains fragments of humanly introduced ochreous and black pigment, two of which have scratches from rubbing or grinding. YFT1 is the first site from the western coast of South Africa to provide large samples of MSA artifacts and food debris in place. Superimposed hearth features demonstrate that MSA people occupied the site. The YFT1 artifacts resemble those from Die Kelders Cave 1, which have been dated to 70,000-60,000 years ago by ESR and OSL. The YFT1 deposits probably span many thousands of years, because they record fluctuations in the mussel/limpet ratio that likely reflect substantial sea-level changes.

YFT1 contributes significantly to our understanding of modern human origins. First, Klein has repeatedly argued that MSA people differed technologically and ecologically from their LSA successors and that this difference explains why only LSA people expanded to Eurasia about 50,000 years ago. However, these comparisons have been based primarily on sites from the southern coast of South Africa. It is possible that these findings might be strictly local and not pertain in different environmental zones. Data from YFT1 are consistent with southern coast evidence for more limited, less intensive MSA coastal exploitation. Second, the limpets and tortoises potentially can track MSA human population density, while small mammals will help control for climate. Granite limpets from throughout the YFT1 sequence are significantly larger than those found in nearby LSA sites, suggesting that MSA humans consistently lived at lower population densities than their LSA successors.

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<sup>1</sup> Department of Anthropology, University of Wisconsin-Madison, 1180 Observatory Drive, 5240 Social Science Bldg., Madison, WI 53706-1393 USA

<sup>2</sup> Program in Human Biology, Building 80, Inner Quad, Stanford University, Stanford, CA 94305-2160, USA

<sup>3</sup> Department of Anthropology, Cornell University, Ithaca, NY 14853, USA

<sup>4</sup> Archaeology Contracts Office, University of Cape Town, Rondebosch 7700, South Africa

<sup>5</sup> Social History Collections, Iziko Museums of Cape Town, P.O. Box 61, Cape Town 8000, South Africa

<sup>6</sup> South African Museum, Iziko Museums of Cape Town, P.O. Box 61, Cape Town 8000, South Africa

<sup>7</sup> Department of Archaeology, University of Cape Town, Rondebosch 7700, South Africa

## **Out of Africa: assessing southern latitude records for hominin adaptations and dispersals**

Michael D. Petraglia - Leverhulme Centre for Human Evolutionary Studies, Downing Street, Cambridge, CB2 3DZ, England.

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While significant headway has been made in recent years in synthesizing a diversity of palaeoanthropological information in support of the dispersal and evolution of hominin populations outside of Africa, it is apparent that there are significant gaps in our knowledge of key terrestrial records in large parts of the world. This paper synthesizes the Palaeolithic records of Arabia and South Asia in an attempt to highlight the significance of these regional records and the role that they played in human evolution. Recent archaeological investigations have been conducted in Saudi Arabia and India, providing new information about the Lower, Middle, and Upper Paleolithic records of these regions. While several routes have been hypothesized for hominin colonization and dispersals out of Africa, the Palaeolithic records of southern margin routes have not been closely examined. Preliminary mapping of site distributions indicates that several corridors were used for hominin dispersals, including along the Red Sea margin and the Arabian Sea coast. Among Lower Paleolithic sites, Acheulean occurrences are abundant in Arabia and South Asia, many associated with raw material outcrops. Examination of stone tool reduction sequences and landscape distributions is providing new information and hypotheses about hominin cognition, learning strategies, transport practices, and communication abilities. Study of Palaeolithic site distributions in Arabia and peninsula India indicate occupations in association with wet conditions and the persistence of populations through substantial environmental change and seasonal fluctuations. New findings of volcanic ash deposits in India provide insights into the impact that the Toba super-eruption had on populations residing there at 74 kyr.

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## **Understanding the Soanian Industrial Complex: preliminary excavation results and geoarchaeological perspectives from the Siwalik Hills, northern India**

Parth R. Chauhan - *Department of Archaeology, University of Sheffield, Sheffield, U.K.*

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Most known prehistoric sites in the Siwalik region of South Asia are found predominantly in surface contexts, occurring on various Siwalik surfaces, terraces of varying chronological ages, and in *duns* (intermontane valleys). No palaeolithic sites, belonging to the Soanian industry, have ever been reported to be in unequivocal primary context, been systematically excavated, nor studied through multidisciplinary approaches. This has been partly due to the low profile of primary sites in undisturbed contexts and more often, inconsistent survey and research methods. However, recent (2003-2004) geoarchaeological investigations at Toka show non-biface quartzite artifacts to be in unique geological contexts over an area of one square kilometer. More importantly, a segment of this open-air site is an uplifted post-Siwalik terrace (Upper Pleistocene in age), where artifacts are found buried between strata of conglomerate and silt. Here, horizontal excavations have exposed artifacts to be in fresh condition and in direct association with the raw material source. Surface and excavated assemblages comprise varieties of hammerstones, cores, discoids, choppers, scrapers, flake types, manuports, and even micro-debitage. Many of the specimens show varying degrees of use-wear indicating cutting, pounding, scraping, and chopping functions. The unusually large number of Soanian artifacts collected from the site (over 6000) may possibly represent an episodic or a continuous phase(s) of occupation, highlighting such locations as centers of intense stone tool manufacture, use, and subsequent discard. A majority of the site has been disturbed by post-depositional site-formation mechanisms including bioturbation, neotectonic activity, soft-sediment erosion, fluvial action, colluvial action, and even anthropogenic interference, all at varying intensities. This research provides a unique and rare opportunity to clarify issues concerning the little-understood Soanian Industrial Complex through the study of a primary site for the first time, and attempts to answer some questions about land-use, raw material exploitation, stone tool production, and associated technological organizations. Another major focus is to delineate key site-formation mechanisms, to understand and predict where additional primary sites may be located elsewhere in the Siwalik region. A portion of this research was funded by the Australian Research Council.

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## Missing data in human fossil taxa and implications for reconstruction of phylogeny

M. L. Chang - Doctoral Candidate, Departments of Anthropology and Biology, University of Pennsylvania, Philadelphia, PA 19104

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To reconstruct human evolutionary history, it is necessary to examine fossils that are incomplete. The problem of missing data is often addressed in systematic analyses by excluding taxa or characters. However, it is not clear that excluding these data improves the results of analyses in terms of resolution or accuracy (Wiens, 2003b). Simulation studies indicate that it is not the percentage of missing data that determines effects on accuracy, but whether enough characters are sampled from a taxon in order to place it correctly on a tree (Wiens, 2003a). Prior analyses also suggest that distribution of missing data is a factor: empty cells may be concentrated within a few characters (incomplete characters), or a few taxa (incomplete taxa) (Chang, 2003).

This study assesses the amount of missing data within the Neandertal craniodental sample, and explores the effects of missing data on phylogenetic accuracy through simulation studies. The Neandertal fossil record was evaluated by examining original fossils, casts, and published data. Percentages of missing data were calculated on per-specimen, per-site sample, and whole hypodigm bases. For simulation studies, character sets were generated and used to create model phylogenies to which the results of analyses conducted using incomplete data sets could be compared to assess accuracy.

Researchers engaged in paleoanthropological systematics must exclude characters or taxa only with the greatest reluctance. The percentage of missing data in a matrix can be minimized by treating the entire hypodigm as a single taxon, but this approach also entails a significant loss of information by ignoring variation. The results of this study suggest that the small size of the available character set may make it difficult to balance the need to maximize accuracy with the desire to include as much information as possible.

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Wiens JJ (2003b) Missing Data, Incomplete Taxa, and Phylogenetic Accuracy. *Systematic Biology 52:528-538*

## **The rediscovery of the Neandertal neonatal skeleton of Le Moustier 2(Dordogne, France)**

B. Maureille - UMR 5809 CNRS, Laboratoire d'Anthropologie, Université Bordeaux 1, Talence - France

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In September, 1996, during an inventory at the Musée National de Préhistoire (Les Eyzies-de-Tayac, France), a drawer containing fragmentary and isolated perinate bones and of blocks of sediments, with other human bones still embedded, was found among the collections of the Le Moustier sites (Dordogne).

After removal of the bones from the blocks of sediment and subsequent reconstruction of the skeleton, it became clear these skeletal materials belong to the same individual. Examination of the correspondence of Peyrony, who excavated at Le Moustier in 1913/14 and a careful morphological evaluation of the skeletal materials make it clear that this specimen is Le Moustier 2, a fossil that was thought to have been destroyed soon after its discovery in 1914. Further evidence supporting this identification comes from the sediments in which the human bones were found, which can be identified as that of Layer J, one of the most recent Mousterian levels at the site, with a TL date of 40.3 +/-2.6 ky.

In spite of the difficulties inherent in the determination of the age of death of a non-modern human fossil, the most reasonable estimate is to identify it as a neonate of no more than 4 months of age when it died. Study of its morphological features indicate that there are features that can distinguish a Neandertal perinate from that of an extant Human. For example, there are a number of autapomorphic traits of the cranial and post-cranial skeleton of adult Wurmian Neandertals that are already present on this fossil (for example without an infraorbital depression) while others are absent (for example the susiniac fossa associated with an occipital torus). The completed full descriptive study of the fossil holds the promise of providing a great deal of additional data on Neandertal developmental patterns and their relationships to those of living humans.

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## Exploring occupation mixing at Saint-Césaire using bone refits

Eugène MORIN<sup>1</sup>, Tsenka TSANOVA<sup>2</sup>, Nicolay SIRAKOV<sup>3</sup>, William RENDU<sup>2</sup>, Jean-Baptiste MALLYE<sup>2</sup>, and François LÉVÊQUE<sup>4</sup>.

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The assumption that layers in stratified deposits represent temporally distinct occupations has only been tested in a few cases. Saint-Césaire is a stratified site, which plays a major role in the debates about the Middle to Upper Paleolithic transition. Because the chronology of some of its occupations has been challenged, it became necessary to test the integrity and robustness of its cultural sequence. An extensive refitting program was therefore implemented for addressing this problem. In this study, we present the results on the vertical and spatial distribution of bone refits for eight of the faunal assemblages from this site. Changes in bone counts, species composition, and body part representation are used for testing the site stratigraphy as well.

Refitting was performed systematically across all décapages and levels using a large fraction of the elements for which taxonomic identification was available. Our results show a relatively low level of contamination. This is true for all levels, including the Châtelperronian occupation in which the Neandertal skeleton was found. Therefore, the site is characterized by a relatively fine chronological grain and can be meaningfully used in a diachronic perspective. Moreover, our study highlights the importance of classifying elements or artifacts relative to types of fractures (post-depositional versus syndepositional) in refitting studies if we want to produce meaningful quantifications of degree of mixing.

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<sup>1</sup>Museum of Anthropology, 4009 Museum Bldg., 1109 Geddes, University of Michigan, Ann Arbor, Michigan 48109 USA, e-mail: emorin@umich.edu. To whom correspondence should be sent

<sup>2</sup>Institut de Préhistoire et de Géologie du Quaternaire, Université de Bordeaux I, Avenue des Facultés, 33045 Talence, France.

<sup>3</sup>Institut de Préhistoire et de Géologie du Quaternaire, Université de Bordeaux IV, Avenue des Facultés, 33045 Talence, France.

<sup>4</sup>Service de l'Archéologie. Direction Régionale des Affaires Culturelles de Poitou-Charente, 102, Grand'rue, 86000 Poitiers, France.

## **The Middle to Upper Paleolithic transition in Europe: an overview of recent developments**

João ZILHÃO - Universität zu Köln, Institut für Ur- und Frühgeschichte, Weyertal, 125, D-50923 Köln, Germany

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The Middle-Upper Paleolithic Transition in Europe involves issues of definition, taxonomy and chronology of both technocomplexes and human populations, with implications on the nature and dynamics of their interactions. Recently, significant advances have been made on all these fronts: confirmation of the late survival of the Mousterian in Iberia; firm dating of the emergence of the Châtelperronian at no later than ca.40 ka BP, and definitive refutation of putative instances of its interstratification with the Aurignacian in France; more precise dating of the emergence of the Bohunician to ca.38 ka BP, at about the same type as the Bachokirian; significant rejuvenation of the very early dates for the Aurignacian in Hungary; reconsideration of the cultural integrity, significance, affinities and chronology of the Szeletian; association of bone tools and ornaments with other pre-Aurignacian assemblages besides the Châtelperronian in Greece, the Crimea or the Don basin. Moreover, the earliest modern human fossil remains in the continent have been indirectly dated to ca.34 ka BP at Mladec, in Moravia, and directly dated to ca.35 ka BP at Oase, in Romania. In both cases, such remains have been argued to present archaic features; whether the latter are retention of ancestral traits or evidence of admixture, they in any case suggest that these fossils must represent the earliest European modern humans. Claims of their earlier arrival based on the suggested date of ca.40 ka BP for the emergence of the Aurignacian in Germany are not supported by recent dating of the key sequence of Geissenklösterle, where all results on anthropically-modified bone samples post-date ca.36.5 ka BP and suggest that the site's earliest Aurignacian occupation in fact dates to ca.33-35 ka BP, as do technologically similar assemblages from southwestern France. The significance of these developments for current models on the Transition will be evaluated.

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## The 'Seasonal Exploitation of *Capra Caucasica* During the Middle and Upper Palaeolithic of the Southern Caucasus

Daniel S. Adler<sup>1</sup>, Guy Bar-Oz<sup>2</sup>, Anna Belfer-Cohen<sup>3</sup>, Ofer Bar-Yosef<sup>1</sup>

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Recent applications of taphonomic and zooarchaeological techniques to the study of Palaeolithic faunal acquisition and butchery patterns has contributed greatly to our overall understanding of hominin subsistence strategies throughout Eurasia. Several of these studies have triggered an ongoing debate regarding the interpretation of zooarchaeological evidence and ultimately our perception of Middle Palaeolithic hominin hunting capacities and survival skills. With this debate in mind we conducted zooarchaeological analyses of a late Middle and early Upper Palaeolithic faunal assemblage recently excavated from Ortvale Klde rockshelter located in the Republic of Georgia. Results indicate that the hunting practices of late Middle and early Upper Palaeolithic populations are largely indistinguishable, with seasonal economic strategies geared around the ambushing of prime-age Caucasian tur during their winter aggregations. These data demonstrate that local Neanderthal populations were fully capable of preferentially targeting the largest, strongest, fastest, and most nutritious members of particular taxa, therefore, hunting techniques and behaviors cannot be used to explain the Middle-Upper Palaeolithic transition in the southern Caucasus. Based on other forms of archaeological data from Ortvale Klde and neighboring sites, namely lithic procurement, transport, and reduction behaviors, we hypothesize that developments within the social and symbolic realm of Upper Palaeolithic populations facilitated this regional cultural and likely biological shift more than other factors.

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<sup>1</sup> Department of Anthropology, Peabody Museum, Harvard University, Cambridge, MA 02138, USA.

<sup>2</sup> Department of Archaeology, University of Haifa, Mount Carmel, 31955 Haifa, Israel.

<sup>3</sup> Institute of Archaeology, Hebrew University, Mt. Scopus, Jerusalem, 91905 Israel.

## The Middle-Upper Paleolithic transition in Central Asia: preliminary results from Obi-Rakhmat Grotto, northeastern Uzbekistan

P. J. Wrinn<sup>1</sup>, A. I. Krivoshapkin<sup>2</sup>, A. P. Derevianko<sup>2</sup>, U. I. Islamov<sup>3</sup>, A. A. Anoin<sup>2</sup>, J. D. M. Wagner<sup>4</sup>, and P. J. Patchett<sup>4</sup>

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Although Central Asia was a potential “corridor” connecting hominid populations of northern and western Asia during the Paleolithic, sites in the region have contributed little to discussions of late Pleistocene hominid behavior and migrations. Since 1998, a multidisciplinary Russian-Uzbek-American team has conducted controlled excavations at Obi-Rakhmat, a rockshelter in the northwestern foothills of the Tien Shan Mountains, Uzbekistan, in order to understand the chronology, environments and behavioral variability of the Middle and Upper Paleolithic inhabitants of the region. Twenty-two geological layers, reaching a depth of 10 m, have so far yielded >40,000 stone artifacts, >3,000 identified animal bones, and several teeth and cranial fragments provisionally attributed to *Homo sapiens*. The fairly homogenous Obi-Rakhmat lithic industry has much in common with Initial Upper Paleolithic complexes reported elsewhere in Eurasia (e.g., Bohunice, Boker Tachtit, Üçağızlı, Kara-Bom). Upper Paleolithic narrow-face cores and core-burins dominate the core assemblage, while parallel Levallois cores, which decline in frequency in the upper strata, often show an extension of the platform to the narrow face for blade and bladelet production. Blades constitute the most common blank form and become more abundant and smaller over time, suggesting some local evolutionary tendencies in the lithic technology. Retouched tools are primarily Upper Paleolithic types, including retouched pointed blades, burins, and rare endscrapers. Preliminary analysis of the site fauna has revealed evidence for hunting and butchering of mountain goat and red deer. There is almost no evidence for large carnivore activity. Results of an ongoing, comprehensive dating program (AMS, U-series, OSL, ESR) show that most occupation horizons predate 40,000 BP, and many may be older than 90,000 BP. The current data presented here indicate a very early development of a “transitional” or early Upper Paleolithic industry in Central Asia, although alternative explanations are recognized and require further investigation.

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<sup>1</sup>Department of Anthropology, University of Arizona, Tucson, AZ 85721, U.S.A.

<sup>2</sup>Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Novosibirsk 630090, Russian Federation

<sup>3</sup>Academician Y. Guliamov Institute of Archaeology, Uzbek Academy of Sciences, Samarkand 703051, Republic of Uzbekistan

<sup>4</sup>Department of Geosciences, University of Arizona, Tucson, AZ 85721, U.S.A.

## Move over Teshik-Tash: new hominid remains from Uzbekistan

M. M. Glantz<sup>1</sup>, T. Chikisheva<sup>2</sup>, B. Viola<sup>3</sup>, A. I. Krivoshepa<sup>2</sup>, A. P. Derevianko<sup>2</sup>, U. I. Islamov<sup>4</sup>, P. J. Wrinn<sup>5</sup>, T. B. Ritzman<sup>1</sup>

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In 2003, new hominid remains were discovered at Obi-Rakhmat Grotto and at Anghilak cave, Uzbekistan, marking the first hominid discoveries in this country since the late 1930s. The present research introduces this material, consisting of six teeth and over 150 cranial fragments from Obi-Rakhmat and a 5<sup>th</sup> metatarsal from Anghilak. Because of the association of the Teshik-Tash child with Mousterian-like lithics, the Middle Paleolithic assemblages of Uzbekistan are commonly considered to be the result of Neandertal behavior. New material from Obi-Rakhmat provides our first glimpse of the morphological pattern of individuals responsible for a transitional Middle-Upper Paleolithic tradition. The Anghilak metatarsal, in contrast, is associated with a more typical Middle Paleolithic deposit.

Preliminary analyses of the Obi-Rakhmat remains indicate the presence of at least two individuals in the dentition and cranial fragments. Our working hypothesis is that one individual is no older than 12 while the other is probably in between 5-7 years of age. Taxonomic affinity is assessed using a discriminate function analysis and descriptive statistics of the Obi-Rakhmat finds are presented in a comparative context with other age-appropriate Upper Pleistocene-Holocene specimens. The dental remains are noteworthy because of their extremely large size and overall archaic appearance. Metric comparisons suggest close affinities with the Oase remains from Romania, material identified as anatomically modern human. In addition, one of the Obi-Rakhmat upper molars contains cuspal variations not commonly observed in the hominid fossil record. The large and archaic Obi-Rakhmat teeth are juxtaposed to 150 cranial fragments that are generally gracile, morphology that is possibly the result of ontogenetic age rather than phylogeny. Results indicate that the Obi-Rakhmat remains express a mosaic of archaic and more modern features. Although it is not possible to make a taxonomic assessment of the Anghilak metatarsal, metric comparisons indicate a rather diminutive individual that falls within the ranges of both Neandertal and modern human groups.

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<sup>1</sup>Department of Anthropology, Colorado State University, Fort Collins, CO 80523, U.S.A.

<sup>2</sup>Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Novosibirsk 630090, Russian Federation

<sup>3</sup>Institute for Anthropology, University of Vienna, Althanstr. 14, 1090 Vienna, Austria

<sup>4</sup>Academician Y. Guliamov Institute of Archaeology, Uzbek Academy of Sciences, Samarkand 703051, Republic of Uzbekistan

<sup>5</sup>Department of Anthropology, University of Arizona, Tucson, AZ 85721, U.S.A.

## Grading the late MP, transitional, and early UP industries of eastern Eurasia

(with particular reference to Obi-Rakhmat and Kara-Bom)

L.B. Vishnyatsky - Institute for the History of Material Culture, Dvortsovaya nab.18, St.Petersburg, 191186, Russia

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A lot of work has been done recently to elucidate the character of the MP/UP transition in different regions. The amount of archaeological materials pertinent to the subject has greatly expanded, too. However, not infrequently both new and old assemblages are (re)identified as transitional or EUP without sufficient substantiation, while in fact it is often rather difficult to say with confidence whether an industry should be considered Middle or Upper Paleolithic (even if the material is rich and well dated). First of all this is the case with some assemblages from eastern Eurasia, where the trajectories and tempos of cultural development before, during and after the transition were somewhat different from what we observe in the western parts of Europe and Asia. Here I consider the question of the claimed transitional/EUP status of Kara-Bom in South Siberia (levels 5-6 dated to 42-43 kyr bp) and Obi-Rakhmat in Uzbekistan (levels 2-14 dated to 42-48 kyr bp) using a simple method that allows to evaluate the degree of "advancement" of stone/bone industries. The MP and UP are regarded as two ideal polar extremities each characterized by a number of polar attribute states (flat *vs.* volumetric cores, non-marginal *vs.* marginal flaking, rare *vs.* common evidence of hafting, scarce *vs.* abundant formal bone tools, etc.). The real MP/UP industries form a continuum of states between the two ideal poles and the position of any assemblage on this scale can be expressed in quantitative terms. The values obtained for Obi-Rakhmat proved to be lower than those calculated for Streletskian (let alone Spitsynian) and "gravitate" rather to the MP pole than to the UP one. As to Kara-Bom it appears to be a true transitional industry comparable with those from Ksar-Akil.

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## **The Early Aurignacian and the introduction of Modern Humans in Europe. A Central-European and Balkanic perspective**

Nicolas Teyssandier - UMR 7055 du C.N.R.S. "Préhistoire et Technologie", Maison de l'Archéologie et de l'Ethnologie, 92023 Nanterre cedex, France.

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The Aurignacian has always been equated with the first intrusion in Europe of Anatomically Modern Humans. Theories based on the advance of successive waves of populations have been developed to explain this pan-European phenomenon. They imply cultural and typo-technological analogies between industries attributed to the early phases of the Aurignacian. The present paper is a test of this classical model postulating an East-West cline for the introduction of the Aurignacian in Europe and a monocentric origin. In this perspective, three major sequences always referred to in such theories are examined : Bacho-Kiro in Bulgaria, Willendorf II in Austria and Geißenklösterle in Germany. The results testify to the existence of the Early Aurignacian (i.e. Aurignacian I) in Central Europe both at Geißenklösterle and at Willendorf II. From a typological and technological viewpoint, reconstructed levels II and III of Geißenklösterle and level 3 of Willendorf II are directly comparable to the French classical Aurignacian, and on the evidence of radiocarbon dates, this facies does not seem to be older in Central Europe than in Western Europe. Concerning the Bachokirian or Pre-Aurignacian, defined by Kozłowski and Otte as an initial phase of the Aurignacian, this assertion is challenged on the strength of the analysis of Bacho-Kiro layer 11 and of Willendorf II layers 1 and 2. The final conclusions point to the lack of clearly Aurignacian assemblages stratigraphically and chronologically preceding the classical Early Aurignacian as defined in reconstructed levels II and III of Geißenklösterle. They also underscore major differences between Central European and Balkanic sequences, which may prove relevant to questions concerning the origin and spread of the Aurignacian in Europe.

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## New Data on the Aurignacian of the Upper Danube Valley

Nicholas J. Conard, Abteilung für Ältere Urgeschichte und Quartärökologie, Universität Tübingen, Schloss, Hohentübingen, 72070 Tübingen, Germany

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Recent publications from the Department of Early Prehistory and Quaternary Ecology of the University of Tübingen have presented several competing hypotheses relating to the end of the Middle and the beginning of the Upper Paleolithic in Danube drainage. This paper attempts to falsify and refine the "Danube Corridor", "Kulturpumpe", and "Population Vacuum" hypotheses in light of the new radiometric dates and results from ongoing excavations in the Swabian Jura.

The available data suggest a relatively rapid colonization of the Danube Valley by modern humans. Based on a series of TL dates from Geißenklösterle, the Aurignacian appears to begin around 40ka bp. Uncalibrated radiocarbon dates from multiple sites indicate that the most intense period of Aurignacian occupation dates to between 30 and 35ka, with occasional dates as far back as ca. 40ka. This distribution of dates suggests a relatively low initial population followed by increasing population densities. This period is near the limit of reliable radiocarbon dating, and fluctuations in atmospheric radiocarbon complicate the chronology.

If one assumes that Neanderthals made the Middle Paleolithic assemblages and modern humans the Aurignacian assemblages, there is only very scant evidence that Neanderthals and modern humans encountered each other in the Swabian Jura. The "Population Vacuum" hypothesis postulates that harsh climatic conditions led to low population density or a complete depopulation of the region by Neanderthals during the terrestrial equivalent of the Heinrich 4 event. In connection with the subsequent climatic amelioration, modern humans may have entered the largely depopulated upper Danube Valley. Other hypotheses to explain the available data will also be considered, and the ongoing attempts to date the modern human skeletal remains from Vogelherd will be discussed.

New excavations at Hohle Fels have produced a wealth of additional information on the Aurignacian of the region. Particularly important is the discovery of three figurines carved from mammoth ivory. These figurines represent a horse, a water bird and a therianthrope with human and feline characteristics similar to the *Löwenmensch* from Hohlenstein-Stadel in the nearby Lone Valley. These new finds provide key information with which to test Joachim Hahn's *Kraft und Aggression* hypothesis and with which to consider the hypotheses about shamanism that have been put forward by Jean Clotte, David Lewis-Williams and others.

Although it is highly unlikely that figurative art, musical instruments, new forms of ornament, organic and inorganic tools all originated in the Upper Danube, the caves of the Swabian Jura provide unique evidence for all these classes of artifacts and point to the region one of several important centers of cultural innovation during the early Upper Paleolithic. The data from Swabia highlight the fact that different European regions provide different patterns in the material culture of the early Upper Paleolithic. Thus simplistic continental-wide models for the beginnings of the Upper Paleolithic and the spread of modern humans need to be balanced by high resolution regionally based hypotheses for this key transition in human evolution.

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## Bones, Bodies and Bears in the Peștera cu Oase, Romania

E. Trinkaus<sup>1</sup>, Ș. Milota<sup>2</sup>, M. Gerhase<sup>2</sup>, L. Sarcina<sup>2</sup>, A. Bîlgăr<sup>3</sup>, O. Moldovan<sup>4</sup>, R. Rodrigo<sup>5</sup>, S.E. Bailey<sup>6</sup>, R.G. Franciscus<sup>7</sup>, M. Ponce de León<sup>8</sup> and C.P.E. Zollikofer<sup>8</sup>

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The recent redating of European purportedly early modern humans, late dates for regional Neandertal samples, and ongoing controversies concerning the chronology and nature of technotypological facies of the European earliest Upper Paleolithic are interacting to provide a complex biocultural mosaic across Europe between 40 and 30 ka BP. In this context, the discovery of human remains and human behavioral residues in a *Ursus spelaeus* hibernation cave, the Peștera cu Oase in southwestern Romania, further elaborates the situation. The Oase 1 mandible, discovered in 2002 and directly AMS <sup>14</sup>C dated to 34–36 ka BP, is the oldest “modern” human in Europe. Although cladistically “modern,” it presents archaic features which are rare or absent in early and recent modern humans. The contemporaneous Oase 2 craniofacial and neurocranial remains and the Oase 3 temporal bone, discovered in 2003, are also cladistically “modern” and have probable African morphological affinities. However, they exhibit archaic features relative to early and recent modern humans, further highlighting the contrasts between this sample and more recent “modern” Europeans. In addition, the evidence for human manipulation and transpositioning of ursid remains in the Peștera cu Oase and the taphonomic issues raised by the introduction of human remains with exceptional preservation of fragile portions and without carnivore damage into an ursid hibernation chamber indicate behavioral, and possibly mortuary, patterns rarely documented in Paleolithic Europe. Given the current archeological and paleontological debates on what constitutes “modern” in the Late Pleistocene, the Oase remains assist in further clouding this Late Pleistocene human rubicon.

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<sup>1</sup> Department of Anthropology, Campus Box 1114, Washington University, St. Louis MO 63130, USA

<sup>2</sup> PRO ACVA GRUP, Str. Surduc 1, 1900 Timișoara, Romania

<sup>3</sup> Str. Decebal 1, 1500 Drobeta Turnu Severin, Romania

<sup>4</sup> Institutul de Speologie “Emil Racoviță,” Clinicilor 5, P.O. Box 58, 3400 Cluj-Napoca, Romania

<sup>5</sup> Centro Nacional da Arqueologia Náutica e Subaquática, Instituto Português de Arqueologia, Avenida da Índia 136, 1300 Lisboa, Portugal

<sup>6</sup> Department of Anthropology, George Washington University, 2110 G Street, Washington DC 20052, USA

<sup>7</sup> Department of Anthropology, University of Iowa, Iowa City IA 52242, USA

<sup>8</sup> Anthropologie, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland

# Speaking with beads: the ethnolinguistic geography of Early Upper Paleolithic Europeans

Marian Vanhaeren<sup>1,2</sup> and Francesco d'Errico<sup>2</sup>

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Our knowledge on the migration routes of the first Anatomically Modern populations colonising the European territory at the beginning of the Upper Palaeolithic, on their degree of biological, linguistic, and cultural diversity, and the nature of their contacts with local Neanderthals, is still faint. Ethnographic studies indicate that among the different components of the material culture which may survive in the archaeological record, personal ornaments are one of those that better reflect the ethnolinguistic diversity of human groups. The ethnic dimension of beadwork is conveyed through the use of distinct bead types as well as by peculiar combinations and arrangements on the body of bead-types shared with one or more neighbouring groups. One may expect this must leave detectable traces in the archaeological record. To explore the potential of this approach we recorded the occurrence of 131 bead-types at 70 European Early Upper Palaeolithic sites. Principal component and seriation analysis of Aurignacian personal ornaments identify a definite North-South cline with seven geographically cohesive sets of sites. Each set is characterised by peculiar bead-types and by personal ornaments shared with the adjacent sets. The farthest sets do not share any bead types and oppose Aurignacian sites from Italy and the Rhône valley to those from Northern Europe. We argue that this pattern, which is not explained by chronological differences between sites or raw material availability, reflects the ethnolinguistic, and possibly, the genetic diversity of the earliest anatomically modern European populations. Comparison of this pattern with the typological and technological variability of personal ornaments produced by late Neanderthals is used to test scenarios on the reality and nature of contacts between these two populations.

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<sup>1</sup> UMR 7041 CNRS, Archéologies et Sciences de l'Antiquité, Ethnologie préhistorique, 21 allée de l'université F-92023 Nanterre, France. vanhaere@mae.u-paris10.fr

<sup>2</sup> UMR 5808 CNRS, Institut de Préhistoire et de Géologie du Quaternaire, Université Bordeaux I, Avenue des Facultés, F-33405 Talence, France. f.derrico@iquat.u-bordeaux.fr



## Morphology and Variability of the Earliest "Modern" Europeans

S.E. Bailey,<sup>1</sup> R.G. Franciscus<sup>2</sup> & E. Trinkaus<sup>3</sup>

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The recently discovered Peștera cu Oase human remains significantly add to our sample of the earliest modern humans in Europe (principally those from Fontana Nuova, Mladeč, Les Rois, La Quina and Vogelherd), and emphasize the variability of these earliest "modern" Europeans. All of these specimens present a suite of derived "modern" characteristics of the upper facial skeleton, nasal aperture and internal floor, temporal region, neurocranium, mandible and postcrania, combined with a set of features that are generally archaic. However, the outstanding characteristic of this sample is the degree of variability present in the small number of specimens.

Upper facial breadth is marked on Oase 2 relative to Mladeč 1 and 2 and comparable to Mladeč 5 and Vogelherd 1, but Mladeč 8 exhibits a wide nasal breadth contrasting with those of Mladeč 1 and 2 and Oase 2. All of the preserved teeth are morphologically "modern," do not exhibit derived Neandertal traits, and generally exhibit the primitive retentions seen in African populations. However, Oase 2 is exceptional for the presence and moderate expression of a C5 and Carabelli's cusps on the M<sup>2</sup>s and for the occlusal complexity of the M<sup>3</sup>s. Moreover, the Oase 1 and 2 and Mladeč 8 molars are exceptionally large, and the former two exhibit a M1<M2<M3 size pattern. Postcranially, the Mladeč 24 and Vogelherd 3 humeri bracket the range of Late Pleistocene humeral robusticity; the Mladeč 27 and 28 femora contrast in pilasteric development, and the Fontana Nuova 4 and Mladeč 30 tali bracket the range of relative neck length.

The mosaic of features of this sample, both in terms of archaic versus modern and in their combinations across specimens, suggests dynamic human evolutionary patterns that are more complicated than previously thought.

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<sup>1</sup> Department of Anthropology, George Washington University, 2110 G Street, Washington DC 20052, USA

<sup>2</sup> Department of Anthropology, University of Iowa, Iowa City IA 52242, USA

<sup>3</sup> Department of Anthropology, Campus Box 1114, Washington University, St. Louis MO 63130, USA

## **Continuous changes in lower limb lengths of Upper Paleolithic Mesolithic Europeans.**

Sang-Hee Lee Department of Anthropology, University of California, Riverside, CA 92521-0418

David W. Frayer, Department of Anthropology, University of Kansas, Lawrence, KS 66045

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Metric changes in limb lengths in the European Upper Paleolithic and Mesolithic have important implications for understanding the adaptive strategies and evolutionary trajectories of these groups. Previous studies have shown a difference in estimated stature between Early Upper Paleolithic and Late Upper Paleolithic, and between LUP and Mesolithic. The two climatic and geological events associated with the change are the Last Glacial Maximum around 18 thousand years ago (Kya) and the onset of Holocene at 10 Kya. While informative, these studies break the continuous Upper Paleolithic and Mesolithic into discrete categories by pooling time periods into a single centroid value, which, in effect, interrupts the continuity of the sequence. Here, we test the hypothesis of no change in lower limb length over time by considering the distribution of unit changes in a continuous framework. In place of stature, we substituted adult (and near adult) femur and tibia lengths for Upper Paleolithic and Mesolithic Europeans. For each specimen we used radiocarbon dates to place the specimen in a time sequence. To avoid masking the possibility of different evolutionary trends between males and females, we separated the data set by sex. We developed a resampling algorithm using a distribution of increments to test the null hypothesis that a random process generated the observed data set. The null hypothesis is rejected for both the male and female samples. The results of our analysis show that both 18 Kya and 10 Kya are significant turning points in the patterns of these changes.

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## **The development of grinding-stones technology and the transition from hunter-gatherer to farmers in the Levant: new data from a functional analysis of Natufian implements of Hayonim Cave.**

Laure Dubreuil - University of Michigan, Museum of Anthropology, 4009 Museum Building - 1109 GEDDES  
Ann Arbor, MI 48109, A. Belfer-Cohen and O. Bar-Yosef

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Abstract: In the Levant, the development of grinding stone technology is one of the most striking changes observed prior to the rise of full-fledged Neolithic societies. Although these tools are present in earlier assemblages, a remarkable increase and a diversification of their morphology occur during the Natufian. The implications of this phenomenon as regards the Natufian settlement pattern as well as its potential meaning concerning changes in subsistence strategies have been extensively discussed. Consequently, grinding tools became a cornerstone of many scenarios seeking to unravel and explain the emergence of agriculture. However, most of these scenarios rely on a presumed tight association between grinding stones and plant processing, which is essentially based on the prevalence of this association among modern ethnographic societies. Testing this assumption is rather crucial to assess and clarify the different hypotheses that have been put forward to explain the shift to extractive economy. In this study, the authors present a methodological research aimed at developing use-wear approaches of Natufian grinding stones. Several grinding experiments were performed. These experiments focused on a specific category of tools, the "flat implements" (combining grinding-slabs and handstones) and show the possibility to distinguish these tools from abraders and polishers, and other comparable types of tools. The analysis of the Hayonim Cave assemblage suggests that only a portion of what it is generally regarded as grinding implements has, in fact, been used for grinding. For instance, the "handstones" of Hayonim Cave show use-wear that can be related to hide processing. This sample indicates that grinding-stones encompass diverse categories of tools, used for various activities. These results suggest that Natufian grinding implements should not be viewed as specialized tools targeted for plant processing and that the development of grinding stone technology is not unequivocally related to an increase in plant consumption.

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