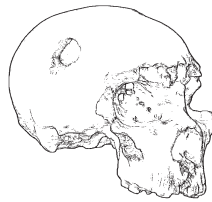


**European Society for the study of Human Evolution (ESHE)**

4<sup>th</sup> Annual Meeting

Florence, Italy • 18 – 20 September, 2014



Cover image: Saccopastore I

"The discovery of the Neanderthal cranium at Saccopastore (Roma) demonstrates that these humans lived in Latium, together with the large extinct mammals of the Pleistocene, during the interglacial, being witness to the last eruptions of the nearby volcanoes." Translated and adapted from S. Sergi, 1929 (*Rivista di Antropologia* vol. XXVIII).

Proceedings of the European Society for the study of Human Evolution 3

Citation: PESHE 3, 2014

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Cover Design: Carolin Herold ([www.ch-grafikdesign.de](http://www.ch-grafikdesign.de))

ISSN 2195-0776 (Print), 2195-0784 (Online)

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Dear Participants of the 4th Annual meeting of the *European Society for the study of Human Evolution*,  
**Welcome to Florence!**

We are very pleased to welcome you to Florence, whose fame for its artistic beauties is well known to world. Together with its art, history, landscape and food, Florence is also important for its science with the University that has its origins in the *Studium generale*, established in 1321. This scientific legacy is particularly evident in the impressive scientific collections of the Natural History Museum, founded in 1775, and you are encouraged to visit its various sections during your stay in Italy. This year's excursion will provide the opportunity to visit the area of the *Grotte di Equi* (cave and shelter), set in a beautiful landscape in the northern tip of Tuscany, where recent activity resumed old excavations in late Pleistocene deposits.

As the 4th annual ESHE meeting commences, the successful journey of the society continues. In early August 2014, the society's membership included 375 individuals. Continuing in the ESHE tradition, the number and quality of the submissions for presentations at our annual meetings has remained very high. Taking into account the experience of the first three ESHE meetings, the board has decided to extend the length of our yearly conference to 3 days in order to comfortably accommodate its scientific program.

In order to encourage and facilitate the participation of students in the conferences, it has also been decided to dedicate a portion of the society's budget to travel grants, supporting those presenting posters or papers. Preference will be given to student participants coming from distant and/or disadvantaged areas. These grants will be offered in addition to the prizes awarded since 2013 for outstanding student posters.

During our general assembly an important issue will be to vote for the renewal of the board officers who work to manage the society and the preparation of the yearly meetings.

We are very grateful to our 2014 local organizers, who have made the Florence conference possible, in particular to *Prof. Jacopo Moggi-Cecchi* (Department of Biology, Università degli Studi Firenze) who headed most of the local organization with the assistance of the colleagues of his Department: *Prof. David Caramelli*, *Prof. Roscoe R. Stanyon*, and *Prof. Marco Bazzicalupo* (Head of Department) and to *Prof. Lorenzo Rook*, Head of the Department of Earth Sciences *Prof. Guido Chelazzi* (President, Natural History Museum), *Prof. Giovanni Pratesi* (Director, Natural History Museum), *Dr. Emanuela Paribeni* (Superintendency for Archaeological Heritage, Tuscany) and *Dr. Alessandro Palchetti* (B&P Archeologia).

The 2014 ESHE meeting is sponsored by the Fondazione Ente Cassa di Risparmio di Firenze, the University of Florence (BIO, DST, MSN), the Istituto Italiano di Antropologia and the Associazione Antropologica Italiana. It is also supported by the Istituto Italiano di Paleontologia Umana.

The preparation of the meeting and the publication of our abstract volume have been made possible by the endless work of the ESHE Board Officers and Board Members and in particular by *Alyson Reid*, *Philipp Gunz*, *Shannon McPherron*, *Marie Soressi* and *Thomas Terberger*.

In 2015, the meeting of the European Society for the study of Human Evolution will take place at the British Museum (London, UK) and its organization is already well advanced.

**With best wishes,**

**Jean-Jacques Hublin**

*President, European Society for the study of Human Evolution*

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## Origins and general information

The University of Florence can trace its origins to the *Studium generale*, which was established in 1321.

The importance of the *Studium* was sanctioned by a bill by Pope Clement VI, with which the securities issued by it were recognized and validated. With this bill, the 'privilegia maxima', already granted to the University of Bologna and Paris was extended to Florence. In 1364 under the Emperor Charles IV, the *Studium* became Florentine Imperial College. When the Medici obtained power of the government of Tuscany and moved it to Pisa in 1472: transfers of the *Studium* to Pisa became frequent, depending on the changes in government. Charles VIII brought it back to Florence from 1497 to 1515, the year in which, with the return of the Medici, the *Studium* was again moved to Pisa. Despite this final move, many courses remained in Florence. Research carried out in the numerous academies flourished in the meantime, such as the Accademia delle Crusca and the Accademia del Cimento, the first scientific society established

in Europe in 1657. In 1859, the University re-emerged as Istituto di Studi Superiori (Institute of Higher Education). In 1923 it was established as a fully-fledged public university.



School of Education and Humanities, main Building

Mathematics, Physics and Natural Sciences, Political Science, Psychology. Scientific research is carried out in the 24 Departments of the University, grouped into 5 major areas: Social Sciences, Humanities, Sciences, Technology and Biomedical. A large part of the yearly budget is allocated to scientific research. In the recent past the University of Florence has been ranked top among Italian Universities in the distribution of national research funds. High-level research avails itself of the "centres of excellence", which attract funding and form synergies with other institutions.

The University of Florence is one of the largest organisations for research and higher education in Italy, with over 1900 tenured teaching staff and researchers, over 1600 permanent technical/administrative staff and language assistants and over 55,000 students enrolled. The University is structured into 10 Schools: Agriculture, Architecture, Economics, Education and Humanities, Engineering, Law, Human Health Sciences,



School of Architecture, main building



Library Humanistic Studies



## Libraries and Museum

There are approximately three-and-a-half million books and a large number of periodicals available in five libraries covering the main disciplinary areas, with around 60 annexed reading rooms. The university library system also offers online catalogues and many other resources in digital format (journals, articles, books). Students are offered courses for guidance in the use of the library and in bibliographical research, as well as rooms with computer work stations that are also open in the evening.

In collaboration with other universities, important projects are underway which will increase direct access to databases and full-text electronic periodicals from individual work stations. The digital publishing service provided by Firenze University Press, F.U.P., can be considered a model university publishing house; it cooperates with professors and researchers to promote and increase the value of scientific and didactic production, thus offering electronic and paper publications scientifically guaranteed by the university itself.

The most important natural history museum in Italy belongs to the University of Florence. It is also one of the oldest and most renowned museums at an international level: the Museum of Natural History, founded in 1775 by the Grand Duke Peter Leopold. The Botanical Garden section of the Museum is however even older, dating back to 1545. Consisting of six sections scattered over the old centre of Florence, the Museum houses 8 million exhibits, some of outstanding scientific and naturalistic importance: sixteenth-century herbaria and precious eighteenth-century wax-works, fossil skeletons of elephants and collections of multicoloured butterflies, large tourmaline crystals and Aztec relics, impressive wooden sculptures and the largest collection of inflorescence in the world. A wonderful combination of nature, history, science and art emerges from this context.

The international dimension is in the DNA of the University of Florence, and not just because of the city in which it is located. There are more than 260 agreements with many universities in 70 countries. Since 1999, the University of Florence has been recognized as "Jean Monnet European Centre of Excellence" for training activities and research related to the issues of European integration and its development. In the School of Political Science and Law, there are currently six Jean Monnet Chairs, taught by specialized scholars in the field. In addition, courses of study leading to joint degrees with other foreign universities and five schools (Agriculture, Economics, Architecture, Law, Political Science) offer courses or individual lessons in English.

The international dimension is demonstrated by the nearly three thousand foreign students enrolled, an over a thousand European exchange students. In 2011, the University of Florence received an award from the National Agency for Lifelong Learning Programme for the efforts made in the context of international mobility through the Erasmus program, especially regarding their acceptance of foreign students.

Public research in Florence has one of the largest and most productive roles, in relation to the number and variety of scientific researchers and junior scientists in training, intense participation in programs of national and international research, the scientific results achieved and the cash flow from the outside that supports the research and transfer. This combination of factors qualifies the University of Florence as a modern "research university" and determines its strong positions in national and international assessments, thanks to centers and laboratories of international prestige as the LENS (European Laboratory for Nonlinear Spectroscopy) and CERM (Center for Magnetic Resonance research), regularly attended by Nobel Laureates and locations of the most advanced research.



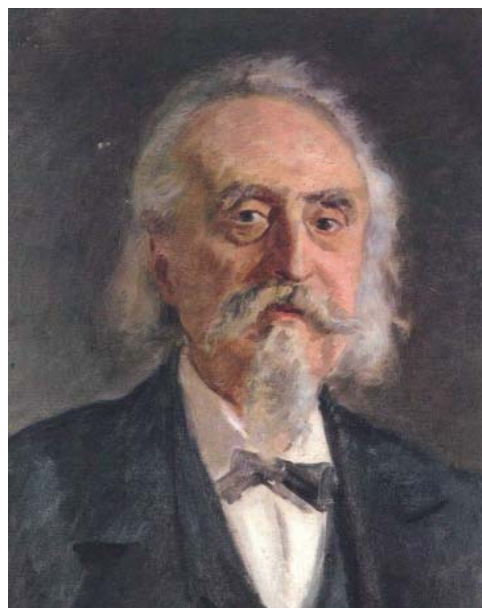
Natural History Museum - Zoology section. The anatomical waxes collection.



## The Department of Biology, Anthropology Labs

Anthropology in Florence is represented today by a series of laboratories, based in the historical building called Palazzo Nonfinito ('unfinished palace') and is part of a large Department of Biology, whose different sections are scattered in the Florence area. It has its roots in the Museum of Anthropology, founded in 1869, as the National Museum of Anthropology and Ethnology, following an idea by Paolo Mantegazza (1831-1910), who in the same year was appointed Director and also the first Italian Chair of Anthropology at the Florence Institute of Higher Studies. Mantegazza was also the founder of the Italian Society of Anthropology and Ethnology (1870) and its journal *Archivio per l'Antropologia e la Etnologia* (Archive for Anthropology and Ethnology) (1871), still published today.

Mantegazza considered anthropology as "the natural history of man", whose scope was "to study man with the same experimental criterion with which plants, animals, stones are studied, [...] without the yoke of religious traditions, of philosophical preconceptions". It purported to study man, "as he is seen and as he is touched", because "anthropology is a branch of the natural sciences and like all its other sisters can have only one policy, observation illuminated by experiment". His interests and research spanned from anthropology to ethnology and psychology and was among the first scientists to use photography as a scientific instrument, to be used together with its artistic potential to document all aspects of human life and activity.



Paolo Mantegazza

The museum, at first, comprised few ethnographical objects from the Medici collections, a small collection of prehistoric tools from the island of Elba and a few skeletal remains collected by Mantegazza himself in Argentina. Through the years, the anthropological and ethnological collections increased numerically with the help of many Italian institutions and also following donations resulting from scientific expeditions.



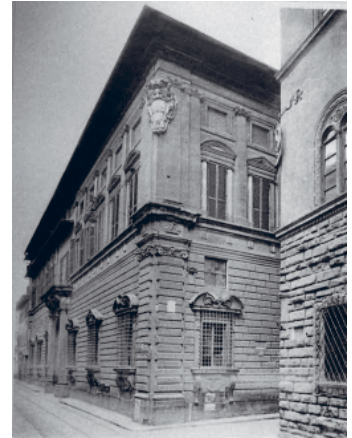
Palazzo Nonfinito, main gate.

Currently, the collections include approximately 25,000 ethnographic objects from all over the world, 7,000 anthropological remains from prehistoric times to today, 26,000 photographic prints and 7,000 negatives, 800 anatomical plaster casts, over 9000 lithic tools, and a collection of about 80 scientific instruments. In addition, the museum has an archive of 545 pieces, including letters, documents and manuscripts, valuable evidence of the activity and the thought of Paolo Mantegazza and his school. For their history and for the scientific and methodological aspects that led to their formation, the collections of the Museum of Anthropology and Ethnology today constitute an important document of the cultures of the peoples of the world and the evolution of anthropological thought in Europe.

Mantegazza died in 1910 and Aldobrandino Mochi (1875-1931) replaced him in the teaching of anthropology and as museum director. Mochi's interest in the study of fossil man was the basis of the establishment of an important institution whose aim was to reconstruct the most ancient history of humankind. In May 1913, the *Committee for Research on Human Palaeontology in Italy* was founded in Florence, with its headquarters in Palazzo Nonfinito. After the interruption due to World War I, it became the *Italian Institute of Human Palaeontology* in January 1927. Mochi dedicated a substantial part of his activities to this institution and from that moment human paleontological research became a matter of close cooperation between the institute, the university and the museum.



The first three decades of the 20th century were particularly fruitful for discoveries and activities in the field of human paleontology. On the one hand, the Italian Institute of Human Palaeontology were involved in excavations and explorations of numerous sites in southern Italy, the Apuan Alps and Liguria. On the other hand, they took part in numerous missions in Libya, Eritrea and Somalia, a reflection of the colonial policies of the Italian Fascist period, which brought many collections to the Museum in Palazzo Nonfinito.



Palazzo Nonfinito

Mochi died in 1931 and Nello Puccioni (1881-1937) replaced him as museum director. Puccioni was another important figure in Italian human paleontological research who had often dealt with prehistoric material, for example during his participation in the second Stefanini mission in Somalia (1923/1924).

When Puccioni passed away in 1937, the museum directorship went to Lidio Cipriani (1892 - 1962) who was well-known for his many daring expeditions in south-central Africa from 1927 to 1930, missions that provided the museum with abundant anthropological materials. During World War II, the directorship passed to Giuseppe Genna, who managed the difficult task of safeguarding the collections and continuing the activities of the museum.

Meanwhile, in 1936 another student of Mochi, Paolo Graziosi (1906-1988), started teaching palaeoethnology in the Faculty of Arts and Philosophy. Shortly thereafter the Institute of palaeoethnology was established, also based in Palazzo Nonfinito: hence this building in Via del Proconsolo became an important centre of research, not only in anthropology but also in palaeoethnology. Graziosi would later become an important student of prehistoric man and especially of artistic manifestations.

On Graziosi's retirement the chair of Anthropology and the direction of the Museum were entrusted to Brunetto Chiarelli (1934 - ), whose research and activities resumed the original ideas and approach of Mantegazza towards Anthropology as natural history of man. It is in this light that Chiarelli first introduced in Italy the field of Primatology. Chiarelli retired in 2008. Today, research in Anthropology in Florence embraces fields from Primate cytogenetics, to Paleogenetics and Paleoanthropology.



Department of Biology, Zoology labs,

## Keynote Speech

### *Comparing genes across linguistic families*

**Prof. Guido Barbujani**

Dept. of Life Sciences and Biotechnologies, University of Ferrara

Thursday, 18 September

University of Florence Main Hall • Piazza di San Marco, 4, 50121 Florence

Parallel analysis of genetic and linguistic diversity may cast light on both biological history and cultural transmission. Significant associations were observed in the past, resulting in coherent phylogenies of languages and populations. However, most classical studies were hampered by the impossibility to compare the vocabularies of distantly-related languages. A novel method, the Parametric Comparison Method (PCM), has been proposed for inferring language diversity from supposedly universal syntactic and grammatical (rather than lexical) features, thus enabling comparison across established families. This method succeeds in reconstructing the phylogeny of modern Indo-European languages in striking correspondence with consolidated results of lexical comparison. A cross-disciplinary comparison of linguistic and genetic variation in Europe, the latter inferred from genome-wide SNP data in 15 populations, shows significant correlations between linguistic and genomic diversity and, contrary to previous observations, language proved a better predictor of genomic differences than geography. These results pave the ground for previously unfeasible large-scale correlations across different language families.

## Curriculum vitae

Guido Barbujani was born in Adria (Italy) in 1955, and graduated in Biology in 1978. In 1983 he became Assistant professor of Genetics (University of Ferrara, then University of Padova). From 1987 to 1989 he was a postdoctoral research scientist in the Department of Ecology and Evolution (State University of New York, Stony Brook) and in 1992 he became an Associate professor (University of Bologna, then University of Ferrara). Since 2001 he has held a position as Professor of Genetics and Population Genetics (University of Ferrara). He is author or co-author of over 185 publications in international journals.

His research interests include reconstructing human past evolutionary and demographic changes. To that end, together with his research group he is developing statistical methods to describe in a quantitative, reproducible manner the geographic patterns of DNA diversity, and applying them to the study of both modern and ancient individuals' DNA. Computer simulations and Bayesian methods are used to test the genealogical relationships among ancient and past populations, from Neandertals through the inhabitants of pre-classical Europe, up to modern times.





## The site of Equi and its context

Equi is located on the northern side of the Apuane Alps, Northern Tuscany. Today, the area is characterized by a mountain environment, mostly on the southern side. The region is distinguished by several V-shaped valleys, even if some areas were influenced by Late Pleistocene glaciation events, and remnants of glacial cirques are most frequent on the north-eastern side of the Regional Park, where many slopes are north-facing. Braschi et al. (1986) first recognized a glacier presence close to the town of Equi, developed at a low altitude (about 400 masl) thanks to geomorphological evidence in the area of Pizzo d'Uccello (one of the highest peaks in the Apuane Alps, 1780 masl).



Valley of the Fagli Creek: at the center of the rock wall is the entrance to the 'Grotta della Tecchia' (photo by Paolo Nannini, the Superintendence for Archaeological Heritage of Tuscany).

The Equi site is located along the valley of Fagli creek (coordinates WGS84: 44.150, 10.167). The deposit records a time range of at least 45 ka, from the Late Pleistocene (vertebrate fossils, and Musterian lithic industries) to the Holocene (Medieval pottery and Neolithic rests). The Late Pleistocene fossiliferous sedimentary succession is generally correlated with the MIS3 (Caloi e Palombo 1994).

Human-made lithic evidence was described in an extensive paper by Branchini (1928). She confirmed their attribution, relating them to the final phase of Mousterian, in the Italian literature also known as "Alpine Mousterian" (Battaglia 1932; Graziosi, 1934; Rellini 1935, 1937; Giacobini 1982). The site was historically used by locals for different reasons (burials; sheep repair; refuge during war times, etc.) and a small wall was also built outside of the shelter. Despite the fact that the occurrence of ancient bone was commonly known, the scientific interest first began in 1909, when some remains



The town of Equi Terme seen from Tecchia (photo by Antonio Trivelli).



were collected by Giovanni Pondenzana (from the Civic Museum of La Spezia), and an extensive excavation started one year later, under the direction of geologist Carlo De Stefani, Chair of Geology and Physical Geography at the Florence “Regio Istituto di Studi Superiori”, and continued until 1920 (De Stefani 1917). The De Stefani team found the entrance of the cave in 1911, and though ten years of fieldwork they collected thousands of vertebrate fossils in association with human artifacts. The excavations also revealed two hearths (today no longer preserved).



Outlook of the exhibition “But not only the bear lived in the cave” (photo by Paolo Nannini, the Superintendence for Archaeological Heritage of Tuscany).

The careful work of De Stefani included the relative localization of each specimen, and these data allowed for a recent reevaluation of the species distribution within the depositional record, and the evaluation of a quite homogeneous assemblage through time (Ghezzi et al., in press). Between the First and Second World Wars, the site was at the centre of a debate, disputing on the contemporary existence of Neolithic populations and cave bears (*Ursus spelaeus*). The debate ended in 1933 proving the mixing of upper layers (Graziosi 1934; Rellini 1935). Since 1967, the site was periodically and inconsistently investigated (Ambrosi and Fabbri 1975) and since 2009 the shelter (locally known as ‘Tecchia’) and the cave have been secured and set up for both promotional tourist use and new excavations of the area (Iardella et al. 2009). These recent activities have been made possible thanks to the carefulness and the financial support from the Superintendent for the Archeology of Tuscany, the Municipality of Fivizzano and the Regional Park of Alpi Apuane (Paribeni et al. 2009; Iardella et al. 2011). Under the shelter, recent excavations revealed the occurrence of layers yielding Mousterian lithic artifacts. The layer was sampled for C14 dating and returned an age older than 50 Ka. In addition, the deposits of the cave continue to return well-preserved faunal remains (and artifacts) dated at about 43-44 Ka BP (Bigagli et al. 2013).

In order to underline the importance of Equi within the regional context of the Apuane Alps, the administrative and legal recognition as a site of natural, historical and paleontological importance has been reworked, including Equi among the “Archeological subjects of interest for the landscape”. (Paribeni et al. 2009).

Historical excavation recorded a very rich fauna (De Stefani 1917). It consists of small and large vertebrates, such as: *Ursus spelaeus* (cave bears), *Canis lupus* (wolves), *Vulpes vulpes* (fox), *Cuon alpinus* (dhole), *Panthera leo spelaea* (lion),

*Panthera pardus* (leopard), *Lynx lynx* (eurasian lynx), *Mustela nivalis* (least weasel), *Mustela putorius* (european polecat), *Martes martes* (pine marten), *Martes foina* (beech marten), *Cervus elaphus* (red deer), *Sus scrofa* (wild boar), *Rupicapra rupicapra* (chamois), *Capra ibex* (alpine ibex), *Capra hircus* (goat), *Lepus sp.* (hare), *Marmota marmot* (marmot), and *Castor fiber* (beaver). There are several micromammals, small bats, birds, reptiles, amphibians and fishes. A first preliminary analysis of the fauna was performed by Regalia (1911); the later part of the fossil collection has been described by different researchers (Pieragnoli 1919; Fracassi 1920; Del Campana 1923, 1924, 1954).

Mammals found at Equi are mostly carnivores, with an enormous record of cave bear remains, several felines, wolves, foxes, and a few specimens of the dhole (*Cuon alpinus*) (Ghezzi and Rook, in review). Moreover, Equi represents the largest collection of fossils of European leopards (more than 200 specimens, both young and adult individuals).

Fossil vertebrates were spread over the whole excavated surface and were mainly disarticulated, even if De Stefani (1917) attested the presence of joined bones (of limbs). The cave was probably a frequent winter hibernation den (at least for cave bears). The presence of predators (bears, but also leopards and wolves) must have been assiduous.

Bone surface taphonomy does not reveal the occurrence of bite marks, proving an evidence of probable reciprocal avoidance among carnivores, alternating seasonal frequency of the cave.

In the faunal association from Equi hyenas are absent: skeletal remains, digested bones, and coprolites are lacking entirely, which is peculiar since these are recorded in coeval deposits in the area (Capriolo Cave and Buca della Iena) (Pitti and Tozzi 1971).

Considering the occurrence along the depositional record, we can appreciate, from older to recent layers, the increase of woodland and opportunistic species, such as fox and mustelids, while the occurrence of other predators appears to be constant.

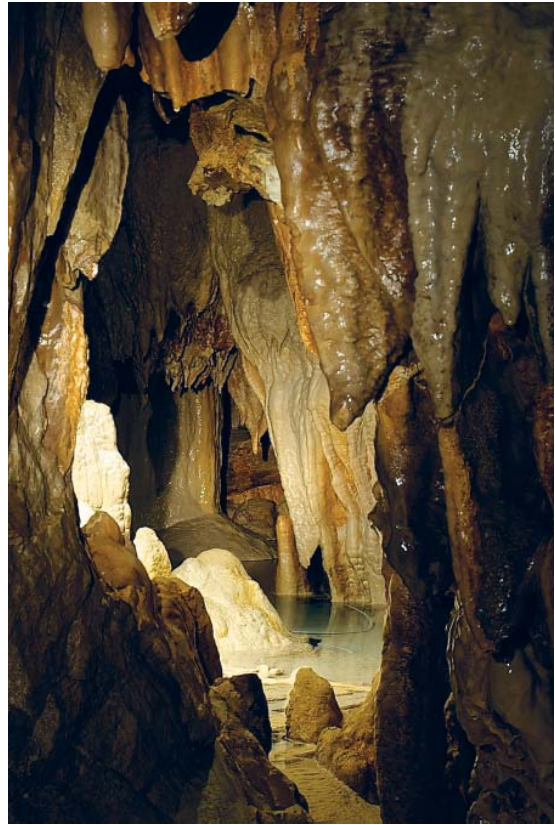


Skull of *Ursus spelaeus* during excavation (Photo by Massimo Pasquali).



**Equi represents an important site within the Apuan context for several reasons:**

- The great number of paleontological evidences testifies a dynamic and difficult environment, also for large carnivores (there are many pathological modifications on bones and probably a high percentage of mortality).
- Human evidences testify the frequentation of the area, even if the Neanderthals used the shelter and cave just for temporary occasions and not for long periods.
- The revaluation of the site of Equi allows promoting the interests of local and regional administrations toward their history and the importance of conservation and preservation of their ancient richness, also for a touristic and economic uses.
- Finally, the site is not yet fully excavated, and the continuation of surveys will reveal new evidence, thanks to the presence of intact layers in the three areas of investigation (the shelter, the entrance, and the inner side of the cave).



Buca di Equi, detail (photo by Antonio Trivelli).

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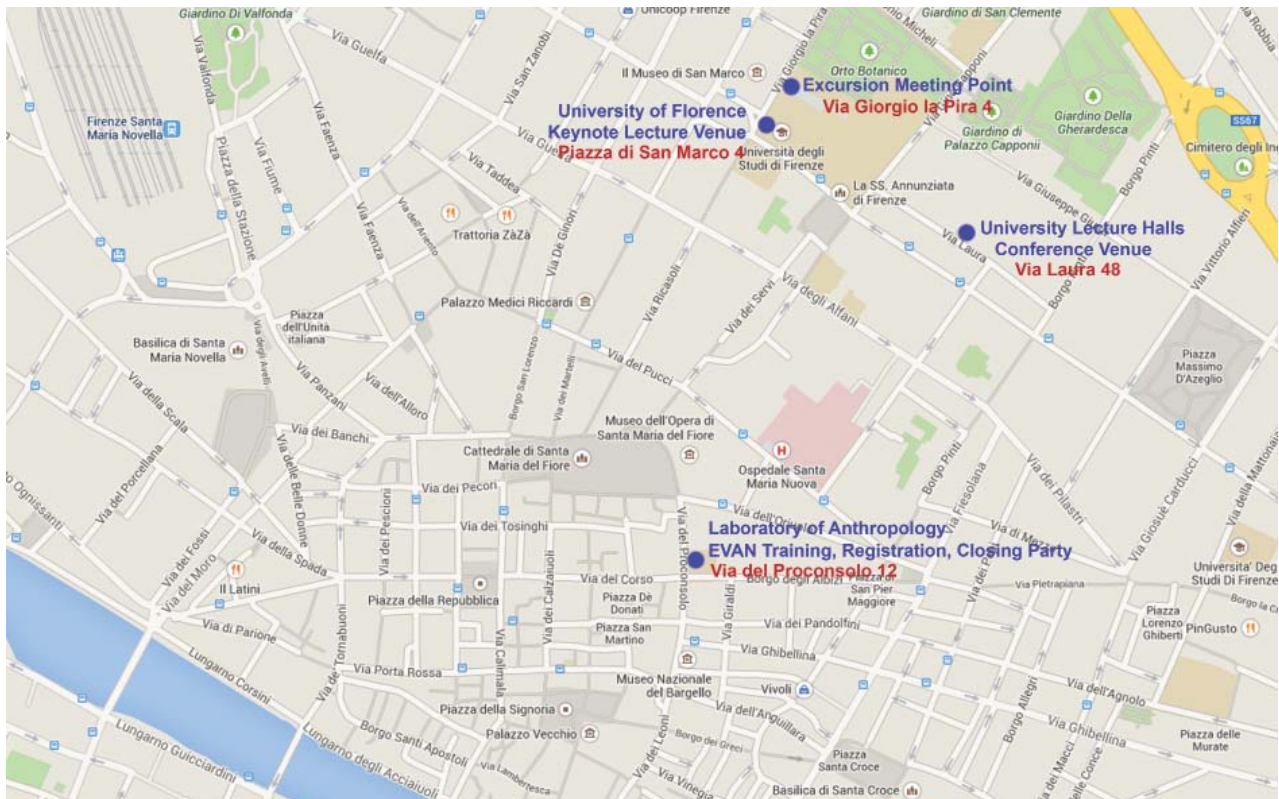
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## Sunday 21 September • Excursion: Grotte di Equi (Equi Cave)

Meeting Point: Via Giorgio la Pira 4

Hours	Event
07:30 – 10:00	Drive from Florence to Equi Cave
10:00 – 13:00	Site visits
13:00 – 14:30	Lunch (Included in the price of the excursion).
14:30 – 17:30	Site visits
17:30 – 20:00	Drive back to Florence

The Grotte di Equi consists of a series of caves, set within a beautiful northern Italian landscape. The focus of the visit will be the “Tecchia di Equi”, a small cave where the excavation was carried out. In addition, we will have the chance to see the “Grotte di Equi”, a tourist cave; a nature path to see the “Solco di Equi”, panoramic site and a small lab with educational facilities (Geolab). The excursion includes a fully catered lunch of local Italian specialties.



<b>Thursday, 18 September</b> University of Florence • Via Laura 48, 50121 Florence	
8:00-8:30	<b>Registration</b>
8:30	<b>Opening Speech: Jean-Jacques Hublin</b>
<b>Session 1</b>	
8:50	<i>Brain size in Mio-Pliocene hominoids: the result of selection or pleiotropy?</i> <b>Gabriele Macho</b>
9:10	<i>Hominin ecology and behavior based on 1.5-million-year-old footprint assemblages from Ileret, Kenya</i> <b>Brian Richmond et al.</b>
9:30	<i>Age-at-Death and Dental Developmental Pattern of the Australopithecus sediba Juvenile MH1 Determined from Synchrotron Virtual Paleohistology</i> <b>Adeline Le Cabec et al.</b>
9:50	<i>The significance of Australopithecus sediba for understanding Paranthropus robustus</i> <b>Jeffrey Schwartz</b>
10:10	<i>Middle Pleistocene narratives and the Sima de los Huesos evidence</i> <b>Juan Luis Arsuaga</b>
10:30-11:00	<b>Coffee Break</b>
<b>Session 2</b>	
11:00	<i>Binning a bone of contention from the Homo erectus type locality Trinil</i> <b>Josephine Joordens et al.</b>
11:20	<i>A winter wonderland? Mid-latitude seasonality strategies in the Lower Palaeolithic</i> <b>Robert Hosfield</b>
11:40	<i>Mounting evidence for multiple hunting episodes in the Schöningen 13II-4 “Spear Horizon”</i> <b>Jarod Hutson et al.</b>
12:00	<i>Spruce and pine – new investigations on the wooden weapons of Schöningen, Lower Saxony (Germany)</i> <b>Thomas Terberger et al.</b>
12:20	<i>The Ceprano calvarium, twenty years after. A new generation of (digital) studies</i> <b>Fabio Di Vincenzo et al.</b>
12:40	<i>The hominin frontal bone recently discovered in the Po Valley, Northern Italy</i> <b>Giorgio Manzi et al.</b>
13:00-14:30	<b>Lunch Break</b>
<b>Session 3</b>	
14:30	<i>New Neandertal remains from Sirogne cave, Rocamadour (Lot, France)</i> <b>Priscilla Bayle et al.</b>
14:50	<i>Facial Growth Remodeling in Middle-Pleistocene Homo</i> <b>Rodrigo Lacruz et al.</b>
15:10	<i>All you wanted to know about growth of African pygmies but no one could tell....until now</i> <b>Fernando Ramirez Rozzi et al.</b>
15:30	<i>Exploring taurodontism in Neandertals</i> <b>Stefano Benazzi et al.</b>
15:50	<i>Small bones, big differences - A comparison of modern human and Neandertal ear ossicles</i> <b>Alexander Stoessel et al.</b>
16:10	<i>TOSPEAK, a primate long non-coding gene with human-specific promoter regulates development of the capacity to speak</i> <b>Zhiming Fang et al. (Presented by Raymond Clarke)</b>
16:30-17:30	<b>Coffee Break</b>
17:30-19:00	<b>Keynote Speech</b> <b>Professor Guido Barbujani • <i>Comparing genes across linguistic families</i></b> University Main Hall • Piazza di San Marco, 4, 50121 Florence

<b>Friday, 19 September</b> University of Florence • Via Laura 48, 50121 Florence	
<b>8:30-9:30</b>	<b>Session 4: PECHA KUCHA</b>
1	<i>The cave, the skull and the women: female representation in Palaeolithic research</i> <b>Rebecca Wragg Sykes et al.</b>
2	<i>The Châtelperronian: an updated review</i> <b>Morgan Roussel and Marie Soressi</b>
3	<i>A reappraisal of the early Upper Paleolithic assemblages from Maibulak, Kazakhstan</i> <b>Radu Iovita et al.</b>
4	<i>Endocranial shape asymmetry in humans and apes</i> <b>Simon Neubauer et al.</b>
5	<i>The Higher Cognitive Functions of the Recently Expanded Parietal Lobes in Homo sapiens</i> <b>Frederick Coolidge</b>
6	<i>Exploring hominin and animal interactions in the Swabian Jura: Cave use and subsistence patterns during the late Middle and early Upper Paleolithic</i> <b>Keiko Kitagawa et al.</b>
7	<i>The Grotta di Cala dei Genovesi – New studies on the Ice Age cave art on Sicily</i> <b>Gianpiero di Maida et al.</b>
8	<i>What is genetic modernity?</i> <b>Ryan Raaum</b>
<b>9:30-10:00</b>	<b>Coffee Break</b>
<b>Session 5</b>	
<b>10:00</b>	<i>The Middle Palaeolithic living floor of Unit 15 (55 kyrs BP) from the Oscuruscuito Shelter, Ginosa, Taranto, Southern Italy</i> <b>Annamaria Ronchitelli et al.</b>
<b>10:20</b>	<i>Neanderthal occupation of the East European Plain: New data from the Middle Dniestr valley (Ukraine)</i> <b>Philip R. Nigst et al.</b>
<b>10:40</b>	<i>Cranial diversification in Neandertals and modern humans compared to common chimpanzees</i> <b>Timothy D. Weaver et al.</b>
<b>11:00</b>	<i>Palaeoclimatic data from Lake Tana, Ethiopia, support anatomically modern human dispersal from Africa at 112 – 97 ka</i> <b>Henry Lamb et al.</b>
<b>11:20</b>	<i>Testing modern human out-of-Africa models: population genetic and craniometric approaches</i> <b>Katerina Harvati and Hugo Reyes-Centeno</b>
<b>11:40</b>	<i>Khoe-San retain a gracilized version of the ancestral modern human phenotype</i> <b>Philipp Gunz et al.</b>
<b>12:00-13:30</b>	<b>Lunch Break</b>
<b>Session 6</b>	
<b>13:30</b>	<i>Can distal fibular morphology be used to infer Au. afarensis locomotor behavior?</i> <b>Damiano Marchi</b>
<b>13:50</b>	<i>The Appositional Articular Morphology of the Talo-crural Joint Reflects Substrate Use Within Species: An Examination of Three Closely Related Hominoid Species</i> <b>Kevin Turley and Stephen Frost</b>
<b>14:10</b>	<i>Did a longer “functional” lumbar spine in early hominids facilitate the evolution of the lumbar lordosis?</i> <b>Nakita Frater et al.</b>
<b>Session 7</b>	
<b>13:30</b>	<i>Early Palaeolithic fire at a late Early Pleistocene hominin site: Cueva Negra del Estrecho del Río Quípar, Caravaca de la Cruz, Murcia, Spain</i> <b>Michael John Walker et al.</b>
<b>13:50</b>	<i>Behavioural Implications of Large Flake Acheulian technology</i> <b>Sheila Mishra</b>
<b>14:10</b>	<i>The Middle Palaeolithic sites at Neumark-Nord 2 (Germany): Optically and thermally stimulated luminescence dating</i> <b>Daniel Richter et al.</b>



14:30	<i>Spinal stenosis in Homo erectus</i> <b>Marc Meyer and Martin Haeusler</b>	<i>Neanderthal spatial behaviour during the Late Interglacial within a lake shore environment: the case of Neumark-Nord 2 (Germany)</i> <b>Alejandro García-Moreno et al.</b>
14:50	<i>Spino-pelvic alignment: An evolutionary perspective</i> <b>Ella Been et al.</b>	<i>What Role for Mediterranean Europe in the MP/EUP shift</i> <b>Laura Longo and Silvana Condemi</b>
15:10	<i>Ancestral Aches? Vertebral morphology, locomotion, and human spinal health</i> <b>Kimberly Plomp et al.</b>	<i>Size Matters - Patterns of choice and constraint in Lower and Middle Palaeolithic microlithic assemblages in central Europe</i> <b>Iris Newton</b>
15:30-17:30	<b>Poster Session 1</b>	
17:30-18:30	<b>ESHE General Assembly</b>	

**POSTER SESSION 1**  
FRIDAY, 19 September 15:30-17:30

Authors of odd-numbered posters are expected to be present during the first hour (15:30-16:30). Authors of even-numbered posters should be present in the second hour (16:30-17:30)

1	<i>Size and sex variance in Paranthropus robustus: Taxonomic and Palaeobiological implications</i> <b>Andrew Gallagher et al.</b>
2	<i>A specimen of Paranthropus robustus from Bolt's Farm Caves system, Cradle of Humankind, South Africa?</i> <b>Sandrine Prat et al.</b>
3	<i>Mid-Pliocene Primates (Cercopithecoidea) from Brad Pit B, Klinkerts (Bolt's Farm Cave System, South Africa)</i> <b>Dominique Gommery et al.</b>
4	<i>Ancient human DNA, finally a research field where data sharing is common practice</i> <b>Paolo Anagnostou et al.</b>
5	<i>Hominin Footprints from Early Pleistocene Deposits at Happisburgh, UK</i> <b>Nick Ashton et al.</b>
6	<i>X-ray microtomographic-based structural analysis of the dental remains from the Mousterian and Aurignacian levels of the Fossellone cave, Latium, Italy</i> <b>Claudio Tuniz et al.</b>
7	<i>The Gravettian mandibles from Grotta Paglicci (Apulia, Italy): a geometric morphometrics study</i> <b>Aurélien Mounier et al.</b>
8	<i>The "forgotten" Palaeolithic human remains from the site of Roc-en-Pail (France). Reassessment of the archaeological context and taxonomical diagnosis: a new Neanderthal humerus</i> <b>Christine Verna et al.</b>
9	<i>Preliminary study of the head-neck complex of Neanderthal ribs from the El Sidrón site (Asturias, Spain)</i> <b>Daniel García-Martínez et al.</b>
10	<i>Thorax kinematics and the reconstruction of body models in hominin evolution</i> <b>Markus Bastir et al.</b>



11	<i>Muscle cross-sectional area estimation for Neanderthals and Paleolithic modern humans</i> <b>Astrid Slizewski et al.</b>
12	<i>Examining the influence of habitual loading along the long bone diaphyses of varsity athletes; skeletal plasticity and constraint</i> <b>Jason Nadell and Colin Shaw</b>
13	<i>Re-evaluation of the Pleistocene and Holocene long bone robusticity trends with regards to age-at-death estimates and size standardization procedures</i> <b>Lukáš Friedl et al.</b>
14	<i>A study of three-dimensional quadric surface fitting to model variability in femoral curvature</i> <b>Tara Chapman et al.</b>
15	<i>Breakage patterns of hominin long bones from Sima de los Huesos (Atapuerca, Spain)</i> <b>Nohemi Sala et al.</b>
16	<i>The stout navicular bones from the the Middle Pleistocene site of Sima de los Huesos (Atapuerca, Burgos, Spain)</i> <b>Adrián Pablos et al.</b>
17	<i>Dorsal canting in human pedal and manual proximal phalanges does not covary: an alternative explanation for high dorsal canting in manual phalanges</i> <b>Anneke H. van Heteren et al.</b>
18	<i>Evolution of the ulnar and radial sides of the human hand</i> <b>Tea Jashashvili et al.</b>
19	<i>Morphometric maps of the developing human humerus</i> <b>Thomas O'Mahoney et al.</b>
20	<i>Revisiting the hominoid humerus – A 3D GMM assessment of locomotor and shape correlates</i> <b>Margherita Sbranchi and Martin Friess</b>
21	<i>Cortical bone topography and cross-sectional geometric properties of Paglicci 12 and Paglicci 25 Gravettian human femora</i> <b>Laurent Puymerau et al.</b>
22	<i>The Gona pelvis and sexual dimorphism in Homo erectus compared with living hominoids</i> <b>Zachary Cofran</b>
23	<i>A new partial pelvis (Pelvis 2) from the Sima de los Huesos site (Atapuerca, Spain)</i> <b>Alejandro Bonmati-Lasso et al.</b>
24	<i>Shape, size and maturity trajectories of the human ilium and interpopulation differences in the ontogeny of sexual dimorphism</i> <b>Laura Wilson et al.</b>
25	<i>Variation in the shape of the birth canal in modern humans is significant and geographically structured</i> <b>Lia Betti</b>
26	<i>Quadrupedal subjects in a family (Adana, Turkey): new insights into the biomechanical influences on skeletal development</i> <b>Noémie Bonneau et al.</b>
27	<i>Rodent biochronology at Klinkert's (Sterkfontein Valley, South Africa)</i> <b>Frank Senegas</b>

28	<i>Organization Of Lithic Technology At Lalitpur: A Large Flake Acheulean Site In India</i> <b>Neetu Agarwal and Sheila Mishra</b>
29	<i>Towards luminescence dating of the Lower Paleolithic</i> <b>Christina Ankjærgaard et al.</b>
30	<i>Contribution of the ESR dating method to the chronological framework of the oldest hominid occupations in southwestern Europe</i> <b>Mathieu Duval</b>
31	<i>Further elements on the chronology of the Roc de Marsal (SW France) Middle Paleolithic sequence: insights from quartz Single Grain OSL and various K-feldspar IRSL signals</i> <b>Guillaume Guérin et al.</b>
32	<i>Rediscovering and reinterpreting old data from the archaeological collections of the Portuguese Scientific Missions in Southwestern Angola</i> <b>Daniela Matos et al.</b>
33	<i>Evaluating archaeology – using network analysis to visualise research behaviour</i> <b>Trine Kellberg Nielsen</b>
34	<i>Techno-typological analysis of bifacial component at Gombe site (Kinshasa, DRC). An assessment of the Lupemban in Western Central Africa</i> <b>Sylvie Numuhire</b>
35	<i>Middle Stone Age ochre processing tools from Porc-Epic cave (Dire Dawa, Ethiopia)</i> <b>Daniela Eugenia Rosso et al.</b>
36	<i>Varsche Rivier 003: A Middle Stone Age site with Still Bay and Howiesons Poort assemblages in southern Namaqualand, South Africa</i> <b>Teresa Steele et al.</b>
37	<i>The invisible frontier: East African MSA/LSA transition in Goda Buticha (Dire Dawa, Ethiopia)</i> <b>David Pleurdeau et al.</b>
38	<i>Multidisciplinary studies of a 31,000 year old canid skull from Aghitu-3 Cave, Armenia</i> <b>Andrew W. Kandel et al.</b>
39	<i>When Did the Upper Paleolithic Begin on the Russian Plain? (In the Context of Pollen and IRSL/OSL Dates on Kostenki-12 Site and Their Correlations with Pollen and O16/O18 and C13/C14 “Calendars”)</i> <b>Galina Levkovskaya et al.</b>
40	<i>Upper Paleolithic Funeral Ceremony: Bioarchaeology Of The Person From Kostenki Xiv (Markina Gora)</i> <b>Alexandra Buzhilova</b>
41	<i>East European models for the Middle-to-Upper Palaeolithic transition in Eastern Europe</i> <b>Andrey A. Sinitsyn</b>
42	<i>Iberomaurusian Funerary Rituals: Cultural And Social Aspects Of The Tavoralt Population</i> <b>Valentina Mariotti et al.</b>
43	<i>Siberian zoomorphs: A search for meaning and implications for the Upper Paleolithic evidence</i> <b>Sandra Sázelová</b>
44	<i>Engraved human bone from the Magdalenian site of Gough's Cave, Somerset (UK)</i> <b>Silvia M. Bello and Rosalind Wallduck</b>
45	<i>Lower Magdalenian Lithic Raw Material Conservation in Cantabrian Spain</i> <b>Lisa M. Fontes</b>
46	<i>New insights into the multiple Mesolithic burial of Groß Fredenwalde, NE-Germany</i> <b>Bettina Jungklaus et al.</b>

Saturday, 20 September University of Florence • Via Laura 48, 50121 Florence		
	<b>Session 8</b>	
9:30	<i>Dating the Middle to the Upper Palaeolithic Transition in the South Levant: Where to From Here?</i> <b>Elisabetta Boaretto and Omry Barzilai</b>	
9:50	<i>The Early Upper Palaeolithic at Manot Cave, Western Galilee, Israel</i> <b>Omry Barzilai et al.</b>	
10:10	<i>Explicit similarities and expected variability: the Initial Upper Paleolithic in Northeast Asia</i> <b>Nicolas Zwyns et al.</b>	
10:30	<i>A local Mousterian origin for the Châtelperronian?</i> <b>Karen Ruebens et al.</b>	
10:50-11:10	<b>Coffee Break</b>	
	<b>Session 9</b>	
11:10	<i>A high-resolution chronostratigraphic framework for the Upper Paleolithic of southeastern Iberia</i> <b>João Zilhão et al.</b>	
11:30	<i>The early Gravettian. New excavations at Dolní Věstonice-Pavlov</i> <b>Jiří Svoboda et al.</b>	
11:50	<i>The Use of Non-Flint Lithic Raw Material in the Final Gravettian. Abri Pataud (level 2), Languerie-Haute Est (levels F, 36 and 38), Les Peyrugues (level 18)</i> <b>Laurent Chiotti et al.</b>	
12:10	<i>New insights from old artefacts: A quantitative reassessment of the LSA technology of the Central Kenyan Rift</i> <b>Alex Wilshaw and Marta Mirazon Lahr</b>	
12:30-14:00	<b>Lunch Break</b>	
	<b>Session 10</b>	<b>Session 11</b>
14:00	<i>Time-related changes in fossil cercopithecoid inner craniodental structures and chronological seriation of South African hominin-bearing sites</i> <b>Amélie Beaudet et al.</b>	<i>How well is plant consumption recorded in Ovatve dental calculus?: Implications for ancient dental calculus studies</i> <b>Chelsea Leonard et al.</b>
14:20	<i>A morphometric analysis of the hominin deciduous lower second molar (I/12a) from Qesem Cave</i> <b>Cinzia Fornai et al.</b>	<i>Starch taphonomy on stone tools: considering anthropogenic alterations, climate, and soil chemistry</i> <b>Cynthianne Debono Spiteri et al.</b>
14:40	<i>Taxonomic interpretation of the Salé (Morocco) hominin endocasts</i> <b>Dominique Grimaud-Herve</b>	<i>Tooth cusp sharpness as a dietary correlate in great apes</i> <b>Michael Berthaume</b>
15:00	<i>Biological constraints and evolution of language: a hypothesis on the exaptation of human vocal structures</i> <b>Alessandra Falzone et al.</b>	<i>Sequence analysis of tool prehension and manipulation: a new method to analyze hand dexterity</i> <b>Antony Borel et al.</b>
15:20	<i>Vascular system development of small tubular bones of Neanderthals from Altai caves</i> <b>Maria Mednikova and Maria Dobrovolskaya</b>	<i>The Evidence for Time Keeping Among Pre-Neolithic Hunter-Gatherers</i> <b>Marnie Dunsmore</b>
15:40	<i>Mitochondrial genome variation in late Pleistocene Europe</i> <b>Cosimo Posth et al.</b>	<i>Modelling the tool use and diet of Paranthropus and Homo habilis</i> <b>Adam Newton</b>
16:00-18:00	<b>Poster Session 2</b>	
19:00-23:00	<b>ESHE Closing Party</b>	

**POSTER SESSION 2**  
**Saturday 20 September 16:00-18:00**

Authors of odd-numbered posters are expected to be present during the first hour (15:30-16:30). Authors of even-numbered posters should be present in the second hour (16:30-17:30)

47	<i>Bidirectional gene flow between Central and Eastern Africa in the Early Holocene and low genetic input of East African mtDNA lineages into Bantu populations before their expansion South</i> <b>Silva Marina et al.</b>
48	<i>Human and Caprine remains from Leopard Cave (Erongo, Namibia): Southern Africa before and after the introduction of pastoralist practices</i> <b>Florent Détroit et al.</b>
49	<i>Impact of geographic, chronological, climatic and linguistic factors on human cranial variation: new insights on the peopling of the New World</i> <b>Manon Galland et al.</b>
50	<i>Modeling Population Dynamics of the Late Neanderthal Subgroups</i> <b>Anna Degioanni et al.</b>
51	<i>The postnatal ontogeny of neurovascular versus musculoskeletal landmarks on the cranial base of modern humans and chimpanzees (Pan troglodytes)</i> <b>Sandra A. Martelli and M. Christopher Dean</b>
52	<i>Exploring the relationship between spheno-occipital synchondrosis closure and cranio-facial growth in hominoids</i> <b>Almudena Alcázar de Velasco et al.</b>
53	<i>"Grandmother, what big browridge you have!" - The mechanical relevance of the browridge in Kabwe 1 (Homo heidelbergensis)</i> <b>Ricardo Miguel Godinho and Paul O'Higgins</b>
54	<i>Maxillary sinuses, craniofacial morphology, and adaptation in Pleistocene hominins</i> <b>Laura Buck et al.</b>
55	<i>New Evidence Suggesting a Dissociated Aetiology for Cribra Orbitalia and Porotic Hyperostosis</i> <b>Frances Rivera and Marta Mirazon-Lahr</b>
56	<i>Another Measure of Man: comparison of point-cloud based analysis of photogrammetric 3d models and landmark-based geometric morphometric shape analysis in hominid mandibles</i> <b>Brenna Hassett and Timothy Lewis-Bale</b>
57	<i>Smoothing procedures in Geometric Morphometrics: a critical assessment</i> <b>Antonio Profico et al.</b>
58	<i>Heritability and Plasticity in Teeth: A Papionin Model for Testing Environmental and Phylogenetic Hypotheses in Primate Evolution</i> <b>Nicole D.S. Grunstra and Robert A. Foley</b>
59	<i>ELOVL2, FHL2 and PENK DNA hypermethylation as an age-predictor in modern human teeth samples</i> <b>Christina Giuliani</b>

60	<i>Variation of 3D outer and inner crown morphology of lower premolars in modern humans</i> <b>Viktoria A. Krenn et al.</b>
61	<i>Jaws: Morphological Evidence from the South African Australopitbs on the Evolution the Hominin Mouth</i> <b>Julie Lawrence</b>
62	<i>Comparative endostructural characterization of the Middle Pleistocene human dental remains from Fontana Ranuccio and Visogliano, Italy</i> <b>Clément Zanolli et al.</b>
63	<i>Predicting jaw shape based on models of maxillomandibular integration</i> <b>Stefanie Stelzer et al.</b>
64	<i>Dental Microwear Texture Analysis and the Diet of the Schladina Child</i> <b>Sireen El Zaatari et al.</b>
65	<i>Stress distribution and molar macrowear in Pongo pygmaeus: a new approach through Finite Element and Occlusal Fingerprint Analyses</i> <b>Luca Fiorenza and Stefano Benazzi</b>
66	<i>Functional Equivalence within the Developing Masticatory System</i> <b>Olivia A.M. Smith et al.</b>
67	<i>Elucidating Differences in the Feeding Ecology of Extant Apes Using Finite Element Analysis</i> <b>Laura C. Fitton and Phil J.R. Morris</b>
68	<i>Investigating the link between past adaptations and modern diseases: a nutrition-related perspective</i> <b>Marco Sazzini</b>
69	<i>Variation of the Enamel-Dentin-Junction morphology of upper premolars in modern human populations</i> <b>Lisa Buchegger et al.</b>
70	<i>The distribution of authigenic minerals in the Middle Stone Age deposits of Sibudu (South Africa), and implications for the preservation of archaeological features</i> <b>Susan M. Mentzer et al.</b>
71	<i>Insights into site formation processes of the Middle and Upper Paleolithic layers in Sector West of La Ferrassie (Dordogne)</i> <b>Vera Aldeias et al.</b>
72	<i>Late glacial landscapes and cave sites formation processes: an innovative approach from the Ach and Lone valleys of the Swabian Jura (SW Germany)</i> <b>Alvise Barbieri et al.</b>
73	<i>Residuals of short time occupations or structured landscape using- new aspects to the find layers from the Middle Paleolithic of Weimar-Ehringsdorf</i> <b>Tim Schüler</b>
74	<i>Projet NéMo: The Chronology and Cultural Context of Neandertal Skeletal Material in Southwestern France</i> <b>Jean-Philippe Faivre et al.</b>



75	<i>Neanderthal local raw material utilization and transport: A view from southwestern France</i> <b>Sam Lin et al.</b>
76	<i>The importance of limestone in the subsistence activities during the Middle Paleolithic: the levels J, M and O assemblages of the Abric Romaní site (Barcelona, Spain)</i> <b>María Gema Chacón et al.</b>
77	<i>Neanderthal land-use inferred from the Discoid lithic industry at Grotta di Fumane, unit A9</i> <b>Davide Delpiano and Marco Peresani</b>
78	<i>Plant foods in Middle Palaeolithic subsistence in Italian and Southern European Neanderthal populations</i> <b>Robert Power et al.</b>
79	<i>Trace Element Distributions in Early and Late Forming Tooth Enamel</i> <b>Louise Humphrey et al.</b>
80	<i>The antler and bone points from the Early Upper Palaeolithic layers of Fumane Cave (Verona, Italy): technological reconstruction and implications for the cultural attribution</i> <b>Camille Jéquier et al.</b>
81	<i>Exploring Palaeolithic weapon delivery systems using a controlled and realistic experimental setup: preliminary results</i> <b>Nina Schloesser and Radu Iovita</b>
82	<i>Evaluating performance effects of ochre and beeswax in Middle Stone Age resin based compound adhesives by lap shear testing</i> <b>Paul Kozowyk</b>
83	<i>A poisoned chalice: investigating the presence of poisons on Paleolithic arrows</i> <b>Valentina Borgia et al.</b>
84	<i>Techno-functional features of the Protoaurignacian (backed) bladelets from four French lithic assemblages</i> <b>Amaranta Pasquini</b>
85	<i>Searching for the origins of food storage in the European Gravettian</i> <b>Alexander J.E. Pryor et al.</b>
86	<i>Kill Locality and Settlement: a comparison of two Magdalenian site types</i> <b>Elaine Turner and Martin Street</b>
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Abstracts  
European Society for the study of Human Evolution

Florence September 2014

Poster Presentation Number 28, Fr (15:30-17:30)

## Organization Of Lithic Technology At Lalitpur: A Large Flake Acheulean Site In India

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We propose to discuss the Acheulean lithic technology at Lalitpur, an important excavated locality in North Central India. The site of Lalitpur was discovered by Singh (1965) and later excavated by the Deccan College, Pune (IAR 1961-62) and Archaeological Survey of India under Joshi (IAR 1963-64). Use of granite as the principal raw material makes the assemblage unique. We restudied the assemblage from the excavations conducted by Deccan College, Pune stored at its museum repository. Study of the whole assemblage, including flakes, cores and fragments, besides the large cutting tools using a combination of chaîne opératoire and attribute analysis as against the traditional approach focusing on shaped tools revealed important facts about the organization of lithic technology by the Acheulean hominins at the site. In this paper, we shall focus on the following key aspects of lithic technology which have important implications for the behavior and cognitive abilities of *H. erectus*, the hominin associated with Acheulean technology:

1. Definite selection of suitable raw material, curation and transport of tools;
2. Predominant use of large flake blanks for the manufacture of tools;
3. Existence of two different chaînes opératoires, one for small flakes inferred from small cores; the other for large flakes inferred from the tools themselves;
4. High percentage of finished tools and fragmented chaîne opératoire, suggesting high mobility and a dynamic system;
5. Knapping methods resulting in low amount of waste or debitage products;
6. Considerable planning and organization of the knapping sequence despite little core preparation resulting in predetermined end products, large flakes suitable for use;
7. Lack of bifacial shaping and very little secondary retouch on the artefacts;
8. Lack of refinement or emphasis on bifacial and bilateral symmetry
9. Considerable standardization in end products;

The study suggests that the early phase of the Acheulean in India is not characterized by bifacial shaping which is essentially considered to be the hallmark of Acheulean technology. It is however characterized by simple but efficient core organization resulting in suitable end products or large flakes of suitable size and morphology requiring little secondary modification.

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Poster Presentation Number 52, Sa (16:00-18:00)

## Exploring the relationship between sphenoccipital synchondrosis closure & cranio-facial growth in hominoids

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The sphenoccipital synchondrosis (SOS) is an important growth locus in the cranial base that remains open until puberty or adolescence in humans and until the early adulthood in Great Apes. As SOS is located between the anterior edge of the occipital bone and the posterior end of the sphenoid body, SOS growth may affect both to the basicranial and facial development. Because of that, a possible role of the SOS in the integration of the craniofacial system has been extensively discussed in recent times regarding primates [1]. In contrast, available data regarding growth in the SOS and its relation with the adjacent regions (i.e. cranial base and face) are scarce and, sometimes, lead to contradictory interpretations [2]. It has been previously hypothesized that growth in SOS has different effects in the Great Apes and in the human cranial base kyphosis [3]. On the other hand, it has been established in humans that individuals that show abnormal SOS development also shows abnormal facial development [4]. Here, we have investigated the relationship between the basicranial and face growth and the SOS closure stage in dry skulls of three hominoid species: *Pan troglodytes* (n=129), *Gorilla gorilla* (n=110) and *Homo sapiens* (n=111) (sex pooled samples). The sample has been divided into six age classes: 1: complete or incomplete deciduous dentition in occlusion, 2: M1 in occlusion, 3: M2 in occlusion, 4: M3 in occlusion and not completely ossified skeleton, 5: M3 in occlusion and completely ossified skeleton, 6: M3 in occlusion, completely ossified skeleton and dentition showing signs of ageing. Three SOS stages of closure have been established: open, fusing and closed. The metrical variables included in the study are: Lengths: basion-sphenobasion, basion-oral, sphenobasion-oral, staphylion-oral; Height: hornion-staphylion; Widths: between zygionions, between zygomaxilars, between the inferior point of the sphenomalar sutures, between P4/M1, between M1/M2, between the posterior points of the alveolar arch; Angle: basion-sphenobasion-hornion. We have relied on correlation analyses between metrical variables and SOS closure stage and in ANOVA and post-hoc analyses between individuals with different SOS stages. Only individuals belonging to age classes involved in the SOS closure has been included into those analyses. With this procedure, some individuals have been excluded in an attempt of comparing only those individuals that, belonging to the same age class, differs in the SOS closure stage. In order to evaluate other factors than SOS closure, differences in measurements has been explored between individuals with closed SOS from different age classes. A positive correlation has been found between basicranial and lower face measurements and the SOS closure stage in all three species. Basicranial angle does not show a statistically significant correlation in Great Apes, but it is negatively correlated to SOS closure stage in humans. Statistically significant differences have been found between individuals with different SOS stage in the majority of linear dimensions in the three species and also in the basicranial angle in humans. No statistically significant differences have been found between individuals with closed SOS that belong to different age classes. These results agree with the craniofacial integration theory and suggest that SOS could be playing an important role, active or passive, not only in the integration of the cranial base and the face, but also in facial development in hominoids. The present work supports the idea that SOS growth could have different effects among primates in the basicranial angle.

**Acknowledgements:** We owe our most sincere gratitude to the Museu Nacional de História Natural e da Ciência (Portugal) and to the Powell-Cotton Museum (U.K.) for making their anthropological and Great Ape collections available to this study. A. A. is the beneficiary of a predoctoral grant from the Spanish MINECO, reference No. BES-2010-039961, and was the beneficiary of predoctoral support from the Atapuerca Foundation. This research was also financed by the MINECO, project No. CGL2012-38434-C03-01.

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Poster Presentation Number 71, Sa (16:00-18:00)

## **Insights into site formation processes of the Middle and Upper Paleolithic layers in Sector West of La Ferrassie (Dordogne)**

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The site of La Ferrassie is one of the best-known Paleolithic sequences in Europe. Besides preserving several layers associated with the first half of the Upper Paleolithic, La Ferrassie is also famous for its role in the broader question of Neandertal mortuary behavior and its eponymous Ferrassie Mousterian industry. The remains of two well-preserved Neandertal adults (La Ferrassie 1 and 2) and five other individuals were found during the extensive excavations lead by Capitan and Peyrony in the early 20th century. Archaeological research continued at La Ferrassie by Delporte from 1968 to 1973, and so most of the geoarchaeological-oriented research has since focused primarily in the long-sequence of deposits exposed in the easternmost section of the site. New research began in 2011, exposing intact layers in the extreme western area of the site, immediately adjacent to the reported location of the adult skeletons. One of the goals of this project is to address the stratigraphical context of the human occupations and previously discovered Neandertal remains by reconstructing the formation processes of the archaeological record. At the base of the sequence in this part of the site are basal red sands - largely predating human occupations - that result from fluvial deposition with local contributions of limestone roof fall slabs. These sediments are overlain by several yellow to brown sandy layers associated with Middle Paleolithic occupations and, overlying them, is a thin red clayey layer with a blade-based industry and bladelets (presumably Châtelperronian). Finally, the top of the sequence is capped by several layers containing Aurignacian. The sedimentation of these layers is linked to slope processes (mud flow and dry fall talus) originating from the NW, that is, from a topographically higher limestone platform that is an extension of a small cave located higher up in the cliff. However, due to quarrying and the construction of the road in the late 19th century, the original morphology and extension of this platform are difficult to reconstruct. In addition to the slope deposits, the presence of calcareous coarse sands and numerous limestone slabs and boulders points to a gradual collapse of the roof that originally covered this area of the site. The lowermost Middle Paleolithic deposits bear evidence of syn- and post-depositional cryoturbation in association with the onset of colder climatic conditions. Although the layers tend to be predominantly calcareous, lateral variations in the deposits are expressed by increasing decalcification towards the cliff face to the NE. This decalcification resulted in compaction of the deposits and the release of poorly bleached quartz grains from the limestone slabs. Biogenic (e.g., mm-sized coprolites) and anthropogenic inputs in the form of lithic artifacts and faunal remains (often showing signs of thermal alteration due to burning) are relatively abundant, frequently showing coarse bedding with an orientation which follows the overall inclination of the sedimentary layers. The above evidence suggests that the sedimentation processes of this sector West of La Ferrassie are substantially different from those operating in the long-sequence preserved towards the east, and thus the site is much more complex than would seem to be the case from examining the eastern section alone. Perhaps even more important, the majority of the human occupation in this westernmost part of the site must have been originally located on a topographically high area to the NW of the current excavations, which was since destroyed by road construction. This may or may not have significant implications for the context of the Neandertal remains, which will be one of the primary research foci of the upcoming (2014) season.

Poster Presentation Number 4, Fr (15:30-17:30)

## Ancient human DNA, finally a research field where data sharing is common practice

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Background Data sharing is currently regarded as a crucial factor for scientific progress. However, a robust and sustainable data sharing is far from being reached in most research fields. Empirical approaches to the study of data sharing, both questionnaire-based surveys or analyses of data retrievability from scientific literature, have the advantage to provide quantitative answers to questions which regards the identification of motivations underlying sharing behaviour, the adequacy of tools and infrastructures, and the efficiency of current policies and strategies. Furthermore, this kind of approach may help identify “flagship research fields” which, along with their symbolic value, they may provide the open research data movement ideas and practices which could be adopted to increase data sharing in other fields. Empirical studies carried on up until now have failed to identify such positive examples. Aims In this study, we analyze rate and mode of data sharing in publications regarding human ancient DNA studies, a research field of particular interest for empirical studies due to its high standards in terms of reliability and experimental reproducibility. Methods We inspected a total of 162 papers published between 1988 and 2013, which were retrieved from the PubMed using 14 combinations of relevant key words. Papers went through a double data collection procedure, each performed by an experienced researcher using an already developed protocol [1] which was slightly modified to adapt it for ancient DNA studies (adding information on experimental procedures). Datasets were counted as shared if they were presented in a way that permits their reuse in individual or population analyses without any substantial limitation. Furthermore, in order to gain further insights into the sharing behavior among researchers working with ancient human DNA, we asked first, last and corresponding authors of the papers inspected to fill in an ad hoc developed questionnaire. Results and discussion We inspected a total of 208 datasets regarding mitochondrial, Y chromosomal and autosomal polymorphisms. Two hundreds and five datasets (97.6%) were found to make their genetic information fully available and reusable. This sharing rate is by far the higher among all research fields analysed to date. The questionnaire based survey suggests that this behaviour may be explained by the authors’ awareness of the importance of openness and transparency for scientific progress. We argue that this latter condition, coupled with the adoption of stringent standards and cross-laboratory validation procedures, was crucial to overcome doubts concerning scientific rigor and data reliability in this research field. More in general, the case of data sharing in ancient human DNA studies conveys an important message: rigorous and reliable scientific practices may be developed by making data sharing go hand in hand with openness to scientific inquiry, even in the presence of complex experimental challenges.

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Poster Presentation Number 29, Fr (15:30-17:30)

## Towards luminescence dating of the Lower Paleolithic

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Throughout the Mediterranean area, there is a number of Paleolithic sites containing evidence of hominin presence related to the early Out-of-Africa migrations. However, the ages of the fossils and artifacts are often imprecise, and are largely based on non-radiometric dating methods such as faunal correlations, magnetostratigraphy, pollen, etc. Such is the case with the ages of several key Paleolithic sites in Israel, e.g. Lake Zihor ( 1.6 Ma), 'Ubeidiya ( 1.4 Ma), Evron ( 1.0 Ma), and Gesher Benot Ya'aqov ( 0.7 Ma), whose precise chronologies are still debatable [1]. Here, we present a new development of the optically stimulated luminescence (OSL) dating method, which can potentially provide a direct and independent chronometry for these (and similar) sites, based on in-situ radiometric dating of quartz grains using violet light. Conventionally, the OSL method determines the deposition time of sediments, and is advantageous because the minerals of interest (quartz and feldspar) are widespread on Earth. The method limitation is in the early saturation of the luminescence signal, allowing application only to the past 0.15 Ma (quartz) or 0.50 Ma (feldspar). Recently, we have demonstrated that the Violet Stimulated Luminescence (VSL) signal saturates much later than the conventional OSL, and yields correct ages within a young age range of <0.33 Ma [2]. The present study aims to verify the VSL method on its upper dating end (>0.5 Ma), in an environment with maximum external age constraints. We investigate a classic columnar section in the Golan Heights (northern Israel), in the vicinity of Gesher Benot Ya'aqov and 'Ubeidiya. The site exposes nine basalt flows (K-Ar dated 1.5 – 0.7 Ma [3]) containing seven layers of paleosols that developed on the surface during the time in between the volcanic eruptions. These soils have previously been used to reconstruct the mid-Pleistocene paleovegetation and paleoclimate in this region [4]. Revised <sup>40</sup>Ar/<sup>39</sup>Ar chronology for all basaltic flows verifies former results and is further supported by paleomagnetic data, providing narrow and independent age constraints for the thermal VSL signal resetting in the quartz-bearing paleosols. However, preliminary VSL ages underestimate the overlying basalt ages by 60%, possibly reflecting a thermal resetting history due to an elevated geothermal gradient and/or hot water convection and springs. Current research divides between (i) investigation of the possible thermal resetting mechanisms and reconstruction of the thermal history of the site (thermochronology) [5], (ii) calibration of the VSL signal at an alternative site with a simpler geological history (Lake Turkana, Kenya), and (iii) preliminary dating of the Middle Paleolithic sites of interest.

**Acknowledgements:** This work is financed by Technology Foundation STW (STW.10502) and NWO VENI (grant 863.13.023).

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Podium Presentation: Session 1, Th (10:10)

## Middle Pleistocene narratives and the Sima de los Huesos evidence

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Historical sciences produce stories (scenarios). These narratives cannot be tested themselves, although must be based on scientific hypotheses. If one of the hypotheses is proven false, the narrative should necessarily be changed. The stories about human evolution in Europe during the Middle Pleistocene period depend to a great extent on hypotheses about phylogeny, chronology and paleoclimate. In this paper I will comment on the first two, relying especially on the splendid fossil record from the Sima de los Huesos (Atapuerca). The SH fossils are part of the Neanderthal clade, but they are not identical to other fossils of the same period that are also assigned to the Neanderthal evolutionary group. There are European Middle Pleistocene fossils that are either less Neanderthal-derived than SH or not Neanderthal-like at all in the preserved anatomical regions. In order to establish the pattern of evolution, a substantive part of the scenario, the geological age of the fossils is crucial. If the older the fossil (whatever the provenance within Europe), the less Neanderthal-derived, then the pattern would be anagenetic, and evolution in Europe would be lineal, gradual and involving the entire European population. If true, any European hominin fossil would be sufficient to date the site. Too good to be true? In contrast, if the ancestral stem group survived after the Neanderthal lineage branched off, then the pattern would be cladogenetic (and consistent with punctuated equilibrium), and as a consequence a primitive morphology could still be found in fossils that are younger than the derived ones. SH has been recently dated to around 430,000 years old. Most of the other European Middle Pleistocene fossils are apparently younger, including specimens that (although more fragmentary) look more primitive than SH, but it is not easy to date fossils for this time period in non-volcanic regions. In this paper, the morphology and chronology of SH and other European fossils is reviewed, but the conclusion is that we must improve the fossil record and, especially, the dating of the sites, in order to know one day which is the real evolutionary pattern and how the story should be told.



Poster Presentation Number 5, Fr (15:30-17:30)

## Hominin Footprints from Early Pleistocene Deposits at Happisburgh, UK

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The oldest known hominin footprints outside Africa were discovered at Happisburgh, United Kingdom. The footprint horizon has been dated to between ca. 1 million and 0.78 million years ago. Since 2005 a number of Early Pleistocene flint artefacts have been found alongside fauna and flora extending the presence of humans in northwest Europe by at least 350,000 years. The sediments in which the footprints were found consist of laminated silts laid down by a large river within the upper reaches of its estuary. The surface where the footprints were found was close to the foreshore and extended ca. 12m<sup>2</sup>. The hollows in the surface were markedly different from features formed by well documented sediment erosion and deposition in estuarine environments. The features observed at Happisburgh do not conform to those described in the erosion literature, which suggests that they are not related to the sedimentary processes taking place in the estuary at the time of deposition. Depositional sedimentary structures are visible in the sediments surrounding the footprints and are similarly also preserved on exposed surfaces, but these are clearly distinguishable from the features observed at Happisburgh that we consider to be footprints. The footprint surface was recorded using multi-image photogrammetry. The hollows are distinctly elongate and the majority fall within the foot sizes of juveniles and adults. In many cases the arch and front/back of the foot can be identified, and in two cases the impression of toes can be seen. The orientation of the prints indicates movement in a southerly direction on mud-flats along the river edge. Initial analyses of the footprint length to stature ratios revealed that the hominins who made the prints are estimated to have been between ca. 0.93 and 1.73 m in height. This is suggestive of a group of mixed ages. Comparisons with stature estimates for *Homo antecessor*, the only known species in western Europe of a similar age, show that the foot sizes and estimated stature of the hominins from Happisburgh fall within the range derived from the fossil evidence of *Homo antecessor*. Three-dimensional models of the footprints have been created and new functional analyses of the footprints with direct pixel-level statistical comparison to early hominin (Laetoli, Ileret) and pre-shoe human (Namibia) footprint trails will be presented.

**Acknowledgements:** We would like to thank Tim Albins and Nigel Larkin for help and advice in recording the surface together with Clive and Sue Stockton, Malcolm Kirby, Mike Chambers and the people of Happisburgh for their continued support. We are also grateful to David Waterhouse and John Davies of Norfolk Museums and Archaeology Service and to Brian Farrow and Russell Tanner of North Norfolk District Council for logistical help in the Project. We are grateful to Lol Baker from the Liverpool John Moores Fab Lab for help with 3D printing. Finally we thank the Calleva Foundation for support of the Pathways to Ancient Britain Project of which the research at Happisburgh forms a part.

Poster Presentation Number 72, Sa (16:00-18:00)

## **Late glacial landscapes and cave sites formation processes: an innovative approach from the Ach and Lone valleys of the Swabian Jura (SW Germany)**

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The caves located within the Ach and Lone valleys of the Swabian Jura (State of Baden-Württemberg, southwestern Germany) are key sites to study the arrival of modern humans in Central Europe. For over a century, archaeological excavations conducted in these cave sites have provided spectacular finds, such as figurative art and musical instruments, that date to the Aurignacian. Previous geoarcheological studies have noted the similarities between the archaeological and natural records deposited in the caves of Hohlenstein, in the Lone Valley, and Hohle Fels, in the Ach Valley. At both sites, excavators report the presence of gullies and rills, suggesting a stratigraphic discontinuity prior to the Magdalenian. Additionally, thick colluvial infilling of the caves suggest that drastic changes in environment and landscape took place after the Late Glacial Maximum. The aims of our research are to reconstruct these landscape changes, to investigate their impact on the sedimentation processes within the caves, and examine how these changes in sedimentation within the caves shape the record of human occupation in the Swabian region. To achieve these goals we decided to use an innovative approach combining geophysical and geomorphological prospecting, coring and micromorphology. Here we present an overview of our preliminary results. Thanks to more than two hundred 1 m-long cores collected in the Lone valley, we were able to produce a detailed map of the surface sediments present in the area between Bockstein and Vogelherd caves. Combining this information with data obtained from a preliminary ground-penetrating radar (GPR) survey, we were able to conduct focused GPR survey in key areas of both the valleys. The geophysical prospection conducted outside of the entrance of Hohle Fels cave, in the Ach Valley, has revealed the depth of the bedrock (-3 m circa) and a preserved deposit coming from the entrance of the cave. These results provide important information about the extent of a possible migration of the Ach River towards the entrance of the cave during and after the LGM. Additionally, the GPR has clearly documented the presence of Late Pleistocene or early Holocene colluvial deposits that dip towards the entrance of the cave. The data collected in front of Hohlenstein and Bockstein, in the Lone Valley, indicate phases of channel migration and colluviation. Based on the GPR data, we have also produced high resolution 3D models and georeferenced time slices in order to obtain an accurate geographic positioning and enhance our understanding of the identified features. According to the information obtained from the geophysical surveys, we were able to identify key areas to be further investigated by coring and trenching. The data obtained from the geophysical and coring survey of the Ach and Lone valleys are compared to the results of micromorphological studies of the deposits from Hohle Fels and Hohlenstein caves. By integrating different scales of observation, we are able to identify the processes that have led to the formation of the sequences deposited within the caves and determine correlations between them and the major sedimentation processes active on a regional scale.

Podium Presentation: Session 8, Sa (9:30)

## The Early Upper Palaeolithic at Manot Cave, Western Galilee, Israel

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The Upper Palaeolithic period of the Levant is divided into three chronological stages (Initial, Early, Late), with several cultural entities [1]. While the Initial stage is the interface between the Middle and the Upper Paleolithic periods, it is the Early Upper Palaeolithic when modern human populations have fully established themselves in the region. The Early Upper Palaeolithic consists of two cultural entities, "Ahmarian" and "Levantine Aurignacian". The Ahmarian, dispersed throughout the Levant, is conceived as local tradition whereas the Aurignacian, constrained to few cave sites in the Mediterranean woodland region, is considered an interference of European populations. A recent excavation project at Manot Cave in the western Galilee, Israel exposed rich Early Upper Palaeolithic contexts embedded within an active speleothem cave [2-3]. The earliest attributed to the Ahmarian were recovered in excavation Area C (layer 7) superimposed by Aurignacian layers (layers 6-2). The Ahmarian at Manot is characterized by the production of long and narrow uni- and bi-directional blades produced by soft hammer stones. The "tool kit" consists mainly of blade tools such as retouched blades, endscrapers, burins and straight el-Wad points. Radiocarbon dates set the age of Unit 7 to ca. 46–42 kcal BP (68%). The Levantine Aurignacian, currently the dominant cultural tradition within the Upper Palaeolithic at Manot, was recorded in two excavation Areas; C and E. The distinctive finds include carinated and nosed endscrapers, Aurignacian blades, curved-twisted bladelets and antler spear points. Notably, a relatively fair amount of sea shells were recovered from these contexts: some were used for personal ornamentation, and some likely consumed as food. The radiocarbon ages of the Aurignacian layers in Area C is ca. 39–35 kcal BP (68%) while in the Area E is ca. 37–33 kyr cal BP. The Upper Paleolithic contexts at Manot are professed with faunal and botanical remains [3]. The faunal assemblages are rich and diversified and consist of large (ungulates) and small game (birds and reptiles). The botanical remains consist *Prunus* and *Quercus* species indicating open park environment. The new excavations at Manot revealed a rich stratified Early Upper Palaeolithic sequence. The earliest is the Ahmarian tradition that dates to the very beginning of the Early Upper Palaeolithic stage. The presence of several superimposed Aurignacian layers in excavation Areas C and E attest a repetitive exploitation of the cave by the latter. The Aurignacian at Manot was intensive and long and probably lasted until ca. 30 kya, which is also the estimated time for the collapse of the cave entrance.

**Acknowledgements:** Excavations at Manot Cave, Israel are supported by grants from the Dan David Foundation, Irene Levi-Sala CARE Foundation and the Leakey Foundation.

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Poster Presentation Number 10, Fr (15:30-17:30)

## Thorax kinematics and the reconstruction of body models in hominin evolution

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Evolutionary interpretations of fossil hominin body models depend on the anatomical reconstruction and verisimilitude in the assemblage of fossil remains [1,2]. However, reconstruction of fragmented structures or taphonomic distortions must be distinguished from body reconstructions that reassemble skeletal parts excavated out of its anatomical context. Here we address problems related to the latter as they emerge in our work on quantitative reconstructions of fossil hominin body models. A major problem in this task is the question how to assemble mobile, serial anatomical elements. The hominin thorax is a useful example illustrating how new morphologies emerge from the assemblage of serial mobile anatomical elements. For example, it has been shown that the morphology of vertebrae influences the way how these vertebrae can be connected with each other to build the spine and its curvatures as part of the ribcage [3]. But also the position of the ribs within their costovertebral joints influences thorax morphology. Indeed, chest shape is altered during respiratory kinematics, although 3D skeletal variation during respiration is not well-known. Different kinematic patterns of upper and lower thorax motion have been suggested but not yet quantified statistically. These factors are relevant to reconstructing body shape because the widths of the lower ribcage and the pelvis are assumed to correlate [2]. However, again, no 3D study has yet addressed this assumption. Here, we present ongoing research on these problems assessing A) respiratory kinematic changes in thorax shape, B) the integration between the lower thorax and the pelvis and C) the kinematic status of the AMNH-Neandertal thorax [1]. A) Experimental CT data of modern human ribcages during maximum inspiration and expiration (N=40) and 3D geometric morphometrics (GM) of 402 semi(landmarks) [4] were used to quantify kinematic shape variation. Results indicate that kinematic vectors of the upper and lower thorax diverged significantly with an angle of 47.8 degrees ( $p < 0.0001$ ). This means that while the upper thorax expands vertically during inspiration, the lower thorax expands vertically *and* laterally, increasing its lower width. B) 150 3D (semi)landmarks on reconstructions of human cadaver CT-scans were analyzed to test the hypothesis of integration between the lower thorax and the pelvis. Preliminary results of Two-Block Partial Least Squares analyses based on common and isolated Procrustes registrations support this hypothesis showing high and significant correlations ( $r > 0.9$ ,  $P < 0.04$ ) between lower thoracic and pelvic widths. Putting both results together demonstrates that ribs articulated in inspiratory position will lead to greater estimates of central body width than ribs in expiratory position. C) Finally, to assess the respiratory status of the AMNH-Neandertal thorax reconstruction we computed 95% confidence intervals of kinematic thorax shape variation in modern humans. The PCA shows considerable overlap but the Neandertal thorax is closer to the mean shape of ribcages in expiration than to the mean shape of ribcages in inspiration. This suggests a realistic assemblage and estimate of its torso and its central body width. However, recent study of Kebara 2 has proposed a considerably larger lower thorax than previously assumed [5], which may imply a central body width greater than the current estimate [1]. Further research should address this problem. We suggest that, because respiratory kinematics influence lower thorax width and because the latter is integrated with the width of the pelvis, controlling for thorax kinematics is important for the verisimilitude of fossil hominin body reconstructions such as Kebara 2, Nariokotome, Sts-14 or *Au. Sediba*.

**Acknowledgements:** This research is funded by the CGL2012-37279 (MINECO; Spain), The Leakey Foundation and PI10/02089 (Fondo de Investigación Sanitaria) Ministry of Health, Spain.

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Podium Presentation: Session 3, Th (14:30)

### New Neandertal remains from Sirogne cave, Rocamadour (Lot, France)

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While adjacent territories are well-known for bearing a number of Neandertal remains, few discoveries from the limestone plateaux of the Quercy region have been reported [1]. In June 2013, we organized the first prospective fieldwork in Sirogne cave, in Rocamadour, after the discovery by one of us (DM) of a human mandible from a young adult and a deciduous canine associated with about one hundred faunal remains during potholing exploration. We aimed to evaluate the anthropological and archaeological potential of the site. The cave is located on the North side of the Alzou canyon and is part of a karstic complex formed in a Jurassic cliff [2]. During the first season at Sirogne, we clarified the context of the discovery of the mandible and found five new human teeth (a deciduous molar, a permanent incisor, a permanent canine, and two permanent molars) raising to four the minimum number of individuals found in the cave. A large number of faunal remains representing a broad diachronic faunal spectrum have also been found, as well as Middle Paleolithic artifacts made from quartzite, flint, and limestone. The faunal assemblage has mainly been gathered by humans. To date, all human and archaeological remains were found in sediments affected by major post-depositional processes. In addition to carrying out a morphometric comparative analysis of the external aspects of the human remains, we have evaluated enamel thickness and dental tissue proportions using microCT scans performed on the MRI platform (University Montpellier 2, France) with Skyscan 1076 X-ray equipment. Reconstructions were created with an isotropic voxel size ranging from 17.93 to 36.18  $\mu\text{m}$ , and semi-automatic threshold-based segmentation was conducted using Avizo v.7 (VSG). The mandibular remains consist of nearly complete half of a corpus that is preserved from the alveolar socket of the canine to the third molar. Results show that the human remains from Sirogne cave represent new Neandertal fossils. Moreover, some evidence suggests that Sirogne may be the same cave referred to as 'Crozo del Dua'. This site was excavated during the first half of the twentieth century by André Niederlander [3, 4, 5] and has already yielded five human remains representing at least three Neandertal individuals [1]. However, no precise geographic information was provided to identify the location of this cave. It is the basic geographic data, peculiar topography of the cave, as well as the correspondence between archaeological records, and the discovery of a North-South trench at Sirogne that strongly suggests that these caves are the same site. The reassessment of the archaeological record from Crozo del Dua, and the examination of a photographic record of archaeological sites from the first half of the twentieth century should help to clarify this issue. If Sirogne is indeed Crozo del Dua, one mandible and eleven isolated teeth representing at least five Neandertals have been found to date at the site. Future field seasons at the site will focus on the evaluation of the integrity of the stratigraphic and archaeological units from the trench found in 2013.

**Acknowledgements:** We acknowledge the following institutions for their support: Direction Régionale des Affaires Culturelles and Service Régional de l'Archéologie Midi-Pyrénées, Musée National de Préhistoire Les Eyzies-de-Tayac, Conseil Général du Lot, association Archéologies (Montauban), Archéosphère SARL (Bordeaux). We particularly thank Didier and Isabelle Baudet, and Guy Bariviera for their help during the fieldwork. MicroCT data used in this work were produced through the facilities of the MRI platform and of the LabEx CeMEB with the financial support of the IdEx Bordeaux (contract number: ANR-10-IDEX-0302). We also thank Renaud Lebrun (University Montpellier 2). This research is supported by the LabEx LaScArBx (contract number: ANR-10-LABEX-52).

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Podium Presentation: Session 10, Sa (14:00)

## Time-related changes in fossil cercopithecoid inner craniodental structures and chronological seriation of South African hominin-bearing sites

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Phylogenetic and evolutionary reconstructions of southern African fossil hominin assemblages are limited by difficulties related to direct application of chronometric methods because of the nature itself of the karst deposits and of their complex stratigraphy [1]. As yet, biostratigraphic comparisons and inter-sites correlations are among the most reliable methods for temporal seriation of the paleocaves [2, 3]. Given the relative high density of their remains occurring in eastern and southern African sites, their large geographic distribution and common stratigraphical association with hominin remains, cercopithecoids are among the best candidates in the search for temporal biomarkers suitable for dating South African paleontological sites [4]. In this perspective, refinement in the characterization of their time-related evolutionary changes and morphostructural variation patterns is necessary. We investigated the craniodental remains (N>80) from ten fossil papionin and colobine taxa selected from different stratigraphic units at Sterkfontein, Swartkrans, Kromdraai and Makapansgat, and also considered for comparison a representative sample of seven extant species. The fossil remains were detailed by X-ray microCT at a spatial resolution ranging from 20 to 120 µm at the South African Nuclear Energy Corporation (Necsa) and the Evolutionary Studies Institute at the University of the Wits, Johannesburg. Depending on the preservation quality and degree of completeness of each specimen, we detailed for their subtle morphology four inner craniodental structures considered as rather effective in discriminating among extant hominid and fossil hominin taxa, but that have not been extensively reported for their variation patterns in other primate clades and, mostly, have not been taken simultaneously into account in a comparative perspective. More specifically, we assessed tooth endostructural organization and the morphology of the bony labyrinth, the inner facial skeleton, and of the endocranium. Following 3D virtual reconstruction, the geometry, morphology and dimensions of these structures have been comparatively assessed on the fossil and modern specimens by linear, surfacic and volumetric variables, as well as by geometric morphometrics methods (semilandmarks and deformation-based models). Currently available results show that the morphologies of the enamel-dentine junction and of the semi-circular canal are particularly efficient in discriminating at specific level among the cercopithecoid taxa considered in this study, thus allowing for some taxonomic and phylogenetic refinement (e.g., in the case of the large papionin taxa *Dinopithecus ingens* and *Gorgopithecus major*). In addition, they reveal that the investigated structures are time-sensitive and show evolutionary changes in fossil taxa. By using different states of these indicators as chronological markers, we thus preliminarily revised the sequences of the cited South African sites showing that, with the only exception of Kromdraai A, our temporal attributions are consistent with the biozones proposed by Heaton [5].

**Acknowledgements:** S. Potze, C. Steininger and B. Zipfeld for access to fossil material; J. Cuisin for comparative material; G. Clément and M. Garcia-Sanz for acquisitions at the MNHN, L. Bam and J. Hoffman at Necsa, and T. Jashashvili and K. Carlson at the Univ. of the Wits; E. Delson and N. Jablonski for scientific collaboration; D. Ginibriere and C. Zanolli for contribution to data processing; the National Research Foundation (NRF) and the Dept. of Science and Technology (DST) of South Africa. Research supported by the Center of Research and Higher Education (PRES) of Toulouse, the Midi-Pyrénées Region, the French Ministry of Foreign Affairs.

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Podium Presentation: Session 6, Fr (14:50)

## Spino-pelvic alignment: An evolutionary perspective

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The term spino-pelvic alignment refers to the complicated relationship between the morphology and orientation of the pelvis to that of the vertebral spine and the center of gravity. Most researchers refer to the sagittal plane variables (angles and relative distances) when they describe spino-pelvic alignment but it has to be noticed that a close relationship exists in the coronal and horizontal planes as well. The major variables that describe the spino-pelvic alignment in the sagittal plane include anterior/posterior pelvic tilt; sacral slope; pelvic incidence; lumbar lordosis; thoracic kyphosis; C7 plumb line and the line of gravity. In a healthy adult human subject the above variables work in concert with each other to align the segments at a position that will enable healthy upright posture. For example, low pelvic incidence would be accompanied by low (decreased) lumbar lordosis and anterior position of the line of gravity. Developmentally, these variables co-develop with each other until reaching an adult configuration by the third decade. Imbalance of the above variables has been shown to be correlated with spinal pathology such as spondylolisthesis, flat back syndrome, and scoliosis. Corrective surgery has to take into account the interrelationship of these structures and potential pathological subsequences of improper balance. During human evolution the spinal curvature as well as pelvic and sacral orientation have changed dramatically, from a very small pelvic incidence and spinal curvatures in non human hominoids to large curvatures in modern humans. This change was accompanied by a dramatic shift of the line of gravity and C7 plumb line. In this work we will describe the spino-pelvic adjustments to upright posture and bipedality of four major hominin groups; Australopithecines, *H. erectus*, Neandertals and *H. sapiens*. We have used a few different methods to calculate sacral orientation [1,2], lumbar lordosis [3], thoracic kyphosis [4], and cervical lordosis [5] of extinct hominin specimens. We applied these methods to each of the following hominin specimens; Sts 14 as a representative of Australopithecines, KNM-WT 15000 as a representative of *H. erectus*, Kebara 2 as a representative of Neandertals and Skhul 4 as a representative of early *H. sapiens*. As a reference population we also measured spinal curvatures of 74 modern humans on lateral spinal radiographs, in a standing upright position. Our results indicate some differences in spino-pelvic alignment between these four groups. For example, Sts 14 shows sacral orientation and lumbar lordosis that are within the range of modern humans, although slightly below its mean, and at the same time the cervical lordosis of this specimen is much smaller than the average modern human. KNM-WT 15000 (*H. erectus*) shows sacral orientation, lumbar lordosis and cervical lordosis that are within the range of modern humans, although below its mean. Kebara 2 (Neandertal) on the other hand, shows very small lumbar lordosis and sacral orientation (vertical sacrum) with thoracic kyphosis and cervical lordosis that are within the range of modern humans, although slightly below its mean. Skhul 4 shows high sacral orientation (horizontal sacrum) and high lumbar lordosis, which are above the mean for modern humans but within the range. These results indicate that each hominin group had "solved" the requirements of erect posture in a different manner, implying that the mechanisms involved in shaping the vertebral curvatures of hominins might include not only erect posture and bipedality but possibly other factors such as encephalisation, mastication apparatus, thorax and pelvic size and shape.

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Poster Presentation Number 44, Fr (15:30-17:30)

## Engraved human bone from the Magdalenian site of Gough's Cave, Somerset (UK)

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The archaeological record for the Magdalenian (15-12,000 year BP) reveals the development of rich decorative forms, with many portable objects engraved with animal representation (1) or notches (2). The decoration of human bones is generally rare in the archaeological record, particularly throughout European prehistory. The Magdalenian site of Gough's Cave (Somerset, UK) is a large show-cave on the southern side of Cheddar Gorge. Several archaeological excavations (between 1927 to 1992) have uncovered exceptional rich deposits with notable finds which include a '*bâton percé*' made from a reindeer antler, a bevel-based rod of mammoth ivory, amber pebbles, minute fragments of ivory with groups of incisions (interpreted as 'tallies' or calculators), a dense cluster of re-fitting flint debitage and butchered bones. Analysis of the human remains has provided incontrovertible evidence for nutritional cannibalism and the modification of human skulls to produce skull-cups (3). In this paper we describe a set of unusual zig-zagging incisions observed on the lateral side of the diaphysis of a human right radius. These were previously attributed to the filleting of muscle along the shaft (4); however, they are located on an area of the bone without muscle attachments. New micro-morphometric analyses of the marks have shed doubt on this interpretation. The cuts have a regular cross-sectional profile, suggesting the same tool edge was used to produce the marks. The tool was held almost perpendicularly to the bone surface, which is atypical for cut-marks made during filleting. Moreover, the angle of inclination of the tool switches from about 100° to 87°, suggesting the modification was not created by a continuous sawing action. Comparison with filleting marks on human and animal bones from the same site has further demonstrated clear differences between filleting marks and the modification observed on the human radius. We suggest that these modifications are likely to be the result of engraving; a rare example from a prehistoric context.

**Acknowledgements:** We would like to thank Chris Stringer and Robert Kruszynski for sharing their knowledge and experience of the Gough's Cave collection. The research work is part of the 'Human Behaviour in 3D' Project, funded by the Calleva Foundation and the 'Cutmark micro-morphometrics and corpse decay' Project funded by the Leverhulme Trust.

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Podium Presentation: Session 3, Th (15:30)

## Exploring taurodontism in Neandertals

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Taurodontism is considered a dental anomaly with relatively low incidence in contemporary societies [1], but it represents a common trait frequently found in Neandertal teeth [2]. Three hypotheses are envisioned to explain the high frequency in Neandertals: biomechanical advantage, adaptation to a high attrition diet, genetic drift effects. In this contribution we used finite element analysis (FEA) and advanced loading concepts based on macrowear pattern information [3] to evaluate whether taurodontism supplies some dental biomechanical advantages. The microCT data of the lower right first molar (RM<sub>1</sub>) and upper right second premolar and first molar (RP<sup>4</sup>-RM<sup>1</sup>) of the Neandertal specimen Le Moustier 1 were segmented, and the dental surface models were imported into the Occlusal Fingerprint Analyser (OFA) software to detect the contact areas during the power stroke. Loads were applied to a finite element model of the RM<sub>1</sub> based on the areas identified during maximum intercuspatation contact, as well as to both the digital models of a shortened and hyper-taurodontic version of Le Moustier RM<sub>1</sub>. Moreover, we simulated a scenario where an object is held between teeth and pulled in different directions to investigate whether taurodontism might be useful for para-masticatory activities. Our results do not show any meaningful difference among all the simulations (including those with the pulp chamber filled with dentine) in displacement, stress distribution and bending resistance, pointing out that taurodontism does not improve the functional biomechanics of the tooth. Similarly, taurodontism does not seem to favor pulling para-masticatory activities, as all simulations show the same patterns and almost the same magnitude of maximum principal stresses. Therefore, taurodontism should be considered either as an adaptation to a high attrition diet or most likely it is the result of genetic drift effects. Finally, our results have important implications for modern dentistry in endodontic treatments, as we have observed that filling the pulp chamber with dentine-like material increases tooth stiffness, and ultimately tensile stresses in the crown, thus favoring tooth failure.

**Acknowledgements:** We are grateful to the Museum für Vor- und Frühgeschichte in Berlin and particular to Almut Hoffmann to provide access to the original specimen and to allow the acquisition of  $\mu$ CT data of Le Moustier 1 skull fragments and mandible. The data are stored in the digital database of the Max-Planck Institute for Evolutionary Anthropology in Leipzig.

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Podium Presentation: Session 11, Sa (14:40)

## Tooth cusp sharpness as a dietary correlate in great apes

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Mammalian molars have undergone heavy scrutiny to determine correlates between morphology and diet. Here, the relationship between one aspect of occlusal morphology, tooth cusp radius of curvature (RoC), and two broad dietary categories, folivory and frugivory, is analyzed in apes. Based on previous dental topography studies, I hypothesize that there is a relationship between tooth cusp RoC and diet, and that folivores have sharper teeth than frugivores. Given an allometric relationship that exists between blade RoC and body size [1,2], the possible correlation between tooth cusp RoC and tooth cusp size is also investigated. Eight measures of tooth cusp RoC (two RoCs per cusp) were taken from 53 upper M<sup>2</sup>s from four species and subspecies of frugivorous apes (*Pongo pygmaeus*, *Pan troglodytes troglodytes*, *Pan troglodytes schweinfurthii*, and *Gorilla gorilla gorilla*) and two subspecies of folivorous apes (*Gorilla beringei beringei*, and *Gorilla beringei graueri*). Phylogenetically corrected ANOVAs were run on the full dataset and several subsets of the full dataset (i.e. just buccolingual RoCs, just mesiodistal RoCs, and just buccolingual RoCs of the paracone and metacone), as mesiodistal RoCs have been ignored in previous studies [1-3], to determine if tooth cusp RoC was correlated to diet. Results revealed that, when buccolingual RoCs are taken into account, tooth cusp RoCs can successfully differentiate folivores from frugivores. However, when just mesiodistal RoCs were considered, tooth cusp RoCs could not differentiate folivores from frugivores. PCAs revealed that folivores consistently had duller teeth than frugivores. In addition, a weak, statistically significant positive correlation exists between tooth cusp size and tooth cusp RoC. I hypothesize differences in tooth cusp RoC are correlated with wear rates, where, per vertical unit of wear, duller cusps will have a longer length of exposed enamel ridge than sharper cusps. More data need to be gathered to determine if the correlation between tooth cusp RoC and tooth cusp size holds true when small primates are considered

**Acknowledgements:** I thank my PhD advisor, Ian Grosse, and committee members, Elizabeth Dumont, Laurie Godfrey, and Frank Sup, for pushing me to take on this project and for comments on the article. I am grateful to Peter Ungar for allowing him to scan tooth molds housed in the Paleoanthropology Laboratory at the University of Arkansas with the University of Arkansas's laser scanner to gather the data; Sarah Livengood for helping the author plan his trip to the University of Arkansas; the Smithsonian, Royal Museum for Central Africa, American Museum of Natural History, Cleveland Museum of Natural History, and State Museum of Anthropology and Paleoanatomy in Munich for allowing the author to scan the molds of ape teeth taken from their museum specimens. I thank Andrew Smith for his help in R and in running the phylogenetically corrected analyses. Finally, I thank two anonymous reviewers, the Associate Editor and the Editor for their useful comments and help in editing this article.

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Poster Presentation Number 25, Fr (15:30-17:30)

## **Variation in the shape of the birth canal in modern humans is significant and geographically structured**

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The human pelvis shows substantial morphological differences in respect to other apes—differences which have been explained as adaptations to bipedal walking and running, combined with the requirements of a large birth canal to allow the passage of an exceptionally encephalised neonate. Although many of these morphological peculiarities appear to characterise all bipedal hominins, at least from the early australopithecine species, precisely when obstetrical constraints started to play a role, and what their effects might have been, is subject to debate. In addressing these questions, the shape of the birth canal is usually compared across hominin species, using one or more human populations to represent our species' typical shape. A key aspect that should inform these analyses, however, is the extent and pattern of variation within our species. In this study, I collected six canal measurements from 348 females from 24 globally-distributed human populations. The analyses showed a marked geographic structure in the variation of the canal, whereby sub-Saharan African populations are consistently characterised by a deeper birth canal in the anterior-posterior direction, throughout the three planes (inlet, midplane, and outlet), while native American populations fall at the other extreme of variation with a more transversally-wide canal. Asian and European/North African populations show an intermediate morphology. The differences are particularly obvious for the inlet, which tends to be more markedly oval in Americans and Europeans/North Africans, and for the outlet, which tends to be sagittally-oval in sub-Saharan Africans and Asians, while it is generally transversally-oval in Americans and Europeans/North Africans. This geographic pattern of diversity, with sub-Saharan African and American populations at the two extremes of variation, has likely been shaped by the expansion out of Africa of our species. However, the similarities shown by Americans and Europeans might also be partly explained by adaptation to cold climatic conditions during the colonisation of the two continents. The remarkable range of variation in the shape of the human birth canal, and its geographic pattern, can be very informative when evaluating differences in canal morphology in extinct hominin species.

Podium Presentation: Session 8, Sa (9:30)

## Dating the Middle to the Upper Palaeolithic Transition in the South Levant: Where to From Here?

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The start of the Upper Palaeolithic period in the Levant is conceived to reflect the appearance of Anatomically Modern Humans substituting the Neanderthals. This event, named Initial Upper Palaeolithic (IUP), is marked by the shift in stone tool technologies, specifically the replacement of the Mousterian Levallois technique by the semi-prismatic blade technology [1]. The timing of this conversion from the Middle to the Upper Paleolithic was thought to occur at ca. 47 ka BP. But, examinations of old <sup>14</sup>C dates and new dates for IUP sites suggest the scenario to be more complicated. The dating of the MP-UP transition in the Levant currently relies on two sites from the southern Levant (Boker Tachtit and Kebara Cave) and two from the north (Ksar Akil and Üçagizli Cave). The sites, suggesting dissimilar timing for the transition, were excavated using different field methods. They are quite different regarding their geographical and environmental contexts, stratigraphical sequence, lithic assemblage composition and the range and quality of the <sup>14</sup>C dates. Thus a simple direct comparison of their transitional radiocarbon ages is fairly difficult. Boker Tachtit, with four distinct archaeological layers, provided so far five <sup>14</sup>C dates on charcoal measured with decay counting method [2]. An evaluation of these dates shows that only one (SMU-259) could be reliable 46980±2420 BP. The site is now being re-excavated with the main purpose of re-examining the stratigraphy and obtaining additional <sup>14</sup>C dates, using rigorous chemical treatments and analytical conditions. The MP-UP transition was estimated in the 1990's through direct dating of superimposed the Middle and Upper Palaeolithic layers which were recorded in a section in Kebara Cave [3]. The dates indicated that the transition occurred at ca. 48,000 cal BP. A re-excavation of the same section followed by a thorough pre-screening of the charcoal samples for the best preserved material, resulted in 11 dates from the stratigraphic sequence and one from an intrusive channel [4]. The transition date was estimated to be between 48,000 and 46,000 cal BP. Ksar Akil has a long stratigraphical sequence with five layers (XXV-XXI) corresponding to the IUP. Recently obtained <sup>14</sup>C dates proposed the transition occurred at 42.4–41.7 ka cal BP [5]. The dates were made almost exclusively on mollusk shells. The shells dated from the UP produced variable dates and modeling showed that about 23% of these are outliers. It is therefore difficult to accept the proposed timing for the transition based on these results. New <sup>14</sup>C dates on shells were also made for IUP layers Üçagizli Cave (H-F) providing the range of 41.6-36.8 ka cal BP for the transition. At this stage of the research, the date of Middle to the Upper Palaeolithic transition in the Levant is debated. <sup>14</sup>C dates made on charcoal from southern Levantine sites suggest 48-46 ka cal BP whereas <sup>14</sup>C dates on shells from northern Levantine sites suggest 42-36 ka cal BP. To our perception the two radiocarbon dating projects of the transition in Kebara Cave provide consistent results, based on microarchaeological characterization of the contexts and are therefore should be regarded as the most reliable estimates of the MP-UP transition date in this region.

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Poster Presentation Number 23, Fr (15:30-17:30)

## A new partial pelvis (Pelvis 2) from the Sima de los Huesos site (Atapuerca, Spain)

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The Sima de los Huesos (SH) is a Middle Pleistocene cave site located in the Northern Spain (Burgos Province) within the cueva Mayor-cueva del Silo karstic system in the sierra de Atapuerca [1]. The cavity is partially filled with a human-bearing clay deposit which totals more than 6500 remains (including pelvic remains) from at least 28 individuals. This collection is presently dated to a minimum age estimate of c.430 ka [2]. These hominins have been considered phylogenetically related to Neandertals [3]. To date, several studies have focused on the pelvic sample [4, 5]. This collection is composed of more than 150 fragments (minimum number of elements=41; minimum number of individuals=17), including the most complete human fossil pelvis (SH Pelvis 1) [4, 5]. Despite this large sample size, fragmentary nature of the pelvic remains has prevented us to have a further look to significant portions of the pelvic rim. Fortunately, a new association between sacral and hip bone remains has allowed us to add a new partial pelvis (Pelvis 2) to the SH collection. SH Pelvis 2 was previously introduced to evaluate the sagittal lumbo-pelvic anatomy in a previous study [5]. Here, we present a detailed study of SH Pelvis 2 that includes age-at-death and sex determination and a comparative morphometric study. This new association together with Pelvis 1 provide us with an expanded view on the pelvic morphology in this fossil population. SH Pelvis 2 comprises a quite complete left *os coxae* and an almost complete first sacral vertebra. Both remains were not found in anatomical articulation and their association is based on sacroiliac surface morphology and developmental congruency. Due to its fragmentary preservation, a partial reconstruction of the right side of this pelvis has been attempted by means of virtual anthropology techniques based on CT scan images. Regarding age-at-death, SH Pelvis 2 shows a fully mature morphology that probably corresponding to a young to middle adult individual. According to sex-linked traits in extant populations, SH Pelvis 2 shows a modern male-like morphology. This is in agreement with its overall size and robusticity within the SH sample variation. SH Pelvis 1 and 2 shows a common morphometric pattern and, despite some metrical differences, they are very similar in size. They also share a suite of morphological traits including a robust acetabulocrystal buttress, strongly twisted anterior inferior iliac spines and a conspicuous supraacetabular sulcus. Compared to modern humans and neandertals, they stand out for their very large dimensions and pronounced lateral iliac flaring which result in remarkable broad pelves. As previously proposed, this is consistent with a very broad body cylinder in SH individuals compared to modern humans [4].

**Acknowledgements:** This research was supported by the Spanish Ministerio de Economía y Competitividad (MINECO) (CGL2012-38434-C03-01). A. Bonmatí received a Fundación Atapuerca grant. A. Gracia has a contract from the Ramón y Cajal Program (RYC-2010-06152). Fieldwork at the Atapuerca sites was funded by the Junta de Castilla y León and the Fundación Atapuerca.

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Poster Presentation Number 26, Fr (15:30-17:30)

## Quadrupedal subjects in a family (Adana, Turkey): new insights into the biomechanical influences on skeletal development

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The impact of biomechanical constraints on skeletal shape is mostly understood, however the study of the phenotype is generally complicated by a tangle of genetic and epigenetic factors. Both phylogenetic and developmental analyses are traditional tools in order to understand the role of the mechanical environment on the adult phenotype. A better understanding of the role of genetic and epigenetic factors on skeletal features are of critical importance to the study of human evolution and the acquisition of bipedal locomotion in the human lineage. What was the role of genes? What is the role of environment? Some models have been very informative such as Japanese macaques trained to walk bipedally (Preuschoft et al., 1988), or experiments during which goats were deprived of the use of their upper limbs at birth. Recently, humans which practice habitual quadrupedal locomotion were identified and the study of their skeletons constitutes a unique source of information regarding the evolution of the human skeleton. In a South Turkish village five adults of a family of 19 children are suffering a mutation at a gene of chromosome 17, inducing a loss of a fundamental protein implied in the development of the cerebellum (Türkmen et al., 2006; Ozcelik et al., 2008). The cerebrotocerebellar hypoplasia results in a drastic imbalance which renders the acquisition of bipedal locomotion difficult. Two patients and one of their non-pathological brothers were examined at the hospital in Adana. Physical examinations, radiographies and CT-scanning were performed. Three-dimensional reconstructions of the pelvi-femoral complex based on the CT scans were obtained using Amira software. Here, we present our first results concerning three femoral features which are known to be strongly influenced by environmental factors (Tardieu, 2010; Bonneau et al., 2014). Two concerns parameters of the orientation of the femoral neck, i.e. the anteversion and inclination angles, and the last concerns the femoral shaft obliquity. Values measured on the male quadrupedal patient were compared to values measured on the healthy brother who represents a control compared to the general population. The anteversion angle is known to be around 15° in the human population. A measurement of 14° and 12° for the right and left femoral neck anteversion respectively was obtained for the bipedal brother. The values obtained for the quadrupedal patient were greater, as 28° and 24° were measured on the right and left femora respectively. Concerning the femoral neck shaft angle which is on average 130° in human population, angles of 140° and 136° were obtained for the right and left femora of the affected brother, while angles of 127° and 129° were obtained for the healthy brother. Finally, the obliquity of the femoral shaft equalled 7° both in the right and left sides of the bipedal brother (a mean value of 10° is typical for humans) while 4° and 3° were measured in the quadrupedal patient. Our results provided evidence that the habitual locomotor environment significantly affects the femoral shape. In conclusion, quadrupedal locomotion habitually practised by the pathologic patient induced a modification of the orientation of the femoral neck and the obliquity of the femoral shaft. This preliminary analysis will be integrated in the study of the whole locomotor skeleton. The aim is to understand the impact of growth on a skeleton which inherited the characters of bipedal adaptation but did not acquired the epigenetic characters linked with bipedal gait acquisition and was remodelled by habitual use of quadrupedal locomotion.

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Podium Presentation: Session 11, Sa (15:00)

## Sequence analysis of tool prehension and manipulation: a new method to analyze hand dexterity

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Primatology and ethology show that other species than human are able to make tools (Shumaker et al., 2011), select several of their properties (Visalberghi et al., 2009) and even preserve tools for future use. Everyday, new discoveries in these fields show that human tool use specificities are not straightforward to assess. It complicates our understanding of both (human) tool use origin and evolution and our interpretation of archaeological tools, in particular those involved in the debate about the origins of stone tool making, still the center of a large debate around *Australopithecus* and *Homo* (Kivell et al., 2011). In order to infer past archaeological tools and to assess human tool-using hand specificities it is essential to investigate tool manipulation itself. A comprehensive investigation of dynamic manual function and dexterity is necessary. However, so far, these kinds of studies either focused on static finger postures during grasping, or involved complex kinematic modeling necessitating the use of markers on the hand which are often too much constraining for the subject in a complex tool using task and inapplicable for non-human primates (Reghem et al., 2011). In addition, tool using tasks involve several sequences of grasping posture and of repositioning movements that had never been quantified. Thus, such documentation on strategies involving sequences of postures and manipulation is lacking for complex tool using tasks. The present study aimed at setting up a new methodology to examine the dynamic strategies of tool use (i.e. body posture, repositioning and sequences of grasping postures) in human according to the kind of use and/or users. Five subjects with right hand preference participated to the experiment. The size, weight, hand length and several other morphological measurements were taken on each of them. Each subject had to make a spear point (bimanual task) with two different types of bamboo using flint flakes. The experiments were examined second by second to gather the data corresponding to several parameters such as the number of used fingers and the contact areas used from the left and right hand, the type of action, the body posture or the repositioning of the subject, tool and worked material. A time based sequence analysis was performed to examine each variable in relation to the expertise, the sex and the morphological characteristics of the subjects and in relation to the type of worked material as well. It also allowed evaluating costs and benefices. This experimentation showed both consistency and variation among users and type of use depending on the observed parameters. Similarities are found for example for the number of fingers, the position of the hand, the action carried out and the motion of the tool which do not show much variability among the subjects, in particular for the left hand. The contact areas which are the most used are also similar and consist in the pulp of the thumb and index finger. More differences were identified depending for example on the hands used, the worked material and the experience of the subject. In particular, expert is more consistent and finds better compromise between costs and benefices. This methodology proved to be powerful and promising and opens several perspectives. In a short term, it could allow assessing intra and inter-individual variability in grasping and manipulative strategies. The observed parameters could also be used to improve the accuracy and objectivity of the interpretation of the archaeological artifacts: relation between strategies of postures and movement, the shape of tools and the associated use-wears (Borel et al., 2013). In a long term, their discussion in relation to other species could also provide new information concerning the essential elements needed for tool use, its specificities, variability and in a wider theoretical framework its origin and evolution.

**Acknowledgements:** This study has been carried out thanks to a postdoctoral founding from the Fyssen foundation. We thank Elodie Reghem for her help during the experiments and each of the anonymous subjects for their participation.

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Poster Presentation Number 83, Sa (16:00-18:00)

### **A poisoned chalice: investigating the presence of poisons on Paleolithic arrows**

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Ethnographic documentation tells us that very often hunters poison their weapons with toxic substances. The ease with which poisons can be obtained from plants and animals, and the benefits arising from their application on throwing weapons (a safe distance from the hunter's prey, killing large size prey relatively quickly) suggests that this practice could be widespread among prehistoric hunters. In particular, the poisonous substances can incapacitate the animal, irrespective of whether the weapon causing a mortal wound: this is crucial for the recovery of meat and furs in good conditions. In this paper we present the development of a method for the detection of toxic substances on European Upper Paleolithic stone and bone points. This research is part of a wider project on the analysis of residues on the prehistoric projectile points in collaboration with the Department of Chemical and Forensic Sciences of the Northumbria University, Newcastle. The investigation makes use of mass spectrometric analysis to establish the presence/absence of potentially toxic substances even after thousands of years. The plants of the Ranunculaceae family, particularly monkshood, as well as other common toxic plants such as hemlock or andstrychnos toxiferia (curare) are those on which we have more historical information and form the basis of this work. Using a completely non-invasive method, based on the extraction with deionized water, samples were taken from the ethnographic materials preserved in the Museum of Archaeology and Anthropology of Cambridge (UK), and samplings are scheduled at the Pitt Rivers Museum of Oxford (UK) and Museo Etnografico Pigorini of Roma (Italy). The project preview the research of the toxic molecules starting from the present plants and working backwards through the study of the ethnographic and historical weapons: in particular the iron points used by Romans and Gauls, sometimes poisoned with Aconite. The method will be therefore applied to the prehistoric material.



Poster Presentation 69, Sa (16:00-18:00)

## Variation of the Enamel-Dentin-Junction morphology of upper premolars in modern human populations

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Tooth morphology is often used for taxonomic purposes. However, some dental features can be obscured by wear. Relatively new morphometric approaches use non-destructive imaging techniques and focus on the enamel-dentine junction (EDJ), which is usually less affected by wear and presents a genetically stable morphology (Korenhof, 1982). In this study, we contribute to the understanding of the morphological variation of the upper third and fourth premolars (P<sup>3</sup> and P<sup>4</sup>, respectively) in modern human populations, using different Geometric Morphometric (GM) approaches. Furthermore, we aim to develop a data base for further comparative dental studies in human evolution. Our sample comprised seven modern human populations (n = 44): San and other African indigenous individuals, middle Europeans, Javanese, Papua New Guinean indigenous, Australian Aborigines, and Avars, a population of mixed Asian-European descent living in Eastern Europe from the fifth to the ninth century AD. As an out-group we used a sample of *Pongo pygmaeus* (n = 4). All individuals were scanned at the Vienna  $\mu$ CT-Lab. The image data were segmented in order to produce 3D surface models of the crown and EDJ. We collected landmarks on the buccal and lingual horn tips and at the deepest points of the mesial and distal fossae, and used curve semilandmarks along the marginal edge. Additionally, we analyzed landmark configurations (n = 24) gathered from the crown and cervical outlines. The landmark configurations were normalized through General Procrustes Analysis and then a Principal Component Analysis was performed for each of the landmark configurations considered separately. Our results show that the crown outline is the most variable feature within the dental aspects considered. For both crown and cervical outlines in shape space, P<sup>3</sup> show an imperfect separation between *Homo* and *Pongo*, while there is no separation at all in P<sup>4</sup>. In form space, these two genera separate neatly due to size. *Homo sapiens* shows a large intragroup variation for both P<sup>3</sup>s and P<sup>4</sup>s and no clear separation between populations. The EDJ GM analysis for both P<sup>3</sup> and P<sup>4</sup> is the most taxonomically informative separating clearly *Homo* from *Pongo* but there is again no grouping for the various human populations considered. The main source of EDJ variation for both premolar types (PC1 in P<sup>3</sup>=22.1%; in P<sup>4</sup>=25.9%) is mainly associated with the length of the mesio-distal groove. PC2 accounts for relatively complex shape distortions of the whole crown, i.e. a mesio-distal skewing in P<sup>3</sup> (18.9%), and a buccal narrowing or widening in P<sup>4</sup> (16.8%). Along PC3, the cusps' height accounts for the variation observed. In P<sup>3</sup>s (11.2%), the buccal and lingual cusps vary from being approximately the same height to relatively higher buccal cusp. In P<sup>4</sup>s (11.4%) it is a higher relief vs. a lower relief, meaning both horn tips are either relatively tall or low. In terms of size, we found also no clear pattern characterizing different geographical populations. Our findings suggest that there is considerable morphological variation within modern human upper premolars, but it is not associated with the geographical origin of the quite diverse populations included in the study. Moreover, we found that neither crown nor cervical upper premolar outlines are reliable features to distinguish between recent *H. sapiens* and *P. pygmaeus*. This represents a suitable database for further comparative studies on hominin upper premolars.

**Acknowledgements:** We thank Martin Dockner (Vienna Micro-CT Lab) for technical support, Gerlinde Gruber (Medical University Vienna) and Eduard Winter (Natural History Museum Vienna) for access to material, and Katarina Matiassek for background information on collections.

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Poster Presentation Number 54, Sa (16:00-18:00)

## Maxillary sinuses, craniofacial morphology, and adaptation in Pleistocene hominins

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The morphology of Mid-Late Pleistocene (780-12 ka) hominins varies widely for such closely related species and they are reported to have paranasal sinuses of taxonomic and functional interest. Neanderthal maxillary sinuses in particular are said to be distinctively large, explaining their diagnostic mid-facial morphology and resulting from cold adaptation [1], [2], [3]. These assertions were investigated to illuminate causes of inter- and intra-taxon craniofacial variation in Mid-Late Pleistocene hominins, whilst evaluating theories of sinus function and adaptation in later *Homo*. Sinus volumes were measured from CT data, and 3D landmark geometric morphometric methods were used to identify associated shape variables in a large sample of fossil and extant hominins. Relationships were investigated between these sinus variables and taxonomic/population, dietary, and climatic variables. The results demonstrate that the maxillary sinuses appear to have no direct function in Mid-Late Pleistocene hominins, but indicate that they do respond to selective pressures, such as diet and climate, indirectly via cranial adaptation. These effects are of varying strength, and it is likely that stochastic development also plays a part in determining differences in individual volumes [4]. Inter-taxon comparisons show that, compared to other Mid-Late Pleistocene taxa, *H. sapiens* has hypopneumatized maxillary sinuses, rather than *H. neanderthalensis* being hyperpneumatized [4], [5]. Small maxillary sinuses in *H. sapiens* are argued to result from derived craniofacial size and morphology, which are in part adapted to dietary strain and climatic pressures. These conclusions have built on previous studies to overturn long-standing but unfounded theories about the pneumatic causes of Neanderthal morphology and the functional nature of sinuses, whilst opening up potentially valuable research avenues into the relationships between strain, climate, pneumatization, and intraspecific variation.

**Acknowledgements:** LTB thanks the University of Roehampton, The Primate Society of Great Britain, and The Leakey Trust for funding. For access to data LTB thanks Robert Kruszynski, Farah Ahmed, & Margaret Clegg, (Natural History Museum); Janet Monge & Tom Schoenemann (University of Pennsylvania); Phillipe Mennecier, Alain Fromment, & Antoine Balzeau (Musée de l'Homme, Paris); Thomas Koppe (Ernst-Morritz-Arndt University, Greifswald); Christoph Zollikofer (University of Zurich); Amelie Vialet & Henry de Lumley (Institut de Paléontologie Humaine, Paris); Giorgio Manzi (Università La Sapienza, Rome); Gerhard Weber (University of Vienna); George Koufos (Aristotle University of Thessaloniki); Luca Bondioli (Museo Nazionale Preistorico Etnografico "Luigi Pigorini", Rome); Andreas Pastoors (Neanderthal Museum, Mettmann).

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Poster Presentation Number 40, Fr (15:30-17:30)

## **Upper Paleolithic Funeral Ceremony: Bioarchaeology Of The Person From Kostenki Xiv (Markina Gora)**

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Studying of features of a funeral ceremony at the earliest representatives of the Upper Paleolithic is important for the questions connected with understanding of origin of cultural traditions. It is supported by use of various methods and approaches, also as analysis of anthropological data in a context of archaeological knowledge. The anthropological remains of the adult individual found by A. N. Rogachyov in 1954 on the Upper Paleolithic site of Kostenki XIV (Markina Gora), exhibit good preservation and completeness of a skeleton. The skeleton of the adult person settled down in a funeral grave on the left side in the writhed position. Skeleton bones, as well as a bottom of a funeral grave were painted by dark-red ochre. Any accompanying artifacts weren't found. The analysis of pathological features of a skeleton confirms violation of integrity of bodies of two lumbar vertebrae because of the degenerate pathological processes. It could be the result of the spine trauma. Examination of everyday physical activity gave possibility to stress high level of development of a bone relief in places of an attachment of some deep muscles and ligaments on clavicles and tubular bones of upper and lower extremities. The data point to serious physical activities of the individual: elevator loadings and regular long pedestrian transitions. The presence of traces of secondary venous stagnation on the diaphysis of femora is reconstructed as a result of severe loads of the lower extremities. All this is most characteristic for Paleolithic man due to an active physical activity life. In addition for everyday life reconstruction two healed injuries of a skull were fixed, also as well as a possible injury of the left pelvic bone which the individual got shortly before death. Besides, there is indirect evidence of probable postmortem manipulation with a body of the buried. Results of the anthropological analysis are discussed with a similar Paleolithic case in a context of semantics of funeral traditions.

Poster Presentation Number 76, Sa (16:00-18:00)

## The importance of limestone in the subsistence activities during the Middle Paleolithic: the levels J, M and O assemblages of the Abric Romaní site (Barcelona, Spain)

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The limestone is one of the raw materials called “secondary”, on the one hand because its knapping quality and on the other hand because normally their procurement areas are local. This is the “current” idea when the chert is the principal raw material used in a site or in an archaeological level, especially in Middle Paleolithic assemblages. Moreover, its use is normally associated to percussion activities as hammerstones. However, this premise it is not always true and limestone may be used in different ways. In particular, it is worth exploring whether the use of limestone is influenced by the technological context. Two main technological contexts may be identified in the Middle Paleolithic: expedient contexts, in which knappers are no very concerned about the shape and size of the products, and predetermined context, based on the production of specific blanks. The goal of this paper is to ascertain if this expedient/predetermined dichotomy can be also observed in the use of limestone. In this paper we present the data obtained from the study of limestone remains from Abric Romaní levels J, M and O dated between 50 and 55 Ka BP [1]. These levels show clear technological differences. Levels J and M are characterized by a marked expediency in lithic production, whereas level O shows a clear dominance of predetermined (Levallois) strategies. The information comes from the interdisciplinary analysis of their: (1) procurement areas, (2) lithic technology, (3) refits and (4) spatial patterning analysis of the three limestone assemblages. Moreover, the data obtained have been compared with the rest of archaeological remains of these archaeological levels. The results permitted to document various specific functions depending of its use (percussion activities, knapping activities, recycling, structural complex element of combustion and cooking activities), the occupation patterns and its duration, and the subsistence activities developed en each level. The importance of their functions are not always the same in the three levels. The role of limestone is very important, not only in the organization of the technological behaviors but also in the other subsistence activities developed by the Neanderthal groups.

**Acknowledgements:** Excavations at the Abric Romaní were performed with the support of the Departament de Cultura de la Generalitat de Catalunya, Ajuntament de Capellades, Oficina Patrimoni Cultural-Diputació de Barcelona, Tallers Gràfics Romanya-Valls, Bercontres-Centre de Gestió Medioambiental SL, and of the Constructora de Calaf SAU. M.G. Chacón was financed by a postdoctoral grant from the Juan de la Cierva Subprogram (JCI-2010-07863) and by the research project HAR2010-19957/HIST, both with the financial sponsorship from the Spanish Ministerio de Economía y Competitividad (MINECO).

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Poster Presentation Number 14, Fr (15:30-17:30)

### **A study of three-dimensional quadric surface fitting to model variability in femoral curvature**

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Neandertal femora are well known for being large and robust, with large femoral heads and condyles, low angles between the head and neck and for having a marked anterior femoral curvature. When the first Neandertal skeleton was discovered, femoral curvature was thought to be due to pathology. Since that time there have been numerous other discoveries of Neandertal skeletons all sharing the same marked trait, studies have been conducted on anatomically modern humans (amh) and femoral curvature is now seen as a trait of both amh and Neandertals. This study analysed femoral curvature by the use of three-dimensional (3D) quadric surfaces modelled from the bone surface. 3D models provide detailed information and enable femoral curvature to be analysed in conjunction with other morphological characteristics (such as torsion, cervico-diaphyseal angle, length size and position of femoral head, neck and condyles). 3D models were created from CT scans of 75 amh femora, the Neandertal 1 and Spy II femurs and the left and right femurs from an adult male bonobo. Anatomical landmarks (ALs) were palpated in areas of interest (neck, head, diaphyseal shaft, condyles) on the femur. Quadric surfaces (QS) were created from the surface vertices in the areas of interest palpated by the ALs. The diaphyseal shaft was divided into five QS shapes and curvature was measured by degrees of difference between QS shapes. Each bone was placed in a local coordinate system which enabled each bone to be analysed in the same way and degree of femoral curvature was analysed in conjunction with other morphological characteristics. There were few correlations found between femoral curvature and other morphological characteristics in amh. The Spy II (23.9°), Neandertal 1 (17.4°) and bonobo (18.9° and 21.4°) femoral curvature were found to be above the average of amh (14.4°, range: 8.7° – 24°). A statistical difference in degree of curvature was found in different parts of the femoral shaft, with the greatest degree of curvature found in the distal part of the shaft in amh and Neandertals. The Bonobo was found to have the highest degree of curvature in the upper part of the shaft. In conclusion, 3D QS fitting enables the creation of detailed 3D femoral models which can accurately discriminate between different patterns of similar curvatures.



Podium Presentation: Session 9, Sa (11:50)

## The Use of Non-Flint Lithic Raw Material in the Final Gravettian. Abri Pataud (level 2), Laugerie-Haute Est (levels F, 36 and 38), Les Peyrugues (level 18)

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The Final Gravettian levels (22,000 BP) from Laugerie-Haute Est (Les Eyzies-de-Tayac, Dordogne), Abri Pataud (Les Eyzies-de-Tayac, Dordogne) and Les Peyrugues (Orniac, Lot) delivered large quantities of non-flint lithic raw materials, which had never been analyzed in detail before. Their study revealed the presence of numerous tools and a wide variety of raw materials used. Similar behaviors have been identified in all three sites, with the use of these materials for domestic and symbolic activities. Domestic use. Many of the objects were used unmodified as stone fireplaces while others have been knapped, shaped into tools or simply collected. In the latter case, it is not possible to assign them a particular purpose. The percussion material is best represented with hammers used for flint knapping, but also crushing hammers probably used for the fragmentation of bones. Small flint cores with many traces of percussion, which could have been used as hammers or *boucharde*s are present in Laugerie-Haute Est and Abri Pataud. Some flake debitage mainly in quartz and quartzite are attested, but other rarer types of raw materials are also knapped. Choppers were made, some of which were used as crushing hammers. Finally, small pebbles, usually elongated with various traces are multi-functional objects, showing evidence of a great variety of uses: mallets, retouchers, smoothing-tools... Many collected pebbles show no traces of use. It is often pieces with remarkable shapes, colors or materials. Some of them have probably been collected for their aesthetic appearance. Other more common materials may have been reserves of unused raw materials. Symbolic use. Some pebbles and fossils have been used as blanks of art or adornment: perforated, shaped, engraved pieces. Such objects are present only in Laugerie-Haute Est and Abri Pataud. In this latter case, they could have been part of funerary deposits (Chiotti et al, 2009; in press). Although tools made of non-flint lithic raw materials vary very little throughout the Upper Paleolithic, the similarity of the objects on the three sites should be noted, particularly between Abri Pataud and Laugerie-Haute Est. This similarity is also striking concerning the proportions between different types of tools. So it seems that these tools are another element in addition to many other existing (lithic and bone industries, body ornament, ...) to confirm that the layer 2 of Abri Pataud, layers F, 36 and 38 of Laugerie-Haute Est and layer 18 of Les Peyrugues correspond to the same cultural phase. In Abri Pataud and Laugerie-Haute Est, the objects under study show much diversified uses, corresponding to a large number of domestic and symbolic activities. On the contrary, in Les Peyrugues, only some of these activities are present. This fits perfectly the information given by the various existing studies on these sites. Pataud and Laugerie-Haute Est correspond to occupations probably long enough, or recurrent, while Les Peyrugues showed all the characteristics of a very short occupation.

**Acknowledgements:** The present study was conducted as part of the programmed archaeological operation "Human occupation of the Abri Pataud 22,000 years ago", co-directed by Roland Nespoulet and Laurent Chiotti. This operation is funded by the Ministry of Culture (DRAC Aquitaine), the General Council of the Dordogne, the UMR 7194 of CNRS, the Department of Prehistory at the National Museum of Natural History and the National Research Agency (projects ANR "MADAPCA", "GUEROPE" and "ArBoCo." We would like to address our thanks to Jean-Jacques Cleyet-Merle, director of the National Museum of Prehistory in Les Eyzies who opened access to Peyrony and Bordes collections from Laugerie-Haute Est and to Allard collection from Les Peyrugues. We thank also Michel Allard, head of the excavation of Les Peyrugues, which allowed us to analyze the pebbles of level 18. Michel Faure, professor at the University of Orleans, Pierre Lozouet, research engineer at the National Museum of Natural History and Didier Néraudeau, professor at the University of Rennes 1 have identified some of the rocks and fossils, which we greatly appreciate.

Poster Presentation Number 22, Fr (15:30-17:30)

## The Gona pelvis and sexual dimorphism in *Homo erectus* compared with living hominoids

Zachary Cofran<sup>1</sup>

1 - Nazarbayev University

Simpson et al. [1-2] and Ruff [3] noted that the ca. one million year old BSN49/P27 pelvis from Gona, if truly *H. erectus*, implies a substantial amount of body size variation in this species. Ruff suggested the small specimen might come from an australopith rather than *H. erectus*, based on comparisons of variation in other hominins. However, no one has compared the amount of variation implied by Gona to that found in living apes that can serve as alternate models of sexual dimorphism. Here I test the hypothesis that including the Gona pelvis in the Early Pleistocene *H. erectus* hypodigm does not increase body mass dimorphism beyond that observed in living hominoids. Body mass is estimated from femur head diameter for humans (n=86), chimpanzees (n=66), and gorillas (n=93), and from femur head or acetabulum diameter for six early Pleistocene *Homo* fossils in addition to Gona. Two resampling tests assess the likelihood of observing fossil-like sexual dimorphism in extant species, under the assumption that Gona is a female and the other fossils are male. The first test mimics the fossil assemblage, estimating hominoid dimorphism by resampling six males and one female, while the second estimates dimorphism by resampling male-female pairs. Under the first scenario, the fossil estimate of sexual dimorphism is never (p=0), rarely (p<0.001), and frequently (p=0.76) resampled in humans, chimpanzees and gorillas, respectively. In the second scenario, all pairwise estimates of *H. erectus* dimorphism except those based on the two smallest specimens (D4167 and KNM-ER 1472) are higher than 95% of the resampled male-female pairs of both humans and chimpanzees. In contrast, all six fossil estimates fall within the 95% confidence interval of resampled gorilla pairs. These results demonstrate that the Gona pelvis may well belong to *H. erectus*, but only if this species was highly dimorphic. I briefly discuss other evidence for, and the implications of, great sexual dimorphism in *H. erectus*.

**Acknowledgements:** I am grateful to Jeremy DeSilva and Herman Pontzer for providing the extant hominoid data, and to Simpson and colleagues and Chris Ruff for publishing their fossil measurements and estimates. Caroline VanSickle and Herman Pontzer provided useful comments and suggestions in the development of this study.

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Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## The Higher Cognitive Functions of the Recently Expanded Parietal Lobes in *Homo sapiens*

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As Bruner [1] has aptly demonstrated that the parietal lobes in *Homo sapiens* are expanded in comparison to Neandertals and *Homo heidelbergensis*. One curious aspect of this phenomenon is that the traditional parietal lobe function of the brain, somatosensory integration, is thought to be among the phylogenetically oldest functions of the brain. However research, particularly over the past few years or so, has shown that the parietal lobes may be critical to many of the higher cognitive functions of modern *Homo sapiens* including important aspects of working memory [2], numerosity and abstraction [3], egocentric memory [4], episodic memory [5], sense of self, autobiographical memory, auto-noetic thinking, and prospective memory. Interestingly, these evolutionary changes in the parietal lobes in their phenotypic functions as opposed to their original phenotypic function (somatosensory integration) are known as exaptations, and exaptations may have occurred in all lobes of the modern brain. In my 20 Pecha Kucha slides, I shall do the following:

1. Show the parietal lobe expansion in *Homo sapiens* compared to Neandertals and *Homo heidelbergensis* (3 slides)
2. Detail the modern neurological structures of the parietal lobes (IPS, precuneus, inferior structures, etc.; 4 slides)
3. Present the traditional function of the parietal lobes (sensory motor integration; 1 slide)
4. Define adaptations and exaptations (1 slide)
5. Present definitions and parietal evidence for working memory operations (Koenigs et al., 2013; 1 slide)
6. Present the parietal evidence and define numerosity and abstraction (Coolidge and Overmann, 2012; 2 slides)
7. Define and show the parietal evidence for egocentric memory (Land, 2014; 1 slide)
8. Define and show the parietal evidence for episodic memory (Allen & Fortin, 2013; 1 slide)
9. Present evidence that a unity of sense of self may be the parietal lobes (Lou et al., 2004; 1 slide)
10. Define and show the parietal evidence for autobiographical memory (Cavanna & Trimble, 2006; 2 slides)
11. Define and show auto-noetic thinking is linked to the parietal lobes (Tulving, 2002; 1 slide)
12. Define and show evidence for parietal lobe involvement for prospective memory (Addis et al., 2007; 1 slide)
13. General Summary (1 slide)

**Acknowledgements:** Center for Cognitive Archaeology, University of Colorado, Colorado Springs

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Podium Presentation: Session 11, Sa (14:20)

## Starch taphonomy on stone tools: considering anthropogenic alterations, climate, and soil chemistry

Cynthianne Debono Spiteri<sup>1</sup>, Thomas Büdel<sup>1</sup>, Antje Hutschenreuther<sup>1</sup>, Simone Schmidt<sup>1</sup>, Jörg Watzke<sup>1</sup>, Amanda Henry<sup>1</sup>

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Dietary patterns of ancient communities have often been reconstructed through the study of starch granules recovered from archaeological contexts. Starch granules are known to survive over long timescales in protective archaeological contexts, such as within the cracks and crevices on the surfaces of stone tools [e.g. 1], and in the matrix of dental calculus [2, 3]. Several physical and chemical processes may lead to starch granules becoming damaged and destroyed, in particular during cooking and processing [e.g. 4, 5], and their survival potential is also especially vulnerable to post-depositional taphonomic processes. We are currently carrying out experimental work to study changes to the morphology of starch as a factor of time, as well as quantitative variation as a result of decay during burial. For this purpose, we have seeded flint tools with three varieties of starches (wheat, potato and cattail), using both native and cooked starches, and buried them in different environmental and climatic contexts that mimic those found at archaeological sites for a period of three years. One of the main aims of this study is to help predict environments in which we should expect to see good starch preservation. Exogenous contamination is being closely monitored through the burial of untreated flint tools, and analysis of soil taken from the burial context. The surrounding vegetation has also been documented, and the starch content of individual plant varieties analysed. Analysis is being carried out using polarised light microscopy. Results pertaining to changes in starch morphology and quantity are interpreted in light of how different parameters in soil chemistry, including temperature, pH, nutrient and mineral content, water availability and movement, and bacterial load, affect the preservation of starches under different climatic conditions. The sites chosen as burial contexts comprised different geological formations, including meadows, hillsides, a cave site, a forest and a peat bog, and are located in different European climatic zones. Here we present our observations after one year of burial. Results show a remarkable loss of starch over this time period (>95%), especially in sites with a neutral and alkaline pH measurements. Sites with acidic pH levels (e.g. peat bog and forest), and burial contexts located in more sheltered environments (e.g. cave) showed slightly increased starch preservation. Indeed, pH levels have a direct effect on microbial load and activity, which was observed to be a major factor influencing starch preservation/loss. It is hypothesized that the high percentage of starch loss after just one year of burial could be indicative of an initially increased rate of decay of the easily accessible starch, which may plateau in subsequent years, as less starch is available as substrate. Further integration of the results over the next years will better explain the various influences on starch preservation brought about by different soil chemistries, site types and climate.

**Acknowledgements:** Max Planck Society is thanked for funding.

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Poster Presentation Number 50, Sa (16:00-18:00)

## Modeling Population Dynamics of the Late Neanderthal Subgroups

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Neanderthal is a typical European Middle Paleolithic hominid that disappeared at around 30,000 years BP, replaced, although in some cases interbred [1], by modern humans. The demise of the Neanderthals is often associated with a demographic crisis, the causes of which are strongly debated. Demographic differences between Neanderthals and modern humans (survival and fecundity rate, timing of maturation) may have contributed to this demise. The aim of our study is to test, using a modeling approach, the hypothesis that the Neanderthal population was already demographically weakened or endangered when modern humans arrived in Europe. We apply methods issued from animal ecology in order to backcast the past population dynamics of Neanderthals. In particular, we used the Leslie matrix which requires the knowledge of the survival and the fertility rates for each age group. These demographic rates are unknown for the Neanderthals. We first chose average values of demographic rates based on the inter-specific observation on large mammals and other primates, and then adjusted values compatible with a stable population size from 50,000 BP until its demise at around 30,000 BP [2]. Genetic [3] and morphological data [4] support the hypothesis that the late Neanderthal population was probably divided into at least into three geographical subgroups: one corresponding to southern Europe, a second to central Europe, and third to eastern Europe and Asia. We therefore started with initial size of the Neanderthal population at approximately 70,000 individuals [5]. Several simple scenarios have been tested: three subgroups having the same number of people or different initial sizes (including a subgroup corresponding to central Europe with a larger size); three subgroups that became extinct either at the same time or one after another (the first in eastern and the last in southern Europe); all the subgroups are endogamous or shared limited interbreeding between subgroups. We also tested more complex scenarios (eg. three subgroups of different initial sizes that disappeared at different times and present some degree of exogamy). The results of our models indicate that small changes in fertility and survival rates, caused by any environmental factors such as climate, food resources..., are sufficient to account for the disappearance of the Neanderthal population, yet this does not preclude the fact that the arrival of modern humans might have facilitated their demise.

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Poster Presentation Number 77, Sa (16:00-18:00)

## Neanderthal land-use inferred from the Discoid lithic industry at Grotta di Fumane, unit A9

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Studies and models of the way Neanderthal groups using Discoid technology organized their economy and land-use are sparse in Europe. For instance, cyclical and seasonal residential movements were inferred in South-Western France from data about the exploitation of migratory ungulates like Bison and Horse, showing difference with the Levallois system, more targeted to the exploitation of less migratory species (Delagnes and Rendu, 2011). In Mediterranean Europe, data are even scantier than in other zones of Europe. With the aim to achieve new evidence on land-use patterns for future comparisons between these two technological systems, a complete study of over 9.000 flaked stones composing the assemblage at layer A9 at Grotta di Fumane, the north of Italy (Peresani, 1998; Delpiano, 2014), has been carried out. Reduction sequences have been broadly reconstructed for each main group of flint using techno-typological categories of artifacts having economic value within the reduction sequence. Results reveal a difference in the way the raw material sources were exploited. The largest bulk of flint comes from exposures and stream gravels in proximity of the site, while a smaller contribution is provided from semi-local and alloctonous sources. Flint of variable quality, largely available locally from Cretaceous limestones was introduced at a raw state and completely reduced on site, as also shown from the remarkable discovery of a lithic workshop refitted of over fourty pieces recording phases from decortication to full production of flakes. Surprisingly, semi-local materials which represent the 4.5% of the entire assemblage show fragmentation of the reduction sequence. One type was brought into the cave in the form of thick flakes then exploited as core-flakes for producing “Kombewa” type flakes and pseudo-Levallois points. Another type was introduced in the form of partially decorticated small blocks, then exploited as centripete cores for detaching flakes and few points. Finally, few alloctonous materials (0.4%) introduced like finished products or even small portable cores, reveal the presence of groups or individuals equipped with portable toolkits connecting zones over 100km far, possibly the Lombard Prealps or the Emilian Apennines. From these data we assume that Neanderthals bearing Discoid technology exploited flint available in large patches of land accordingly to a balance between transport costs and utility, like other groups bearing, for instance, Levallois technology (Porráz and Peresani, 2006). Besides, at Fumane no particular difference between Levallois and Discoid faunal assemblages are revealed (Romandini et al., 2014). Groups were thus characterized by logistical patterns of mobility, contrary to a general view which considers Discoid technology a way for exploiting resources opportunistically.

**Acknowledgements:** Research at Fumane is coordinated by the Ferrara University in the framework of a project supported by the Italian Ministry of Culture - Veneto Archaeological Heritage, public institutions (Lessinia Mountain Community - Regional Natural Park, Fumane Municipality, Veneto Region - Department for Cultural Heritage), Research Institutions (Max Planck Institute for Evolutionary Anthropology) and private associations and companies.

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Poster Presentation Number 48, Sa (16:00-18:00)

## Human and Caprine remains from Leopard Cave (Erongo, Namibia): Southern Africa before and after the introduction of pastoralist practices

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The timing and process of the origin of pastoralism in Southern Africa is a much debated question. Very recently, substantial advances have been made in the understanding of the genetic make-up of local human groups. The results show a rich and complex history of migration and admixture events, especially around 2 000 yrs ago, the possible time of arrival of pastoralist practices in the region (see for instance [1] and [2]). However, the archaeological evidence related to this major cultural and behavioral transition remains scarce. Located in the Erongo Mountains in Namibia, the site of Leopard Cave yielded the earliest evidence of domesticated animals known so far in Southern Africa [3]. Excavated since 2008, the stratigraphy of Leopard Cave documents seven sedimentological Layers, recording LSA human occupation from ca. 3500 Cal BP to ca. 2200 Cal BP. The elements recovered from the archaeological layers include abundant lithic, faunal and charcoals remains, as well as very few small potsherds. Among them, a small but significant number of remains securely identified as Caprine (two teeth and a portion of mandible with teeth) have been found in layers 5 and 6. However the archaeological assemblages of these layers clearly show that during this time period the inhabitants of the shelter relied predominantly on hunting and gathering. Two of these remains have been directly dated to 2169±40 and 2233±78 Cal BP. These ages indicate domesticates were present in the area well before the arrival of Bantu-speaking populations. However, it is still unclear if the origin of these domesticated animals is linked to the arrival of new herders ("proto Khoekhoe") or to a process of cultural diffusion of herding practices among autochthonous hunter-gatherers. In this research context, the discovery in 2012 of a series of human remains at Leopard Cave is highly relevant. Discovered in the excavation squares opened in the area located just in front of the shelter, these human remains correspond to several cranial fragments (from the skullcap, upper face and mandible) and a few postcranial bones of a single individual. All the human bones were completely covered by a coat of calcium carbonate. After cleaning, it appears that all of them are burnt and some presents series of cutmarks. While the actual anatomical connections of the bones were not preserved, their positions would indicate a primary position for the skull, and possibly a funerary structure. The extension of the excavation to the adjacent area will be undertaken in June 2014 and it is expected that it will provide more elements and data that will allow confirming or rejecting the hypothesis of a primary burial. Two direct radiocarbon dates recently obtained from one skull fragment gave consistent ages of ca. 6500-6700 years cal BP, thus predating the earliest occurrence of caprines recovered from the site until now. Accordingly, these remains most probably document the human groups which were inhabiting Leopard Cave prior to the introduction of domesticates in the region. Because of the scarcity of human remains of this antiquity in Namibia and because of their remarkable features (burnt, cutmarks), they are of primary interest in documenting the biological (and cultural) identity of the pre-pastoral groups inhabiting the region.

**Acknowledgements:** This work benefited from the financial support of LabEx ANR-10-LABX-0003-BCDiv, French Ministry of Foreign Affairs and International Development, Mus um National d'Histoire Naturelle (BQR and ATM programs). We also thank the owner of the Omandumba West farm, Mr. Rust, and his family.

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Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## The Grotta di Cala dei Genovesi – New studies on the Ice Age cave art on Sicily

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The Grotta di Cala dei Genovesi on the island of Levanzo off Sicily's western coast contains one of the most important records of Late Glacial rock art in the Mediterranean region. The animal and human engravings stem from the Late Epigravettian period and are characterized by a naturalistic style, stylistic parallels can be found on the island of Sicily and in southern Italy. More than fifty years after the original documentation, a field campaign by an Italian-German team was carried out in June 2012 as a first step to investigate the Palaeolithic engravings with modern techniques and to modify and complement it where necessary [1]. The systematic approach and the use of 3D scanning technology make the documentation of rock art more detailed, objective and efficient. Consequently the new study has succeeded in identifying various animals with much more detail and also in detecting several new, previously unknown figures. With the identification of four new bovid images the aurochs is now the most prominent animal in the pictorial composition of the cave (13 x), followed by equids (12 x) and cervids (8 x). This dominance of bovids is thought to have a meaning beyond the environmental context: the aurochs was the largest and strongest animal of the Late Glacial to early Holocene of Sicily and represented a dangerous prey at that time. Strong animals had a prominent role in Upper Palaeolithic cave art, and it is probably not a coincidence that in the Grotta di Cala dei Genovesi the aurochs seems to be represented only by depictions of adult individuals, while three of the eight cervid images can be identified as young animals. In addition this dominance shows parallels to a similar phenomenon in Late Glacial cave art of Southern Iberia.

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Podium Presentation: Session 2, Th (12:20)

## The Ceprano calvarium, twenty years after. A new generation of (digital) studies

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The Ceprano calvarium was found on March 1994 in the Mid-Pleistocene site of Campogrande (southern Latium, Italy) [1]. At the time of its discovery its presumed position in the regional stratigraphy suggested an age of about 800-900 ka. However, after systematic field activities started in 2001, new results obtained through a multidisciplinary approach showed that the chronology of the Ceprano calvarium is different, pointing to a time range close to the beginning of MIS 11, more probably between 430 and 385 ka [2]. As a consequence, Ceprano has to be considered part of the European fossil record of the Middle Pleistocene, referred by many authors to be hypodigm of *H. heidelbergensis*. However the absence in Ceprano of any derived Neanderthal-like morphological features and some other archaic characteristic of its cranial morphology [3], detaches the Italian specimen from part of the variability of this taxon in Europe and suggests that it may be a relic representative of the ancestral stock of the *H. heidelbergensis* morphotype, preceding the appearance of regional autapomorphic features [4,5]. So the peculiar morphology of this calvarium – with its unique combination of features – calls for further studies. A problem to be solved is that the calvarium was affected by diagenetic deformation of the postero-lateral vault, requiring an accurate restoration in view of more suitable comparative analysis. In particular, the main deformation is concerned by a lateral downward pressure that the sediments applied onto the left parietal (being flattened and largely fragmented/destroyed), while the contralateral wall was unnaturally warped (being more angulated, with elongated fractures). The deformation also affected the occipital scale, including the transverse occipital torus, which resulted tilted in posterior view. Several attempts to recompose the puzzle of its original morphology were carried out over time. With the aim of digitally removing any plaster residuals from previous interventions and safely manage the various fragments (more than 250 in total), all the human material from Campogrande has been recorded by X-ray microtomography ( $\mu$ CT) with an isotropic voxel size of 40  $\mu$ m. Starting from this digitally cleaned and newly assembled volumes, a digital symmetrization (based on 3D TPS algorithm), was performed. As a result, it was possible to correct the deformation that affected the specimen by a computer assisted technique based on geometric morphometrics obtaining a satisfactory and statistically controlled result. Furthermore an undistorted digital endocast and new high resolution volumes of the frontal sinuses were obtained.

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Podium Presentation: Session 11, Sa (15:20)

## The Evidence for Time Keeping Among Pre-Neolithic Hunter-Gatherers

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This paper synthesizes data from archeology, human ecology and ethnohistory to build a picture of time keeping among hunter-gatherer cultures of pre-Neolithic Northern Europe, Northern Asia and North America. Recent analysis of the pit alignment archeological site at Warren Field, Scotland, dated to 10,000BP, suggests that hunter-gatherers in Scotland were able to correct for the misalignment between lunar months and the solar year [1]. This ability, alignment to solar or stellar events using built structures, has been proposed as a hallmark of the cultural means to measure and maintain accurate time [2]. In North America, analysis of pit houses and stone wheel observatories shows that prior to European contact, hunter-gatherer groups were able to align built structures to the solstices, and to other events in the sky, and calibrate the observable lunar month to the solar year [3,4]. Evidence of counting is another important indicator of the potential to track time. For instance, to count days, and the length of the month, the Blackfoot are recorded to have used knot tying to mark off days from the new moon. Several important artefacts in France, including those found at Abri Blanchard and at Bruniquel, also suggest that hunter-gatherers could count [1]. Some evidence indicates that hunter-gatherer groups maintained pictographic calendars recorded on various media, including birch bark and animal hide. The naming of months for seasonal hunting and gathering patterns is another indication of the longevity of time keeping: the naming of months in the calendar of Todja reindeer hunters of South Siberia, of the Ojibwe and of the Blackfoot, of Canada, reflect naming according to hunting and gathering patterns as they were practiced. Pictographic-mnemonic systems were also used to communicate information inter-generationally among elite groups. For instance, after eighty years, four independent Blackfoot Winter Counts, a pictographic-mnemonic system, recorded a meteor shower which occurred in 1833 with an accuracy to within two years [5]. Given this data, within this paper, a categorized framework is constructed to document and compare time keeping among different hunter-gatherer cultures. The key categories are: solar alignment using built structures, evidence of counting artefacts and counting customs, use of pictographic calendars, months named according to hunting and gathering functions, and evidence of inter-generational communication using pictographic-mnemonic systems. Archaeological dates, specific cosmology and time symbols, and lithics associated with alignment structures or artefacts are categories that augment the framework. Finally, documentation of game (species, regional extinction dates, and migratory or non-migratory) are noted. From the official dates available for man-made alignment structures discussed herein, it can be inferred that accurate monthly time keeping, to within several days of the solar year, was well established on the Northern Plains of North America by 4,500BP, and in Northern Europe, by 10,000BP. Using the information presented in this framework, it is possible to compare time keeping practices of these hunter-gatherer groups. The overall picture, in Northern Europe by 10,000BP, and in North America by at least 4,500BP, are of fully developed time aware cultures that could keep accurate time in order to coordinate their hunting and gathering strategies with the seasons.

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Poster Presentation Number 30, Fr (15:30-17:30)

## Contribution of the ESR dating method to the chronological framework of the oldest hominid occupations in southwestern Europe

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The chronology of the dispersal of the Genus *Homo* into Europe is a key topic in prehistory. Within the European continent, the Iberian Peninsula is probably the area with the highest number of evidence of Early Pleistocene hominid occupations, including places such as Atapuerca Gran Dolina TD-6, Atapuerca Sima del Elefante TE-9, Fuente Nueva-3, Barranco León, and Vallparadís sites. Dating these archaeological sites is quite a challenge because they are not found in any volcanic context, precluding the use of the Ar-Ar method. Actually, only a few numerical dating method can be potentially applied (e.g. TCN, OSL, ESR, U-Pb), but the use of each method is limited by a range of factors (e.g. sedimentary context, depth, presence of carbonates or quartz, etc.) that almost rule out their application on a systematic basis. In that regard, the use of electron spin resonance (ESR) dating is of special interest, since this is a versatile method that may be applied to a wide range of materials such as optically bleached quartz grains, carbonates and fossil teeth, covering thus almost all possible geological contexts for this time range. This is why ESR is undoubtedly the most frequently used method to date early hominid occupations in Western Europe [e.g. 1, 2]. In the last few years, several ESR dating studies have provided new chronological data for some of the oldest hominid occupations in Spain like Fuente Nueva-3, Barranco León and Vallparadís [e.g. 3, 4, 5]. These ESR dating results, combined with those derived from palaeomagnetic and biochronological studies contribute to complete and refine the chronological framework of the first hominid settlements in Western Europe. The objectives of this work are: (i) to present an updated review of these recent dating results and (ii) to provide an overview of the potential, as well as of the current limitations, of the ESR dating method applied to tooth enamel and optically bleached quartz grains from Early Pleistocene sites. The future directions that are worth exploring in the future to improve the accuracy of the method will be also evoked.

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Poster Presentation Number 64, Sa (16:00-18:00)

## Dental Microwear Texture Analysis and the Diet of the Scladina Child

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Microwear texture analyses, the most recent development in the field of dental microwear, has been shown to be an important tool for the reconstruction of tooth use for dietary as well as non-dietary purposes for a variety of species including recent human groups and fossil hominins. Specifically, the application of microwear texture analysis to the anterior dentition of bioarchaeological human groups has proven effective in differentiating these groups based on diet, non-dietary anterior tooth use, and dietary and/or abrasive loads [1]. On the other hand, its application to occlusal molar surfaces of recent human groups has proven useful in distinguishing these groups based on their diets and food preparation techniques [2]. For fossil hominins, the application of microwear texture analysis to anterior dentitions and occlusal molar surfaces of adult Neandertal specimens has revealed strong correlations between paleoecological conditions and non-dietary anterior tooth use behaviors and diets for these fossil hominins [3-5]. To this end, Neandertals that lived under cold, open steppe conditions were found to use their anterior dentition in non-dietary behaviors much more intensely than those that lived in the warm, woodland climates [5]. In terms of diet, Neandertals from cold, open steppe environments were found to have diets that consisted almost exclusively of meat whereas those that lived in more wooded habitats were found to have microwear signatures reflecting a more mixed diet consisting of both meat and plant foods [4]. Here we apply microwear texture analysis to the anterior and molar dentition of the Scladina Neandertal to provide a rare glimpse into the diet and behavior of a sub-adult Neandertal. In comparison with adult Neandertal specimens and recent human groups, the results of this study show that the Scladina Neandertal used his/her anterior dentition solely for dietary purposes and that this child did not practice non-dietary anterior tooth use behaviors. Concerning diet, the microwear textures of the Scladina child show that the diet of this Neandertal can be best described as having consisted of a mix of soft and tough foods in addition to some amounts of dietary abrasives. Also, the anterior dental microwear texture results suggest that some of the foods ingested by this child required a high anterior loading regime. Synthesizing these data, perhaps the Scladina Neandertal was subsisting mostly on dried meat.

**Acknowledgements:** We are grateful for Peter Ungar for providing access to the microscope facilities at the Department of Anthropology at the University of Arkansas at Fayetteville. This study was supported by the Max Planck Society and the National Science Foundation DDIG Program (0925818), and Hunt Post-doctoral Fellowship (8554).

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Poster Presentation Number 74, Sa (16:00-18:00)

### ***Projet NéMo: The Chronology and Cultural Context of Neandertal Skeletal Material in Southwestern France***

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The Aquitaine Basin of south-western France has produced a near unparalleled concentration of Middle Palaeolithic sites, many of which include Neandertal skeletal material ranging from elements in anatomical connection to isolated fragments or single teeth. A new interdisciplinary project (*NéMo – Neandertal face à la mort*) aims to investigate the archaeological, taphonomic, and chronological context of these human remains in order to better understand their cultural association. Based on a substantial corpus of sites from the Périgord, Quercy, Charentes, and Agenais areas of south-western France, the overall goals of the project include (1) developing a more secure absolute chronology of sites from which Neandertal remains have been recovered, (2) evaluating the post-mortem manipulation of the body and possible symbolic implications, and (3) clarifying the “cultural” and economic context of the remains in terms of associated lithic and faunal assemblages. Here we present a general overview of the recently begun *NéMo* project and new fieldwork projects at two key sites in the region, Le Moustier and Combe Grenal. Work by O. Hauser and then D. Peyrony immediately before the First World War at Le Moustier produced at least two sets of Neandertal skeletal material; an adolescent (Le Moustier 1) discovered in 1908 and the recently rediscovered neonatal skeleton (Le Moustier 2, [1]) first uncovered in 1914. Here we present our (Gravina & Discamps) ongoing revision of newly discovered lithic and faunal material, as well as new fieldwork, both of which aim at revising the site’s archaeo-sequence, producing a more refined chronology, and better contextualising the Neandertal remains recovered from Le Moustier. Excavated by François Bordes between 1953 and 1965, the site of Combe-Grenal has yielded an important archaeological sequence in terms of our understanding of the character, diversity, and succession of Middle Palaeolithic industries in south-western France (recent examples include [2] [3]). Moreover, the site has produced numerous human remains (N = 27; e.g. [4]), for the most part associated with the Quina Mousterian. The integrity of the site’s archaeological sequence has, however, recently been called into question [5]. Building on this critique, we present preliminary results of an ongoing critical revision of the Combe Grenal archaeo-stratigraphy.

**Acknowledgements:** The Némo Project (Dirs. J.-P. Faivre, C. Lahaye, and B. Maureille) is financed by a grant from the French National Research Agency (ANR-10-Labex-52).

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Podium Presentation: Session 10, Sa (15:00)

## Biological constraints and evolution of language: a hypothesis on the exaptation of human vocal structures

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In this paper we intend to support the argument that the evolution of human language is biologically linked to central and peripheral structures that are not selected for necessarily linguistic purposes and that we can read in terms of “exaptation” for language. These constraints characterize language as a form of species-specific, articulated vocal production, unique for *sapiens*. In order to do this, we will use the biologically oriented perspective of cognitive sciences, which aims to consider neuroscientific and morphological data, paleoanthropological reconstructions and ethological comparison in an interdisciplinary way. The recent hypothesis on the evolution of language can be divided into two broad categories: those who support the derivation of language from voice, and those who assume a gestural-motor derivation. Our thesis is that language has evolved on the basis of structures that allow the vocalicity, that developed earlier, and therefore present in other species, also phylogenetically distant from *sapiens*. The data arising from the biology of the voice, in fact, allowed to demystify the idea of “specialty” associated with the human vocalicity: not only there are structural characteristics (vocal tract, see Fitch, 2002) similar to humans in many animal species (birds, but also mammals), but also among non-human primates, once considered the comparative emblem of non vocalicity, it is possible to identify complex vocal capacities (eg. singing primates, Gamba & Giacoma, 2005). Although vocal production seems possible in several animal species, our hypothesis seeks to explain not only the evolutionary derivation of vocal possibilities, but the characteristic segmentation of human speech especially. Human language, in fact, is characterized for the production of formantic frequencies, capacity also present in many animal species, and for the possibility of issuing a very broad range of frequencies in a constant manner. This capability is permitted by the typical structure of the vocal tract as a whole (not only by the low position of the larynx) and the ability to fine coordination of orofacial muscles with breathing rhythms. In human speech, in fact, the movements of the vocal tract’s articulators must be precisely synchronized with the vibrations of the vocal folds to clearly differentiate the oppositional phonemes. The difference of a tenth of a millisecond in the timing of the vocal cords’ vibration start, in relation to the movements of the vocal tract, can cause perceptible differentiations of phonetic elements. From the evolutionary point of view, therefore, it can be assumed, in agreement with the majority of the theories on the field, that many of the vocal structures (both central and peripheral) now used for articulate speech may have evolved for reasons not directly related to language and they have been exapted in a second time. Among these structures, both the SVT, with its muscular specific conformation, and the control systems of the muscles are particularly important. In this sense, the peripheral structures are considered not only anatomical constraints but also functional ones: only a certain conformation of muscle and bone, combined with a feedback control system based on continuous learning, allows to produce articulated voice. What was initially used for non-linguistic reasons (eg. chewing, McNeilage, 2008), was subsequently readapted for linguistic purposes because it offered a “speech ready” anatomical basis (Pennisi, 2013). From the structural and functional continuity, therefore, our hypothesis identified in the central and peripheral structures of articulated voice the evolutionary reasons of human language: they are the biological constraints that determine the possibilities of *sapiens*’ species - specific vocalicity and they allow us to use it even in the construction of social relations (Anastasi & Falzone, in press).

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Podium Presentation: Session 3, Th (16:10)

## **TOSPEAK, a primate long non-coding gene with human-specific promoter regulates development of the capacity to speak**

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The human capacity to speak is the foundation of our cultural, technological and scientific development. The primary organ of speech – the larynx – evolved sequentially in higher primates. The flexibility of the laryngeal joints and ligaments enabling the capacity for speech evolved with developmental changes to the anatomy of the supralaryngeal vocal apparatus in higher primates. Interestingly, a sequence of evolutionary changes to the anatomy of the wrist joint also increased flexibility in higher primates increasing supination from 90° to 180° enabling brachiation. Here we describe a large Australian family with severe speech impairment and limited supination (90°) with retrograde development of both the supralaryngeal vocal apparatus and wrist joints. Chromosome FISH analysis of affected family members identified disruption of a previously unidentified processed long-non-coding gene that we named TOSPEAK. TOSPEAK is primate-specific and appears to have evolved through exon recruitment in a common ancestor of extant primates. The basic structure of TOSPEAK continued to evolve in primates along with sequential duplication of a transcription factor binding site within the immediate promoter of higher primates. In vitro testing indicates corresponding sequential increase in TOSPEAK promoter strength in higher primates with human having the strongest promoter. New SITURNA® methodology was used to elucidate a novel non-coding role for TOSPEAK transcription levels consistent with the sequential evolutionary development of the larynx and wrist in higher primates and the capacity to speak in human. Evolution of the capacity to speak appears to be associated with TOSPEAK's regulation of another key aspect(s) of primate evolution. Time permitting, these findings will be contextualized with recent insights into the neurogenetics of speech development and control.



Poster Presentation Number 65, Sa (16:00-18:00)

## Stress distribution and molar macrowear in *Pongo pygmaeus*: a new approach through Finite Element and Occlusal Fingerprint Analyses

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In recent years the scientific community has shown an increased significant interest in the relationship between biomechanics and diet in extant and extinct primates. Most of these conclusions were based on the analyses of cranial morphology or unworn teeth. However, while tooth morphology can suggest what type of food can be processed, dental wear can tell us how a tooth is used. In this study, we examine the stress distribution in a digital model of a second mandibular molar of *Pongo pygmaeus* during occlusal loadings, taking into account the macrowear pattern. We combine together two different digital approaches: Finite Element Analysis (FEA) for the study of stress distribution and the Occlusal Fingerprint Analysis (OFA) for the examination of dental macrowear. The OFA results show a flat wear pattern characterized by large phase II and large buccal phase I facets. On the contrary, the lingual phase I facets are less developed with the exception of facets 5 and 7 that form along the slopes of the metaconid cusp. The FEA results indicate that the crenulated surface of the *Pongo* occlusal crown acts to reduce tensile stresses, which are of low magnitude and mainly concentrated on the occlusal grooves. The protostylid is shaped like a buttress to suffer the high tensile stresses that insist in the deep buccal groove. The molar of *Pongo* seems to resist very well to crushing and grinding stresses (phase II facets), which are typical of a diet that includes hard food objects such as seeds, bark and unripe fruits. On the other hand, the stress distribution on the metaconid is slightly higher and probably related to a shearing action (where the forces are directed parallel to the contact plane). The low blunt cusps, the thick enamel, the crenulated occlusal surface and the protostylid are important dental features that concur to reduce the tensile stresses in orangutans molars. This novel computer-based approach, that integrates together recent developments in dental macrowear and FEA, can potentially become a valuable tool to advance our understanding of the diet, morphology and evolution of extinct hominin species.

**Acknowledgements:** This study was supported by the University of New England (UNE Research Seed Grant 2014), UNE Partnerships and University of New England (Career Development Award for Early Career Researchers)

Poster Presentation Number 67, Sa (16:00-18:00)

## Elucidating Differences in the Feeding Ecology of Extant Apes Using Finite Element Analysis

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In recent years the engineering technique finite element analysis (FEA) has been adopted into the study of human evolution to predict the stresses and strains experienced by hard tissue when exposed to various loading conditions. Using this technique assumptions about functional adaptations to different dietary niches and feeding ecologies have been made for fossil hominins, particularly the australopiths, however we still have very little understanding as to how variations in the predictions of stress and strain actually reflect diet even in extant specimens. *Pan troglodytes* and *Gorilla beringei beringei* provide an ideal opportunity to investigate this, being closely related yet having distinct morphologies and known distinct diets. *G. b. beringei* is highly folivorous whilst *P. troglodytes* is more omnivorous and generalistic in its feeding repertoire. As a consequence of its abrasive folivorous diet it could be expected that *G. b. beringei* would show a greater resistance to stress and strain during molar bites than incisor bites compared to the more generalist *P. troglodytes*. This study investigates whether relative patterns of strain predicted via FEA in these two extant apes reflect their dietary adaptations. Two female crania were virtually reconstructed from medical CT scans and converted into finite element models. A series of loading scenarios were devised to compare incisor vs. molar bites at 400N and comparable maximum bite forces in both specimens. Strains recorded during molar loading in *G. b. beringei* were significantly lower than those during incisor bites, particularly in the subnasal and zygomaxillary region. This suggests *G. b. beringei* is adapted to resist mechanical loads during molar bites more than incisor bites. However, the results of *P. troglodytes* also showed a similar trend. Indeed, while overall levels of strain were higher for both load cases in *P. troglodytes* compared to *G. b. beringei*, the results suggest that *P. troglodytes* experiences a relatively higher level of strain during an incisor bite, contrary to our initial prediction. The patterns of strain recorded for these two morphologically and dietarily distinct apes were not hugely dissimilar, and differences could not easily be related to dietary strategy. Several reasons could explain these findings including the sensitivity of this investigation to often unknown or simplified input parameters and difficulties when comparing the results of FE models. However, this study highlights the difficulty in trying to infer dietary ecology from the results of FEA, and how little we know about relationship between diet, feeding behaviour and the skulls adaptation to masticatory loads. In conclusion this study suggests caution should be taken when using this technique for the elucidation of feeding behaviours and diet, particularly when examining fossils.

Poster Presentation Number 45, Fr (15:30-17:30)

## Lower Magdalenian Lithic Raw Material Conservation in Cantabrian Spain

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**Introduction:** Recent lithic studies framed in Human Behavioral Ecology have focused on how human groups optimized technology to adapt to variable landscapes [1, 2, 3]. Environments pose inherent foraging risks due to resource instability or variation; human groups perceived and responded to these circumstances to remain optimal [4, 5]. Technological optimality could be achieved through creation of stable working assemblages—collections of cores, blanks, and tools that were task-adjustable and could be maintained through strategic provisioning and conservation. Flexible and stable working assemblages were adaptively essential in the environmentally diverse Cantabrian landscape. This paper evaluates lithic conservation during the Lower Cantabrian Magdalenian (c. 20.5-17.5 kya cal BP; LCM) using a newly developed Conservation Index (CI) and argues that Last Glacial foragers balanced four principal strategies to safeguard tool stone and maintain stable assemblages. **Materials and Methods:** Lithic tools and debris from seven LCM archaeological contexts at four sites (Altamira, El Juyo, El Mirón, and El Rascaño) were analyzed and tools classified using the de Sonneville-Bordes and Perrot Upper Paleolithic typology. Tool classifications were evaluated using the CI, which summarizes toolkit conservation via cumulative percentages of four strategies evident in tool classifications: (a) use of bipolar reduction techniques (evidence of supplementing working assemblages with raw materials of lower quality or processing difficulty); (b) repurposing exhausted cores; (c) re-modifying tools; and (d) rejuvenating tools. CI values were compared at each LCM site to understand human adaptive responses to resource instabilities in relation to landscape variability. **Results:** Preliminary analyses indicate that: (a) working assemblage conservation was strongly tied to raw material availability during the LCM; the further a site from Basque region high quality tool stone outcrops, the greater its CI value; (b) while conservation via rejuvenation and re-modification of tools was consistent at all four sites, repurposing cores and use of supplemental provisioning were more variable behaviors that were likely closely tied to settlement patterns, site locations, and local tool stone quality; and (c) bipolar reduction was an important strategy used to supplement assemblages with blanks of lower quality flints or quartzites, especially at central Cantabrian sites where 20-45% of tool assemblages are splintered pieces. Use of bipolar reduction was also directly correlated to distance from high-quality Basque country flint sources. Overall, this research has shown that LCM foragers differentially used the four strategies marked in the CI to adaptively maintain assemblages when high-quality raw materials were scarce. Further scheduled analyses of nine additional Magdalenian collections will provide a wider lens through which to view adaptive-yet-variable Magdalenian conservation behavior and enable comprehensive reconstruction of Last Glacial mobility, assemblage variation, and tool stone provisioning in Cantabria.

**Acknowledgements:** This research was funded by: the National Science Foundation Doctoral Dissertation Improvement Grant 1318485 and the University of New Mexico Latin American and Iberian Institute Ph.D. Fellowship.

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Podium Presentation: Session 10, Sa (14:20)

### A morphometric analysis of the hominin deciduous lower second molar (I/12a) from Qesem Cave

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The hominin fossil record from the Middle Pleistocene site Qesem Cave (QC) is represented by several well preserved permanent and deciduous teeth. These dental remains have been qualitatively described by Hershkovitz and colleagues [1], and a geometric morphometric investigation has been performed for some of the permanent lower posterior teeth [2]. The taxonomy for the QC hominin has not yet been resolved since the dental remains showed a complex admixture of archaic and derived morphological features, and unusual size variation. With the aim to enhance the current knowledge of Middle Pleistocene dental variability and QC taxonomic attribution, we focused on I/12a lower second deciduous molar ( $dm_2$ ) which we investigated through Geometric Morphometric (GM) techniques based on crown and cervical outlines from 3D surface models. I/12a was compared to a sample of 31  $dm_2$ s from fossil and recent anatomically modern human (AMH) and Neanderthal (NEA) individuals. We produced 3D surface models from  $\mu$ CT data and oriented the virtual crowns (with best-fit plane parallel to the X-Y-plane and lingual margin parallel to the X-axis) in order to collect both crown and cervical outlines [3]. Each outline was represented by pseudo-landmarks identified by a fan of 24 equiangularly spaced radii out of the centroid of the outline itself. The landmark configurations were superimposed through General Procrustes Analysis and a Principal Component Analysis was performed on both shape and form coordinates considering cervical and crown outlines separately. AMH and NEA presented a distinct shape in terms of both crown outline (PC1=38.45%; PC2=28.43%) and cervical outline (PC1=37.76%; PC2=22.86%). The main crown outline variation responsible for the separation between the two hominin groups was in the relative dimension of the distal and mesial regions, where NEA and I/12a possessed a relatively broader distal aspect. NEA cervical outline was rather squared, while in AMH the buccal aspect was reduced. Qafzeh 15 AMH showed morphological affinity to NEA for its crown outline, while the other Levantine Middle Pleistocene specimen Skhul I was always within the range of variability of AMH. I/12a allied with NEA for both outlines. Size does not distinguish between groups since AMH and NEA widely overlap in form space in both crown and cervical outline analyses (PC1=87.04% and 83.78%, respectively). I/12a and Qafzeh 15 plot at the highest end of the size range of variability for the very large sizes of both outlines. I/12a showed morphological affinities to NEA for the shape and size of its crown and cervical outlines. This observation is in accord with the findings of Weber and colleagues [2] for QC permanent lower second molar. However, the contrasting results for QC premolars' shape and size suggest caution in interpreting dental morphological variability within Middle Pleistocene hominins. A larger Middle Pleistocene sample would possibly provide more taxonomic insights. A preliminary analysis of the EDJ 3D morphology confirmed the affinity of I/12a to NEA, but showed also some morphological peculiarities that distinguished I/12a from both NEA and AMH.

**Acknowledgements:** This research was financially supported by Sigfried Ludwig - Rudolf Slavicek Stipendienstiftung, 1090 Wien, Widerhoferplatz 4/38, Project number FA547016

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Podium Presentation: Session 6, Fr (14:10)

## Did a longer “functional” lumbar spine in early hominids facilitate the evolution of the lumbar lordosis?

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The lumbar lordosis is one of the hallmarks of human bipedalism. Its evolution in early hominids is thought to have been facilitated by a longer “functional” lumbar spine compared to that of modern humans [1]. The recent discovery of a partial vertebral column of *Australopithecus sediba* demonstrates that all known early hominid fossils had a longer “functional” lumbar spine than the majority of modern humans despite the same segmentation pattern. The so-called functional definition of spinal regions is based on articulation types and the position of the anticlinal vertebra [2, 3]. This definition is often preferred over the traditional presence/absence of movable ribs because the position of both the anticlinal and the transitional vertebra bearing thoracic-type articulations superiorly and lumbar-type ones inferiorly is closely correlated to locomotor types in primates. In early hominids, the transitional vertebra is always at T11, including MH2 (*A. sediba*), Sts 14 and Stw 431 (*A. africanus*), and KNM-WT 15000 (*Homo erectus*). In modern humans, it more frequently occurs at T12, i.e., the last rib-bearing vertebra [4, 5]. Here, we test the hypothesis that a longer “functional” lumbar region reflects a greater mobility and thus greater capacity for lordosis. We analyzed segmental mobility for flexion/extension in functional lumbar radiographs of 120 patients by measuring the angles between the endplates of adjacent vertebrae on lateral X-rays in maximal flexion and maximal extension. The reasons for consultation included unspecific low back pain, spondylolisthesis, and a history of disc herniation in the lower lumbar spine. These pathologies might disturb spinal mobility locally, but there was no indication that they affected mobility at the thoracolumbar border. A MANCOVA showed no influence of the position of the transitional vertebra and facet joint orientation, respectively, onto segmental mobility in the sagittal plane. This challenges the functional significance of vertebral articulation types with respect to the evolution of a human-like lordosis and bipedalism. Moreover, we found no support for the notion that a definition of spinal regions based on articulation types should be preferred over the traditional definition based on the presence of movable ribs. This is corroborated by the absence of an anticlinal vertebra in hominoids. If there was an evolutionary advantage of a longer “functional” lumbar spine, it rather might lie in rotational stability than in sagittal mobility. Rotational stability is important in climbing [3]. We therefore conclude that the more cranially positioned transitional vertebra of early hominids compared to modern humans might reflect a climbing adaptation rather than being correlated to the evolution of lordosis.

**Acknowledgements:** With thank the Mäxi Foundation for financial support.

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Poster Presentation Number 13, Fr (15:30-17:30)

## Re-evaluation of the Pleistocene and Holocene long bone robusticity trends with regards to age-at-death estimates and size standardization procedures

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Several authors (e.g., [1], [2]) declare a decreasing robusticity trend of lower limb long bones in the genus *Homo* through time from the Early Pleistocene until present. This trend is usually interpreted as a consequence of decreasing levels of mobility and activity patterns, changes in lifestyle, and environmental factors. There is also evidence of increasing robusticity over the individual lifespans [3], [4]. Such an increase is caused by continuous bone remodeling which optimizes the structure of a bone to effectively resist mechanical loading and, at the same time, acts more progressively on the side of subperiosteal apposition than on the side of resorption. This paper is aimed at re-exploring temporal trends in robusticity of lower limb long bones within the genus *Homo* in the Pleistocene and Early Holocene. The principle questions tested are whether the consideration of age-at-death of Pleistocene and Holocene individuals can confound, in any way, published robusticity trends, given the fact that robusticity tends to increase over the individual lifespans. Cross-sectional diaphyseal properties of the midshaft and proximal femur and midshaft tibia of Pleistocene and Early Holocene individuals together with the data on age-at-death are used to analyze changes in robusticity in relation to age and evolutionary time. Fully aware of the problematic nature of the age-at-death estimation (i.e., very low reliability of high precision estimates and vice versa), we feel like such an approach could shed new light on the robusticity trends. The results show increasing robusticity in adulthood until the fourth decade and then a slight decrease, an observation that conforms to the previously published results on recent human populations. However, no significant impact of age-at-death to robusticity trends has been detected. In all of the temporal samples analyzed, there is a similar distribution of all age groups with more or less even distribution of younger and older individuals. The decreasing temporal trend of robusticity published by Ruff et al. (1993) [1] was reviewed and could not be verified. Contrary to the expectations, it seems that the long bone robusticity fluctuated in past populations, mainly as a consequence of changes in climate and to a lesser degree their mobility patterns. Moreover, since two different approaches to size standardization of cross-section properties have been utilized in this study (body mass vs. bone length standardization) and yielded contradictory results, we can confirm previous assertion [5] that inferences made from the robusticity measures can very easily be skewed by the standardization procedures.

**Acknowledgements:** This project was supported by a Postdoc support of the University of West Bohemia, a New Technologies for Research of Contemporary and Past Societies Grant (Grant number: OPVK NOTES CZ.1.07/2.3.00/20.0135) and by the grant agency of the University of West Bohemia (grant number: SGS-2014-025).

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Poster Presentation Number 1, Fr (15:30-17:30)

### Size and sex variance in *Paranthropus robustus*: Taxonomic and Palaeobiological implications

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Previous research has highlighted significant male bias in reasonably complete cranio-facial specimens of *Paranthropus robustus* from the Lower Pleistocene of South Africa (mostly Swartkrans). It has been suggested that the Swartkrans sample, largely resulting from an accumulation due to carnivore activity, seems to display a relative abundance of male specimens (at least among the well preserved skulls); this would be the outcome and a possible consequence of the social structure of a highly dimorphic species where non-dominant males spent more time alone and thus were at a greater risk of predation [1]. The comparative metrical analysis of the dental remains of *P. robustus* from the sites of Swartkrans and Drimolen has indicated that the Drimolen specimens are smaller overall than at Swartkrans, and the sample incorporates more variability than at Swartkrans (and in some tooth positions also the Kromdraai sample). The possibility that some kind of selective agent and/or taphonomic bias has produced a differential accumulation of a relatively larger number of small individuals in the Drimolen sample or of a relatively larger number of larger individuals in the Swartkrans sample has been discussed [2]. More recent perspectives have argued that the enigmatic (and unprovenanced) mandibular second molar from Gondolin (GDA-2), considered to be *P. robustus*, is consistent with an extreme level of size dimorphism and that this supports recent contention of a bias of small-males in the *P. robustus* hypodigm [3]. Nevertheless, irrespective of consistencies in exact randomization and permutation approaches using metrics of within-sample variance, such models are dependent upon variance within both the comparative 'reference' and fossil 'target series'. More crucially, these do not consider potential problems with specific specimens, a fact highlighted by the GDA-2 M2 from Gondolin. An alternative approach, yielding justified significance levels, is the z-and-t distributions, which attests to considerable robusticity at  $n \leq 20$ . These allow effective consideration of sex bias, particularly where preservation is sufficient to warrant diagnostic sex assignment of specific individuals that can be used as 'pegs'. When this is applied to dental metrics (BL diameters), generated z-and-t scores for the *P. robustus* maxillary and mandibular dental series (P3-M3) are consistent with within-sample distributions for our four comparatives (*Homo* – *Pan* – *Gorilla* - *Pongo*), not only those highly dimorphic references (*Gorilla* - *Pongo*). Further to this, our results are consistent with significant sex bias in the maxillary and, less consistently, in the mandibular dental series of *P. robustus*. Inclusion of the enigmatic GDA-2 M2 within *P. robustus* generates a marked skew in the distribution that is unreferenced and perhaps unrealistic. Assignment of this specimen to *P. robustus* at present should be considered with extreme caution.

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Poster Presentation Number 49, Sa (16:00-18:00)

## **Impact of geographic, chronological, climatic and linguistic factors on human cranial variation: new insights on the peopling of the New World**

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The origin and dispersal of modern humans in the Americas remain contentious. Skull shape variation has been interpreted as showing evidence of at least two migration waves or alternatively as a relatively continuous process with a major importance of local processes and recurrent gene flow. Here we investigated the structure of craniofacial variation and test for the significance and weight of various extrinsic factors on shape. Using three-dimensional geometric morphometric methods, our work aimed at (i) detecting morphological differences between chronological and geographical groups that may indicate dispersal events (number of waves and migration routes) and/or local differentiation; (ii) evaluating the impact of climate on skull and neurocranium variation; (iii) testing the correlation between craniofacial shape and linguistic families. We analyzed 978 specimens including 3 fossil series respectively from Lagoa Santa (Brazil, Early Holocene), Indian Knoll (United States, Late Holocene) and Tam Hang (Laos, Late Pleistocene) as well as isolated specimens from 20 archaeological sites from the New World and the Old World (Early and Late Holocene) and 30 modern series from Americas, Asia, Australo-Melanesia and Pacific Islands. All specimens were surface-scanned and 39 three dimensional landmarks were extracted and submitted to a Generalized Procrustes Analysis. Shape and size variation of complete skulls and neurocrania were analyzed by means of standard multivariate statistics. Our results show that chronological and geographical factors have a significant effect on shape variation. Yet geography and especially regional differentiation explain much more variance than does chronology. We also detected a gradient change throughout time with higher morphological differences between North and South America observed within fossils and higher differences between East and West America observed within modern populations. In addition, our results confirm the impact of climate effects on shape variation, in particular regarding circum-Arctic populations, impact which is reduced when only neurocranium is considered. Our results also highlight very strong correlations between shape variation and linguistic families. Our study tends to give more support to the hypothesis of one major event followed by in situ differentiation and recurrent gene flow rather than two distinct migration waves.

Poster Presentation Number 9, Fr (15:30-17:30)

## Preliminary study of the head-neck complex of Neanderthal ribs from the El Sidrón site (Asturias, Spain)

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Fossil ribs are important to the understanding of the evolution of form and function of the hominin thorax [1,2]. The head-neck complex of the rib forms a joint with the thoracic vertebrae and defines the orientation of the rib relative to the transverse vertebral process and the rotational axis at the costo-vertebral joint. It contributes thus to thorax morphology and possibly to the potential of its expansion during respiration. This complex is located at the vertebral rib extreme and comprises the head, the neck and the articular and non-articular tubercles. The articular facets of the head and the articular tubercle connect the rib with the adjacent vertebra. Unfortunately, these structures are scarce in the hominin fossil record, particularly in Neanderthals, so its morphology is unclear. While neck length in Neanderthals has been described controversially as identical, greater or even shorter than in modern humans, there is agreement on the larger size of the articular tubercle in Neanderthals [2]. Although rib heads are not well known in Neanderthals, species differences at these parts should be coherent with differences in thoracic vertebrae [3]. Therefore, the previous evidence leads us to expect differences in the shape of these structures but not in overall size. This is the hypothesis addressed in the present paper. In this context, the El Sidrón site (49 kyrs BP) [4] is important because it has yielded several well-preserved Neanderthal proximal costal remains from the upper and lower thorax that can contribute to clarifying the morphology of this important element. To test these hypothesis eight 3D-landmarks of the head-neck complex were measured in 3D-surface models of a comparative sample and analyzed by geometric morphometrics. The Neanderthal sample comprises fossils from the El Sidrón site (N=9), as well as specimens from Kebara 2 (N=4). The comparative *H. sapiens* sample comprises 200 ribs (1st-10th) belonging to 10 adult males and 10 females from the Santarém Collection (University of Coimbra, Portugal). Mean comparisons suggest that overall size does not differ between Neanderthals and modern humans. However, there is evidence for different size relations between its parts (and thus shape). While a consistently bigger articular tubercle has been proposed [2] our results suggest that this is only valid for the lower thorax. Our findings also specify that the tubercle projects more posteriorly in Neanderthals while in modern humans it projects inferiorly. This alters the rib position relative to vertebral transverse process and the rotational axis of Neanderthal lower ribs, possibly in relation to greater diaphragmatic size and activity and associated kinematic differences [1,2]. Multivariate regression indicates that serial shape change in modern human rib head variation explains about 20% ( $p < 0.0001$ ) of total variance. However, serial shape change along proximal ribs may differ between modern humans and Neanderthals: in Neanderthals the rib head tends to be bigger in upper ribs and smaller in lower rib, coherent with larger upper and smaller lower heights of thoracic vertebrae [2]. The results indicate further that cranio-caudal serial decrease of rib neck length could be more pronounced in Neanderthals than in modern humans. Our findings point reinforce the importance of lower thorax anatomy in Neanderthals [1,2] and indicate the need for deeper investigation into serial anatomical structures of the axial skeleton in human development and evolution.

**Acknowledgements:** We thank the El Sidrón Excavation team, Ofer-Bar Yosef, Bernard Vandermeersch, Baruch Arensburg, and Israel Hershkovitz. This project is funded by the Leakey Foundation, the ERASMUS Program of the Autónoma University of Madrid, and the Spanish Ministry of Economy and Competitiveness: CGL2012-37279 (MB), and CGL2012-36682 (AR). El Sidrón Field work is supported by Consejería de Cultura del Principado de Asturias, Grant sponsor: Convenio Universidad de Oviedo-CSIC, Grant number: 060501040023.

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Podium Presentation: Session 7, Fr (14:30)

## Neanderthal spatial behaviour during the Late Interglacial within a lake shore environment: the case of Neumark-Nord 2 (Germany)

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The Eemian lakeland of Neumark-Nord (Sachsen-Anhalt, Germany) is a key site for our understanding of Neanderthal behaviour during the last Interglacial (MIS 5e) on the Northern European Plain. The site of Neumark-Nord 2 is located along the northern margin and slope of a ca. 1,6ha sized small pond within this past lakeland. Detailed excavation exposed a series of archaeological units and by far the richest level, NN2/2B, yielded 20,000 lithic artefacts and 120,000 faunal remains, distributed within and across an area of 500 m<sup>2</sup>. Alongside this archaeological richness, several depressions were excavated at the base of unit NN2/2B filled with archaeological material and were originally interpreted as humanly-made “structures”. Thus, one of the initial aims for our working group was to determine the cause of these features and whether they truly represented an anthropic structure, perhaps caused by a more permanent Neanderthal presence, or were the result of erosional events associated with hydrological erosion. Ongoing zooarchaeological research shows that humans were the main agent of accumulation, with almost no carnivore remains or bone surface modifications. Studies of the Neumark-Nord 2 stratigraphy suggest the basin was infilled over a relatively short time interval (c. 500 years) providing a high-resolution spatial and temporal perspective often lacking in open-air Palaeolithic locations. Thanks to archaeozoological and GIS-based taphonomic analyses, we have identified various processes that have influence the formation of the biostratigraphic sequence at NN2, including the changing level of the water table, overland water flow, erosional events and trampling. Defining these processes, as well as their effect on the archaeological record, is essential to provide a clearer understanding of the humanly-derived accumulation of remains at the site. In this paper, we present an integrative and multidisciplinary analysis of NN2 faunal assemblage and its spatial distribution. Using GIS, the dispersal of the large bone assemblage is both mapped and analysed, focussed on the distribution of specific archaeozoological features, such as the main species, different skeletal parts or human-related modifications, such as cut marks or burnt bones. Through the application of distribution maps and geostatistics, the existence of spatial patterns (i.e. significant concentrations) related with human activity is analysed. Some of the main hypotheses to be tested are the natural or anthropic nature of the depressions, the creation of the site as the result of one single hunting event or multiple occupations, or the identification of “complex” spatial behaviours among Neanderthals, including a differentiated use of space. The combination of comprehensive archaeozoological analyses with a GIS-based spatial analysis provides a detailed picture of Neanderthal behaviour during the Eemian. This will provide a better understanding of the human use of space around NN2 and within the broader Neumark-Nord lakescape, whilst also emphasising illustrating the complexities and differences in Neanderthal behavioural adaptations during Interglacial environments.



Poster Presentation Number 59, Sa (16:00-18:00)

## ELOVL2, FHL2 and PENK DNA hypermethylation as an age-predictor in modern human teeth samples

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The complex interaction between genetics and environment is mediated by epigenetics in a dynamic way. Epigenetics is a molecular mechanism relatively stable over time that, through reversible modification of cytosines and nuclear proteins, is able to produce new phenotypes. The increasing interest in DNA methylation mechanisms has allowed the identification of a new type of biomarkers with a great potential for a wide range of applications [1]. Moreover, since DNA is a highly stable molecule and it has been demonstrated that DNA retains *in vivo* patterns of CpG methylation [2,3] this process can be used to infer the age at death in ancient samples [4]. Considering that material from teeth constitutes the major source of DNA for studies on ancient samples, we analysed DNA methylation profile of 3 different tissues of the teeth (cementum, dentin and pulp) [5] of individuals ranging from 18 to 77 years. We applied Sequenom EpiTYPER assay (with single-CpG site resolution) and we measured DNA methylation level in 3 regions located in the CpG islands of ELOVL2, FHL2 and PENK genes testing for age-association. The results show that DNA methylation of the selected regions strongly correlates with age in particular in cementum and pulp. This is the first biomarker that has been proved to change according to samples age in different tissues of the teeth.

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Poster Presentation Number 53, Sa (16:00-18:00)

**”Grandmother, what big browridge you have!” - The mechanical relevance of the browridge in Kabwe 1 (*Homo heidelbergensis*)**

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With the exception of *Homo sapiens*, all hominin species present a well-developed supraorbital ridge. Two, non mutually exclusive, main hypotheses have been suggested to explain large ridges. The first (spatial hypothesis) is that the morphology of the supraorbital region arises due to the spatial relationships of the brain, cranial base and orbits. Under this model brow ridges have no particular mechanical significance [1]. The second (mechanical hypothesis) posits that the supraorbital ridge develops to resist stresses and strains experienced by the craniofacial skeleton during masticatory loading [2]. Experimental modification of the supraorbital region with subsequent assessment of the mechanical consequences may help resolve this debate. Such experimentation can be carried out *in silico*. The null hypothesis is that changing the form of the supraorbital region does not impact on the magnitude or distribution of strains or modes of large scale deformation experienced by the craniofacial skeleton during simulated masticatory loading. To test this, a specimen of *Homo heidelbergensis* (Kabwe 1) was virtually reconstructed and the morphology of the browridge was manipulated by (1) reducing its size and (2) creating a post-orbital *sulcus*. Voxel based FE models of the non-manipulated and manipulated specimens were created, loaded and solved to assess the strains experienced by the brow-ridge. Maximum and minimum principal strains contour plots, together with modes of large scale deformation of the cranium, were compared among models. Preliminary results simulating central incisor, second premolar and second molar bites indicate that changing the morphology of the browridge does not impact greatly on facial mechanical behaviour during simulated masticatory function. These results falsify the mechanical hypothesis, indicating that growth and development of the browridge is not driven by biomechanical adaptation to masticatory loadings. The findings are consistent with the spatial hypothesis. However, the browridge is bigger than it needs to be to simply fulfil spatial demands. Thus, other factors, such as social signalling, may also partially explain the highly developed browridge of Kabwe 1. This is reminiscent of the paranasal swellings present in male specimens of *Mandryllus sphinx* [3], [4]. Further research is necessary to adequately address this possibility.

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Poster Presentation Number 3, Fr (15:30-17:30)

## Mid-Pliocene Primates (Cercopithecoidea) from Brad Pit B, Klinkerts (Bolt's Farm Cave System, South Africa)

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Bolt's Farm is a composite, temporally broad (Early Pliocene to Late Pleistocene) fossiliferous karstic system in the "Cradle of Humankind", Gauteng Province, South Africa and is known to have yielded some primate remains in the past. Since 2006, the HRU (Hope Research Unit) have identified more than 30 fossiliferous sites dated between 1 to 4.5 Ma on Klinkert's and Greensleeves properties. A recently discovered site on the Bolt's Farm Cave System, Brad Pit B (BPB), has been dated biochronologically via rodent remains, *Euryotomys* sp., to fall between Waypoint 160, Klinkert's, Bolt's Farm Cave System (4.5 to 4 Ma) and Makapansgat (Rodent Corner and Member 3) in Polokwane, Limpopo Province (3.5 to 2.58 Ma), giving a possible age of mid-Pliocene to BPB. BPB has yielded 15 remains of Cercopithecoidea (one skull, one frontal bone, seven mandibles or fragments of mandible, three isolated teeth and three postcranial bones). Comparative analyses with specimens from Pit 23 from Bolt's Farm, Makapansgat (Member 3 and 4) and Sterkfontein (Member 4), indicate that these remains are attributable to, *Parapapio* cf. *broomi* (a small baboon) and *Cercopithecoides* cf. *williamsi* (a colobine), representing the oldest co-occurrence of these two genera in South Africa. The oldest known site within the Bolt's Farm Cave System, Waypoint 160, possibly represents a dry and open environment, as indicated by the presence of the rodent *Petromus bolti*, a genus which is today restricted to the dry, rocky escarpments of Namibia and Angola. At BPB, the presence of *Cercopithecoides* cf. *williamsi* (a semi-terrestrial colobine) and *Euryotomys* sp. (a grassland rodent), possibly suggests a grassland-woodland mosaic at BPB, which would make this the earliest known occurrence of such a mosaic habitat to date in the South African Pliocene. Biogeographically, the BPB fossils also suggest that *Cercopithecoides* and *Parapapio*, may have spread from East Africa to South Africa at an earlier time than generally acknowledged.

Podium Presentation: Session 10, Sa (14:40)

### Taxonomic interpretation of the Salé (Morocco) hominin endocast

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The human remains from Salé are integral to the interpretation of the African Middle Pleistocene fossil hominin record and to the origin of *Homo sapiens*. In 1971, a calvaria, part of the left maxilla and a natural endocast belonging to one individual were fortuitously discovered in a sandstone quarry [1] near the town of Salé, on the Atlantic coast of Morocco. The chronological position of the sediments that yielded the fossils has been roughly correlated to one of the episodes of the “Anfatian” transgression, circa 400,000 BP. The state of preservation of this individual is excellent and while the skull shows evidence of pathology [2] it does not seem to affect the endocranial morphology. The contribution of paleoneurology to the study of human evolution is extremely informative. However, the endocast of Salé has not yet been fully described. Only an estimate of the cranial capacity and a short note on meningeal vascularization has been published [3]. The aim of this study is to provide comparative study of the Salé endocast and to reevaluate the taxonomic position of the Salé hominin. The endocast of Salé was compared to African (KNM-WT 15000, KNM-ER 3733 and 3883, OH9, LH18 and Kabwe from East Africa, and Tighenif and Jebel Irhoud 1 and 2 from North Africa) and Asian fossils hominins (Zhoukoudian, China and Trinil, Sangiran, Ngandong and Sambungmaçan, Indonesia) as well as to a sample of extant modern humans. This exhaustive study includes an analysis of endocranial form (i.e. size and shape), position of the cerebral lobes, hemispheric asymmetry, as well as of the morphology of endocranial features such as encephalic reliefs, cerebral fissures and vascular impressions. The direct measurement of cranial capacity by immersion in water, traditional linear 2D analysis, as well as 3D geometric morphometrics analysis were performed. Despite its remarkably small size (the average of three tests is 920cm<sup>3</sup>), the Salé endocast most closely resembles specimens attributed to *Homo rhodesiensis* (for example by the individualization of parietal reliefs or anterior position of cerebellar lobes) which are clearly distinct from those assigned to *Homo erectus sensu lato* in most of its preserved morphological endocranial features.

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Poster Presentation Number 58, Sa (16:00-18:00)

## Heritability and Plasticity in Teeth: A Papionin Model for Testing Environmental and Phylogenetic Hypotheses in Primate Evolution

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In studies of human evolution we routinely use morphology to infer evolutionary history, functional adaptation, and environmental adaptability. The nature of the inferences that are possible depend upon the heritability of the traits – the more heritable, the stronger the inferences about evolutionary history and adaptation, the lower, the greater the role of local, ontogenetic and environmental processes. Among baboon teeth the mandibular  $M_1$  has the highest degree of heritability, while the maxillary  $M^3$  has the lowest [1], [2]. We use these results to frame a hypothesis that the  $M_1$  and the  $M^3$  may show different signals. We build on this observation by taking standard linear dimensions of these teeth from a sample of macaques (Cercopithecidae: *Macaca*), and explore how differences in the patterns of these variables and ratios between them relate to a number of independent variables (phylogeny, environment, body size, etc.). In particular we attempt to show whether the different levels of variation in more or less plastic traits can be used to test adaptive hypotheses. Linear measurements with predicted highest and lowest heritability estimates, mesiodistal lengths (MD) for  $M_1$  and  $M^3$  respectively, were taken on 744 dry, adult specimens from 12 macaque species. We employ macaques as a model taxon for their taxonomic, ecological and geographical diversity. Using the absolute and size-corrected metrics, overall range of variation, coefficients of variation (CV) and ratios of these between  $M_1$  and  $M^3$ , we describe how these vary among taxa. Our data show that the degrees of variation in  $M_1$  and  $M^3$  are among the lowest and highest for molars, respectively. This is consistent with the baboon results [2] and provides a basis for considering further hypotheses. In combination with the differential heritability estimates for these teeth, it is proposed that the observed variation in  $M^3$  in proportion to that of  $M_1$  is a measure of the degree of influence of environmental effects in shaping phenotypic variation, i.e., phenotypic plasticity: if the  $M^3$  to  $M_1$  variance ratio is high then local environmental influences have had a significant effect on phenotypic expression, whereas if the variation in  $M^3$  is similar to that in  $M_1$ , local environmental influences have had relatively little impact and instead we detect signals of past selection or other evolutionary processes (e.g. genetic drift). First, we consider phylogenetic aspects. Dental variation should reflect phylogeny, but according to our hypothesis,  $M^3$  may show a less consistent signal. We investigate in particular differences between continental and island species, as the latter typically have lower genetic variation (e.g. due to a founder effect) which should reduce the phenotypic variation in  $M_1$  more than in  $M^3$ . Next, we explore the effect of latitude on dental plasticity. Specifically, we hypothesise that, controlling for phylogeny and body size, more northern species should exhibit reduced genetic variation as a consequence of higher selection pressure resulting from harsher environmental conditions while simultaneously displaying increased phenotypic variance as a result of a more variable climate, than more equatorial species. Thus, we expect the ratio of  $M^3$  variation to  $M_1$  variation to increase with latitude. Lastly, macaques can broadly be segregated into species that are found in primary, broadleaf evergreen (BE) forest and species that mostly occur in non-forest habitats (e.g. scrubland, mangroves, or alpine forest), which are less stable or predictable. Macaques surviving in the latter habitats are subject to much more environmental variation than BE macaques. Consequently, we predict that non-BE macaques will show a higher degree of dental plasticity, and this should be signalled in disparate levels of variation in  $M_1$  and  $M^3$ .

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Poster Presentation Number 31, Fr (15:30-17:30)

### Further elements on the chronology of the Roc de Marsal (SW France) Middle Paleolithic sequence: insights from quartz Single Grain OSL and various K-feldspar IRSL signals

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The Roc de Marsal is a small cave located on a cliff close to the Vézères River, in the Dordogne region of France. It is famous for the discovery of the well preserved skeleton of a Neanderthal child [1]. Recent excavations focused on the Middle Paleolithic occupation layers, and revealed very rich deposits in terms of both lithics and fauna. Geoarchaeology shed new light on the processes of sediment deposition and allowed discussing the intentionality of the 'burial' of the Neanderthal child [2]. Combustion features were also uncovered in a very good state at the base of the sequence [3]. In a previous attempt to date the Mousterian occupations of Roc de Marsal [4], TL on heated flints and sedimentary quartz, as well as multi-grain OSL on fine grained quartz extracts from both heated and unheated sediment samples were studied. This original study revealed a systematic discrepancy between OSL and TL ages, and the authors concluded that multi-grain OSL results from fine grain quartz could not be trusted because of small scale dose rate heterogeneities and/or incomplete OSL signal resetting of fine grain quartz, possibly due to roof spall contamination. To resolve this discrepancy and further constrain the chronology of the sequence (in particular, Quina layers at the top of the sequence remained poorly dated because of the scarcity of heated flint samples), coarse grain quartz and potassium-rich feldspar extracts have been studied using, respectively, single grain OSL and various IRSL signals. These luminescence signals, because they provide complementary information, are expected to shed more light on the chrono-stratigraphy of Roc de Marsal. In particular, OSL and IRSL signals have different sensitivities to sunlight exposure: thus, their comparison allows identifying luminescence signals resetting problems at the time of sediment deposition, and help constrain single grain OSL analysis. The OSL from eight samples has been measured; in all cases, the OSL signal is dominated by the fast component. However, the proportion of grains emitting detectable OSL greatly varies between samples: whereas 30-40 % of the grains sampled from combustion features (n=3) are usable for OSL dating, only 5-10 % of the grains from unheated sediment samples (n=5) show an uncertainty on the test dose (25 Gy) response of less than 20 %. Multi-grain post-IR IRSL signals at elevated temperature (225 °C) and IRSL signals at 50 °C have been measured and corrected for fading; they indicate that the OSL signals from all samples were fully reset before subsequent sediment deposition. Statistical analysis of measured OSL data is performed using a newly developed Bayesian central age model [5]. New ages, both from IRSL and single grain OSL signals, will be presented and discussed, and an overall chronological scenario will be proposed.

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Podium Presentation: Session 5, Fr (11:40)

## Khoe-San retain a gracilized version of the ancestral modern human phenotype

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Genetic data point to a sub-Saharan origin of all modern humans living today, however little is known about the morphology of the first *Homo sapiens* in Africa. Here we use 3D geometric morphometrics [1] to compare cranial shape in a worldwide sample of recent and fossil humans from Africa, Europe, and Asia.

Our data comprise cranial landmarks and semilandmarks from two independent datasets (N=298 and N=257, respectively). Given that many modern human fossils are larger than Holocene *Homo sapiens* [2, 3], we assess how evolutionary changes of cranial size within the modern human lineage affected cranial shape. To this end we compute statistical analyses in both Procrustes form space, and shape space, using principal component analysis (PCA), and between-group PCA. In addition we analyse the residuals from group-wise multivariate regressions of cranial shape on cranial size to account for static allometry.

As expected, we find that cranial size has a significant impact on cranial shape. In the evolutionary history of *Homo sapiens* changes of cranial size have therefore shaped many aspects of cranial morphology. Corroborating the results of Grine et al. (2007) we identify the morphology of the Late Pleistocene Hofmeyr skull [4,5] from South Africa as typical of the population from which the Eurasian Upper Palaeolithic modern humans descended. Notably, we find that among recent modern humans, Hofmeyr is closest to the fairly gracile South African Khoe-San. We show that several Middle and Late Pleistocene modern human fossils from Africa, Europe and Asia resemble the click-speaking Khoe-San, when differences in cranial size are accounted for. The present-day Khoe-San therefore retain many aspects of the ancestral modern human cranial morphology, however much less pronounced owing to a gracilization of cranial features that occurred before the Holocene. Our results reconcile cranial morphology with recent genetic studies, which have identified the Khoe-San as the oldest modern human group living today.

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Podium Presentation: Session 5, Fr (11:20)

## Testing modern human out-of-Africa models: population genetic and craniometric approaches

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Genetic and paleontological evidence has generated consensus on Africa as the primary place of origin for anatomically modern humans, with the ancestral population living between 100-200 thousand years ago (ka). However, the timing and geographical pattern of the out-of-Africa event continues to be intensely debated. For extant human populations, the observation of their decreasing genetic and phenotypic diversity at increasing distances from sub-Saharan Africa has been interpreted as evidence for a single Late Pleistocene dispersal, characterized by a series of founder effects during a rapid worldwide expansion out of Africa. However, recent genetic studies, as well as accumulating archaeological and paleoanthropological evidence, challenge this parsimonious model. They suggest instead a “southern route” dispersal into Asia as early as the late Middle Pleistocene, followed by a separate dispersal into northern Eurasia. We present results testing these and other competing out-of-Africa models. In one analysis, we sampled ten populations from Africa and Asia, assessing levels of inter-population differentiation using genomic single nucleotide polymorphisms and anatomical cranial 3D landmark data (Reyes-Centeno et al., 2014). In a biogeographical approach that considered the spatial and temporal predictions of each model, we distinguished which out-of-Africa scenario was most associated with genetic and morphological differentiation between populations while controlling for the time in which populations diverged from each other. Both genomic and craniometric data served to support a multiple dispersals model in which Australo-Melanesian populations are relatively isolated descendants of an early dispersal, whereas other Asian populations are descended from members of a subsequent migration event. Our estimate of genetic divergence between South Africans and Melanesians reveals a calendar date of 116 ka, in intriguingly closer correspondence with archaeological and paleontological evidence of modern human occupation in the Arabian Peninsula and the Levant. Indeed, using an exceptionally large craniometric dataset of Holocene populations from Asia and treating African fossils as hypothetical ancestral populations of either northern or southern route descendants yielded similar conclusions (Reyes-Centeno et al., In Review). Finally, our work sheds light on the “Negrito” hypothesis (Reyes-Centeno et al., 2013), suggesting that the Aeta/Agta “Negrito” of the Philippines are highly admixed from descendants of both dispersal events.

**Acknowledgements:** This work was supported by the Senckenberg Gesellschaft für Naturforschung.

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Poster Presentation Number 56, Sa (16:00-18:00)

## Another Measure of Man: comparison of point-cloud based analysis of photogrammetric 3d models and landmark-based geometric morphometric shape analysis in hominid mandibles

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1 - Natural History Museum London

Advances in computational power and sophisticated algorithms for reconstructing 3d models of anatomical shapes allow for considerable advances in the quantification and qualification of morphological differences between specimens and species by using point cloud data sets which describe the entirety of a shape surface. Geometric morphometric analyses based on landmark data sets are limited to defining variation along planes and axes of specific landmarks, and combining investigation with difference in shape and difference in scale in these analyses is methodologically complex, and can be subject to error introduced by variation in the identification of landmarks [1]. This paper proposes a new method of investigating variation in hominid morphology that is less time and cost intensive than computed-tomography or laser-scanning based modelling, and without the need for standard landmark identification. Dense point cloud 3d models constructed in photogrammetric software—in this case, Photoscan [2], but in principle the method is software agnostic—from multiple photos taken on a standard dSLR camera can be compared directly, point-to-point, either scaled to minimise the effect of size or without scaling, allowing analysis of variation across the entire fossil surface. By comparing morphological similarity from ca. 200,000 points on each model using the open source software CloudCompare [3] it is possible to construct a distance matrix which both describes morphological differences between specimens and characterises this variation in using colour-coded 'heat maps'. This allows variation that occurs on all aspects of the specimen to be identified, including variation in regions that do not support repeatable landmark identification such as contours and projections. Conversely, specific areas of interest can be targeted by limiting analysis, i.e. to sites of muscle attachment. Point-cloud based analysis of morphological variation in casts of fossil mandibles from *Homo sapiens*, *Homo neanderthalensis* and *Homo heidelbergensis* is compared to landmark-based analyses of the same sample, using standard methods (Morphologika [4]). The results of both methods demonstrate plausible groupings of specimens, but there are considerable advantages to exploring the entirety of the shape surface rather than relying on landmark-based methods such as a visual, delimited indication of areas that are more or less similar. A description of the point-cloud based method and findings regarding its utility in comparison with standard landmark-based analysis are presented.

**Acknowledgements:** Many thanks to A. Bevan and L. Buck for early comments, and to R. Kruszynski for assistance with the fossil casts.

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Podium Presentation: Session 2, Th (11:20)

## A winter wonderland? Mid-latitude seasonality strategies in the Lower Palaeolithic

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Any occupation of northern Europe by Lower Palaeolithic hominins (*H. heidelbergensis*/proto-Neanderthals, and *H. erectus* and/or *H. antecessor*?), even those occurring during full interglacials, must have addressed the challenges of marked seasonality and cold winters, the latter including day/night temperature contrasts; the problems of wind-chill and frostbite; the duration, distribution and depth of snow-cover, and other forms of precipitation; reduced daylight hours; and the distribution and availability of animal and plant foods [1]. Solutions to this ‘winter problem’ can essentially be characterised as a ‘stick or twist’ choice: i.e. year-round presence on a local scale versus extensive seasonal mobility. However both of these potential solutions, and the ‘interim’ strategies that lie between these extremes, raise a host of practical problems [2], including maintaining core body temperature, meeting the energetic demands of mobility, coping with reduced resource availability and distribution, and meeting nutritional requirements. This paper explores these challenges and seeks to evaluate the feasibility of different winter survival strategies within a Lower Palaeolithic context, with particular emphasis upon possible strategies for (i) avoiding the excessive lean meat protein problem of ‘rabbit starvation’ ([3]; e.g. through exploitation of ‘residential’ species with significant winter body fat, by targeting specific body parts, following modern ethnographic examples, supplemented by the exploitation of winter plants); and (ii) maintaining body temperatures (e.g. through local mobility, managed pyrotechnology, and/or other forms of cultural insulation; [4]). Reference is made to palaeoenvironmental reconstructions from key Lower Palaeolithic sites [2], with emphasis upon palaeoclimate estimates, available resources, and the evidence that is present (and absent) in the archaeological record for hominin exploitation of particular resources (e.g. the evidence for bear butchery at Boxgrove and the presence of beaver at Bilzingsleben, contrasted with the absence of cut-mark evidence on avifauna, including migratory waterfowl, at Boxgrove [5]). The paper concludes with a suggested winter strategy, and throughout seeks to highlight the practical challenges of mid-latitude winters for Lower Palaeolithic hominins.

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Poster Presentation Number 79, Sa (16:00-18:00)

## Trace Element Distributions in Early and Late Forming Tooth Enamel

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The composition of dental enamel reflects an individual's dietary intake and environment during the period of enamel formation, and is influenced by metabolic parameters and enamel formation processes. The distribution of calcium normalised strontium and barium ratios in enamel from deciduous and early forming permanent teeth is influenced by infant diet and can be used to reconstruct aspects of the weaning process retrospectively [1-4]. Analysis of calcium normalised trace element ratios across thin sections of deciduous teeth has revealed fluctuations between the enamel dentine junction (EDJ) and the enamel surface that are independent of dietary change or other recognised changes in external inputs, and may be related to differential transfer of trace elements across the ameloblast during enamel secretion and enamel maturation [2]. These underlying distributions may confound dietary interpretations. Here we analyse trace element distributions in enamel from early and late forming tooth crowns from two archaeological dentitions using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Second and third permanent molars were analysed to determine whether there are consistent patterns in late forming teeth. First permanent molars from the same dentitions were evaluated for information on dietary change during the first few years of life. The sample comprised fully formed and relatively unworn tooth crowns of three permanent maxillary molars (M1, M2, M3) from each of two individuals from Abingdon, representing the early Medieval and Civil War periods. Longitudinal thin sections were prepared through the mesial cusps and the protocone enamel was analysed. LA-ICP-MS was undertaken at discrete 30 µm diameter sampling points arranged on a grid with a spacing of 300 µm. Ablated sections were digitally imaged at 20x magnification using an Olympus VS-120 scanning microscope. Resulting images were georeferenced using ArcGIS, and the calcium normalised intensities for strontium (Sr), barium (Ba), magnesium (Mg), lead (Pb) and zinc (Zn) plotted within the same local coordinate system. The palatal aspect of each molar was divided into chronological bands based on measurements made along prism paths [5]. A series of contours approximately 35 days apart was then constructed that followed the directionality of accentuated lines or stria paths and each sampling point was assigned a chronological band. Distances between each point and the EDJ, enamel surface, and cemento enamel junction were calculated. Results confirmed that calcium normalised trace element ratios fluctuate in a predictable way according to the location of the sample within the tooth indicating that sampling location must be considered in the interpretation of variation in trace element ratios within a tooth. Within each chronological band, Ba/Ca and Sr/Ca values increased towards the CEJ, reflecting increased distance from the enamel surface and greater proximity to the EDJ. Pb/Ca and Zn/Ca ratios were elevated in subsurface enamel, to a depth of approximately 50-70 µm and 300-400 µm respectively. The Civil War period dentition exhibited uniquely high lead levels throughout the first permanent molar. Within tooth distributions demonstrated a chronologically consistent increase in Sr/Ca and Ba/Ca after 140 days and a corresponding increase in Pb/Ca. These changes are consistent with a shift from breast milk to animal milk between 4 and 6 months after birth and exposure to lead from feeding utensils. This study shows that consideration of several trace element distributions together across early and late forming teeth has the potential to provide more nuanced information on individual dietary intake than analysis of a single trace element.

**Acknowledgements:** This research was funded by the Calleva Foundation.

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Podium Presentation: Session 2, Th (11:40)

## Mounting evidence for multiple hunting episodes in the Schöningen 13II-4 “Spear Horizon”

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Since the initial discovery of the Schöningen spears, several interpretations have been put forth to explain the associated concentration of horse remains, ranging from a single mass kill [1] to multiple kill/butchery episodes [2] and a mass-kill event among a natural background accumulation of bones [3]. The common thread among these hypotheses is that the presence of spears together with the dense bone accumulation and a comparatively small lithic assemblage equates to a dual ambush hunting and carcass processing site, a conclusion largely based on the analysis of only a limited selection of the faunal material. In 2013, the MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution began a comprehensive archaeozoological, taphonomic, and spatial analysis of the complete large mammalian faunal assemblage from the Schöningen 13II-4 “Spear Horizon” to determine the precise sequence of events that led to site formation. Here we present initial results of this work. Our holistic approach combines modern archaeozoological and taphonomic methods with multi-proxy palaeoenvironmental data, microstratigraphy, and an in-depth spatial analysis to contextualize hominin activities at the site on a fine scale. Preliminary results suggest a much more complex depositional history beyond a simple kill/butchery locale. The quantity of butchered horse individuals represented all but excludes a single mass kill event. Aside from the horse assemblage, a diverse array of other large mammal species also preserves traces of hominin butchery and should not be dismissed as a mere background accumulation. Furthermore, both fresh and dry bones were used in the manufacture and re-sharpening of stone tools, suggesting a prior knowledge of the raw materials available for use at the site. Carnivore activity is indicated by tooth marks on numerous bones, which likely represents secondary scavenging of carcasses by various carnivore species. Alternatively, the lakeside setting could have also served as a location at which hominins opportunistically scavenged from other predators. The Schöningen 13II-4 “Spear Horizon” undoubtedly represents a location at which hominins killed and butchered dozens of large mammals, but to characterize the “Spear Horizon” as a straightforward kill/butchery locale is to ignore the complex nature of the site and its unique archaeological record of Middle Pleistocene hominin behaviour. We must think more openly and critically about the full range and sequence of hominin activities at the site. In doing so, the Schöningen 13II-4 “Spear Horizon” can serve as a model to better understand hominin behavioural adaptation to interglacial environments during the Lower to Middle Palaeolithic.

**Acknowledgements:** This research project is a cooperation between MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution, Johannes Gutenberg-Universität Mainz, and Niedersächsisches Landesamt für Denkmalpflege, and is financed by the DFG (GA6839/-1).

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Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## A reappraisal of the early Upper Paleolithic assemblages from Maibulak, Kazakhstan

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The transition from the Middle to the Upper Paleolithic in Central Asia has gained in importance after the recent discoveries of complex population histories in this region (e.g., [1-3]). For such a large area, there are, however, very few sites from the relevant time period. Here we present a revision of the data from one such site, Maibulak, located in the Zailiskiy Alatau foothills of the Tien Shan, approximately 40 km west of Almaty in southeastern Kazakhstan. The site is situated at 1040 m a.s.l. on the right bank of the Maibulak submontane river, which incises the alluvial fan. River cobbles of metamorphic origin are available today in the river bed, and would likely have provided useful raw material for Paleolithic people living in the area. The site was excavated by Ž. Taimagambetov and D. Ozherelyev from 2004- 2006 and again in 2009, over a total horizontal surface of 128 m<sup>2</sup>[4]. The stratigraphy comprises ca. 8-9 m of aeolian loess of various textures. A preliminary chronology of the deposition was obtained by Feng et al. [5] based on 14C dates on charcoal from the north profile, without a specific association to the archaeological materials. In 2013, the site was revisited by an international team in view of evaluating its potential for new studies. With this occasion, new samples for a luminescence chronology, as well as for soil analyses were collected and are currently in processing. Likewise, the lithic assemblages from the two lowermost layers were also re-analyzed. The archaeological stratigraphy contains three main horizons, separated by sterile sediment [4]. The topmost horizon has possibly been disturbed by intermittent loess quarrying during the Holocene and will not be discussed here. The following two horizons (Cultural Horizon (CH) II (n=936) and III (n=1029)) contain a total of 1965 stone artifacts, as well as numerous burning features, including burnt stones that were possibly used as heat retainers. The Levallois technique is well-represented in CH II, despite a relatively late date (14C dates between 29116 ± 415 and 30062 ± 415 uncal. BP, [5]). In CH III (34970 ± 160 uncal. BP [5]; 35240 ± 450 uncal. BP (new charcoal date from one of the preserved hearths, MAMS-19130)), typical Levallois cores and flakes are found at similar depths as what appears to be a well-developed bladelet technology. In total, there are at least 27 bladelets (not including broken fragments), including 2 retouched specimens, as well as 3 prismatic bladelet cores in CH III. Moreover, the bladelets were made on a different raw material from the rest of the assemblage, possibly indicating different treatment of these implements. Both assemblages largely lack formal tools, although endscrapers and sidescrapers are present in both CH II and III. The seeming coexistence of Levallois and bladelet technologies, as well as the late survival of Levallois technology provide interesting problems for typology and periodization in Central Asia, which we discuss in the context of sites of similar age in the greater region.

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Poster Presentation Number 18, Fr (15:30-17:30)

## Evolution of the ulnar and radial sides of the human hand

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The modern human hand is unique in both morphology and functional capabilities compared to the hands of other extant hominoids. Although important organs for manipulation, the hands of apes are also used in locomotion, whether it be for forelimb-dominated suspension and brachiation, climbing, knuckle-walking, or some other form of quadrupedalism (e.g., palmigrady). In contrast, the human hand is no longer a weight-bearing organ for propulsion and support as the forelimbs have been ‘emancipated’ by habitual bipedalism. Rather, human hands are well-adapted for a diverse repertoire of grip types, fine manipulatory functions, and enhanced dexterity. When the modern human hand evolved all of its unique characteristics is debated, but the hominin fossil record suggests that there was a long evolutionary pathway to achieve a human-like hand from an ‘ape’-like hand (e.g., [1], [2], [3]). Moreover, the hominin fossil record suggests that different regions of the hand evolved human-like conditions at different times since the last common ancestor of chimpanzees and humans. For example, a human-like robust pollical distal phalanx may have evolved as early as the Late Miocene (~6.0 Ma) with *Orrorin tugenensis* [4], whereas the styloid process on the third metacarpal apparently did not evolve until the Middle Pleistocene (~1.42 Ma) with *Homo cf. erectus* [3]. While standard linear metrics have been taken on most hand elements, very little empirical data exist on overall shape of metacarpal articular surfaces. Traits of early hominin metacarpal articular surfaces highlighted in the literature have typically been discussed without any supporting quantitative data. Several reasons account for this, the main being that appropriate methods to quantify and statistically analyze these shapes have only recently become practical. In an attempt to investigate metacarpal functional morphology further, Rein and Harvati [4] performed a 3D geometric morphometrics (3DGM) analysis of the Mc3 base, finding that South African hominins were more modern human like than was *Au. afarensis*. In this study, we use 3DGM techniques to investigate Mc2 and Mc5 proximal and distal articular surface shape in early hominins. We focused on articular surfaces of these two elements because they represent the ulnar and radial ‘bookends’ of the non-pollical metacarpals. Specifically, we wanted to address three questions. First, can a landmark-based 3DGM approach effectively discriminate articular shape amongst extant hominoids, and to which, if any extant group are early hominins most similar? Second, are shapes of early hominin articular surfaces more similar to each other, or are those of one fossil group more similar to those of modern humans than other early hominins. Third, are any similarities shared by early hominins and modern humans more prevalent on ulnar or radial side metacarpals (i.e., Mc5 or Mc2, respectively)? Our results show that 3DGM effectively discriminates articular surface shape of extant hominoid metacarpals. South African and East African hominin Mc2 as well Mc5 articular surface shapes are closer to those of modern humans than other comparative groups. Thus, in the 2D space defined by the first two canonical variates of hominoids, hominin and modern human 5th metacarpals reside in the same morphospace, while hominin Mc2 reside in their own morphospace. Based on our analysis, we suggest that hominin ulnar side metacarpals (5th) are more derived in the modern human direction than radial side metacarpals (2nd).

**Acknowledgements:** We thank Dr. Bernhard Zipfel, Stephany Potze for support and access to materials during data collection in American Museum of Natural History; Museum of Comparative Zoology, Harvard University; Smithsonian Institution, National Museum of Natural History, Evolutionary Studies Institute, University of Witwatersrand, Ditsong museums of Africa, Natural History Museum. We are very thankful to Dr. Kristian J. Carlson for giving access for CT facilities. TJ would also to thank the Claude Leon Foundation, SPARC and NRF for awarding her a postdoctoral fellowship.

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Poster Presentation Number 80, Sa (16:00-18:00)

## The antler and bone points from the Early Upper Palaeolithic layers of Fumane Cave (Verona, Italy): technological reconstruction and implications for the cultural attribution

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Fumane Cave, at the bottom of the Alps in Northeastern Italy has proved to be one of the most important sites for the Early Upper Palaeolithic. The excellent state of conservation of the archaeological remains allow a comprehensive understanding of the activities that took place during the frequentations of the site. Aside from a very rich lithic industry, an impressive collection of shells and some of the oldest mobile art discovered in Europe, Fumane Cave yielded a conspicuous amount of hard osseous industry (Broglia and Dalmeri, 2005; Broglia et al., 2006). We conducted a technological analysis of the antler and osseous industry as well as teeth used as ornaments. In addition to the material already found during the excavations, both on site and through sieving, we managed to recover several elements pertinent to the different stages of the chaîne opératoire. This contribution focuses on the antler and bone points. Antler of Cervidae were used to produce five split-based points in the upper levels of the Aurignacian (D3-D6). Three antler points have their base missing, preventing us from being able to make a typological attribution. Moreover, a preform of split-based point in antler was discovered in the A2R layer, which was attributed to the Proto-Aurignacian. From a technological standpoint, we were able to recover four fragments of antlers, which all show clear direct percussion débitage with a large and wide lithic implement. Although we did not find any baguette, thus impeding to understand the exact extraction modality, we were able to determine that the splitting of the base occurred after a first grooving of the superficies, but without any particular preparation of the base, as has been observed in other sites in Germany and France (Liolios, 2006). All the antler points have undergone a thorough grooving in order to give the final form to the point. Moreover, one split-based point has been produced on bone. Although the base and the shaft appear to be fully worked, the distal extremity has been deliberately separated from the rest of the support. Clear stigmata of sawing have been observed on the first half of the width of the point. The other half bears signs of fracturation by flexion. The presence of split-based points within Proto-Aurignacian layers is very rare and has been observed only in a few sites (Tartar and White, 2013), but it is usually attributed to a more recent techno-complex, the Early Aurignacian. The attribution to the Proto-Aurignacian based on the lithic industry at Fumane Cave allows to further extend the data available on this type of hard osseous industry. Another example in a possibly Proto-Aurignacian context is the small split-based point from Potočka zijalka (Jéquier, 2014). Finally, the presence of a split-based point made of bone is very rare and implies a good understanding and mastering of the different techniques used on antler in order to transpose them onto another raw material.

**Acknowledgements:** Research at Fumane is coordinated by the Ferrara University in the framework of a project supported by the Italian Ministry of Culture - Veneto Archaeological Heritage, public institutions (Lessinia Mountain Community - Regional Natural Park, Fumane Municipality, Veneto Region - Department for Cultural Heritage), Research Institutions (Max Planck Institute for Evolutionary Anthropology) and private associations and companies.

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Podium Presentation: Session 2, Th (11:00)

## Binning a bone of contention from the *Homo erectus* type locality Trinil

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The famous Dubois Collection from the *Homo erectus* type locality Trinil, Indonesia (housed in Naturalis Leiden, The Netherlands) is currently under examination by a multidisciplinary team and is yielding exciting new insights in the behaviour of *Homo erectus*. The relevance of this research -and of future research based on the Dubois Collection- is highly dependent on reliable and irrefutable provenances of the studied fossils and on the degree of “homogeneity” of the Trinil assemblage. Ever since Eugène Dubois’ publications on the “Pithecanthropus” fossils from Trinil more than 100 years ago (Dubois, 1894), there have been controversies regarding age, site integrity and the possibly composite nature of the type lot of *Homo erectus* (e.g. Manouvrier, 1895). Notably the pathological Femur I has been a bone of contention: does it belong to the *Homo erectus* material from Trinil, or is it intrusive and should it be attributed to *Homo sapiens*? In addition, concerns have been raised regarding the excavation practices employed by Dubois, resulting in allegations that Femur I may have derived from a much younger stratum than the main fossil-bearing bed Trinil Hauptknochenschicht (Bartsiokas and Day, 1993; Ruff et al., 2013). To address these issues we have performed semi-quantitative XRF-analyses on Femur I, the *Homo erectus* type skullcap (Trinil 2), the additional *Homo erectus* femora from Trinil, and associated vertebrate fossil bones from Trinil and from nearby Kedung Brubus. We show that Femur I, the skullcap and the other *Homo erectus* femora all share the same specific elemental composition profile, and can be reliably binned with that of the other fossil fauna from Trinil. Moreover, we have reconstructed the day-to-day excavation history of Femur I based on correspondence between Dubois and the on-site excavators Kriele and de Winter (Dubois Archive, Naturalis Leiden, The Netherlands). Together, these data allow us to conclude that Femur I has the same stratigraphic provenance as the other fossil bones (including the skullcap) from Trinil. The “modern human” morphology and deviating Ca/P ratio of the inner bone material of Femur I can be explained by its severe pathology. In sum, there is no reason to invoke a much younger age of this heavily fossilised bone. Finally, we briefly discuss the age of Trinil *Hauptknochenschicht*, the lessons learned for dating of Javanese hominin sites, and the implications for timing of the first appearance of *Homo erectus* on Java.

**Acknowledgements:** We thank our colleagues Frank Huffman and Paul Albers for discussions and support.

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Poster Presentation Number 46, Fr (15:30-17:30)

## New insights into the multiple Mesolithic burial of Groß Fredenwalde, NE-Germany

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The number of well preserved, early Holocene burials of northern Central Europe is very limited. From the Preboreal and Boreal loose bones are only available and it is not before the Atlantic period that inhumation graves and isolated cremation graves are present. Among the (late) Mesolithic graves the multiple burial of Groß Fredenwalde located about 90 km NE of Berlin is outstanding. The burial was detected on top of a prominent hill (110 m a.s.l.) in 1962 and unfortunately excavation of the skeletons had been taking place under poor conditions. In 1992 AMS-dating identified a Mesolithic context (c. 6500/ 6300 calBC). Some grave goods were collected and fragments of a slotted dagger underline the rich status of the burial (see Gramsch, Schoknecht 2003). Here we present results of the first detailed anthropological analysis of the skeletons and ongoing re-excavation of the site as well as results of AMS-dating and isotope analyses (<sup>13</sup>C/ <sup>15</sup>N). Most of the bones are red colored indicating the deposition of the dead bodies in ochre stained sediments. The identification of six individuals was possible: two adult men, one adult woman and three children (3 to 8 years old; 2x probably male, 1x probably female). The male adults are about 10 cm taller than the woman (m: c. 1.61 m, f: c. 1.52 m). Health status of the individuals was quite well. However, the woman was suffering from arthrosis in her right elbow and from paradontosis. Her teeth were heavily worn by use as tools. One Child is probably showing evidence of scurvy. No signs of violence are present on the skeletons and the reason for the death of the six individuals remains unclear. In order to better understand the context of the burials re-excavation of the site was conducted in 2012/2013. Small bone fragments of the skeletons damaged during rapid rescue excavation were found as well as a few human bones in an undisturbed position under a charcoal layer. Further excavation is necessary to clarify whether another burial is present on the site. A considerable number of new grave goods make Groß Fredenwalde now one of the richest Mesolithic burials of Central Europe. Samples of the six human individuals and two animal tooth pendants are providing a reliable basis for the AMS-dating. The dates of the humans vary between c. 6150 and 5800 calBC, but the more reliable dates are related to the tooth pendants. They assign the burial to c. 6000 calBC and an early Kongemose context. The differing AMS-dates of the humans might be caused by reservoir effects. The <sup>15</sup>N-values vary between 11.25 to 11.74 ‰ and are indicating some consumption of fresh water fish. These results find parallels in other Mesolithic human remains from northern Germany and they indicate that consumption of aquatic resources in the inland was more frequent than expected. The multiple burial is of major relevance for the characterization of the Mesolithic population of Central Europe just before the colonization of Central Europe by Linienbandkeramik farmers mid of the 6th millennium calBC. First results of aDNA-analysis of Groß Fredenwalde are strongly supporting the idea that the native Mesolithic population was genetically completely different to the new LBK farmers.

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Poster Presentation Number 38, Fr (15:30-17:30)

### **Multidisciplinary studies of a 31,000 year old canid skull from Aghitu-3 Cave, Armenia**

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Multidisciplinary studies at Aghitu-3 Cave, Armenia related to the discovery of a complete canid skull at the boundary between archaeological horizons VI and V provide a backdrop for better understanding the early domestication of canids. The well-preserved cranium and mandible of an adult canid are associated with a canid humerus and radius, radiocarbon dated to about 31,000 cal BP. Several bite marks in the skull suggest its fate. This high altitude (1601 m) site in southern Armenia has yielded three well defined archaeological horizons VII, VI, and III, each containing cultural remains from Upper Paleolithic occupations. These three occupations share a laminar technology that was used to produce bladelets and blades, with a special focus on the production of laterally retouched bladelets, and the predominant use of obsidian as a raw material. The uppermost occupation, archaeological horizon III, shows intensified use of the site, coupled with evidence for bone tool use and personal ornamentation. Parallel to the archaeological studies, investigations of the genetics and morphometrics of the canid skull are currently underway. The genetic study is aimed at identifying whether this canid can be securely attributed to wolf or dog. Similarly, traditional and geometric morphometric studies are aimed at determining whether changes in shape and size can be conclusively attributed to wolf or dog. Isotopic analyses of these bones will help determine the environmental as well as nutritional parameters of the canid. We are also studying the remains of charcoal, pollen, phytoliths and micromammals to establish a multiproxy environmental baseline for this specimen. A further avenue of research will be to examine the nature of the sediment itself, which contains two clearly interstratified tephra layers, using a micro-morphological approach. Finally taphonomic studies of the canid bones will paint a picture of how these bones accumulated at the site. Woven together, these varied datasets will shed light on the relationship between humans and the early domestication of canids.

Poster Presentation Number 33, Fr (15:30-17:30)

## Evaluating archaeology – using network analysis to visualise research behaviour

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When familiarising oneself with a new field of research, one often tries to obtain an overview of its research history, especially the manner in which the general discourse, agenda and emphasis has changed over the years. Methodological and theoretical approaches are often reflections of contemporary academic trends and political agendas, therefore even outdated publications can contain a palimpsest of interesting information about former academic opinions, alliances and conflicts – as well as position the academic discourse in a broader scene of legislation and policymaking. However, obtaining such an overview (and disseminating it to colleagues) can pose highly time consuming, and may at times be seen as unproductive legwork that simply needs to be 'done' in order to focus on more result-driven work. Contrary to this opinion, this poster will hope to show how research history can quickly and comprehensively be analysed using open source software (e.g. Gephi, 1) that can help reveal new perspectives, patterns and relations. Network analysis has already been sporadically introduced in the humanities and has been used with advantage to create visualisations of highly complex networks in academia, e.g. citations, publications, hierarchy (2). Equally, the method has been used in very different enquiries and fields, e.g. in ecological studies of co-occurrence in soil microbial communities (3). However, a more widespread knowledge and implementation of the approach could prove beneficial. This poster will present the theoretical background of network analysis, show how it can be used as a method, evaluate the advantages and disadvantages and discuss the possible prospects of the approach. Inspired by the notion of the hermeneutical spiral, most research can be viewed as mere temporary 'stops' on a long trajectory of changing theoretical frameworks; in this way, old as well as new results, are products of a contemporary epistemological sphere. Therefore it is important to maintain a degree of criticism and objectivity when dealing with all fields of research. The emphasis of this poster will therefore remain introspect, and focus on analysing archaeological academic behaviour through network analysis of bibliometric citation data. Although the compilation of data is always relatively time consuming, the increasing focus on digitalisation of publications is a major advantage that will only make this approach more accessible in the future. A case study will ensure an accurate exemplification of the method. The case study consists of an exhaustive list of publications and their citations dealing with the topic of a possible Neanderthal occupation of southern Scandinavia - a highly controversial topic that has shown to be a challenging one to quantify and evaluate with traditional methods. The input data is a list of publications and their citations, some from as early as the 18th and 19th century, but most from the onset of 'modern academia' in the 20th century up to present day. The outcome of this analysis will be evaluated, and the visualisation presented. Different variables and weights can be added to the analysis, and thus ensures that graded outputs can be produced relative to the research question in focus. This exercise shows how even a highly complex evolutionary line of research can be 'simplistically' visualised without losing their analytical and informative gravity. The visual output aid the identification of general patterns – patterns that can then be more accurately translated and merged with the individual discussion at hand. And importantly, the compiled data can be reused, shared and modified to fit different research question. The efforts presented in this poster will hopefully inspire others to use network analysis to visualise their own data and promote an increasing reflection on our past research and its context.

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Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## Exploring hominin and animal interactions in the Swabian Jura: Cave use and subsistence patterns during the late Middle and early Upper Paleolithic

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The biological and cultural evolution of hominins is not always synchronous, and the transition from the Middle and Upper Paleolithic period is no exception. Thus, the differences in culture, behavior and demography between Neanderthals and modern humans in Eurasia remain a topic of debate. This study documents the subsistence pattern and the use of caves by archaic and modern humans through the analysis of faunal remains from Hohlenstein-Stadel and compares the assemblages with other sites in the Swabian Jura of southwestern Germany. Faunal remains from Hohlenstein-Stadel indicate a mixture of carnivore, cave bear and hominin activities, resulting in a complex depositional history. Large numbers of cave bear remains resulted from natural mortality during the winter independently of hominin and non-ursid carnivore occupation. Prey remains at the site indicate that both hominins and non-human predators visited the cave. During the Middle Paleolithic, the cave served as a den for carnivores, mostly hyenas, and a site for short term occupation for Neanderthals documented by burnt faunal material and lithic artifacts. During the Aurignacian, the faunal remains show fewer signatures of carnivores and human activity related to subsistence practices. Shed antlers, an ivory figurine, *Löwenmensch*, and personal ornaments suggest role of Hohlenstein-Stadel as a non-habitation site.

The comparison of several sites in the Swabian Jura reveals regional patterns of suggest a role subsistence behavior and the use of caves by animals including cave bears and carnivores. Horse is the most abundant herbivorous taxon during the Middle Paleolithic and Aurignacian, targeted both by hominins and carnivores alike. There is a significant increase in the abundance of reindeer in the Aurignacian, reflecting increased population of reindeer in the region, which possibly corresponds to the cooler climate at the beginning of the early Upper Paleolithic. Cave bears dominate in certain cave localities, which demonstrates that the use of sheltered area for hibernation did not alter over time. A decrease of middle and large sized carnivores, predominantly hyenas, and damage made by non-human predators across sites indicate that the role of carnivores in the accumulation of faunal material diminished during the Aurignacian. Inversely, anthropogenic modifications increased across most sites compared to the Middle Paleolithic, pointing to greater contribution of faunal remains by modern humans. There is evidence for increased cave bear exploitation at certain locales during the Aurignacian. These trends reflect greater anthropogenic signals in the cave deposits overall and attest to intensified use of sites by modern humans compared to the Neanderthals. The study of faunal assemblages suggests that difference in the subsistence behavior of Neanderthals and modern humans is not primarily influenced by cognitive abilities and likely reflects changes in the climate and local abundance of prey in the Swabian Jura. Significant distinction between the two hominin species manifests not in terms of prey choice, but instead in the social and economic use of caves. Modern humans visited the cave more frequently and/or utilized the sites more intensely than Neanderthals, resulting in the decrease of carnivores in sheltered sites. The Aurignacian population of the Swabian Jura is characterized not only by the presence of elaborate symbolic behavior, but also by intensified exploitation of caves and a significant impact on the local population of predators.

**Acknowledgements:** We thank all of the organizations that have funded this work including the Deutsche Forschungsgemeinschaft, the Heidelberger Akademie der Wissenschaften, the Universität Tübingen, Heidelberger Cement, the Voith Corporation, Alb-Donau-Kreis, Kreis Heidenheim, the Gesellschaft für Urgeschichte, the Museumsgesellschaft Schelklingen, the Landesamt für Denkmalpflege Baden-Württemberg, the cities of Blaubeuren and Niederstotzingen, the Förderverein Eiszeitkunst im Lonetal and the Deutscher Akademischer Austauschdienst. KK also thanks Kurt Wehrberger in Ulmer Museum (ADD) and Dr. Claus-Joachim Kind from Denkmalpflege Baden-Württemberg (ADD) for providing access to faunal material from Hohlenstein-Stadel. Further, we would also like to thank our colleagues in Institut für Naturwissenschaftliche Archäologie and Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters for their continual support and help.



Poster Presentation Number 82, Sa (16:00-18:00)

## Evaluating performance effects of ochre and beeswax in Middle Stone Age resin based compound adhesives by lap shear testing

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Ochre, and possibly beeswax or fat, is assumed to have been purposefully used to physically alter the performance of compound adhesives, and it is this use of disparate ingredients in combinative processes that is seen as some of the best evidence of advanced cognition and fully modern behaviour outside of the use of symbolism [1, 2]. However, as yet it is unclear how efficient different adhesive recipes are, to what extent specific ingredients influence the performance, and how difficult it is to combine ingredients to maximum effect. In the study presented here, a series of laboratory based lap shear tests following modern adhesive testing standards were conducted in order to gain further insight into the effects of specific ingredients and ingredient ratios. Previously, actualistic experiments conducted in South Africa used acacia gum [3]; however the only chemically identified Middle Stone Age adhesive for this region is of a conifer resin [4], the chemical and physical properties of which can be significantly different. Therefore, we tested a selection of adhesive mixtures made from pine resin that contained different portions of ochre as a loading agent and beeswax as a plasticiser. Lap shear tests are employed in aerospace and automotive industries for comparative analyses of modern adhesives. In this study we used the maximum force, displacement, and fracture type of single lap joints to determine the optimum adhesive mixture and changes caused by recipe variations. Results indicate that there are significant changes in performance due to relatively small changes in ingredient ratios and creating the best performing adhesive is a precision job. In addition, we found considerable performance variation within one recipe, thus lending further support to the notion that high levels of skill and knowledge would be required to consistently produce the most effective adhesives. Modern standardized tests have also proven to be a fast and accurate method of comparing prehistoric adhesives, and have shown potential scope for performance testing in different simulated environmental conditions, and of different haft types.

**Acknowledgements:** We thank Dr. Hans Poulis and the Delft Aerospace Structures and Materials Laboratory at Delft University of Technology, and Prof. Annelou van Gijn and the Artefact Studies Laboratory at Leiden University for their advice and generous use of lab space. This project is sponsored by Netherlands Organisation for Scientific Research (NWO) through a Veni grant.

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Poster Presentation Number 60, Sa (16:00-18:00)

### Variation of 3D outer and inner crown morphology of lower premolars in modern humans

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Dental morphology plays an important role in the taxonomic assessment of hominin fossil specimens. In spite of the fact that modern humans are often used as comparative sample, a comprehensive assessment of 3D dental morphology for modern populations has not been achieved. The Outer-Enamel-Surface (OES) is traditionally investigated using linear measurements (e.g. B/L, M/D diameter, crown height) alongside qualitative descriptions, or analyses based on 2D images which allow only limited statements about spatial properties. The underlying Enamel-Dentin-Junction (EDJ) has not been considered yet in many studies. Nevertheless, the importance of destruction free micro-CT scanning is increasingly recognized. With improved imaging techniques and the implementation of Geometric Morphometrics it is now possible to capture the whole geometry of both inner and outer dental surfaces. However, to our knowledge, such a study has not yet been published on lower premolars. We applied geometric morphometric techniques on 3D surface models from micro-CT datasets in order to investigate the morphological variation of lower premolars in a geographically diverse sample of recent modern humans. Our aim is to provide a morphological assessment of both the OES and EDJ, which might also serve the purposes of further comparative studies. The sample comprises 40 individuals, each represented by P3 and P4, including Africans, Australasians, Avars (8th century warrior nomads with Asian origins) and Central Europeans. The lower P3s and P4s were scanned at the Vienna Micro-CT Lab (voxel size 25-50µm). Three-dimensional surface models of OESs and EDJs were created, containing four real landmarks (cusps and fossae) and 20 curve semilandmarks along the occlusal ridge. The sets of 3D landmarks were converted into Procrustes shape coordinates and subsequently analysed using Principal Component Analysis (PCA). Furthermore, we carried out a qualitative assessment of some discrete traits (e.g., transversal crest, accessory cusps). Our findings show significant shape changes primarily in the mesial and lingual part of both types of premolars. This is due to an extensive variability regarding the number and position of lingual cusps throughout the whole sample, observable on OES, and more evidently on EDJ. Additionally our findings on EDJ suggest that P3s devoid a lingual cusp more frequently than stated in the current literature. Generally, EDJ seems to reveal certain characteristics with more confidence than OES. We also recognize striking variability concerning the transverse crest including all possible variants from single to double, prominent to shallow, and the frequent appearance of accessory crests. As compared to P4s, P3s are even more variable. PCA shows a surprisingly large overlap between the geographically diverse populations which include hunter/gatherers, nomads and agriculturalists, both for P3s and P4s in shape and form space. Our first results indicate that a distinction of populations based on shape and form of lower premolars might be challenging due to the very high intragroup variation.

**Acknowledgements:** We thank Martin Dockner (Vienna Micro-CT Lab) for technical support, Gerlinde Gruber (Medical University Vienna) and Eduard Winter (Natural History Museum Vienna) for access to material, and Katarina Matiasek for background information on collections.

Podium Presentation: Session 3, Th (14:50)

### Facial Growth Remodeling in Middle-Pleistocene *Homo*

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Facial bone growth remodeling is a key developmental characteristic that impacts adult facial phenotypes through the combined activities of bone deposition and bone resorption. These activities are best characterized in sub-adult individuals because as bones increase in size during growth, remodeling adjustments are required to maintain shape and overall proportions of the facial skeleton. Here we investigate the evolution of facial growth remodeling patterns in fossil *Homo*. Morphological descriptions of the species *H. antecessor* have emphasized the distinct midfacial anatomy of the specimen ATD6-69, which was said to represent the earliest recorded sample of modern midfacial architecture distinct from more primitive species such as *H. erectus/ergaster*. ATD6-69 has also been linked to the origins of Neanderthals. An important hypodigm whose evolutionary history has been associated with *H. antecessor* and Neanderthals is represented by the Middle Pleistocene hominin sample from Sima de los Huesos (SH), Spain. To better understand the evolution of Pleistocene hominin lineages and ontogenetic differences relative to modern humans, we mapped facial growth remodeling (bone deposition vs bone resorption) in the *H. erectus/ergaster* specimen KNM-WT 15000, in ATD6-69, and in a sample of four SH sub-adults. Results show that bone resorption dominated over the nasomaxillary complex of ATD6-69, as in *H. sapiens*, but differed from KNM-WT 15000 and the SH hominins where bone deposition was found to dominate growth. Resorption on the lower face of ATD6-69 is in keeping with some of its modern human-like anatomy. For the SH hominins, bone deposition appears to be an important effector of their key distinctive morphological characteristics, some of which have been noted to be shared with Neanderthals (i.e. the degree of midfacial prognathism, expanded maxillary sinuses, large infraorbital plates). Our findings provide a better understanding of developmental differences among Pleistocene hominins and modern humans.

Podium Presentation: Session 5, Fr (11:00)

## Palaeoclimatic data from Lake Tana, Ethiopia, support anatomically modern human dispersal from Africa at 112 – 97 ka

Henry Lamb<sup>1</sup>, Matt Grove<sup>2</sup>, Richard Bates<sup>3</sup>, Sarah Davies<sup>1</sup>, Dei Huws<sup>4</sup>, Michael Marshall<sup>1</sup>, Helen Roberts<sup>1</sup>

1 - Aberystwyth University · 2 - University of Liverpool · 3 - University of St Andrews · 4 - Bangor University

Understanding the role of climatic change in the emergence of anatomically modern humans in eastern Africa and their subsequent range expansion has been hampered by the paucity of continental palaeoclimatic records from the region. Here we use a well-dated, near-continuous high-resolution seismic and lake-sediment record of climatic change for the last 250,000 years from Lake Tana in the Ethiopian highlands to test a model of hominin dispersal rooted in the evolutionary biology of fluctuating environments. Lake Tana, the source of the Blue Nile, is both close to the postulated area of human emergence in the Afar and southern Ethiopian Rift, and to the likely 'northern' and 'southern' dispersal routes from Africa. Chronology of the 92 m-long core is based on post-IR IRSL ages on on 4-11  $\mu\text{m}$  polymineral fine grains; XRF geochemical data are interpreted as proxies for moisture variability, catchment erosion and mineral weathering. The Tana record shows marked stability and a moist climate during the last interglacial, contrasting with strong variability in prior and subsequent intervals. The Accumulated Plasticity Hypothesis predicts that population dispersal is likely to have occurred in stable climatic phases following intervals of strong climatic variability, and that dispersal potential will be greatest when transitions between high and low variability phases are abrupt. The well-dated Tana sequence of geochemical proxy-climatic data matches these conditions, with an abrupt change from variable to markedly stable wet climate at 112,000 years ago, suggesting a likely dispersal phase lasting until 97,000 years ago. The dating of this dispersal phase is consistent with early *Homo sapiens* dispersal into the Levant, and accords well with some dates for the 'southern route' out of Africa. Although the dates of the Lake Tana dispersal phase are well constrained, the dates of occupation at the Levantine sites are less so; further testing of the hypothesis is required.

Poster Presentation Number 61, Sa (16:00-18:00)

## Jaws: Morphological Evidence from the South African Australopiths on the Evolution the Hominin Mouth

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1 - LCHES, University of Cambridge

Jaw morphology is of critical importance to hominin evolution. Maxillary and mandibular elements are the most numerous in the fossil record and provide a wealth of information about the individual and their taxon [1], [2], [3]. The jaws of the earliest uncontested bipeds, the australopiths, have long been equated to the “parabolic” hominin shape, which is contrasted against the U-shape of the great apes [4]. But what creates this mouth shape and what does it mean for the functioning of this anatomical unit? This study takes a holistic approach to understanding the morphology of the entire oral cavity considered in light of the correlations between individual anatomical elements and overall mouth shape. Here we use a combination of linear and 3D data from homologous anatomical landmarks, 27 of which represent the upper mouth and 47 of which are mandibular, to identify patterns of morphological variation in the australopith mouth. 69 *Australopithecus africanus* and 78 *Australopithecus robustus* specimens are compared against adult gorilla (N=33: 13 female, 20 male), chimpanzee (N=30: 21 female, 9 male), and human (N=52: 14 female, 38 male) skulls. Intergenous and intragenous variation is explored via principal components analysis (PCA) and multivariate regression. The main results from the PCA run on 44 maxillary and mandibular linear measurements show that the australopith variation is separate from, and lies between the human and great apes ranges. The robust and gracile australopith ranges overlap on PC1, which explains 66.2% of the variation, but separate on PC2, which accounts for a further 9.1% of the variation. A large proportion of these PC2 differences are linked to the relative and absolute dimensions of the anterior teeth. Analysis of the 3D shapes from the more complete anatomical elements, such as the tooth rows, also show the clear distinction between the australopith morphology and the 3 extant genera. Following a procrustes superimposition of the maxillary tooth row, australopiths (N=14) markedly separate from both humans and apes on PC1 (46.7%) and PC2 (14.4%). To explore the potential allometric influence, centroid size was regressed against the PC scores. PC2 is highly correlated ( $r^2 = .62$ ,  $F(1, 113) = 184.7$ ,  $p < .01$ ) with size (based on centroid size) but PC1 is only weakly correlated ( $r^2 = .12$ ,  $F(1, 113) = 15.8$ ,  $p < .01$ ). PC1 shape differences are dominated by the changes in the diastema and relative proportions of the anterior and posterior tooth row. Robust australopiths are situated at the most positive extreme of PC1 with no diastemata, very small anterior dentition, and very large posterior dentition. The gracile australopiths show a less extreme version of this morphology with relatively larger anterior teeth. The strong focus on the “megadontic” australopithecine morphology in previous research may have overshadowed the importance of the anterior tooth patterns seen here. They are highly correlated with other anatomical elements and the overall mouth shape. PC2 separates humans from australopiths and apes, with humans having a noticeably more convex molar tooth row. The even distribution of robust and gracile australopiths across PC2 supports the idea that their morphological differences cannot simply be explained by allometry [5]. This research elucidates upon the unique mosaic of anatomical features that constitute the South African australopith mouth. It is far more than a mere combination of “human-like” and “ape-like” features. Specifically, the presence of distinctive features that would not be predicted from extant morphological patterns features, such as in the anterior teeth, may shed more light on australopith behaviour (i.e. feeding and the use of extra-oral processing). Such insights will have extensive implications for functional morphology and hominin evolution.

**Acknowledgements:** Access to collections: Dr Bernhard Zipfel and Professor Francis Thackeray, University of Witwatersrand. Stephany Potze, Ditsong National Museum of Natural History. Matthew Lowe and Dr Robert Asher, Cambridge Museum of Zoology. Roberto Portela Miguez, Natural History Museum, London. Dr Lahr and Maggie Bellatti, the Duckworth Collection. Funding: Wellcome Trust, Allan and Nesta Ferguson Charitable Trust, Church Tenements Charity, Jesus College, British Fund for Women Graduates, The Cutlers Company Charitable Trust. Academic support: Dr Marta Mirazón Lahr, Dr Aurélien Mounier and Professor Robert Foley.

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Podium Presentation: Session 1, Th (9:30)

## Age-at-Death and Dental Developmental Pattern of the *Australopithecus sediba* Juvenile MH1 Determined from Synchrotron Virtual Paleohistology

Adeline Le Cabec<sup>1,2,3</sup>, Paul Tafforeau<sup>1</sup>, Tanya M. Smith<sup>2</sup>, Kristian Carlson<sup>4,5</sup>, Lee Berger<sup>4</sup>

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The recent discovery of the *Australopithecus sediba* partial juvenile skeleton (MH1, [1]) has yielded an important source of information for exploring the radiation of Pleistocene hominins. Initial assessment of dental eruption and epiphyseal fusion suggested that MH1 died at 12-13 years of age if it had followed modern human developmental patterns. Over the past decade, the increased use of synchrotron imaging (especially at the ESRF [2,3]) has offered new approaches for addressing the study of dental development and microstructure of exceptionally well-preserved and precious fossil hominins. Here we use propagation phase contrast X-ray synchrotron micro-tomography to non-destructively investigate the dental microstructure and calcification stages of the preserved MH1 permanent teeth. Virtual histological slices and 3D renderings of the outer and inner dental surfaces were combined to assess the long-period line periodicity, long-period line numbers, cuspal enamel thickness, crown formation times, and calcification stages. Despite the advanced stage of first molar wear, we assumed that it initiated at birth, and subsequent stress events were used to match teeth and to estimate the age at death. The long-period line periodicity is 9 days, which is similar to other hominin values. Additional developmental comparisons with australopiths or early *Homo* are limited due to the lack of available histological information. Third molar calcification is particularly advanced relative to modern human standards, which would suggest an age of 10.5-11.5 years. Results indicate that MH1 died at a younger age than suggested by modern human eruption or calcification standards. This rapid developmental pattern is similar to other Pliocene and Pleistocene hominins, including early *Homo*. The study reached a level of detail allowing for building a developmental chart showing the relative formation of the crown (initiation, cuspal and lateral) and of the roots of the permanent teeth of MH1. These findings will also allow more nuanced studies of the associated cranial and post-cranial material, as they are independent of living ape and human developmental standards.

**Acknowledgements:** We are grateful to the excavation team at the Malapa site, the National Research Foundation of South Africa, the National Geographic Society, the Gauteng Provincial Government, the Cradle of Humankind Management Authority, the Department of Science and Technology, the Nash Family Trust and Malapa Nature Reserve, the University of the Witwatersrand, the ESRF (ID 19 and ID 17 staff) and the National Science Foundation (USA). Funding: NSF Grant N° BCS 1126470, Harvard University, ESRF Grant N° EC521, the Radcliffe Institute for Advance Study, Wenner-Gren Hunt Fellowship, the Dpt. of Human Evolution at the MPI-EVA and the National Research Foundation of South Africa.

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Podium Presentation: Session 11, Sa (14:00)

## How well is plant consumption recorded in Ovatwe dental calculus?: Implications for ancient dental calculus studies

Chelsea Leonard<sup>1,2</sup>, Layne Vashro<sup>2</sup>, James O'Connell<sup>2</sup>, Amanda Henry<sup>1</sup>

1 - Plant Foods in Hominin Dietary Ecology, Max Planck Institute for Evolutionary Anthropology · 2 - Department of Anthropology, University of Utah

Starch granules and phytoliths in dental calculus are commonly used as markers of plant consumption in ancient human and hominin populations, but it is unclear how accurately these plant microremains record the plant component of diet. This project examines how well starch granules and phytoliths in dental calculus from Ovatwe forager-horticulturalists of Northwestern Namibia record the range of plants consumed, and whether the quantity of microremains in calculus is proportional to dietary concentration. We collected dietary data through observation and interview in both rainy and dry seasons between September 2012 and June 2014, and obtained calculus samples from 77 individuals between the ages of 20 and 83. We compared data on plant consumption with plant representation in dental calculus on both an individual and population level. Most of the consumed plant foods are not represented in Ovatwe calculus, in part because not all plants produce starches and phytoliths, and in part due to a lack of preservation. While the Ovatwe commonly consume least thirty plants, the maximum number of plants represented on an individual level is six, compared with ten on a population level. Resampling from the observed data indicates that it is necessary to sample several individuals to detect the consumption of staple foods in the diet such as maize. However, with a large enough sample size it is possible to see the presence of plant foods that are not exploited as intensively. We estimated the expected relative representation of starches in Ovatwe calculus from each plant by multiplying the number of starches per gram dry weight by the average amount of each plant food consumed. We found no relationship between expected and observed starch representation, suggesting that the relative representation of starch granules in dental calculus is not a good predictor of the dietary importance of plant foods. We also find evidence for non-dietary processing of palm leaves for basket making. This is the first study to test how well plant microremains in dental calculus reflect plant consumption in a population with a documented diet. Results from this project have implications for interpreting plant microremain data from archaeological dental calculus samples. We suggest that analysis of starch granules and phytoliths in dental calculus is best suited to questions about the presence or absence of specific plants in the diet. Understanding resource use is central to understanding many aspects of ancient human and early hominin lifeways, and this method provides a potentially powerful tool for identifying plant consumption.

**Acknowledgements:** This project was funded in part by the Max Planck Society and in part by NSF Award BCS-6021542 Principal Investigator, Francis H. Brown and Co-Principal Investigators, Thure E. Cerling and Ronald L. Bruhn. We would like to thank the Ovatwe for their participation in this research.

Poster Presentation Number 39, Fr (15:30-17:30)

## When Did the Upper Paleolithic Begin on the Russian Plain? (In the Context of Pollen and IRSL/OSL Dates on Kostenki-12 Site and Their Correlations with Pollen and O16/O18 and C13/C14 “Calendars”)

Galina Levkovskaya<sup>1</sup>, Mikhail Anikovich<sup>1</sup>, Nadezhda Platonova<sup>1</sup>, John Hoffecker<sup>2</sup>, Lyudmila Shumilovskikh<sup>3</sup>

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Archeological layers V/K12 and IV/K12 of the Kostenki 12 site are the most ancient Paleolithic layers of the Russian Plain [1,2] (Anikovich et al., 2005, 2007; Hoffecker et al., 2008). They lie under CI/Y5 Italian tephra (39,3 kyr BP) and excursion Laschamp (40,7 kyr BP). The chronology of these layers is discussed in the context of IRSL/OSL dates spanning from 52,34-43,47 kyr (Hoffecker et al., 2008) and correlations of K12 pollen diagram [2,3] with: Glinde (51,55-47 kyr) and Moershoofd (46,25-43,5 kyr) Northern Europe interstadials (Ran, 1990; Behre, van der Plicht, 1992); Glinde+Moershoofd zone 11 (52-42,3 kyr) at diagram Monticchio in Italy (Watts et al., 1996); Black Sea core 25-GC1 diagram (Shumilovskikh et al., 2013) dated on the basis of varvochronology and other methods, with the largest (within MIS3-2) maxima of broad-leaved trees (oak) spanning from 53,08-51,08 and 46,315-45,35 kyr, CI/Y5 tephra and excursion Laschamp; oscillations 14-12 (span 52-43 kyr) of the GISP2 O16/O18 Greenland scale (Johnson et al., 2001); oscillations 14-12 (span 52-43 kyr) of the GISP2 O16/O18 Greenland scale (Johnson et al., 2001). Layer V most ancient Paleolithic complex includes fauna remains (red deer predominate) and only 10 artifacts prepared from low quality Kostenki region flint. Its interpretation as Mousterian or Upper Paleolithic is not clear [1]. Layer V (K12 soil D) is synchronous [2,3] with the Glinde interstadial (51,55-47 C14 kyr) optimum, and Borschevo-5 lowest paleosoil with “elm” maximum. This optimum is characterized by the absolute (within MIS3-2) maxima of pollen from broad-leaved trees: dominants – elm at Kostenki or oak at Monticchio (first half of the span 50-42,3 kyr) and Black Sea core 25-GC1 (53,88-51,08 kyr). It correlates with DO14 of O16/O18 GISP2 Greenland scale (54-50 kyr) and C13/C14 minimum 14 at France stalagmite Vil.9 “calendar” (54-50 kyr). Layer IV/K12 is definitely the most ancient Upper Paleolithic layer [1]. This complex includes fauna (mammoth predominate) and 72 flint artifacts (10 of which have undergone treatment). It has some archaic features connected with the low quality of local flint. Some artifacts from nonlocal flint have evidence of well-developed technology like at Kostenki 14 layer IVb. But they belong to different environmental megastages: elm (IV/K12), and younger (spruce) – IVb/K14 [3] (Levkovskaya et al., 1983; Velichko et al., 2007). Layer IV/K12 began to form at the Moershoofd optimum (46-44 kyr; Ran, 1990) but during its end. This optimum is registered as the second maximum of elm pollen in Kostenki-12 and oak – in core 25-GC1 (46,315-45,35 kyr) and in Monticchio (second half of the span 50-42,3 kyr). It correlates with DO12 of GISP2 O16/O18 “calendar” (its optimum is about 46,8-45,3 kyr) and oscillation 12 at C13/C14 Vil.9 scale (47-42,3 kyr). The upper part of IV/K12 formed during Moershoofd final thermophilous (elm forests and wet meadows) stage. The last corresponds to the most wet phase (45,5-42,3 kyr) in the Villars cave, during which the rate of stalagmite growing was maximal (Genty et al., 2003). The abrupt end of Moershoofd in different regions is 42,3 kyr. Pollen [2,3] and detailed paleozoological data (Hoffecker, Kuzmina, 2005) showed that layer III/K12 of Strelets culture (first phase) formed during periglacial steppe megastage (when horse predominated) and later during the first coniferous spruce phase (when reindeer predominated). It began to form after 42,3 kyr. All the other Kostenki Upper Paleolithic layers under CI/Y5 tephra, including the lowest layer IVb/K14 (with developed Upper Paleolithic complex; Sinitsyn, 2013), are younger than end of “elm” (42,3 kyr) and steppe megastages, and connected with coniferous megastage. The age of the most ancient Eurasian Ust-Ishim anthropological remains containing the DNA of *Homo sapiens sapiens* is about 45 kyr and of anthropological K14 remain – 37,5 kyr (Gibbons, 2014). The first correlates with the most ancient in Kostenki region Upper Paleolithic layer IV/K12 (“elm” megastage final phase: 45,5-42,3 kyr) and the second – with the Kostenki “spruce” megastage.

**Acknowledgements:** The authors are grateful for financial support to Russian Foundation for Humanitarian Research: grants No 12-01-00345a and 13-01-00292a, and to program of fundamental research of presidium of Russian Academy of Sciences “Traditions and innovations in history and culture (2012-2014)”

Poster Presentation Number 75, Sa (16:00-18:00)

## Neanderthal local raw material utilization and transport: A view from southwestern France

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Studies of Neanderthal mobility rely largely on the sourcing of distant raw material types to measure the extent of artifact transport [e.g., 1-2]. In areas such as the Aquitaine region of southwestern France, on average over 95% of the artifacts in the Middle Paleolithic assemblages were made on flint materials obtained in the local environment, typically within a 4km radius of the site [3]. Although raw materials from sources up to 100km away do occur, their quantities tend to be minimal. This flint rich context, where workable materials were relatively abundant, poses a challenge to the study of the ways Neanderthals utilized and transported local lithic resources. This research applies an alternative approach for measuring artifact transport through quantifying the cortex proportions of lithic assemblages [4]. Based on estimates of the size and shape of originally worked nodules, it is possible to calculate the excess or deficit of cortex surface area relative to the artifact volume present within a given assemblage – this relationship is expressed as the Cortex Ratio. The imbalance between assemblage cortex and volume, in turn, indicate artifact transport to and from the assemblage locality. Here, Cortex Ratios are calculated and statistically validated for three Middle Paleolithic sites in the Aquitaine region of France – Roc de Marsal, Pech de l'Azé IV, and Combe-Capelle Bas. The ratios suggest a tendency of homogeneous transport pattern during Marine Isotope Stage (MIS) 5 and more heterogeneous patterns in MIS 4 and 3. Through experimental simulation, the artifact transport process underlying the formation of the observed cortex proportions contradicts existing models of end-product export. Instead, emphasis for selection seems to have been on the size of the artifacts rather than their stages within the blank production sequence. Further comparison between Cortex Ratios and assemblage density also reveal inter-assemblage variation possibly related to changing land use in response to climatic and ecological conditions. The findings of this study support recent observations on the dynamic nature of Mousterian lithic technology and the importance of artifact transport in the formation of the Middle Paleolithic record [5].

**Acknowledgements:** Artifact and raw material scanning was made possible by the equipment and financial aid provided to Lin by the Max Planck Institute of Evolutionary Anthropology. Alain Turq provided valuable information for raw material survey. The authors thank Tim Weaver for pointing towards the potential offered by the permutation test and helpful comments on Monte Carlo and bootstrapping techniques.

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Podium Presentation: Session 7, Fr (14:50)

## What Role for Mediterranean Europe in the MP/EUP shift

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Until recently only Middle Paleolithic or Early Upper Paleolithic sites of northern and central Europe were brought into the discussion of the shift from Neanderthals to modern humans. The role played by Mediterranean Europe was weak and, due to the lack of articles dealing with southern Europe available in English, the archaeological evidence on this topic was not readily accessible and was not cited in the leading scientific journals. Nonetheless, many southern European sites have been yielding consistent and reliable stratigraphic sequences, as well as human fossils associated with behavioral activities like the production of stone tools and intentional transformation of fauna and other “raw materials”. PaleoDNA analysis, new protocols for reliable radiocarbon dating, and paleoenvironmental reconstructions of MIS 3 which are now also applied to the Mediterranean sites, present a wholly different scenario concerning the role played by Mediterranean Europe in the demise of Neanderthals. At present only 6 LMP/EUP Italian sites are bearing AMS dating (new pre-treatment techniques). Three of them are in Northern Italy: Fumane, Mezzena, and Riparo Mochi. The others are in Southern Italy: Grotta del Cavallo, Serino and Castelcivita. Among these sites Riparo Mezzena is the only one bearing a direct dating on genetically typed *Homo neanderthalensis* unequivocally associated to Mousterian. This paper presents the situation of the northern Mediterranean basin and focuses specifically on the Italian Peninsula - with special emphasis on Mezzena - and on its relationship with presently available data from western and eastern regions of Southern Europe. Radiometric data and the archeo-stratigraphic sequence of Fumane cave proves the continuous presence of AMHs since GI 10, supporting for some favourable conditions for human survival even during CI-HE4 crisis. Such refuge conditions, common to the Northern Mediterranean areas from Gibraltar to Italy, may support for successive dispersals of the EUP makers, arrived into Southern Europe ca. 40-36 ka uncal 14C BP. Considering this time-span climatic condition around Europe, in some cases terminal MP industries predate Campanian Ignimbrite (CI) eruption (Southern Italy, Crvena Stijena in Montenegro, Klissoura cave in Greece) while in others the Neanderthals demise (Iberia, Vindija, Spy) could have happened after such event. The occurrence of AMHs in North and Central Europe starting from 44.2-41.5 ka cal 14C BP, attested at Kent's cavern, and thanks to the AMS date of the oldest symbolic behaviour in EUP in Germany, allows to reconsider AMHs diffusions in Europe during the last phase of Neanderthals survival. For Southern Europe data available for Mezzena support for the Hn presence in some areas of the European continent even 5/6000 years after the arrival of AMHs. The role played by Mediterranean Europe and, in particular, by the Italian Peninsula seems to had been until now underestimated and the existing data both on i) paleoDNA, ii) morphological, iii) cultural, and now iv) radiometric basis, allow to present a much different scenario for the demise of Neanderthals. This appears to be occurred much later and with more significant biological consequences than what acknowledged. Moreover the presently available data can confirm that in southern Europe *Homo neanderthalensis* have not become extinct soon after the arrival of AMHs and pose into question the hypothesis of the lack of reliably dated Neanderthal fossils younger than 40 ka cal 14C BP in any other region of Western Eurasia. **Acknowledgements:** Analytical Data has been acquired within the project “Human Fossils of the Verona area” coordinated by L.L. in collaboration with David Caramelli, Elisabetta Boaretto, Ursula Thun Hohenstein and Paolo Giunti.



Podium Presentation: Session 1, Th (8:50)

## Brain size in Mio-Pliocene hominoids: the result of selection or pleiotropy?

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Hypotheses explaining brain size evolution commonly focus on the cognitive advantages that large brains confer to the species and/or on energetics, i.e. how the metabolic costs of large brains are overcome. Brain size is however highly constrained phylogenetically, although it is genetically linked to body size, which, in contrast, varies more freely (Kamilar & Cooper, 2013). The total amount of energy available to an animal constrains the combined expenditure of both, body and brain (Fonseca-Azevedo & Herculano-Houzel, 2012). This underlies the relatively tight brain:body allometry across primates, as well as the observed grade shifts between clades with different dietary strategies (Isler et al., 2008). While energetic considerations thus account for most, if not all, brain size amongst primates, the causes and mechanisms underlying the initial, albeit small, encephalisation in hominins remain unclear, particularly so as hominins had abandoned exclusive frugivory but have not yet resorted to habitual meat consumption. Here, I first test how primate brain size may be affected when body size in only one sex has been selected for, either through sexual or directional selection, thus resulting in an increase in energy expenditure in one sex but not the other. After controlling for phylogeny, sexual dimorphism and sex-specific body mass I found females of sexually dimorphic species to have statistically significantly larger brains than expected on the basis of their body masses (or sociality) alone ( $r = 0.40$ ;  $p = 0.0001$ ). This is not an artefact due to the larger-bodied, sexually dimorphic cercopithecines/hominoids however (Rensch rule); the trend extends across all clades, although in strepsirrhines it is not statistically significant. To test the strength of the relationship further only species where females > 1kg and female body mass < male body mass were selected. The results remain statistically significant for females ( $r = 0.37$ ,  $p = 0.007$ ). In males, no statistically significant relationships were found in any of the analyses. The results suggest a pleiotropic link between body mass and encephalisation, even when the smaller sex (usually females) has not been the target of body size selection. This cautions against the use of average ECVs and body sizes for palaeoanthropological purposes and life history reconstruction. The finding is discussed within the context of Mio-Pliocene hominoid evolution. Even though sample sizes are limited, it appears that Miocene apes were probably similar to extant great apes with regard to brain size, as evidenced by *Dryopithecus brancoi* (10 Ma) and *Sabelanthropus tchadensis* (7 Ma). In the former species, body mass and sexual dimorphism can also be assessed. The brain size increase in subsequent australopiths, albeit small, is consistent with propositions of a pleiotropic effect resulting from selection for larger-bodied males, probably in response to the habitat becoming increasingly open (Cerling et al., 2011); except for *Ardipithecus*, body size sexual dimorphism is generally marked in the earliest hominins. The absolute increase in ECV resulting from such pleiotropic effects would however have impacted on hominin energetics and life histories. Only once energetic constraints were successfully overcome, i.e. through extension of the dietary niche, sociality and material culture, could further encephalisation occur. This process was neither gradual nor incremental, which probably explains the relatively long stasis of ECV in australopiths until the emergence of *Homo*.

**Acknowledgements:** This project was funded by CGL2010-20868.

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Podium Presentation: Session 2, Th (12:40)

## The hominin frontal bone recently discovered in the Po Valley, Northern Italy

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We report the discovery of a fossil hominin cranial bone of Neanderthal morphology recently discovered near Spinadesco, Cremona, in the Po Valley, Italy. The specimen (code St.n.166623, nicknamed "Pàus" from an ancient name of the river Po) consists of the almost complete frontal bone of an adult individual, found on a sand bar of the left bank of the river, probably carried by the current from upstream Middle-Late Pleistocene deposits. It is preserved at present in the Museo Paleontologico di San Daniele Po, Cremona. This frontal bone represents the unique fossil evidence with Neanderthal affinities discovered so far in the Po valley. Thus, given its importance, a commission of experts under the supervision of the Soprintendenza per i Beni Archeologici della Lombardia has been constituted and is now working on the human specimen and its paleoenvironmental context. Neither lithic tools nor faunal remains were found in association with the human finding. Nevertheless, a very abundant fossil fauna came from the same area in the past, and is mainly characterized by cold-adapted Mammals (e.g., *Mammuthus primigenius*, *Megaloceros giganteus*, *Stephanorhinus kirchbergensis*, *Elephas antiquus*) [1]. The human frontal bone appears somewhat modified in its exocranial aspect by taphonomic actions related to water transport and sediment erosion, while its inner surface is better preserved, suggesting that it remained protected for a certain period of time, before its separation from the other cranial bones and/or from the sediments. The specimen is broken anteriorly, in correspondence of an area around the glabella, lacking the nasal spine and most of the orbital plate; nevertheless, it preserves the superior and medio-lateral components of the supraorbital torus and large part of the sinuses. Laterally and posteriorly the sutures have been only partially worn. The endocranial morphology is well distinguishable; it notably includes the superior sagittal sulcus and the frontal crest, while some convolutions and sulci of the frontal lobe of the brain are also visible. With the aim to perform detailed morphometric analyses, Pàus has been imaged by X-ray microtomography ( $\mu$ CT), according to the following parameters: 145 kV voltage, 200  $\mu$ A current, and a projection each 0.075°. The final volumes were reconstructed with an isotropic voxel size of 41  $\mu$ m. By the first observations and quantitative analyses, the general aspects of both the frontal squama and the torus are consistent with the Neanderthal morphology; the pattern of variation of cranial vault thickness, in particular, recorded along the mid-sagittal section ranges from 5.1 mm to 28.8 mm, overlapping the Neanderthal profile [2]. Ongoing researches on Pàus – which will include morphological, palaeogenetic, paleoenvironmental and archaeological aspects – will extend our knowledge on the variability of *Homo neanderthalensis*, furnishing a connection between samples from central Europe [3] and those in the peninsular Italy [4,5].

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Podium Presentation: Session 6, Fr (13:30)

## Can distal fibular morphology be used to infer *Au. Afarensis* locomotor behavior?

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The fibula has rarely been considered in comparative morphological studies. The bones normally used to investigate early hominin locomotor behavior are the largest bones of the hindlimb, femur and tibia. The reason for this choice is probably due to the relatively minor role of the fibula in carrying mechanical loads. However differences in morphology (and inferred function) of the fibula between human and non-human great apes, and within non-human great apes, have been noted in the past and related to differences in positional behavior. Recent research [1,2] have pointed out the correlation present between diaphyseal structural properties of the fibula and locomotor behavior in living hominids (i.e. *Pongo*, *Gorilla*, *Pan* and *Homo*), and its possible application to inferring early hominin locomotor behavior. The problem with the method proposed in these studies is the extreme rarity of complete fibular diaphyses in the early hominin fossil record. However, distal fibular fragments are present in the fossil record. In particular, five distal fibulae of *Australopithecus afarensis* (i.e. AL 288-1at, AL 333-1a, AL 333-1b, AL 333-85, AL 333w-37) from the Hadar region of Ethiopia are available. Several morphological traits in the distal part of the fibula have been used in the past to infer locomotory adaptations and in particular the degree of arboreality in fossil hominins [3]. However, the descriptions of these traits are often qualitative. In this preliminary research articular measurements of the distal fibula of living hominids (*Pongo*, *Gorilla*, *Pan* and *Homo*, N = 107) are quantified. Besides articular area and breadth of the fibulotalar articular surfaces (i.e. proximal and distal), quantitative analysis is provided here of: 1. the angles formed by the fibulotalar articular surfaces with the longitudinal axis of the fibula; 2. the angle between the proximal portion of the fibulotalar articular surface and the subcutaneous triangular area of the fibula, which was hypothesized to be related to the degree of arboreality in great apes (Stern and Susman, 1983). Results show that the morphological characteristics of the distal fibula bear signals correlated with different locomotor behaviors particularly useful to distinguish between bipedal and non-bipedal hominids. The application of this method to the five distal *Au. Afarensis* fibulae available shows how these morphological traits can be added to the ones normally investigated by palaeoanthropologists to better understand early hominin locomotory behavior.

**Acknowledgements:** I wish to thank Bernhard Zipfel for granting access to the high quality casts of the fossil distal fibulae present at the University of the Witwatersrand and Brendon Billings for access to the human material in the Dart Collection, School of Anatomical Sciences, University of the Witwatersrand.

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Poster Presentation Number 47, Sa (16:00-18:00)

## **Bidirectional gene flow between Central and Eastern Africa in the Early Holocene and low genetic input of East African mtDNA lineages into Bantu populations before their expansion South**

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The Bantu expansion had a major impact in Africa, with consequences both at cultural and genetic levels. It started in the region of Cameroon and Nigeria less than 5 thousand years ago (5 ka) [1] and it is thought to have taken two main routes into South Africa: (1) throughout the west through Angola around 3.5 ka and (2) towards the Great Lakes in East Africa, reaching the region of Uganda about 2.5 ka, where they stayed for a few hundred years, expanding later into the south, having reached Mozambique by 1.8 ka [1]. The latter (Eastern route) is of particular interest to study potential crossings between migrants and local central populations during the period in which the Bantu people were stationed in the Great Lakes region. Regarding L2 haplogroup, despite its Western origin, it is nowadays very frequent also in Eastern and Southern Africa. Considering this pattern, L2 movements were postulated to be related to the Bantu expansion. However, a previous analysis based on HVS-I (Hypervariable segment I) of mtDNA showed that the expansion to the East might have occurred much earlier, during the improvement of environmental conditions in the early Holocene (around 10 to 12 ka). The present study aims to reconstruct the phylogeny of L2 haplogroup, in order to provide insights on the complex net of migrations that occurred in Africa in the last thousand years. We sequenced 50 mitogenomes representative of the haplogroup diversity across Africa (with focus on East Africa), which were combined with more than 500 sequences available in online databases. Phylogenetic reconstruction was performed using parsimony, maximum likelihood and Bayesian inference, employing different molecular clocks (including a whole-genome clock corrected for purifying selection and a synonymous clock) [2]. Our phylogenetic analysis of complete mtDNA L2 sequences indicates that lineages in Southern Africa differ from the ones in East Africa and cluster directly with Central/West African lineages at a recent time scale. On the other hand, lineages in the East seem to be much older, suggesting that L2 most probably arrived in the East earlier than the Bantu expansion, in Early Holocene, when climate conditions improved and gene flow across Central Africa was probably frequent [3]. The same pattern is observed in haplogroup L0a, but in an opposite direction. L0a had its origin in the East (being today common in the South) and moved to Central Africa also during the improvement of climatic conditions [4]. Similarly, south lineages of L0a do not seem to be related with those in the East. These evidence, together with the absence of Eastern typical haplogroups (L4, L5, L6, L3h, L3i) in the South, suggest that Bantu permanence in East Africa did not result in admixture with local populations and the population that migrated South had almost entirely ancestry in a Central African mtDNA gene pool. We concluded that two different independent major expansions were associated to haplogroup L2: an initial, and more ancient migration (during the Early Holocene) and potentially driven by climatic improvement around 10 to 12 ka (when L2 lineages arrived in East Africa) and, more recently, the Bantu Expansion, that took L2 towards the South.

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Poster Presentation Number 42, Fr (15:30-17:30)

## Iberomaurusian Funerary Rituals: Cultural And Social Aspects Of The Taforalt Population

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The study of prehistoric funerary practices usually relies on the field documentation regarding the excavation of burial areas. For ancient excavations such documentation can be absent or unavailable. It is the case of the Iberomaurusian necropolis of Taforalt (Morocco, ca 15-12500 Cal BP) that was excavated by Jean Roche in the 1950s. His observations regarding the presence of particular sepulchral structures, the presence of mouflon horns or skulls and the use of ochre testify to complex funerary practices. Given the absence of detailed excavation records, the mortuary behaviour at this site was investigated in previous works on the basis of the analysis of the human skeletal collection, namely the contents of each grave (reconstructed through the ID number on bones) and the distribution of intentionally modified specimens (ochre-dyeing, cut marks). The results suggested that the burial area included primary and secondary depositions, even within the same grave, of about 40 adolescents and adults. Treatment of the cadaver and manipulation of dry bones were attested, and intentional *peri mortem* violence and cannibalism could be hypothesised, even if not proved (Mariotti et al., 2009; Belcastro et al., 2010). New excavation campaigns were conducted at the Taforalt cave from 2005 to 2013 and 13 new burials were discovered, providing the opportunity to document in situ the features of these burials (Humphrey et al., 2012, 2014). Recently, Jean Roche kindly made available some unpublished documents regarding the 1950s excavations of the Taforalt necropolis. These documents include photographs and plots of some graves. In this work we provide a synthesis of the funerary rituals of Taforalt on the basis of the whole available documentation. We also try to glean information about the society, culture and belief systems of the Taforalt Iberomaurusian group/s. This study has revealed a complex of structured funerary rituals probably reflecting specific conceptions of life and death, and functional to the establishment of a strong group identity. We further postulate an evolution of certain kinds of funerary behaviour (e.g. from simple re-use of graves with accidental bone dispersion to formal secondary rituals), probably associated with a parallel evolution of the conceptions and beliefs that justify them, or simply in relation to different social needs. We propose that death became a recognized social condition, and the funerary rites became true rites of passage necessary to accompany the transition of individuals to their new social status.

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Poster Presentation Number 51, Sa (16:00-18:00)

## The postnatal ontogeny of neurovascular versus musculoskeletal landmarks on the cranial base of modern humans and chimpanzees (*Pan troglodytes*)

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Kimbel et al. [1] have noted that relative bicarotid canal width in humans, *Ardipithecus* and australopithecids differs fundamentally from that of chimpanzees (*Pan troglodytes*). We used an aged growth series of 21 chimps and 48 humans to perform a 3D geometric-morphometric and statistical comparison (Principal Components Analysis, Permutation tests and Discriminant Function Analysis) to ask whether the same differences exist between other neurovascular landmarks on the cranial base (foramen magnum and stylomastoid foramen) in modern humans and *Pan*. We then asked at what age after birth this clear pattern of relative bicarotid canal width becomes established in each and how it changes during growth with respect to these other neurovascular landmarks. In both human and *Pan* neonates the 16 landmarks denoting the stylomastoid foramina, carotid canals and foramen magnum outline all lie in the same horizontal plane. The only difference in neonates is that the anterior margin of the foramen magnum is already positioned relatively posterior to the plane of the carotid canals in *Pan*. During postnatal ontogeny, both humans and *Pan* show a similar early growth pattern but humans are distinguished by an extended growth trajectory. In *norma lateralis*, in both taxa the anterior margin of the foramen magnum rotates strongly inferiorly relative to the plane of the carotid canals, tipping the foramen magnum into a posterior-inferior orientation relative to that in neonates. However, the relative antero-posterior position of the anterior margin of the foramen magnum remains fixed with respect to the plane of both the carotid canals and the stylomastoid foramina. In *norma basalis*, the anterior position of the foramen magnum is already associated with a relatively greater width between the carotid canals in human neonates. This difference between *Pan* and humans is both established at birth and remains stable throughout the whole of postnatal ontogeny and seems most likely related to adult posture. When 32 other musculoskeletal landmarks (representing the mastoid processes, mandibular condyles, occipital condyles, and *longus capitis* muscles) are added to this stable neurovascular base, each of them can be seen to migrate markedly in different ways relative to the more stable neurovascular structures. The mandibular condyles (a proxy for the TMJ position at the skull base) are initially positioned relatively anteriorly in *Pan* and human neonates but then migrate posteriorly in both throughout growth coming to lie in the same coronal plane as the carotid canals. *Longus capitis* muscle markings begin in the same coronal plane as the carotid canals in both human and *Pan* neonates and remain this way in humans during postnatal growth. In *Pan*, however, they extend anteriorly as the basioccipital lengthens during postnatal ontogeny. In both *Pan* and humans, the mastoid process drops to a lower level and migrates laterally, together with *porion*, with respect to the more medial neurovascular structures. We conclude that despite considerable postnatal migration of musculoskeletal structures involved in mastication and balance of the head in humans and *Pan*, a stable pattern of neurovascular structures within the cranial base becomes established at, and before, birth. With the exception of foramen magnum orientation, this neurovascular layout remains stable throughout the whole of postnatal ontogeny. Using the bicarotid rather than the bi-*porion* plane may be more stable for judging the anteroposterior position of the foramen magnum. The pattern of relative bicarotid canal width observed in adults by Kimble et al. [1] is likely to be a reflection of very early anterior or posterior positioning of the foramen magnum relative to other cranial base structures. It may also reflect prenatal growth processes of the brain and spinal cord and the early establishment of cerebral vascular patterns.

**Acknowledgements:** We thank C.E.P. Zollikofer and M. Ponce de Leon, F. Spoor, P. O'Higgins, T. Nishimura and the Digital Morphology Museum at the Primate Research Institute, Kyoto University for access to comparative chimpanzee material in their care and J. Hodler and his team at orthopaedic University hospital Zurich for CT scan access and support. We are also very grateful to Frédéric Richard, S. Blau and VIFM, Monash University Melbourne for providing the human CT scan data set. Our thanks also go to Myriam Leon for assisting in data processing.

Poster Presentation Number 32, Fr (15:30-17:30)

## Rediscovering and reinterpreting old data from the archaeological collections of the Portuguese Scientific Missions in Southwestern Angola

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Africa has become a major focus on the debate of the emergence of modern human behavior and rise of anatomically modern humans due to increasing data on early Middle Stone Age sites in southern African territories. However very little is still known about the prehistoric occupation of Angola, remaining as an important gap in the archaeological record. The Tropical Research Institute (IICT) in Portugal holds an important tropical repertoire resulting from intense fieldwork during the Scientific Missions in mid-20th century. The former National Board for Geographical Missions and Colonial Research (JIU) left a large collection of assemblages with lithic materials, faunal remains and sediments, but also geographical and anthropological documents mapping regions of archaeological potential correlating with artifacts from survey and excavation. In this poster we present the preliminary results of an ongoing work of inventory and analysis of the archaeological collections in the IICT. The cataloging of the artifacts has resulted in a database called *Matriz* that aims to publish on-line the total collection of 114,480 artifacts from a hundred archaeological sites in Angolan frontiers, mostly from the Southwestern region. The GIS mapping of the ESA and MSA sites surveyed and excavated by the members of JIU's team in Angola has provided an overview of the spatial dispersion of hunter-gatherers sites in this sub-tropical area. The systematic analysis of the assemblages is still a work in progress but one of the sites from the Humpata Plateau has already offered important data for this cultural framework. Our approach was first based on attribute analysis and typological classification of the lithic assemblage of Leba Cave, in the province of Huíla. The site was excavated in the 1950s during the Anthropobiological Mission of Angola, by the geologist-delegate Camarate França. The author reported a sequence of three archaeological horizons with faunal remains and lithic artifacts that remained scarcely studied and unpublished. The technological and typological analyses of the lithic industry allowed to set out a chronological and cultural sequence of three stages of the Middle Stone Age based on patterns of variability in stone tool production, raw material procurement and reduction sequences. There are discrete patterns of change in raw material management, size, flaking techniques and tool types that correlate to different phases of deposition that may range from the final Early Stone Age (layer VI) to a latter occupation of the Late Stone Age (layer III). In between, layer IV has the highest percentage of elements, mostly flakes and non-retouched lithic points with evidences of hafting purposes. Such chains of manufacture and use of stone-tipped spears for composite tools demonstrate a new level of cognitive and behavioral complexity that commonly is associated with the MSA. Also a bone tool was identified and analyzed giving another point of interest in the evolutionary debate. The great amount of faunal remains from layers IV and III allowed sampling for chronometric dating from which preliminary results underpin an early MSA occupation of Leba Cave comparable with the sites of South Africa that currently have the earliest dates for the pack of modern human behavior.

**Acknowledgements:** This research is being supported by grant from Fundação para a Ciência e Tecnologia, PTDC/ IVC-HFC/ 5017 /2012 "PROMEMICI - Protagonistas e memórias das 'missões científicas'. Arqueologia e agenda colonial portuguesa". Thanks are also due to Nuno Bicho, Curtis McKinney e Marina Évora.

Podium Presentation: Session 10, Sa (15:20)

## Vascular system development of small tubular bones of Neanderthals from Altai caves

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Southern Siberia is a unique place for study of fossil man. The rapid progress of genome decoding techniques has culminated in the sequencing of mitochondrial and nuclear DNA of several fossil hominins of different origin from Central Asia, carried out at the Max Planck Institute for Evolutionary Anthropology in Leipzig [1, 2, 3]. Excavated in Denisova Cave girl's pinkie bone added a new evolutionary branch, but it was recently shown that before Denisovan presence the same cave could be a sanctuary for Neanderthals. Neanderthal migration to Southern Siberia was detected by archaeological, palaeogenetic and anthropological studies. Today their skeletal remains of fragmentary preservation are estimated in three caves of highland Altai, subdivided by hundreds of kilometers. Modern radiological and microscopic techniques offer deeper insight into the skeletal development of fossil and extant members of the genus *Homo* and enable researchers to work with small bones and bony fragments. Earlier using microfocuss X-ray we tried to differentiate between "archaic" and "modern" samples in degree of trabecular system development and mineral density [4]. Then we have used the nondestructive method of micro computerized tomography for a comparative histological assessment of the Denisova girl's biological age [5]. In this case manual phalanges of adult Neanderthals from different Altai caves (Okladnikov, Chagyrskaya, Denisova) were studied. Comparative data were taken by the scanning of bones of anatomically modern humans from Sunghir and Markina Gora. 3D and 2D magnified reconstructions are analyzed, and a comparative histological assessments of the microstructural features of bones are made. The volumetric X-ray microscopy we used is a nondestructive technique of evaluation of vascular net density in compact bone, which is an important advantage given the uniqueness and the fragmentary nature of finds. The method gives evidence for relatively high morphological variability of development of vascular system of adult Neanderthals inhabited Okladnikov, Chagyrskaya and Denisova Caves. The results can be interpreted from different points, including occupational or genetic differences. The study was supported by RFBR, grant of-m 13-06-1224

**Acknowledgements:** Authors are deeply grateful to A.P. Derevianko and M.V. Shunkov, S.V. Markin, who granted access to the Altai fossils. Our thanks are due to T.S. Balueva for the opportunity to study the Sunghir 1 skeleton, to V.I. Khartanovich for the opportunity to study skeleton Markina Gora (Kostenki 14).

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Poster Presentation Number 70, Sa (16:00-18:00)

## The distribution of authigenic minerals in the Middle Stone Age deposits of Sibudu (South Africa), and implications for the preservation of archaeological features

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As part of a broader geoarchaeological project at the Middle Stone Age site of Sibudu (KwaZulu-Natal, South Africa), we conducted a mineralogical study in order to reconstruct the impacts of sediment chemistry and rockshelter microenvironments on the preservation and distribution of archaeological materials and features. During the 2014 excavation season, we collected and analyzed more than 700 sediment samples in the field using a portable Fourier transform infrared spectrometer (FTIR). The on-site analyses yielded 1762 individual spectra, which were paired with three dimensional coordinates collected using a Total Station. We identified at least 10 distinctive primary and secondary mineral phases, and plotted their distributions on the archaeological profiles. Supplemental analyses conducted in a laboratory setting include micro-FTIR analyses on thin sections and resin-impregnated blocks, and x-ray diffraction. The results for three main profiles and a limited sample of a fourth indicate that the distributions of primary and secondary mineral phases are vertically and horizontally variable. Primary minerals that we identified in the sequence include calcite, opal, quartz, feldspar, mica minerals, and kaolinite. As Sibudu is a sandstone shelter, the primary source for calcite to the archaeological deposits is wood ashes. Likewise, bedding layers provide one source of opal. These observations are supported by previous micromorphological analyses of both combustion features and bedding [1],[2]. Our FTIR analyses indicate that calcite is consistently present in the uppermost 30 cm of the deposits, while opal is present throughout. Sulfate minerals, such as gypsum, are abundant within the upper portions site, where they variably appear in the form of large nodules and cements. In addition, the lateral distribution of sulfate minerals appears to correlate with proximity of the deposits to the bedrock wall. Secondary phosphate minerals in the form of crusts and nodules include members of the apatite and whitlockite groups, as well as brushite and taranakite. Our results suggest a more complicated history of diagenesis at the site than the one presented in previous works by Schiegl and colleagues [3],[4]. Furthermore, the distributions of calcite and phosphate minerals are indicative of dissolution and phosphatization of ash sourced from combustion features. Finally, opal in the form of primary phytoliths and secondary nodules, the latter in association with other end-stage diagenetic phases, are suggestive of variability in the preservation of bedding layers at the site.

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Podium Presentation: Session 6, Fr (14:30)

### Spinal stenosis in *Homo erectus*

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Spinal canal dimensions in the Nariokotome boy KNM-WT 15000, the best preserved skeleton of *Homo erectus*, are strikingly narrow except for the caudalmost lumbar vertebrae when compared to modern humans [1]. They thus resemble those of chimpanzees and australopithecines. The hypothesis of Latimer and Ohman [2] that Nariokotome's narrow spinal canal resulted from congenital pathology was recently challenged by Schiess and Haeusler [3]. MacLarnon [1] proposed the alternative hypothesis that a narrow spinal canal was characteristic of *H. erectus*. Moreover, she suggested that it indicates a less developed muscular control for breathing and thus inferior speaking capabilities than in modern humans. So far, however, there were no fossils available to test these hypotheses. Here, we compare the Nariokotome spinal canal to a subadult *H. erectus* from Dmanisi [4]. Sagittal and transverse spinal canal dimensions of the Dmanisi vertebrae are markedly larger than that of Nariokotome for T3, but more similar for T11 and L2. The difference becomes even larger when the actual vertebral canal area is measured. Relative to body size, the spinal canal areas of Dmanisi fall in the lower range of variation of modern humans, whereas the entire Nariokotome spinal canal is markedly narrower and resembles that of chimpanzees. Differences in spinal canal shape between the two fossils appear to explain their cross-sectional area differences, with the Dmanisi canals mirroring the human shape. Nonetheless, relative spinal canal areas of Dmanisi and Nariokotome are similar for T11 and L2, and the disparity of T3 equals one interquartile range of the modern human distribution. Thus, the normal range of variation in spinal canal areas of *H. erectus* may be described as intermediate between modern humans on the one hand and australopithecines and chimpanzees on the other hand. However, given the narrowness and distinctive shape of the upper thoracic spinal canal of Nariokotome, a localized relative spinal stenosis cannot be excluded in this specimen. Enlarged spinal cords in the thoracic region of humans have been linked to the unique human ability for fine control over respiration for speech, as several muscle groups associated with respiration are innervated exclusively by the thoracic spinal cord [1]. Clinical evidence shows, however, that the diaphragm is the chief muscle of respiration, with the intercostal and abdominal muscles serving only as accessory muscles of respiration [5]. Speech production is unaffected by the complete loss of intercostal and abdominal muscles, demonstrating that the role of the thoracic muscles in speech is negligible. Since the size of the thoracic spinal cord has no relation to spoken language in humans, the thoracic vertebral canal size is of no value in predicting language ability in extinct members of the genus *Homo*.

**Acknowledgements:** MH thanks the Mäxi Foundation for financial support.

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Podium Presentation: Session 7, Sa (13:50)

## Behavioural Implications of Large Flake Acheulian technology

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Large Flake Acheulian is a term recently introduced to refer to the Acheulian assemblages in India and Africa which are dominated by cleavers made on large flakes (Sharon, 2007). Most of the Acheulian assemblages known from India belong to the Large Flake Acheulian. The Acheulian was first defined by the European Acheulian, which developed from the Large Flake Acheulian. Some characteristic features of the European Acheulian are absent in the Large Flake Acheulian while other features in the Large Flake Acheulian have been identified which have previously not been accorded the significance they deserve. The most significant difference between the Acheulian and the earlier Oldowan is that Oldowan assemblages have complete chaine operatoires while Acheulian assemblages have fragmented chaine operatoires. This difference is significant because of its behavioral implications. Complete chaine operatoires of the Oldowan are due to the Oldowan hominins making, using and discarding stone tools in a single location while Acheulian hominins made, used and discarded stone tools at different locations. This pattern follows from a profound difference in behavior—Oldowan hominins carried objects in their hands, while Acheulian hominins had developed a technology to carry objects. The Acheulian technology is a consequence of a non lithic technology developed to carry objects. It can be further suggested that the objects carried were not primarily the stone tools, but edible vegetables, and that the emergence of the Acheulian is related to the use of technology to collect and process vegetable foods. Fragmented chaine operatoires attest to the collection and transport of material but technology to process vegetable foods would potentially include pounding, grinding and cooking. Thus gathering rather than hunting might have been more crucial in the dietary shift which occurred in the transition from *Australopithecus* to *Homo*. In this presentation the argument for relating the emergence of the Acheulian to a technology aided vegetarian diet will be presented.

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Poster Presentation Number 7, Fr (15:30-17:30)

## The Gravettian mandibles from Grotta Paglicci (Apulia, Italy): a geometric morphometrics study

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The Paglicci site is located on the southern slope of the Gargano Promontory (Apulia, Southern Italy) it is composed of the present-day cave and a rock shelter that, in the past, was part of the same cave-system. The site has been continuously excavated since the early 60s: from 1961 to 1963 by F. Zorzi (Natural History Museum of Verona); from 1971 to 2001 by A. Palma di Cesnola (University of Siena); and from 2001 to present days by A. Ronchitelli (University of Siena). The 12m thick sequence uncovered inside the cave yielded archaeological, paleontological and anthropological remains spanning from Lower-Middle Palaeolithic (Acheulean, Early Mousterian) to Final Epigravettian, comprising Aurignacian and Gravettian. Among the several human remains uncovered in Paglicci, the most important are two Gravettian burials that are among the oldest in Europe. The two individuals from these burials, Paglicci 12 (Mezzena and Palma di Cesnola, 1972), a juvenile male, which age at death was around 12 years old (PA12) and Paglicci 25 (Mezzena and Palma di Cesnola, 1989-90), a young adult female around 20 years (PA25). Over the years they have been the subject of general anthropological studies (Mallegni and Palma di Cesnola, 1994; Mallegni et al., 1999), but with the development of new analytical techniques in palaeoanthropology, the morphological affinities of the two specimens are being reconsidered. The main objective is to contribute to the understanding of the first peopling of Europe by *Homo sapiens* looking at various aspects of these populations such as their morphological characteristics, health status, and cultural background. The present study focuses on the morphometric affinities of the mandibles of PA12 and PA25 which were compared to 78 Old World modern human specimens. The mandibles were described thanks to 22 landmarks and were analysed through a geometric morphometrics analysis (General Procrustes Analysis GPA, Principal Component Analysis PCA and Discriminant Function Analysis DFA). The 10 first PCs of the PCA (72.40% of the total variance of the data) were used as variables for the DFA which aims to discriminate 5 pre-defined groups: extant Europeans (N=14, Romania and England), extant Asians (N=14, China and Indonesia), extant Africans (N=13, Nigeria), Neolithic Europeans (N=13, Loisy-en-Brie, France), Neolithic Africans (N=13, Hassie-el-Abiod from Mali; Gamble's Cave 5, Nakuru IX, Willey's Kopje II, Elmenteita A, D and F from Kenya) and Palaeolithic specimens (N=11: Oberkassel 1 and 2 (German), Ohalo II (Israel), Abri Pataud (France), Predmosti 3 and 4 and Brno II (Czech Republic), Combe-Capelle (France), Grimaldi 5 (Italy), Qafzeh 9 and Skhül V (Israel)). We used the discrimination pattern between those 5 groups in order to assess the morphological affinities of the Paglicci mandibles which were introduced a posteriori in the DFA. The classification results indicate that apart from the Neolithic Europeans all groups overlap in their morphology. It is especially difficult to distinguish between extant Europeans and Asians, while extant Africans present a slightly different morphotype which is closer to Neolithic Africans. These specimens as well as the Palaeolithic mandibles show a much more robust morphology. Both Paglicci mandibles are classified as Palaeolithic specimens by the DFA. PA12 is especially similar to the Grimaldi 5 mandible which also belonged to a juvenile individual while PA25 is more similar to Combe-Capelle and Oberkassel 1. This morphological affinity indicates that PA25 mandible is very robust despite the fact that it is a female individual. Finally, both Paglicci mandibles are also similar to African Neolithic specimens. Contrary to the European Neolithic mandibles, the African Neolithic specimens show close morphological affinities with the Palaeolithic fossils. This could indicate a different migration pattern between Europe and Africa during late Palaeolithic and Neolithic.

**Acknowledgements:** We thank the Soprintendenza per i Beni Archeologici della Puglia which authorized and supported the excavations at Grotta Paglicci over the years.

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Poster Presentation Number 12, Fr (15:30-17:30)

## Examining the influence of habitual loading along the long bone diaphyses of varsity athletes; skeletal plasticity and constraint

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Elements of the upper and lower limb have been demonstrated to economically adapt their structure and shape in response to the mechanical loads they endure. The role that skeletal plasticity and genetics collectively play in this process, however, is not well understood. Here we investigate how aspects of the long bone proximal, distal and middiaphyses respond to different forms of habitual dynamic loading. Peripheral quantitative computed tomography (pQCT) was used to generate cross-sectional images at three different segments along the radius, ulna, and tibia, as well the humeral midshaft among varsity level athletes including swimmers ( $n = 15$ ), cricketers ( $n = 17$ ), field hockey players ( $n = 15$ ), cross-country runners ( $n = 15$ ) and a relatively sedentary control group ( $n = 21$ ). Geometric properties indicative of mobility and behavior were assessed at 50% humeral length, 66%, 50%, and 4% of radial and ulnar length and 50%, 38%, and 4% of tibial length. The properties of interest included cortical area ( $CA$ ), indicative of diaphyseal strength under pure axial compression and tension; total area ( $TA$ ), encompassing the sub-periosteal surface including the medullary cavity; polar second moment of area ( $J$ ), indicative of torsional rigidity about the section; and diaphyseal shape, expressed as the ratio  $I_{max}/I_{min}$  (or maximum divided by minimum bending rigidity), which corresponds with a cross-section's deviation from circularity [1]. One-way ANOVA and coefficients of variation were then used to compare inter- and intragroup structural variation across elements and cross-sectional segments. Architecture at the humeral midshaft appeared more responsive to activity based loading than either the radius or ulna, suggesting that the forearm may be more genetically canalized than the upper arm. However, we provide evidence that long bone geometry at the distal, proximal, and midshaft segments of the forearm are also impacted by habitual loading behaviors associated with swimming as well as cricket bowling and hitting. Along the tibia, variation between athletes and controls was most pronounced at midshaft while the 38% and 4% segments appeared incrementally less responsive to loading associated with running or field hockey. It is possible that adaptation at the distal tibia is more constrained within and between groups because of the close proximity of this region to the site of ground impact, where safety factors should be greatest [2]. Our results support the evidence that weight-bearing bones, when placed under a continuous and vigorous loading regime, will elicit a site-specific adaptive response for the purpose of structural optimality in that given region. Moreover, we demonstrate that plasticity is not only variable between limbs but along particular segments of the long bone diaphyses as well. The close relationship between tissue plasticity and constraint along the diaphysis described here is capable of lending insight into the adaptive morphology associated with archaic and modern human behavior. Further, these findings may aid in future behavioral interpretations in the fossil record.

**Acknowledgements:** We wish to thank A. Laskey, S. de Bono, A. Prentice, and other staff at the MRC Human Nutrition Laboratory, Cambridge, UK for access to pQCT technology, assistance obtaining ethical approval for this study, and the development of the questionnaire.

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Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## Endocranial shape asymmetry in humans and apes

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Functional brain lateralization – specializations of brain areas in different hemispheres – is to some extent related to morphological brain asymmetry and thus also to the shape of endocrania. An understanding of endocranial asymmetries is therefore important to discuss hominin brain evolution. Humans, for example, have a typical combination of right frontal and left occipital protrusions, called petalias, as well as a larger left Broca's cap region than the right. These endocranial features have been related to handedness and language. While apes also have asymmetric endocranial casts, they seem to lack a consistent population-wide pattern. However, endocranial asymmetry has been described qualitatively rather than quantified. Here we present a comprehensive geometric morphometric approach to quantify endocranial asymmetry of humans and apes and explore the pattern and the amount of asymmetry as well as the relationship between endocranial volume and asymmetry. To do so, we generated virtual endocrania of 36 humans, 28 chimpanzees, 36 gorillas, 43 orangutans and 10 gibbons and measured 309 landmarks and semilandmarks on the endocranial surface. To remove asymmetric shape variation that is related to the arbitrary location of semilandmarks, the semilandmarks were allowed to slide according to a symmetric landmark configuration. We then investigated symmetric and asymmetric shape variation based on the relabelled reflections of the landmark configurations. Our landmark data document the known contralateral frontal-occipital petalias together with differential projections of the left and right temporal poles. The major axes of asymmetric variation vary to some degree among the investigated species. Unexpectedly, gorillas show a distinct pattern of asymmetry that is highly directional towards one side and different from the other groups. In addition, gorillas have the most asymmetric endocrania. The amount of asymmetry is not related to endocranial volume, neither between nor within species. We demonstrate that our quantitative multivariate approach captures relevant endocranial asymmetries and does not require defining a midline for the analysis, a step that sometimes is problematic. It adds to our knowledge about the pattern and the amount of brain asymmetries in living primates. This is essential for the interpretation of hominin fossil endocrania, given that brain lateralization is an important process in human brain evolution.

**Acknowledgements:** This research was funded by the Max Planck Society.

Podium Presentation: Session 11, Sa (15:40)

## Modelling the tool use and diet of *Paranthropus* and *Homo habilis*

Adam Newton<sup>1</sup>

1 - University of Liverpool Alumnus

In this paper I present the results of my doctoral thesis: The question of this thesis concerns the differences in diet and tool use between *Paranthropus* and *Homo habilis*. Was the use of technology by *H. habilis* an alternative to the megadont trend seen in *Paranthropus* in gaining and consuming food resources? So in other words, the technology of *Homo habilis* was compared to the anatomical specialisations of *Paranthropus*. To investigate this issue a computer model was built using the modelling software Simile. In the model there is a population of hominins whose technological and anatomical attributes can be altered. The jaw anatomy can represent either *Paranthropus* or *H. habilis*, and the hominins can possess digging sticks and/or stone tools. The hominins move around on a landscape that contains six broad food types, with resources that vary seasonally. The calorie return rate from each food type depends upon the attributes of both the food types and the hominins. The data provided by the model is a calorie count over ten simulated years, thereby providing a measure of the relative success of the hominins under a range of conditions (e.g., jaw size, tool using ability, dry or semi-arid landscape). By changing the hominin attributes and the conditions of the environment and running the model under a wide range of different configurations it was possible to explore various scenarios of early hominin subsistence. A secondary research aim concerned the applicability of computer modelling as a research tool for investigating the behavioural ecology of early hominins. The results showed that despite a similar average yearly calorie intake, *H. habilis* was able to gain more calories when food resources were scarce relative to *Paranthropus*. Digging sticks could also have made a considerable difference to the calorie intake of *Paranthropus* in times of seasonal resource scarcity. Altogether, the modelling method employed here was shown to be highly worthwhile, not just for testing hypotheses, but also for generating new ideas and theories. Computer modelling is, however, a method that requires commitment in order to build up a model to a useful level. However, once this has been achieved the rewards are clear.

**Acknowledgements:** I gratefully acknowledge the contributions that so many people have made to this work. Special thanks to my supervisor Professor John Gowlett for supporting me and guiding my work throughout the last seven or so years. Many thanks to for the British Academy Centenary Research project 'Lucy to Language', for both the academic and financial support it has offered over the years. Not to mention countless glasses of free wine. A very special thanks goes to my parents, Ian Newton and Chris Harding, and also to my stepfather, Derek Harding. And lastly I thank my wife, Dr Iris Newton, for all her advice and support, and also for putting up with me for all these years.



Podium Presentation: Session 7, Sa (13:30)

## Size Matters - Patterns of choice and constraint in Lower and Middle Palaeolithic microlithic assemblages in central Europe

Iris Newton<sup>1</sup>

1 - Alumna University of Liverpool

This paper presents the results of my doctoral thesis: The question raised in this doctoral thesis is one of choice: To what extent did the makers of microlithic tool kits during the Lower and Middle Palaeolithic merely respond to environmental pressures and to what extent did they choose to shape their environment, by means of their toolkits, according to their needs? The analysis of stone tool assemblages has traditionally been conducted in one of two ways: with a typological or with a quantitative (numerical) approach. Typological approaches have been found wanting – their greatest danger lying in the subjectivity of the researcher; but also, and this is specific to the older archaeological periods, the typological approach can be fraught with difficulties due to a lack of recognisable types. Both of these pitfalls have been squarely addressed by numerical approaches, but the sheer quantity of data points that can possibly be recorded and statistically analysed from any one piece makes these methods difficult to work with. For this investigation, I have developed a shorthand methodology that rests heavily on numerical approaches and abandons typology, but takes into consideration certain qualitative aspects of typological approaches. The investigation thus encompasses both development and test case for a third approach in stone tool analysis. Assuming a certain degree of choice, a selection of Lower and Middle Palaeolithic microlithic assemblages was analysed to investigate possible patterns within the material with regards to raw material selection, tool shape and size. The emerging pattern is viewed against the backdrop of ecological variables, i.e. climate, environment, potential resources and the archaeological evidence of actually exploited resources. The impact of smallness is then explored in areas such as subsistence and lifestyle, hafting, learning and focus of attention. A further aspect to be considered in this investigation concerns the recurrence of microlithic assemblages during the Middle Palaeolithic and the question of continuation of a technological tradition over a long period of time. I have analysed data collected from microlithic assemblages from Poland (Trzebnica 2d, Trzebnica 2g, Rusko 33, Rusko 42) and Germany (Bilzingsleben, Ehringsdorf Lower Horizon, Taubach) with the help of the statistic software package PASW17. The results indicate that early human populations in central Europe had far greater opportunities to shape their subsistence strategies and choose their lifestyles than was previously assumed. Environmental pressures and restrictions are partly but not solely responsible for the chosen strategies. Raw material availability had an influence but was not always the determining factor in artefact size, shape and technological strategies. As for the question of recurrence versus continuation of small tool traditions into the Middle Palaeolithic: The results suggest that there was no continuation, which may be unsurprising given the long periods of time involved. Instead similar strategies were chosen in similar environmental and climatic conditions, but with morphologically and technologically varying toolkits.

**Acknowledgements:** I thank my supervisor Professor John Gowlett for supporting and guiding my work. I am grateful to Alfred Latham, Stephen Lycett and Julien Louys for their advice on statistics. I thank Clemens Pasda at the University of Jena, who gave me access to the material from Bilzingsleben and Taubach; Jan-Michał Burdukiewicz Andrzej Wiśniewski at the University of Wrocław, who let me study the assemblages of Rusko, Trzebnica and Wrocław Hallera Street; Wil Roebroeks, Dimitri de Loecker, Alia Gurtov and Eduard Pop, who shared their preliminary results from Neumark-Nord 2/2 with me. This work was supported by a grant from the Arts and Humanities Research Council and by the British Academy Centenary Research Project ‘Lucy to Language’.

Podium Presentation: Session 5, Fr (10:20)

## Neanderthal occupation of the East European Plain: New data from the Middle Dniestr valley (Ukraine)

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While Neanderthal occupation in Western and Central Europe is well documented from 250 kya onwards, current data suggest that the vast East European Plain (EEP – between the Carpathian and Ural Mountains and the Black Sea and Scandinavia) was colonised only from the Last Interglacial onwards. Earlier incursions are documented but limited to the EEP's southernmost fringes (i.e., northern Caucasus and northern Black Sea coast). The reason for the late colonisation of the EEP is most probably due to colder and especially more arid conditions when compared to Western and Central Europe. Here, we present new data on timing and environmental context of the Neanderthal occupation of the Middle Dniestr valley resulting from our new fieldwork in this region since 2011. The Middle Dniestr valley is a key area of the southwestern EEP and contains by far the richest Middle Palaeolithic record of the EEP ([1], [2], [3]). Neanderthal occupation of this specific region is documented in the Early Glacial and Middle Pleniglacial based on pre-1980s fieldwork ([1], [3], [4]). Good examples are the Middle Palaeolithic horizons (Mousterian with Levallois technology) of the site Molodova V. Recently they have been attributed to the Middle Pleniglacial ([5]). In the current project, we are surveying previously unavailable outcrops (vertical exposures) created by the Dniestr Reservoir Lake. Our fieldwork includes surface surveys, geological sections and excavations. All fieldwork is conducted by a multidisciplinary team including Quaternary field geologists who provide high-resolution pedo-stratigraphic analysis of the sequences. We are applying a chronostratigraphic approach ([5]) to the sequences studied in our project. Environmental analysis utilizes sedimentological, pedological, soil micromorphological, palynological and malacological data as well as data from plant macro-remains. Dating includes radiocarbon and OSL dating. In this presentation, we are focusing on the results of our work at the two sites Neporotovo 7 and Molodova V. The newly discovered site Neporotovo 7 is a Middle to Late Pleistocene locality exposed over 50m along the Dniestr river. The 7 meters deep sequence includes from base to top Middle Pleistocene loess, the Last Interglacial-Early Glacial pedo-complex, and Early, Middle and Late Pleniglacial loess-paleosol deposits. Four archaeological horizons (AH) are embedded in the sequence. One AH (*Bos/Bison* remains and lithics) is located below the Last Interglacial-Early Glacial pedo-complex, the first of this age in the southwestern EEP. Three AHs are located above in the Early Glacial, and Early and Middle Pleniglacial deposits respectively. Our results include a detailed chronostratigraphic and environmental record. Pedo-stratigraphic and palynological data allow a detailed reconstruction of the environmental conditions during Neanderthal occupation at the site. Further, we compare the new Neporotovo 7 dataset with existing and new data on the Mousterian of the Middle Dniestr valley, including the lower AHs of Molodova V. We conclude that hominins were present on the southwestern EEP prior to the Last Interglacial and that most likely the Middle Palaeolithic horizons at Molodova V – as at Neporotovo 7 – predate the Middle Pleniglacial. Further, we show that Neanderthals occupied the southwestern EEP during cold and arid periods.

**Acknowledgements:** This research is funded by the Leakey Foundation, a EU FP7 Marie Curie Career Integration Grant, the Max-Planck-Society, the McDonald Institute for Archaeological Research (D M McDonald Grants and Awards Fund), the Sir Isaac Newton Trust, the University of Cambridge, and the MO/36/021 Research Project of the Belgian Science Policy.

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Poster Presentation Number 87, Sa (16:00-18:00)

## Mesolithic animal exploitation and palaeoeconomy: Discussion of a new methodological approach

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During the Holocene two economic systems were pursued: “Neolithic” agriculture and stock breeding and “Mesolithic” exploitative hunting, gathering and fishing. To understand the relationship between these oppositional economic concepts, a detailed study of economic practices applied during the Mesolithic is necessary. Against this background a new economically focussed methodology will be discussed.

Studies of economic systems consider basic questions related not only to subsistence but to a wide spectrum of physical and social requirements. Therefore palaeoeconomic behaviour encompasses all activities necessary to gain sustenance and is manifested in various aspects of the archaeological record. One way to characterize these complex systems is the application of a methodology which is based on an economic concept currently used for discussion on Neolithic economy. In a pilot study, the approach of “total” animal exploitation (see Fontana et al., 2009) is combined with a palaeoeconomic model. In this model the components of the entire palaeoeconomic system are defined and related to each other. To illustrate the potential of this methodological approach, one aspect of mesolithic economic behaviour, the exploitation of hunted animals, is considered. The big game species such as red deer, roe deer, elk, aurochs and boar are analysed in regard to different aspects of their exploitation. Therefore, food remains and remains of organic tool production from early Mesolithic northern German sites are compared with regard to the frequency of species represented. The faunal material originates from lakeshore sites including Hohen Viecheln and Rothenklempenow.

The pilot study demonstrates that animal species can be regarded as an entity that is equipped with a specific set of components. Thus, human exploitation of various animal species is not solely based on nutritional requirements. To understand the contribution of each animal species within the economic system, the different aspects of their utility use have to be considered and related to each other. Studies on the Mesolithic based on a holistic point of view gain new insights into past human behaviour. Based on this study, diachronic analysis of preceding and succeeding archaeological periods could improve our understanding of economic evolution during the Holocene.

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Poster Presentation Number 34, Fr (15:30-17:30)

## Techno-typological analysis of bifacial component at Gombe site (Kinshasa, DRC). An assessment of the Lupemban in Western Central Africa

Sylvie Numuhire<sup>1</sup>

1 - Université Libre de Bruxelles (ULB, BE)

The Lupemban, named after the eponym site of Lupemba which is located in the south of the Democratic Republic of Congo, designates a lithic industry from the Middle Stone Age in Central Africa. One of the significant typological aspects of this industry is the presence of core-axes and points, as well as the component of bifacial knapping [1]. Its geographical distribution and its chronological limits are, however, very flexible. This broad interpretation of the Lupemban Industrial Complex is mainly related to the history of its definition originally based on surface collections and also to the attempts of harmonizing various local and regional sequences of sub-Saharan African lithic material, during the second half of the twentieth century [2]. Recent research on the Middle Stone Age, and more particularly the dating evidence that has become available for Lupemban reference sites such as Kalambo Falls, Twin Rivers (both located in Zambia) and Sai Island (Sudan), allows for a new assessment of Lupemban materials in the western and eastern regions of Central Africa. To do so, we focused on the lithic material from the lower layers of the first excavations conducted by Jean Colette between 1924 et 1927 at Gombe (ex-Kalina, DRC) – reference site for Western Central Africa – which is currently preserved at the Royal Museum for Central Africa (Tervuren, Belgium). Though Colette himself described these assemblages as Kalinian and Djokocian they have become included in the Lupemban complex. The restudy implied a reconstruction of the original stratigraphic position of the various artefacts through archives and decoding information on the lithic pieces themselves. In this poster we report on the results of the typo-technological analysis of the core-axes and points, which are considered as typical of the Lupemban, and to which extent the Gombe lithic industry is similar to those of other sites considered Lupemban both in Eastern and in Western Central Africa [1], [3], [4], [5].

**Acknowledgements:** I would like to thank the following people for their scientific support in preparing this poster: E. Cornelissen at the Royal Museum for Central Africa and O. Gosselain and M. Groenen at the Université Libre de Bruxelles and also to N. Devleeschouwer and A. Vral at the RMCA for their assistance in consulting the archives and collections.

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Poster Presentation Number 19, Fr (15:30-17:30)

## Morphometric maps of the developing human humerus

Thomas O'Mahoney<sup>1</sup>, Philip Withers<sup>1</sup>, William Sellers<sup>1</sup>, Andrew Chamberlain<sup>1</sup>

1 - University of Manchester

The growth and development of long bones are of considerable interest in the field of comparative anatomy and palaeoanthropology, as study of modern groups can potentially be used as analogues for reconstructing past behaviour. Traditionally, cross sectional geometry of long bones has been examined at set intervals along the shaft. More recently, the technique of "morphometric mapping" (e.g. Bondioli et al. 2010, Morimoto et al. 2011) has been used as both an exploratory and a hypothesis testing technique. We concentrate in this particular study on a large developmental series of human humeri (n=90; ages 22 weeks in-utero to 17 years). The cortical thickness and biomechanical properties between 20 and 80% distance from the distal metaphysis were mapped in 200 intervals (approximately every 0.33%) in order to answer a set of questions, as well as more general exploration. These questions were:

- Are there statistically significant differences between age groups, and can inferred broad activity patterns account for these?
- At what age group does a more 'adult' pattern of morphology manifest itself?
- Are the conventional intervals (15; 35; 50; 65; 80%) biomechanically meaningful?

**Methods** All humeri are from a large medieval cemetery series (Newcastle Blackgate) and all specimens analysed preserved all of the area of interest. Bones were scanned over 2 days using a Nikon Metris Custom Bay at 58KeV with no filter. Scans were reconstructed from raw tiffs and sonograms using Nikon CT Pro and Matlab. The bones were then aligned along principal axes and segmented using Avizo. The segmented TIFFs were then analysed using automated batch routines in Matlab and ImageJ. The maps were analysed using a fast Fourier transform followed by PCA. Using these methods, we are able to demonstrate the significant differences between age groups. We also apply the same methodology to the partial Neanderthal juvenile humeri from Weimar Ehringsdorf; Sesselfelsgrötte and Krapina and present their respective maps for visual comparison and interpretation.

**Acknowledgements:** We are grateful to Mrs Kay Hinckley and Mr J Davidson for funding this study and presentation. Charlotte Brassey gave assistance with logistical aspects of CT scanning and post-processing, as well as helpful discussion of biomechanics. Tristan Lowe provided assistance with the Nikon custom Bay and Diane Mahoney Swales assisted with sample selection and dental ageing. We would like to acknowledge the assistance provided by the Manchester X-ray Imaging Facility, which was funded in part by the EPSRC (grants EP/F007906/1, EP/F001452/1 and EP/I02249X/1) We are also grateful to the NESPOS society for making the Weimar-Ehringsdorf, Krapina and Sesselfelsgrötte CT data available.

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Poster Presentation Number 16, Fr (15:30-17:30)

## The stout navicular bones from the the Middle Pleistocene site of Sima de los Huesos (Atapuerca, Burgos, Spain)

Adrián Pablos<sup>1,2,3</sup>, Carlos Lorenzo<sup>2,4</sup>, Ignacio Martínez<sup>2,5</sup>, Ana Gracia-Téllez<sup>2,5</sup>, José Miguel Carretero<sup>1,2</sup>, Juan Luis Arsuaga<sup>2,6</sup>

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In the *Homo* fossil record is not frequent the existence of foot remains prior to Neandertals and modern humans. Some navicular bones have been previously described (e.g. Jinniushan, OH8 and LB1). However, it is unknown when the modern morphology of the navicular has arisen. Trinkaus [1] established a modern morphology of the Neandertal foot indistinguishable of modern humans in the implied locomotor capabilities. Nevertheless, this author established a great navicular tuberosity and a general robusticity for this bone in Neandertals relative to modern humans. In the Middle Pleistocene site of Sima de los Huesos (SH) 25 navicular bones have been recovered, which represent nearly the half of the *Homo* fossil record prior to *Homo sapiens*. The sample of navicular bones from SH corresponds to a minimum number of individuals of 14, what represent the half of the 28 individuals identified in the whole sample [2]. Luminescence and paleomagnetic dating suggest a minimum age for the SH hominins of 430 ka [3]. This date is in broad agreement with the evidence provided for the ancient mitochondrial DNA [4]. Due to the evolutionary and morphological relationship between Neandertals and the Sima de los Huesos hominins, important information can be extracted from the SH navicular bones that is relevant to understanding the evolution of the Neandertal foot. The analysis of 14 metrical variables in the huge collection of the navicular bones from the Sima de los Huesos site allows us establishing similarities or differences with other samples/populations. The navicular of the Sima de los Huesos, as that of Neandertals, is robust, very broad and with a significantly wide talar articular facet. However the navicular bones from the Sima de los Huesos show significant differences in the minimum interarticular thickness, which is lower than in those from Neandertals and modern humans. Furthermore, a very projected navicular tuberosity in SH differentiates it of Neandertals and modern humans. The weight-bearing tubercles on the navicular indicate a high body size in the hominins from Sima de los Huesos. This study confirms the evolutionary relationship between this Middle Pleistocene population and the Neandertals. Nevertheless, some traits differentiate the SH hominins and Neandertal navicular bones. These results are also in accordance with the proposed large corporal size for the population from Sima de los Huesos and the primitive biotype of this hominins from the Middle Pleistocene [5].

**Acknowledgements:** We are deeply grateful to SH excavation team and our colleagues from LEH-ISCIII. We are indebted to many people who have allowed access to some important skeletal collections. This research is funded by Junta de Castilla y León, Fundación Atapuerca, Ministerio de Economía y Competitividad of Spain (Project CGL2012-38434-C03-01 & 03), 2009-SGR-2009-324 project, and European Social Fund (Fondo Social Europeo-CPIN.03-461AA-692.01). A.G.-T. has a Contract-Grant from the Ramón y Cajal Program, RYC-2010-06152.

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Poster Presentation Number 84, Sa (16:00-18:00)

## Techno-functional features of the Protoaurignacian (backed) bladelets from four French lithic assemblages

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Between 40 and 30 ka BP, major transformations characterize the Middle-Upper Palaeolithic “transition” in the Western Europe: the disappearance of Neanderthal concomitant with the arrival of *sapiens* (AMH); the emergence and the spread of osseous tool production; the expand of blade stone tool technology along with bladelet production. The bladelet strategy becomes one of the most important cultural markers of the lithic industries at the beginning of the Upper Palaeolithic [1, 2]. A solid homogeneity of backed bladelets (with abrupt marginal inverse, and even alternate, retouching – aka Dufour bladelets – above all, and some rare examples of direct retouch on one or two edges, often on the distal end) distinguish the Aurignacian lithic traditions (Early Aurignacian and Protoaurignacian), in a large area from the Near East to the West of Europe. Backed bladelets constitute the main part of the retouched tool (up to 80%). For this reason, many discussions have taken place recently regarding the typological and technological specificity of this microlithic production [3, 4]. It appears that, the small and twisted Dufour backed bladelet production differentiates the Early Aurignacian lithic tradition from the typical Protoaurignacian one (independent reduction sequence *versus* intercalated blade reduction sequence). The function of Aurignacian bladelet production is one of the most interesting topics in recent years among scholars working on the beginning of the Upper Palaeolithic. However, at present only some specific studies, mainly based on low-power approach, have been carried out and exclusively on Early Aurignacian retouched bladelets. The aim of this paper is to present the functional analysis, by combined high- and low-power approaches, of the full Protoaurignacian lithic assemblages from four French sites, three around the Mediterranean fringe area (Observatoire, Esquicho Grapaou, Laouza) and one from the inner continental region (Cottés) [5]. We will focus on the production and consumption strategies of bladelet production. Were Protoaurignacian bladelets used exclusively for hunting activities, as suggested by some Aurignacian Dufour backed bladelets? How were they utilised? Does their morpho-metric variability represent a discriminating factor for functional purposes? Can we consider the unretouched items only as (discarded) debris or could they have been an unused stock of blanks? Or, have these been used as well? The results of our analysis allow us to highlight some major issues:

- Protoaurignacian bladelets had a multifunctional role as projectile elements, as well as for “domestic” purposes (hafted individually or in series);
- A great variety of unretouched lamellar items were used, according to the morpho-technical characters of their blank.

The implications and importance of these results, the multifunctional role of bladelets and the utilisation of the unretouched items, will be discussed.

**Acknowledgements:** I would like to thank H. Plisson for his support throughout my research. I am very grateful to numerous people for providing access to the lithic assemblages for my Ph. D. research : M. Soressi for Cottés ; G. Porraz and P. Simon for Observatoire ; F. Bazile for Esquicho-Grapaou and Laouza.

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Poster Presentation Number 37, Fr (15:30-17:30)

### The invisible frontier: East African MSA/LSA transition in Goda Buticha (Dire Dawa, Ethiopia)

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The Horn of Africa is one of the postulated starting points of the dispersal of modern humans out of Africa. Despite extensive archaeological surveys in the area during the 20th century, few in situ, well dated sites are known from this region. A survey of cave-bearing geological formations in the Gara Nigus mountain ridge, Western Harerghe, led to the discovery of several previously unknown caves with anthropogenic deposits. Excavation of one of them, Goda Buticha, near the village of Serkama in the Dire Dawa area, revealed a >2.5 m-deep anthropogenic sequence showing two distinct sediment complexes. Lithic artifacts and the remains of wild animals are distributed throughout the sequence, at an average density of 1000 artifacts/ m<sup>3</sup>. Human metacarpals, teeth and a skull fragment derived from the lower part of the sequence. The top of the sequence correspond to a LSA lithic assemblage (bladelet production and backed microliths) with MSA components (like Levallois production), while the lower part of the sequence includes a clear late MSA industry including unipolar and convergent Levallois debitage, typical MSA unifacial and bifacial points and side-scrapers, accompanied by bladelets, retouched microliths, and an increase in the use of obsidian. The gradual change in typological and technological characteristics and raw material distributions throughout the sequence of Goda Buticha lends itself to alternative hypotheses of gradual change through time vs. increased variability (possibly on a regional scale) during the Late MSA (LMSA), followed by an abrupt cultural change. The radiocarbon ages reveal that occupational phases are separated by a sharp chronological hiatus in the Lower Complex, between the youngest MSA layer dated to 35.5 Cal BP and the overlying mid-Holocene deposits (between - 6.3 ka Cal BP and 4.7 ka Cal BP). The sharp chronological Upper Pleistocene/ Holocene hiatus indicates a probable gap in sedimentation and site occupation during MIS2, corresponding to severe arid conditions in Northeastern Africa (Big Dry). New OSL dating analysis effort, as well as sedimentological analysis confirm these data and refine the chronology and deposition processes. Broad lithic similarities with other sites in the Horn of Africa, the Ethiopian highlands and other sub-Saharan sites, place Goda Buticha in a broader regional context. Within this framework, this single sequence highlights important lacunae in the ability to identify cultural shifts from Middle to Later Stone Age. It emphasizes the need for rethinking the cultural taxonomies applied to MIS 3 and MIS 2 lithic industries in African prehistory.

**Acknowledgements:** We thank the Ethiopian Authority for Research and Conservation of Cultural Heritages (ARCCH) for permission to survey in the area and to excavate in Goda Buticha. This research was supported by grants from the National Geographic Society (grants 8110-06 and 8510-08) and from the Wenner-Gren Foundation (Grant ICRG – 102). We would like to acknowledge the efforts of Tilahun G/Selassie, Workalemahu Bekele, Hadis, DeJene Dendana Gulti, as well as the local people living near the site for their assistance with the excavation. We are also very thankful to Sébastien Nomade for providing some radiocarbon analysis facilities. We are grateful to the French Center for Ethiopian Studies for providing logistical support and for funding part of the post-excavation analyses. We thank the Tourism and Culture Offices of the Eastern Harerghe, Western Harerghe, the Dire Dawa Administration, and Harari National Regional State for fieldwork administrative support.

Podium Presentation: Session 6, Fr (15:10)

## Ancestral Aches? Vertebral morphology, locomotion, and human spinal health

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Back pain is a major human health issue but the aetiology of many back problems remains poorly understood. Humans are afflicted by back problems more frequently than other primates and consequently researchers have suggested that our lineage's shift to bipedalism may be one factor contributing to the prevalence of back problems. This hypothesis has been widely discussed, but inadequately tested. Here, we report a study designed to begin rectifying this situation. Previous studies of human skeletal samples have found a correlation between vertebral shape and the occurrence of Schmorl's nodes. Schmorl's nodes are depressions on the vertebral body resulting from vertical herniation of the intervertebral disc. Based on this, we hypothesized that vertebral shape may be an important component of a stable bipedal spine and that particular shapes may be inadequately adapted for the strain placed on the spine during upright posture and locomotion, and may give rise to Schmorl's nodes, and other spinal pathologies. To test this hypothesis, we carried out a geometric morphometrics-based comparative analysis. Landmarks were used to capture the shape of the final thoracic and first lumbar vertebrae of humans (with and without Schmorl's nodes), *Pan troglodytes*, and *Pongo pygmaeus*. These species were chosen because they exhibit different locomotory behaviours. Landmark coordinates were analyzed using geometric morphometrics. The data were regressed on centroid size to minimize the influence of allometry and analyses were performed on the residuals. Canonical Variates Analyses indicated that the shape of pathological human vertebrae is more similar to the shape of chimpanzee vertebrae than to the shape healthy human vertebrae. Between-group Procrustes analyses were significant, with the sole exception of the distance between pathological humans and chimpanzees. PCA results also indicate a difference between species, except pathological humans and chimpanzees. These results indicate that human vertebrae with Schmorl's nodes share shape similarities with chimpanzee vertebrae, and support for the hypothesis that back pain may, in part, be due to individuals having a plesiomorphic vertebral shape, one which is relatively poorly suited to bipedal posture and gait.

**Acknowledgements:** This research was funded by MITACS, the Social Sciences and Humanities Research Council of Canada, the Canada Research Chairs Program, the Canada Foundation for Innovation, the British Columbia Knowledge Development Fund, and Simon Fraser University.

Podium Presentation: Session 10, Sa (15:40)

### **Mitochondrial genome variation in late Pleistocene Europe**

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Studies of ancient human mitochondrial DNA (mtDNA) suggest genetic continuity between Upper Paleolithic and Mesolithic hunter-gatherers in Europe, followed by an almost complete replacement with limited genetic admixture by Neolithic farmers. The analyses of both partial and complete mtDNA of pre-Neolithic European individuals revealed a predominant frequency of mitochondrial haplogroups belonging to clade U. By contrast, early Neolithic European farmers were found to belong to a wider range of different mitochondrial clades with similar frequencies to modern contemporary Europeans. However the mitochondrial genome variation during Paleolithic and Mesolithic time across Europe is currently poorly understood as only a limited number of hunter-gatherers from those periods have been genetically analyzed. Environmental changes in the late Pleistocene such as the Last Glacial Maximum (LGM, 24,000-16,000 years BP) could have influenced human migration pattern and changed the European genetic population structure. In this study high-throughput sequencing technologies are adopted to reconstruct the complete or almost complete mitochondrial genome of Late Pleistocene and Early Holocene modern humans from different archaeological sites in Europe. DNA is extracted from skeletal remains, converted in genetic libraries, the mtDNA is enriched through a bait capture technique and sequenced on a next generation sequencing platform. The authenticity of the obtained mitochondrial sequences as ancient human DNA is verified by analyzing typical ancient DNA damage patterns as well as establishing a single source of mtDNA in the studied samples. Moreover, the DNA molecules that are damaged indicating an ancient origin are filtered and analyzed in order to confirm the assigned mitochondrial haplogroup. Finally, the authentic sequences are used to reconstruct phylogenetic relationships of Paleolithic, Mesolithic and Neolithic Europeans, to address questions about genetic diversity through time and space.



Poster Presentation Number 78, Sa (16:00-18:00)

## **Plant foods in Middle Palaeolithic subsistence in Italian and Southern European Neanderthal populations**

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A clear picture of resource exploitation by Neanderthals is important for understanding this Middle Palaeolithic hominin. Yet, the nature of their dietary ecology has long been an uncertain and contentious topic. Analyses of associated archaeological faunal remains have indicated that Neanderthals frequently hunted large game, and later studies suggested that large game was part of a spectrum of resources which was significantly narrower than the succeeding modern human populations in Eurasia. Researchers have employed a variety of methods to explore Neanderthal diets, including isotopic analysis, micro- and macro- dental wear, unfortunately, these can only yield information on general categories of food resources such as the source of dietary protein, or the relative consumption of hard versus tough foods, and thus do not adequately inform us about food choice and dietary breadth. The lack of data about the types of plant resources that Neanderthals gathered is of particular concern in the Mediterranean part of their range. It is unclear how the region's diverse and mild environments affected resource use, but some variation, such as less reliance on large game, has been proposed in the Western Mediterranean. Other areas, such as the central Mediterranean, have been less well studied. In order to explore Neanderthal diets in the central Mediterranean region, we analysed particles of plant debris trapped in Neanderthal dental calculus from Guattari and Fossellone cave of the Monte Circe complex in Lazio, Italy. These fossils are dated to approximately 57 and 51 ka with combined uranium-series dating. Calculus samples reveal an unprecedented range of dietary and behavioural markers, including starches, dicot phytoliths, grass phytoliths, diatoms, unsilicified grass, spores and pollen indicating the consumption of various resources including monocot and dicot plants by these individuals. Comparing these data to those from other regions offers insights into diet from coastal environments in the peninsular central Mediterranean.

Poster Presentation Number 2, Fr (15:30-17:30)

## A specimen of *Paranthropus robustus* from Bolt's Farm Caves system, Cradle of Humankind, South Africa?

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The specimen comes from a block of breccia labelled "BF" (an abbreviation for Bolt's Farm), collected by a local lime miner (Mr. Fourie), at the end of the 1940's. As this miner collected in several places in the Cradle of Humankind, including Bolt's Farm and Swartkrans, the precise location of the breccia block is questionable. Bolt's Farm is a large area with more than 30 fossiliferous sites from about 1 to 4.5 millions years before present, identified by the HRU (HOPE Research Unit), located in the south-west margin of the Cradle of Humankind, South Africa. We define it as the area mapped by the expedition of the University of California lead by Camp between 1947-1948. In the 1980's, a large quarry was opened to the north of this area. In order to determine (non-destructively) whether the block of breccia "BF" contains additional fossil material, we undertook micro-CT scans at microfocus x-ray computed tomography facility at the Evolutionary Studies Institute, University of the Witwatersrand. The images reveal that in addition to the tooth there is a small fragment of mandible. X-ray images also facilitated an examination of root morphology of the tooth. Using x-ray images we obtained three dimensional data for enamel and dentine. Enamel thickness and dental trait expression at the enamel-dentine junction (EDJ) could be assessed. Alongside of studying the root morphology, enamel thickness and EDJ, we have undertaken morphological, morphometrical studies of the crown in order to taxonomically identify this specimen, using a comparative sample of 154 lower first and second molars attributed to *P. robustus*, *Au. africanus*, *Au. sediba*, and early *Homo* from Swartkrans, Drimolen, Kromdraai, Sterkfontein and Malapa sites. The BF right lower molar is a complete crown, moderately worn with a large mesial wear facet and a small distal wear facet. In occlusal view, this tooth has a typical hominin shape and general appearance. The tooth exhibits features present in specimens of *P. robustus*, such as a large tuberculum sextum (C6), no tuberculum intermedium (C7) or protostylid. Metrically, relative to the *P. robustus* sample, it falls in the range of variation of lower first molars from the site of Swartkrans.

**Acknowledgements:** We thanks the CNRS (LIA 1041 HOMEN CNRS and UPR 2147 CNRS) and the National Research Foundation (South Africa) for financial support and the University of Witwatersrand (Evolutionary Studies Institute, School of Anatomical Sciences) for access to the specimen and the microfocus x-ray computed tomography facility.

Poster Presentation Number 57, Sa (16:00-18:00)

## Smoothing procedures in Geometric Morphometrics: a critical assessment

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In recent years the application of Geometric Morphometrics to human evolutionary studies combined with last-generation imaging techniques has remarkably increased. Among them, high-resolution computerized tomography allows a great level of detail on anatomical structures, but massive amounts of data are generated and more computational effort is required. Digital simplification - through reduction of geometries, in conjunction with a smoothing process - overcomes this problem, providing a lighter reconstruction of a specimen, which becomes more suitable for computer manipulation and analysis. Smoothing is a mathematical procedure commonly used on digital specimens, in order to make continuous an outline otherwise discrete. However, these simplification methods lack standardized protocols and are often applied following no definite criteria. The aim of this work is to examine the impact that geometric transformation of smoothed surfaces has on semilandmark-based Geometric Morphometrics [1]. We thus evaluated the influence of different types of smoothing algorithms (i.e. Laplace, HCLaplace and Taubin) on morphometric analysis, using a bilateral symmetric surface with a highly uniform vertex distribution pattern (model A). Such a basic surface was chosen because it allows to investigate algorithms differences disregarding other variables related to local complexity patterns. A second surface (model B), obtained from a high resolution CT-scan of a cranium (inter-slice=0.33mm), was used to assess the impact of smoothing on distinct anatomical districts (cranial vault and zygomatic-supraorbital torus outline) as well as on surfaces at different resolutions. Simulated lower resolution surfaces (LR-A, LR-B) were produced for both the models. A 100 semilandmark (SL) reference set was built on LR-A, uniformly distributed onto the surface; other SL reference sets were used on two LR-B surfaces, each one with different inter-slice distances (LR-B1=0.66mm; LR-B2=0.99mm). All the low resolution (LR) surfaces underwent a smoothing process and the SL sets were slid both onto the model surfaces and the smoothed ones. The Euclidean distance calculated between different SL sets was used as an estimator of how much the smoothing process affects the sliding involved in the SL-based Geometric Morphometrics; therefore the distances between SL set on the model and SL set on LR surfaces provides a threshold value indicating an upper limit of smoothing levels, beyond which the smoothing process increase the difference between the low resolution SL set and the same set on the model. All computational processes were performed with R [2-4]. Our results point out that the Taubin algorithm [5] is the best choice when Geometric Morphometrics is applied on smoothed specimens: in fact it implies a lesser variation in centroid size and increases the smoothing levels that keeps the differences below the threshold value; moreover it leads to an optimal distance which is always smaller than the ones achievable with the other tested algorithms. Applications of the Taubin algorithm on model B show that a parsimonious level of smoothing is desirable for every combination of resolution and district. Indeed an excessively high level of smoothing will lead to a larger distance between the set on the high resolution surface and that on the smoothed one. Furthermore, we observed that for lower surface resolution more smoothing levels are permitted. As expected, for what concerns the SL sets, we observed that the optimum level of smoothing leads to smaller distances from the model as the surface resolution increases. It is straightforward that a smoothing algorithm can not fully restore the information lost from an excessive decrease of the specimen resolution. In conclusion, the present results encourage a deeper survey about this methodological issue, focusing on the need of a protocol, considering other variables and different surface simplification methods.

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Poster Presentation Number 85, Sa (16:00-18:00)

## Searching for the origins of food storage in the European Gravettian

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This poster introduces a new project that reinvestigates the origins of food storage in prehistory. Seasonal environmental change plays a critical role in structuring the lives of people living a hunter-gatherer lifestyle. The influence of seasonal changes is especially clear in mid- and high-latitude areas where environments are characterised by rapid vegetation growth and high productivity during the summer followed by long, intense winters. This inevitably leads to periods of reduced food availability, and as a result hunter-gatherers living in these regions are under pressure to develop coping strategies to maintain their food supply within reasonable geographical distances. One such strategy is the storage of food [1]. This adaptation releases human groups from the need to follow food, both plant and animal, around the landscape according to its seasonal availability. The technology underpinning food-storage is thought to have originated in Europe at least 30,000 years ago, during the strongly seasonal climates of the Upper Palaeolithic [2]. However, while this scenario is plausible, food-storage has never been convincingly demonstrated anywhere during the Palaeolithic by direct, science-based evidence and has been discussed instead almost exclusively as a theoretical concept [3-4]. Furthermore, the proxy evidence, such as pits and hearths for meat-smoking at sites where storage behaviours have been suggested remain ambiguous with multiple interpretations discussed in the literature [2]. Our aim is to develop a methodology for securely identifying long-term food storage practices in the archaeological record, and building on the work of Soffer [2] and others to explore whether food storage was *necessary for the complex settlements, art and social identities seen at the Gravettian sites such as Dolní Věstonice-Pavlov and Kostenki*? To do this we will intensively target a small number of occupation sites to reconstruct: A) the seasonal movements and season-of-death of major prey animals, and B) the seasonality of human presence at the site: the key indicator for food storage will be human presence during a season when major prey animals were not being killed. Our methodology will incorporate three main strands of evidence: (1) strontium and oxygen isotope data to reveal the seasonal migration patterns of prey species, (2) dental cementum studies to reveal the season in which the animals died and (3) data from charcoal in hearths revealing the season in which the wood was harvested and therefore the seasonality of human presence at a site. The rationale for using hearth charcoal assumes that Gravettian-era hunters occupied a wood-scarce landscape and would have managed their wood supplies by deliberately creating dead wood to burn by pruning or felling nearby trees and leaving that wood to dry out prior to use. While faunal isotopic data have been used widely in archaeological studies to reconstruct animal mobility and seasonality, the use of charcoal to infer the seasonality of human occupation represents an innovative approach that we are developing and evaluating as part of this research. This poster will outline this methodology in detail and report the results of an investigation into whether or not firewood was a scarce resource in the European Gravettian, which is the first methodological aspect tackled by this project. **Acknowledgements:** We are grateful to the Leverhulme Trust who are funding this research, to Jiri Svoboda and Andrey Sinitsyn for providing access to samples to make this research possible, and to many other friends who have offered thoughts and opinions in developing this project.

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Poster Presentation Number 21, Fr (15:30-17:30)

## Cortical bone topography and cross-sectional geometric properties of Paglicci 12 and Paglicci 25 Gravettian human femora

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Structural morphology of the femur reflects habitual mechanical loads related to levels and patterns of physical activity, as well as adaptive changes during growth in locomotion modes and, likely, climate adaptation (Ruff et al., 2006). In the Late Pleistocene, recent analyses have documented significant changes within early modern humans related to mobility, geographical variation, and lower limb diaphyseal morphology after the last glacial maximum. A decreased lower limb robusticity following a decreased mobility can be observed; this process was the result of reduction in the level of musculoskeletal stress. Notably, the adult femoral shaft is reported to demonstrate increasingly circular mid-shaft sections, reflecting reduced anteroposterior bending strength during the Upper Paleolithic (Shackelford, 2007). Conversely, the condition shown by the juvenile anatomically modern fossil human femur, as well as sexual dimorphism levels in diaphyseal strength are still poorly reported. By using techniques of CT-based 3D virtual modeling and quantitative analysis (i.e. cross-sectional geometric properties analysis and morphometric mapping) (Bondioli et al., 2010), we characterized the endostructural femoral morphology of two Gravettian skeleton burials from southern Italy that, so far, are among the oldest in Europe: Paglicci 12 (late adolescent male) and Paglicci 25 (young adult female) (Palma di Cesnola, 2001). Standardized cross-sectional geometric properties were measured at a series of regular intervals and compared with the evidence from a reference sample of 102 adult individuals. Cortical bone thickness was detailed between 20% and 80% of the biomechanical femoral length. In order to place Paglicci 12 and Paglicci 25 within the pattern of variation reported for the European Late Pleistocene fossil record, comparative data for percent of cortical area (%CA) and the Ix/Iy ratio measured at 20%, 35%, 50%, 65% and 80% cross-sectional level were obtained for a number of Upper Paleolithic human femora (Trinkaus and Ruff, 2012). The diaphysis of Paglicci 25 is more robust than Paglicci 12, with a greater resistance to axial bending and torsional loads. As revealed by morphometric mapping, cortical bone topography in both fossil specimens traces the pattern shown by modern humans and other Upper Paleolithic specimens, with areas of relative increased thickness located medially (at 60-80%) and laterally, besides those surrounding the linea aspera. Nonetheless, all along the diaphysis, values of %CA and of the Ix/Iy ratio for the Paglicci 25 femur systematically fall within the Upper Paleolithic female range of variation and, whereas even the juvenile Paglicci 12 femur falls within male variation.

**Acknowledgements:** We thank the Soprintendenza per i Beni Archeologici della Puglia which authorized and supported the excavations at Grotta Paglicci over the years.

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Pecha Kucha Presentation: Retracted

## What is genetic modernity?

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Anatomical and behavioral modernity are much like pornography; we may not be able to precisely define them, but we think we know them when we see them. In contrast, genetic modernity is a more abstract concept. Models of modern human origins often invoke a bottleneck in which some limited population of not-quite-human hominins acquires truly modern human characteristics and then sallies forth to spread their genes far and wide. Weaver (2012) has argued that no such event is necessary to explain the changes in hominin/human anatomy. If he is correct, then it is possible that multiple populations of hominins more or less stumbled into modernity. Which, of course, seems ludicrous. But we have strong evidence that humans blundered into agriculture and all of its consequences independently in several parts of the globe, which makes the idea of the independent acquisition of modernity a little less suspect. Genetic data have had important impacts on our understanding of modern human origins, and continue to offer sometimes surprising insight (Denisovans), but relatively little attention has been paid to the meaning of genetic origins. Almost all recent population genomic analysis suggests that the human population that was the most recent common ancestor to all living humans lived around 100 thousand years ago (and no more than about 150 thousand years ago). This time frame coincides more or less with the earliest evidences of behavioral modernity, but is more recent than the first evidence of anatomical modernity by 50 thousand years or more. This observation suggests that genetic modernity is not singular, but rather should be divided into "population coalescent" and "genotypic" modernity. Population coalescent genetic modernity refers simply to the common ancestral population of all living humans; this population may not have been the first population to have all of the modern human characteristics, but it is the most recent common ancestor. In this formulation, genotypic modernity is reserved for the first population that had the derived genetic variants necessary for both anatomic and behavioral modernity. This formulation of genetic modernity offers a framework for the integration of population genomics and developmental and functional genomics.

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Podium Presentation: Session 3, Th (15:10)

## All you wanted to know about growth of African pygmies but no one could tell... until now

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Small stature populations inhabit the equatorial area of all continents. Those living in Africa called ‘pygmies’ share a common ancestor which split from that of non-pygmies populations around 60,000 yrs BP [1]. Studies on genetic introgression have demonstrated that small stature in African pygmies is due to genetic bases being Baka pygmies the group with the lesser degree of admixture. Contrary to genetic aspects which received great attention although the precise genetic foundation remains at present elusive [2], few works have try to understand the mechanism by which low stature is attained in adults, in other words growth and development were approached very rarely in these populations. Previous studies on growth have suggested that low stature is the result of the lack of growth spurt in adolescence [3] or the precocious arrest of growth [4]. However growth and development cannot be adequately described if studies are not based on longitudinal data obtained in individuals with known age. Based on date of birth obtained by nuns with medical training in South East Cameroon from the late '80 until now, we started in 2007 a project to characterize growth and development in Baka pygmies. During the last 8 years we have followed with a yearly periodicity around 500 Baka pygmies aged from 0 to 25 years. Somatic growth was described from anthropometric measurements (height, weight, head circumference) and complemented with life history variables as age at menarche, interbirth interval and age at first reproduction. Individuals were aged in days which allows to form age classes depending on the requirements of the analysis or the comparisons to be performed as well as to establish the model which best explain the dynamic of growth. Probit analysis was used to establish the median age at menarche. Results for interbirth interval are given every month and age at first reproduction every year. Our results suggest that Baka pygmies are born with values similar to those in non-pygmies populations. The model of growth shows a similar dynamic than in other modern human groups with a clear growth spurt in adolescence. Growth seems to extend during few years more than in occidental societies, aspect which remains the condition observed in Africa non-pygmy populations. The main particularity of growth of Baka is a reduced rate from 2-3 years of age. Median age at menarche is at 14.4 years and first reproduction is observed at 16 years of age although is more common at 17 years of age. Interbirth interval is around 2.5 years. Our results do not support the hypothesis of a lack of growth spurt or precocity of growth to explain the reduced adult stature. Differently, based on the largest sample size never previously obtained for a hunter-gatherer society and including exclusively individuals with known age from birth to adulthood our results suggest that pygmy phenotype in Baka is due to a lower rate of growth from 2-3 years of age.

**Acknowledgements:** We are very grateful to nuns of Bosquet as well as the authorities of the IRD in Cameroon. Many thanks to all our collaborators, specially Laurent Maget, Kalo Pierre et Etoa Jean-Blaise. This works received financial support from Wenner-Gren Foundation (Grant to FRR), National Geographic Society (Grant 8863-10 to FRR) and ANR program Blanc ‘GrowinAP’.

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Podium Presentation: Session 1, Th (9:10)

## Hominin ecology and behavior based on 1.5-million-year-old footprint assemblages from Ileret, Kenya

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Footprint assemblages preserve information that is not normally available from the skeletal and dental fossil record, including evidence about surface anatomy, biomechanical movement, the sizes and composition of hominin groups, and the animals sharing the environment with hominins (e.g., [1,2]). Furthermore, footprint assemblages preserve this information within very short time frames, typically on the order of hours to days. This unusual time resolution allows us to assess how, or whether, the evidence of hominin and other animal communities differs between these short (hours-days) snapshots in time and the fossil skeletodental evidence that typically represents time-averaging over thousands of years. Here we report our findings based on a series of excavations (2010-14) in the Koobi Fora Formation at Ileret, Kenya. We have uncovered dozens of hominin footprints and many other animal prints at eight sites in the 8.5m-thick Okote Tuff Complex (1.51-1.53 million years old, or Ma). This study focuses on what the Ileret footprint assemblages suggest about early Pleistocene hominin ecology and behavior. Hominin prints are represented in five of the eight Ileret footprint assemblages examined here. When individual print abundances are examined, hominins are much more abundant than expected based on their abundance in the skeletodental fossil record in the same Okote Tuff Complex deposits (Fisher's exact test;  $p < 0.0001$ ). Bovids are the most abundant taxon represented in the footprint assemblages, but prints of hippopotamus as well as several varieties of water birds (e.g., pelicans, storks) are also preserved, indicating close proximity to water. The prevalence of hominin prints suggests that they spend more time in these near-water environments than expected based on their skeletodental abundance alone. To examine the size and demographic composition of the hominin printmakers, we compared the fossil footprints to a large sample of experimental footprints made when walking in the same 'fossil' sediment by habitually barefoot and minimally-shod Daasanach ( $n=48$ ) who live near Ileret. The hominin footprints at most of the 1.5 Ma sites are large, comparable in size to footprints made by adult Daasanach males. These footprints yield body mass and stature estimates comparable to or above the predicted sizes of male *Homo ergaster* or *Paranthropus boisei*. At one of the sites (FwJj14E), at least five hominin trails are oriented together in a direction that differs significantly ( $p < 0.05$ ) from other animal print orientations. These trackways appear to represent adult males occupying the same territory within a very short time, potentially traveling together. These footprint assemblages raise provocative questions about early Pleistocene hominin habitat preferences and social behavior. **Acknowledgements:** This work was funded by the National Science Foundation (BCS-0924476, -1128170, -1232522; DGE-0801634), Wenner-Gren Foundation, Leakey Foundation, and The George Washington University Selective Excellence Initiative and University Facilitating Fund.

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Podium Presentation: Session 7, Fr (14:10)

## The Middle Palaeolithic sites at Neumark-Nord 2 (Germany): Optically and thermally stimulated luminescence dating

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The excavations at Neumark-Nord 2 have provided an exceptional opportunity for dating and the detailed analysis of the environmental settings of Neandertal activities around a shallow water basin during the Eemian and Early Weichselian periods [1, 2]. The sedimentary sequence of the Neumark-Nord 2 basin above Saalian tills contains several Middle Palaeolithic sites within lacustrine (silts), as well as loessic sediments. Lithic artefacts are generally very limited in size in all archaeological units, and especially small in the upper of the two main archaeological units. The lower archaeological unit 2/2 consists of a Mousterian industry which is characterised by a Levallois component and a dominance of notched pieces. Moreover, scrapers lack formal classificatory attribution and bifacial forms are absent. The lithic assemblage of the upper archaeological unit (2/0) is dominated by formal scrapers and bifacial tools, notably Keilmesser and leaf points, which assign the inventory to the Keilmessergruppen (Micoquian-Prądnikian). Palynology and magnetostratigraphy assign Eemian and post-Eemian ages to the sequence, with an almost complete palynological sequence of the Eemian interglacial. This is supported by the typical interglacial fauna in unit 2/2 with straight tusk or European forest elephant, high amounts of large bovid (aurochs), horse, red and fallow deer, very few carnivores and the European pond turtle. The number of cut and other butchery marks on the mammal bones is high (10%) with almost no carnivore involvement. In unit 2/0 the faunal spectrum is a bit poorer and more indifferent with large bovid (bos and/or bison), horse, red deer, a proboscidean and red fox. Furthermore, the Eemian age for the lower unit 2/2 is confirmed by Thermoluminescence (TL) dating of heated flint. We here apply a new measurement protocol, which allows for the successful dating of very small samples of heated flint. The depositional age of an overlying sandy lake shore deposit, which contains archaeological unit 2/0, is determined by Optically Stimulated Luminescence (OSL). We here apply standard procedures and a new technique based on spatially resolved OSL. Good agreement of OSL results is obtained between the two techniques employed, and ages also agree with the published standard OSL age of  $88 \pm 8$  ka [3] from an independent laboratory. However, published TL dating of the sediment of unit 2/0 provide an unusually large range between 200 and 90 ka [4], which is incompatible with sedimentology. Only few of these individual TL ages for the sedimentation agree with the OSL data, which were obtained by more recent and advanced techniques. This comparison exemplifies the unsuitability of TL for sediment dating and the better precision of OSL methods. Furthermore, new OSL techniques, like spatially resolved luminescence, have the potential for an additional increase in precision. While the prehistoric event of lighting a fire is dated by TL of heated flint from unit 2/2, the depositional age by OSL provides a *post quem* age for the Keilmesser artefacts contained in the sediment of unit 2/0. Using state of the art luminescence techniques, the archaeological sites at Neumark-Nord 2 can be situated more precisely within a climatostratigraphic framework.

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Poster Presentation Number 55, Sa (16:00-18:00)

## New Evidence Suggesting a Dissociated Aetiology for Cribra Orbitalia and Porotic Hyperostosis

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Anaemia can reflect disease burden, nutritional deficiencies, or long-term immunological adaptations to malaria. Osteological lesions associated with anaemic conditions can thus offer unique insights into human palaeobiology. An association between porotic cranial lesions and anaemia was noted by Ales Hrdlicka [1] in Peruvian skulls, as well as through T.B. Cooley's [2] medical study of children. The latter became known as Cooley's anaemia (Thalassemia  $\beta$  or major), a severe genetic affliction that, in the cranial vault, often results in marrow hyperplasia - the trabecular restructuring of the superior diploic bone and ultimately the obliteration of the outer cranial table. This exposes the underlying spongy structure, creating the appearance of pitting, known as porotic hyperostosis [3]. Porotic lesions are not limited to the vault; they occur in the superior orbital roofs as well, referred to as *cribra orbitalia*. Both porotic hyperostosis and *cribra orbitalia* are thought to have the same aetiology, often appearing together [4]. It is now generally recognized that Thalassemia  $\beta$  is not the only form of anaemia to have such a distinctive osteological effect. There are a number of other conditions, both genetic (i.e. Thalassemia minor, sickle cell anaemia, hereditary nonspherocytic haemolytic anaemia) and acquired (i.e. iron-deficiency anaemia, scurvy, rickets, polycythemia Vera, cyanotic congenital heart disease) that do as well [5]. Therefore, there has been much debate about the specific aetiology of porotic lesions, particularly in anthropology. It is a general consensus that a blood disorder is likely to be the primary cause of these distinctive lesions, since the expansion of the cranial diploë, due to hyperplasia, is the common characteristic of these ailments. In this study, we present results that challenge the association of parietal and orbital porotic lesions, and consequently the link between the latter and anaemia. A CT analysis of cranial thickness measurements (n=186) across the vault of individuals with *cribra orbitalia* (n=23), lacking porotic hyperostosis, and a healthy population (n=77) shows that the pathological individuals are marked by a considerably thin diploë. This is contrary to the expected hyperplastic response of marrow expansion that is typical of blood disorders such as anaemia, genetic or acquired. Thus, it is suggested that *cribra orbitalia* is most likely disassociated with the cause(s) of porotic hyperostosis observed on the vault. This is important because assuming a similar aetiology for both cranial lesions has shaped the understanding of ancestral disease, especially since these lesions and/or the abnormal diploic expansion have been noted in hominins, such as Eliye Springs (i.e. KNM-ES 11693), Singa and Salé. Reconsidering a separate aetiology of porotic cranial lesions may correct the path by which we understand the afflictions and potential environmental conditions sustained in the course of human evolution, and that still affect human populations today.

**Acknowledgements:** A sincere thank you to our funding bodies: UKIERI; Leverhulme Grant, and ERC. Also to: Addenbrooke's Hospital, Cambridge; the Duckworth Collection, LCHES; Professor Robert Foley, LCHES; Fabio Lahr, and Maggie Bellatti, LCHES

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Podium Presentation: Session 5, Fr (10:00)

## The Middle Palaeolithic living floor of Unit 15 (55 kyrs BP) from the Oscurusciuto Shelter, Ginosa, Taranto, Southern Italy

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The Middle Palaeolithic Oscurusciuto rock shelter opens in the Pleistocene calcarenites in the ravine of Ginosa, about 20 km from the Ionic coast. The research that the University of Siena has been carrying out since 1998 has brought to light a stratigraphic sequence about 6 meters thick, made out of sub-horizontal layers with a dominant sandy-silty matrix [1] [2] [3]. The collapse of the shelter's vault (large blocks can be observed along the stratigraphy) resulted in the erosion of some of the deposit. As a consequence, this is narrower in the upper layers, whereas in the lower ones the exposed surface reaches an extension of 60 square meters. The upper part of the stratigraphy (base of SU 1) yielded a <sup>14</sup>C date of 38.500 ± 900 BP (AMS, Beta 181165; cal 42.975 ± 788 BP). A further post quem chronological marker is represented by a thick layer of tefra (SU14) attributed to the Mount Epomeo Green Tuff from Ischia (R. Sulpizio pers. comment), dated to about 55 kyrs BP. This volcanic layer seals a palaeosurface (SU15) placed at a depth of about 3 meters from the top of the deposit. The specific interest of this palaeosurface, exposed over an area of 18 square meters, is given by the presence of stone alignments referable to two possible structures, alongside large quantities of lithic and faunal remains. The first structure comprises a 2 meters wide semicircle standing against the north wall of the shelter and formed by small clusters made of 3-4 stones each. The archaeological remains are more abundant between the stones, along the perimeter of the structure, and outside it. In correspondence with the stones, the palaeosurface is characterized by a slight but clear relief. The second structure is by the side of the previous one and has similar dimensions. Its perimeter is raised and encloses a depressed area with few anthropic remains. The external area is characterized by abundant fragments of long bones from large ungulates, lithic remains and some stones which do not appear to be structured. The preliminary study of bones, mostly fragments of diaphysis and portions of mandibles and maxillaries, has allowed to determine the presence of at least one fallow deer and a minimum number of 5 individuals of aurochs of different ages. The lithic industry, like in the other levels of the sequence, shows an exploitation of local raw materials (jasper, flint and quartzarenite pebbles of different dimension and shapes) for the production of mostly elongated blanks through a unipolar Levallois modality. Apparently there is not any relevant technical investment for the transformation of the blanks by means of retouch. A 3D modelling of the surface has been made with a digital photogrammetric technique. 120 pictures have been taken around the selected area. From these, a three-dimensional model with high resolution texture has been elaborated. The resulting digital surface can be used for many analyses, among which the automatic generation of orthophotos, crossing sections, DEM and areas computation. A geo-database for the management and analysis of spatial data (both at the macro and micro levels) was also created. In the context of the micro-level, the vectorial mapping of the archaeological remains and of the structures through photogrammetry is ongoing. The gathering of the quantitative data (in relation to the lithic industries and to the faunal remains) and data elaboration through the geo-database, will allow to obtain important information for the understanding of the wide behavioural variability expressed by Neanderthal groups in relation to territory management, technology and, particularly, to the organization and use of the living space. The SU 15 of Oscurusciuto is a highly interesting archaeological evidence to grasp the cultural complexity of Neanderthals.

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Poster Presentation Number 35, Fr (15:30-17:30)

## Middle Stone Age ochre processing tools from Porc-Epic cave (Dire Dawa, Ethiopia)

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Systematic exploitation of pigment at Middle Stone Age (MSA) sites from Africa and Mousterian sites from Europe and the Near East has been repeatedly interpreted as reflecting modern cultures and high cognitive functions [1]. This view, however, is controversial, and evidence shows that iron rich minerals were also used for functional purposes during the MSA [2]. The debate is hampered by a lack of information on the earliest use of pigment in many regions of Africa, including East Africa, where the most ancient remains of *Homo sapiens* were recovered [3]. With the exception of a few sites from Sub-Saharan Africa, information on the way pigment was selected, processed, stored, and used is still scant, which complicates the detection of behavioural consistencies, and their evaluation in terms of cognition. In order to gain a better understanding of the emergence of pigment related technology in East Africa, and to evaluate the degree of behavioural complexity reflected by this material, we analyse ochre lumps and ochre processing tools recovered by Kenneth D. Williamson [4] in 1975 and 1976 in the MSA layers of Porc-Epic Cave (Dire Dawa, Ethiopia). Porc-Epic cave is a key palaeolithic site located between the Afar Depression and the Somali Plateau, with a sedimentary sequence including Late MSA, Later Stone Age (LSA) and Neolithic layers. Reconditioning, and labeling of ochre lumps from Williamson's excavations identified a hitherto virtually unknown ochre related assemblage comprising 4213 lumps of red, brown and yellow iron rich minerals, 40% of which bear anthropogenic modifications, and 23 ochre processing tools. Consisting of more than 40kg of ochre pieces this is, at present, the largest known collection of this type found at a MSA site. Analysis of the spatial and stratigraphic distribution of these items identifies concomitant concentrations of ochre lumps and processing tools at different depth intervals and locations [5]. The highest concentration of ochre lumps, comprising 1373 pieces, is found in close association with 13 processing tools. This suggests possible changes in the location of the areas devoted to ochre processing, and makes Porc-Epic cave one of the rare sites from this period in which pigment treatment can be documented in detail. Ochre processing tools consist of upper and lower grindstones made of quartzite, calcite, sandstone, basalt, quartz, and shale. In a few cases, large ochre nodules were used as upper grindstones. Traces of utilisation on lower grindstones vary according to the type and hardness of the raw material, and include sub-parallel striations, smoothed prominent areas, and percussion pits. These marks are associated to red, brown and yellow ochre residues on one or both sides of the grindstones, or on the entire surface of these tools. Residues of ochre powder adhering to twenty-one grindstones were sampled and analyzed with SEM-EDX and Raman spectroscopy. Results are compared to ongoing Raman, colorimetric, XRF and XRD analyses conducted on ochre lumps found in spatial association with the processing tools and ochre powder produced by experimentally grinding iron rich rocks collected close to the site. Results indicate that these tools were used to grind a variety of ochre of different shades, mostly composed of hematite and goethite, each providing powder of a different shade. Experiments also suggest that the resulting powders may have featured, depending on the grindstones used, different coarseness and incorporated a variable amount of quartz grains. This is consistent with the hypothesis that pigment powder of different shades and textures was used for different purposes.

**Acknowledgements:** We thank João Zilhão, PhD co-supervisor of one of us (DER). The Authority for Research and Conservation of Cultural Heritages (ARCCCH) granted access to the ochre from Porc-Epic Cave. Research by one of us (DER) was funded by the Doctoral Research scholarship program of the Martine Aublet Foundation and the Wenner-Gren Foundation. This research was conducted with the financial support of the European Research Council Advanced Grant, TRACSYMBOLS No. 249587 awarded under the FP7 program.

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Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## The Châtelperronian: an updated review

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Because the Châtelperronian is in a stratigraphic position at the crossroads of the Middle and Upper Palaeolithic, because it is of Upper Palaeolithic type, and because only Neanderthal remains were discovered associated with it, the Châtelperronian is often called a “transitional industry.” Even if Mousterian “souvenirs” had been actively searched within Châtelperronian industries, they are almost non-existent. It is indeed clear that the Châtelperronian is neither an intermediate between the Middle and the Upper Palaeolithic nor a mix of Middle and Upper Palaeolithic behaviours. On the contrary, it is a unique set of behaviours which shares commonalities with contemporaneous techno-complexes. With this talk, we will offer an updated overview of the Châtelperronian [1,2] and will provide new information on the Châtelperronian from Les Cottés. We will conclude with discussing potential new line of evidence to improve our understanding of the rise and fall of the Châtelperronian. For instance, the relationships of the Châtelperronian with the early phases of the Aurignacian have been recently reevaluated [3,4]. Blade production as well as bladelet production - as documented at Quinçay and now in Les Cottés - are fundamentally different from the Protoaurignacian and Early Aurignacian ones. Châtelperronian bladelets produced in a Châtelperronian manner and retouched into large Dufour like bladelet cannot be a coincidence and are best interpreted as evidence of superficial contact between the Châtelperronian and the Protoaurignacian. This implies first, a contemporaneity of these two groups on a large geographical scale, and second the adoption of the idea “retouched bladelets” driven by the search of new solution for projectile technology. In the last case, idea of Châtelperron points used mainly as projectile should be reevaluated. Two cave sites with a stratigraphy composed of several Châtelperronian layers, at Arcy-sur-Cure and Quinçay, preserve ornaments, bone tools, black and red pigments in association with this unique blade production. These former behaviours are for now only known on the northern limits of the Châtelperronian. The geographic position – and maybe the dating - of these two sites at the margins of the distribution of the Châtelperronian might explain the development of specific behaviours.

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Podium Presentation: Session 8, Sa (10:30)

## A local Mousterian origin for the Châtelperronian?

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Recent, detailed analyses of key individual Châtelperronian (CP) assemblages [1,2] stress the distinct Upper Palaeolithic nature of this entity, which occurred in France and northern Spain between ca. 44 and 39 ka cal BP. A blade technology with a focus on backed elements and the co-occurrence of bone tools, personal ornaments and pigments characterise the Châtelperronian. This fully Upper Palaeolithic nature more than ever raises questions about the origins of this industry and its links with the local Mousterian. Since the early 20th century the presence of retouched backed knives in both the CP and Mousterian of Acheulean Tradition (MTA) has been used to argue for an evolutionary link between these two entities. More recently, this link has been supported further by technological studies, arguing for a unique shared focus on elongated and backed blanks [3]. Conversely, other studies have stressed the role of taphonomic disturbance, questioning these typo-technological links and the Mousterian origin of the CP in general [4, 5]. However, fully comprehending the origins of the CP requires a wider, data-driven perspective, re-assessing the integrity, chrono-stratigraphic and typo-technological characteristics of both the Châtelperronian and the various French late Mousterian assemblages. This presentation will focus down on detailing the typo-technological characteristics of the Châtelperronian and its Mousterian substrate. It firstly reassesses the contextual quality of the 143 assemblages that over the years have been assigned to the Châtelperronian. It is clear that many face severe interpretive limitations, mainly related to poor excavation and recording techniques, non-diagnostic lithic characteristics or small assemblage size, and/or taphonomic disturbance. Subsequent further analyses will then focus on the 25 well-contextualised assemblages and their typo-technological composition. Secondly, the various late Mousterian entities present in France between ca. 50 and 40 ka cal BP, including the MTA type A, MTA type B and the discoidal-denticulate Mousterian, are discussed, with a specific focus on the characteristics of the Mousterian assemblages underlying the CP and differences in lithic density, assemblage size and typo-technological composition. Finally, the evidence both in favour and against a Mousterian origin for the Châtelperronian is debated, alongside its potential behavioural implications.

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Poster Presentation Number 15, Fr (15:30-17:30)

## Breakage patterns of hominin long bones from Sima de los Huesos (Atapuerca, Spain)

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Hominin skeletal remains usually are found broken in the Pleistocene archaeological sites. How and when the bones were broken is one of the main taphonomical questions that require an answer. The bone fracturation pattern in archaeological contexts differs depending on the origin of the accumulation. The Sima de los Huesos (SH) site (Atapuerca, Burgos, Spain) is the largest accumulation of human remains of the Middle Pleistocene ever known. Although there are different scenarios, to date the formation of the hominin accumulation is still unsolved. One of the keys to make interpretations about the origin of an accumulation of skeletal remains and taphonomic history is to recognize the fracturing origin. Studies in the last two decades have proposed different hypotheses to explain the fracturation causes in human bones of SH. This new study on the taphonomy of SH sample tries to provide new data in order to contrast the different interpretations on this matter. The objective of the present work is to describe and to quantify the fracturation patterns observed in the SH sample, in order to approach to the origin of the human's accumulation. The fractures on the hominin long bones were analysed and classified according to Villa and Mahieu (1991). Villa and Mahieu (1991) establish a complete methodological framework for the study of fractures in hominin samples, and they compare the frequency of the attributes in three prehistoric assemblages of known accumulation origin (collective burial, ancient anthropic fracturation (cannibalism) and excavation fractures sample). The results show that the SH hominins long bones show a fracture pattern characterized by far for the dominance of transverse fractures to the long axis, complete circumferences and fracture edges with right angles and jagged surfaces. These properties are the expected for the post-depositional fractures and are compatible with collective burial assemblages (Villa and Mahieu, 1991). The SH long bones sample do not have *antemortem* fractures, i.e. with evidence of bone remodelling. The only exception is the metatarsal AT-534 which shows a stress fracture in the diaphysis (Gracia-Téllez et al., 2012). Although the majority of the analysed fractures show post-depositional characteristics, a small portion (around 4%) of analysed long bones, display oblique fractures with bevelled angles and smooth surfaces, typical of biostratinomic fractures (*perimortem*). Some agents can produce this kind of bone breakage, i) hominin breakage; ii) carnivore feeding or iii) trauma process. No tool cutmarks, peeling, percussion marks or any other anthropic modification has been found in the hominin sample, and so it is very improbable that hominins could be the responsible of that kind of fracturing. The presence of tooth marks is not associated with fracture edges, and the long bone ends are usually well preserved. These results indicate that carnivores are not the main responsible of bone fracturing for the SH sample. The third possibility to explain the *perimortem* fracturation is the traumatism processes, compatible with a blunt force trauma produced by a free-fall down the vertical shaft that conform the access to SH chamber.

**Acknowledgements:** This study was possible thanks to the Atapuerca excavation team, especially those involved in the excavations at the Sima de los Huesos site. The research was funded by the MINECO project (CGL2012-38434-C03-01), Fundación Atapuerca (Postdoctoral grant to N. Sala) and Ramón y Cajal Program, RYC-2010-06152 (Contract-Grant to A. Gracia-Téllez).

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Poster Presentation Number 43, Fr (15:30-17:30)

## Siberian zoomorphs: A search for meaning and implications for the Upper Paleolithic evidence

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**Approach:** Ethnological analogies derived from studies of recent environments and societies in Arctic Siberia are being generally applied in archaeological interpretative models. The analogies prove to be inspirational, because each of them have the potential to enlarge the scope of archaeological evidence by including aspects of social and symbolic systems within recent societies. The search for ethnological analogies is usually connected with everyday life reconstruction and is used for interpretations of Upper Paleolithic thinking and symbolism. A discussion about their potentials in Upper Paleolithic mobile art is supported by a relatively broad spectrum of represented animals and by different materials used in the production. A relation or disproportion of these “natural symbols” might be estimated and each zoomorphic theme is proposed to its probable social function, namely: 1) to solve hunting problems; 2) to obtain/debilitate animal power; 3) to represent allegoric meaning and 4) to ascribe mythological importance. However, we do not expect accurate identification between the perception of animals among Upper Paleolithic humans and recent Siberian societies. Thus, we concentrate on overcoming our Western cultural attitude to the human-animal relationships of which Siberian societies certainly had a different conception. In our tradition, animals are seen as a part of nature and thus the particular differences between animal species reflect fine natural aspects. Humans with their biological body and cultural mind are perceived as something extraordinary and subsequently overcoming any other being in nature. Nevertheless, such relationship is not reflected by Siberian societies where human-animal relationships are not declared on the basis of coincidence. These are the result of a large number of complex ritual activities and symbolic approaches into the world where Animal-People are respected like other human nations. **Analysis:** We analyze electronic databases and literature on 1023 zoomorphic and theriantropic figurines collected during the Jesup North Pacific expedition (1897-1902) [1]. Subsequently, the social value and mythological context that accompany each zoomorphic theme were documented. The causality between raw materials, artistic style, final polishing and utilization of the objects was recorded within this collection. But several questions remained still unresolved because of limitations given by the nature of ethnological collection and available descriptions. Our knowledge is thus bordered either by an absence of specific archeological element within recent cultures or by its insufficient explanation caused by scientific interests of ethnologists, or by the fact that the researcher has been excluded from such social activities which might be disrupted by unfamiliar presence. **Results:** Despite the problems with comparing and identifying ethnological and archaeological records, the paleoethnological framework helps us to realize how dynamic and complex the cultural background is accompanying each zoomorphic theme and that an assessment of the social value of each zoomorphic theme is almost unpredictable process. Moreover, these states do not reflect just the actual situation, but they are essential and sometimes inseparable components of a cultural memory, with a tendency to memorize zoomorphic themes gradually disappearing from actual environment of societies.

**Acknowledgements:** I would like to express my appreciation to L. Kendall, N. A. Gregorev and B. Landua from American Museum of Natural History in New York for the access to Jesup North Pacific databases and for permission to reproduce images from the collection; to J. Mlíkovský from National Museum in Prague for consultation of avian figurines; to J. Svoboda from Faculty of Science at Masaryk University and Institute of Archaeology CAS in Brno for his comments.

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Poster Presentation Number 68, Sa (16:00-18:00)

## Investigating the link between past adaptations and modern diseases: a nutrition-related perspective

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A string of biological and cultural changes strongly related to the occupation of new environmental contexts has characterized the evolution of the human lineage, especially during the widespread colonization of non-African continents by anatomically modern humans. Therefore, geographically and temporally defined variation of selective pressures acting on the genomes of both *H. sapiens* ancestors and modern populations triggered genetic adaptations in response to local environments. In particular, necessity to cope with unprecedented nutritional landscapes prompted a number of biological shifts in many human groups, mainly related to the introduction of considerable modifications of their diets and of new challenges to their metabolism [1,2], contributing to influence a variety of traits, among which differential disease susceptibility of human populations due to possible maladaptive processes [3]. In fact, the rate of dietary changes dramatically increased in the very recent evolutionary history of our species, as a consequence of introduction of agricultural and pastoralist practices, of consumption of industrial refined foods and of ever-increasing globalization [4], thus potentially converting some adaptive traits into maladaptive ones. In accordance to this view, increasing discordance between our anciently determined biology and contemporary nutritional or cultural patterns is supposed to have contributed to the spread of several complex diseases, which may represent by-products of past adaptive events due to loci that have become detrimental in modern societies [5]. To test this hypothesis, we have investigated the genetic legacy of natural selection on a panel of about one hundred genes representative of the main players driving functional pathways associated to food digestion and energy balance, or which turned out to be altered in metabolic and nutrition-related diseases. Sequence data for human populations living in different biomes were collected from public databases and used, in combination with unpublished data on individuals affected by certain nutrition-related diseases, to explore patterns of variation at more than 100,000 single nucleotide variants and/or indels. Population differentiation analyses based on the calculation of pairwise *F<sub>st</sub>* indices among genetically homogeneous clusters of populations and on their comparison with genome-wide *F<sub>st</sub>* distributions pointed out a few genes unusually differentiated with respect to average genomic patterns. Haplotype structure and potential deviations from a neutral model of evolution were then investigated at these candidate regions by applying several neutrality tests and by performing calibrated coalescent simulations, to disentangle the interplay between natural selection, demographic events and local mutation/recombination rates in shaping the observed patterns of variation. This enabled to elucidate implications of loci responsible for past adaptive events in the examined diseases, contributing to explain their underlying mechanisms and present-day epidemiological patterns, as well as some of the evolutionary processes that made our genome prone to the side effects of modern environmental stimuli.

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Poster Presentation Number 20, Fr (15:30-17:30)

## Revisiting the hominoid humerus – A 3D GMM assessment of locomotor and shape correlates

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The humerus in anthropoid primates exhibits a number of features that correlate with locomotor behavior, at least along broad categories. For example, differences in humeral torsion and curvature, depth and shape of the olecranon fossa, extension of the capitulum in inferior view, development of the medial and lateral trochlear ridge have been well documented among hominoids, and they have been used to infer locomotor behavior from various fossil hominins. The 1.98 Million year old remains from Malapa (*Au. sediba*) have yielded intriguing results in that they exhibit forearm features that suggest late retention of climbing and suspensory abilities, as expressed in the moderate ulnar trochlear keeling, and the curved phalanges. The purpose of this study was to further quantify humeral shape in hominoids using 3D geometric morphometrics, and to test to which extent it can be linked with locomotor behavior. A second goal was to assess shape variation seen in fossil hominins, such as *Au. sediba*, against that seen in extant apes. In particular, we sought to quantify shape variation of the distal articular surface, via the use of semilandmarks. The distal joint is thought to reflect differences in mechanical stresses resulting from functional requirements of arboreal/terrestrial locomotion. Extant hominoids exhibit differences in locomotor behavior, ranging from largely terrestrial quadrupedalism in *Gorilla*, to predominantly arboreal quadrupedalism in *Pongo*, and the highly specialized brachiators (Hylobatidae), and we hypothesized that overall and distal humeral shape varies accordingly, therefore providing the means to assess locomotion in extinct species. We collected 3D landmarks and semilandmarks on 99 extant hominoids (including 21 modern humans) and 13 fossil hominins. Landmarks were extracted by a single observer (MS) from surface scans with a resolution of 0.28mm. After allowing semilandmarks to slide, all landmarks were subjected to Procrustes superimposition, and the residuals were used for all subsequent multivariate statistical analyses. The results confirm that extant ape humeri can be distinguished on the basis of the degree of arboreality: Hylobatids had the most distinct shape, especially with respect to the most terrestrial hominoid *Gorilla*. *Pongo* bore more affinities with Humans in its distal articular surface, which may reflect in the latter a loss of features related to terrestrial adaptation. When the considerable size variation was taken into account, *Gorilla* and *Pan* were relatively similar to each other, while showing their greatest differences with respect to *Pongo* and Humans. Regarding its humeral shape, *Au. Sediba* exhibited affinities with more arboreal species such as *Pongo* and *Pan*, and was outside the range of modern humans, thus confirming that this hominin species retained a significantly more arboreal locomotor behavior.

**Acknowledgements:** L. Berger for graciously having made available casts of *Au. sediba*.

Poster Presentation Number 81, Sa (16:00-18:00)

## Exploring Palaeolithic weapon delivery systems using a controlled and realistic experimental setup: preliminary results

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In the last decades many researchers in the field of use wear studies made an effort in developing solid methods to identify stone artefacts which were used as tips of penetrative hunting weapons (lances, javelins, darts, and arrows). This study focuses on the approach proposed by Karl Hutchings [1,2], which relies on secondary fracture characteristics (namely, Wallner lines and fracture wings) to infer the precursory loading rate of the impact that caused the fracture and, consequently, the type of launching mechanism used in the delivery of the weapon. These fracture characteristics and their properties were already discovered in the 1930s by Helmut Wallner and known for a long time in the field of brittle fracture mechanics [3]. Their archaeological application was extensively discussed by John Tomenchuk in his dissertation [4]. Wallner Lines (WL) and fracture wings (FW) occur on crack fronts of brittle solids, like glass, obsidian and also fine-grained chert. Their characteristics allow for the calculation of the instantaneous crack speed at a particular point on the crack front. This velocity is dependent on several factors, the most important of which is the precursory loading rate (i.e., the rate at which force is applied, such that faster impacts result in faster crack speeds). Previous studies have hypothesized that it is possible to distinguish between different launching mechanisms based on a sufficiently large sample of fractures, because fractures resulting from different impact speeds can themselves be classified into three stages (quasi-static, rapid, and dynamic) which in turn correspond to different ranges of precursory loading rates [1]. In the current study, new experiments were conducted to evaluate the reliability of this method from two different points of view. First, since in a previous controlled experiment Iovita et al. [5] simulated *impact* velocities, but all others reported *launch* velocities, we aimed to check velocity curves for the entirety of the trajectory, from launch to impact. Second, since Iovita et al. [5] used soda-lime glass and synthetic targets, we wanted to produce a comparative, yet well controlled dataset from an experiment with animal targets and a naturally-occurring raw material. Using this more 'realistic' set-up, we measured the velocities and acceleration of three delivery systems (lance, javelin, and spearthrower dart) to 1) evaluate the magnitude of the distinction between impact velocities (at target entry as well as inside the target) and 2) determine if the pattern observed can be related to a particular delivery system as claimed in the literature. In total a number of 75 identical glass copies of a Levallois point [5] and 75 knapped obsidian points (25 per delivery system) of the same size were hafted on the spears/darts and thrust/thrown on a complete horse carcass by experienced experts. The acceleration curve of each shot was measured, including during the actual impact, with the help of an accelerometer attached to the weapon itself. Projectile velocities were recorded using a video camera. The broken points were analysed under a microscope and WF and FW photographed and fracture speeds calculated (for detailed explanation of the method see [1,4]). Here we report the first results of this experiment. We can preliminarily conclude that the relation between precursory loading rate and the pattern observed is both weak and dependent on factors that are difficult to reconstruct archaeologically, such as the type of animal hunted with a particular point. The influence of parameters like hide and flesh, which slow down a travelling projectile, play a more important role than previously assumed during impact until the moment of crack initiation. Consequently, they should not be underestimated when reconstructing weapon launching mechanisms from artefacts of archaeological origin.

**References:** [1] Hutchings, W.K., 2011. Measuring use-related fracture velocity in lithic armatures to identify spears, javelins, darts, and arrows. *Journal of Archaeological Science* 38 (7), 1737–1746. [2] Sahle, Y., Hutchings, W.K., Braun, D.R., Sealy, J.C., Morgan, L.E., Negash, A., Atnafu, B., Petraglia, M.D., 2013. Earliest Stone-Tipped Projectiles from the Ethiopian Rift Date to >279,000 Years Ago. *PLoS ONE* 8 (11), 1-14. [3] Kerkhof, F., 1975. Bruchmechanische Analyse von Schadensfällen an Gläsern. *Glastechnische Berichte* 48 (6), 112–124. [4] Tomenchuk, J., 1985. The development of a wholly parametric use-wear methodology and its application to two selected samples of epipaleolithic chipped stone tools from Hayonim Cave, Israel. Ph.D Dissertation, University of Toronto. [5] Iovita, R. et al., in press. Identifying weapon delivery systems using macrofracture analysis and fracture propagation velocity: a controlled experiment, In: Iovita, R., Sano, K. (Eds.), *Multidisciplinary approaches to the study of Stone Age weaponry*. Springer, Dordrecht.

Poster Presentation Number 73, Sa (16:00-18:00)

## **Residuals of short time occupations or structured landscape using- new aspects to the find layers from the Middle Paleolithic of Weimar-Ehringsdorf**

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The site of Weimar-Ehringsdorf is well known for the considerable finds of floral and faunal remains and stone artefacts but also of the remains of the early Neanderthals themselves. Although the travertine deposit including the finds is very large (around 1km in the NW- SE direction) most of the finds related to the human activities come from a relatively small area in the central part (around 50m x100m) where the quarrying took place from the beginning to the middle of the 20th century. The quarry has been active until now. Since 2003 an area with a finding horizon whose appearance differs clearly from that of the central archaeological site is observed in the actual travertine quarrying. A comparison of the new place and the old one is difficult due to the complicated processes of the origination of travertine and the long dismantling history of the site going back till the end of 19th century. Nevertheless, it is remarkable that in the new find layer the density of animal bones is extremely low in contrast to about the same density of artefacts described in the results of the research carried out from 1951 to 1967 as the only well documented small part from the central find concentration from which also all up to now known human remains come from. Attempts to explain these notable differences can be derived from the reconstruction of the ancient landform configuration. This point of view gives some arguments to the structured landscape using of the early Neanderthals, which are discussed here. On the other hand new mining technologies made it possible to get higher temporal resolution in the stratigraphic observation. Within the scope of the production of a new model of the travertinefacies, which is presented here, the interesting question of the temporal relation of single find zones can be partially answered. But the locally discontinuous sedimentation of the travertine and the partially very high growth rates complicate the reconstruction of the temporal expiries. However, these offer on the other hand the possibility to reconstruct short events very exactly with regard to the environmental relations. The aims of this work are to present the first results of the taphonomy of the find layer in consideration by the current state of excaviation.



Podium Presentation: Session 1, Th (9:50)

## The significance of *Australopithecus sediba* for understanding *Paranthropus robustus*

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1 - University of Pittsburgh

Since its announcement, *Australopithecus sediba* has been presented as the “ancestor” of genus *Homo* [1] based on interpretation of cranial, postcranial, and dental features. Nevertheless, its taxonomic distinctiveness has been challenged on the grounds that since the species is based on the skull of a subadult [Malapa Hominid (MH) 1], its adult morphology could be comparable to known australopiths [2]. Although interpretation of the dentition has reaffirmed the status of *sediba* [3], a more detailed analysis demonstrates that the most favorable comparison is with Kromdraai TM1517b, the mandibular holotype of *Paranthropus robustus*. For example, preserved alveoli in MH1 mandible UW-88-8 suggest that the missing P1-2 were similar in shape to TM1517b: i.e. as in MH2 (UW-88-129) MH1 P2 was larger, especially in a distended hypocone region such that the buccal side of the tooth was mesiodistally (MD) somewhat shorter, while the buccal side of P1 was marginally but visibly longer than the lingual side. The M1s of MH1 and TM1517b are especially similar in the oblique orientation of the distal part of the crown and the presence of notches between buccal cusps and a cingulid on the protoconid. Further, UW-88-8 and TM1517b, M1-2 hypoconid bases extend lingually across the crown’s midline; hypoconids are compressed and bear hypocristids; and small hypoconulids angle inward, paralleling the oblique orientation of the crowns’ distal sides. A groove on the internal face of TM1517b’s M1 metaconid base produces a “pillar-like” feature, which is seen on UW-88-8’s M2. As in UW-88-8’s M1, the preserved distal part of TM1517b’s M2 bears a definitive protoconid buccal cingulid that abuts the mesial side of the hypoconid in concert with a notch between these two cusps. Further, the M3s of TM1517b and UW-88-8 are generally similar in size and shape, and also in presenting buccal cusp notches (also in UW-88-55a), distinct buccal cingulids on the distal part of the protoconid, a slight buccal enamel swelling below the hypoconulid, a distobuccally obliquely oriented metaconid base, and MD short trigonid basins confined to the inner portions of the protoconid and metaconid bases. In light of the above, MH1 and 2 should be regarded as *Paranthropus robustus*. Being smaller than TM 1517b, the Malapa hominids were likely female, not male (Berger et al., 2010). Further, preliminary study indicates that TM 1512, not TM 1517a, is comparable to MH1 in upper dental and lower facial morphology, which indicates that the former as well as MH1 represent the skull and upper dentition of *P. robustus*. Given the apparent association of postcrania with Malapa crania, mandibles, and teeth, we might now discuss in earnest the morphology of this taxon and revisit its hypodigm.

**References:** [1] Berger, L.R., de Ruiter, D.J., Churchill, S.E., Schmid, P., Carlson, K.J., Dirks, P.H.G.M., Kibii, J.M., 2010. *Australopithecus sediba*: a new species of *Homo*-like australopith from South Africa. *Science* 328. DOI: 10.1126/science.1184944. [2] Strauss, A., Gunz, P., Benazzi, S., Spoor, F., 2013. Late juvenile cranial growth and the diagnosis of *Australopithecus sediba*. *Proceedings of the European Society for the Study of Human Evolution* 2, 218. [3] Irish, J.D., Guatelli-Steinberg, D., Legge, S.S., de Ruiter, D.J., Berger, L., 2013. Dental morphology and the phylogenetic “place” of *Australopithecus sediba*. *Science* 340. DOI: 10.1126/science.1233062.

Poster Presentation Number 27, Fr (15:30-17:30)

## Rodent biochronology at Klinkert's (Sterkfontein Valley, South Africa)

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Bolt's Farm, as defined by Cooke (1991), is a fossiliferous area 3 km southwest of the Sterkfontein caves (South Africa). The HRU (HOPE Research Unit) is a multi-disciplinary international team working in this area since its creation in 2006. This fossiliferous cave system stretches over two properties: Klinkert's and Greensleeves. Until now, 30 sites have been identified ranging from the Early Pliocene to the Early Pleistocene. There are four sites on the Bolt's Farm cave system that have proven to be of interest and has become the area of focus for the HRU based on their possible age: Aves Cave at Greensleeves and Milo A & B, Brad Pit A & B and Waypoint 160 at Klinkert's. Radiometric dating is a well established method in East Africa but only recently has this method proven beneficial for south-african deposits. Biochronological dating (mainly based on suids, equids and bovids) is one of the popular dating techniques associated with south-african sites. Because of an apparent morphological stasis, the Pliocene and Pleistocene rodents of South Africa were not used a lot as chronological indicators. The discovery of Waypoint 160 and Brad Pit B highlighted the importance of ancient rodent faunas, especially the *Eurytomys* phyletic lineage. It shows, in the upper and lower tooththrows, a progressive fusion of the main cusps into laminae, the disappearance of the accessory cusps and an increase in the number of laminae at the third upper and first lower molars leading to a tooth pattern found today in *Otomys* and *Parotomys*. It indicates a diet change towards a very specialized grass feeding habit that might be linked to the extension of C4 grasslands during the Pliocene in South Africa. The consecutive species of this lineage allows for the biochronological placement of Waypoint 160 and Brad Pit B to slot successively in between Langebaanweg (about 5 My) and Makapansgat Rodent Corner and Member 3 (around 3 My). The biochronological results indicate that the sites of Waypoint 160 and Brad Pit B are currently the oldest identified fossiliferous deposits in the Sterkfontein Valley.

**References:**[1] Cooke, H.B.S., 1991. *Dinofelis barlowi* (Mammalia, Carnivora, Felidae) cranial material from Bolt's farm, collected by the University of California african expedition. *Palaeont. Afr.* 28, 9-21.

Poster Presentation Number 41, Fr (15:30-17:30)

## East European models for the Middle-to-Upper Palaeolithic transition in Eastern Europe

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There are several models for Upper Palaeolithic origins in Eastern Europe:

- Kostenki model with an Initial Upper Palaeolithic stratum as a distinct predecessor to the Aurignacian and contemporaneous to the local "transitional" Streletskian;
- Southwestern with a local Aurignacian of Molodovan variety as well as with several local cultural traditions of varying affiliation;
- Volyn - Transcarpatian with Aurignacian, a probable Initial Upper Palaeolithic (Sokitnitsa), and Levallois-leptolithic (Kremenitsyan) transitional assemblage;
- Crimean with various local late Middle Palaeolithic entities (isochronous and possibly more recent than the Aurignacian) and the unique Upper Palaeolithic assemblage at Buran-Kaya IIIC;
- Northeastern (Urals), similar to the Kostenki model but with local features;
- Caucasus with problematic Aurignacian and Ahmarian.

Evidence has emerged recently for an "Upper Dnepr model" of Middle-to-Upper Palaeolithic evolution, and for Upper Palaeolithic origins in the Middle Volga Basin. The chief obstacle to working out the relationship between Middle and Upper Palaeolithic in Eastern Europe remains the definition of the late Mousterian, due to uncertainties regarding the dating of assemblages. At present, the most likely late Mousterian sites in Eastern Europe include the following: Shlyakh (Middle Don Basin) (layer VIII: 45-46 ka [cal BP: 50 ka]), typologically close to assemblage of Belokuzminovka (Lower Dnepr), and the upper cultural horizons of Khotylevo 1 (Upper Dnepr Basin) with radiocarbon dates of 42, 47 and 49 ka (cal BP: > 50). The lithic assemblages of these sites exhibit some common features, especially technological, which supports the hypothesis of a (pseudo?)-Levallois leptolithic transition to the local Upper Palaeolithic. To these assemblages may possibly be added Rozhok 1 (Sea of Azov coast), where cultural horizon IV yielded the isolated tooth of a modern human in a Mousterian context. New research on the early Upper Palaeolithic of the Middle Volga Basin suggests yet another model, with a radiocarbon date (from M. Otte) on Nepryakhino (cultural layer III) of  $36\,060 \pm 350$  (Beta-244075) (cal BP: 41.0-41.7 ka). This assemblage, together with the site Oundory, provides evidence for a local early Upper Palaeolithic with bifacial leaf points exhibiting similarities to the Buran-Kaya IIIC points. None of the models can be rejected at this point, but a multi-regional pattern of Upper Palaeolithic development appears more likely than a single local origin at this point, whether by in situ evolution or acculturation from external source.

**Acknowledgements:** Grants: Presidium RAS; RFBR 14-06-00295.

Poster Presentation Number 11, Fr (15:30-17:30)

## Muscle cross-sectional area estimation for Neanderthals and Paleolithic modern humans

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We have developed a method for muscle cross-sectional area estimation at of the forearm from cortical bone cross-sectional area of the radius [1]. The formula is based on data about the muscle cross-sectional area and the cortical bone cross-sectional at 65% of forearm length in a living human sample of 695 healthy Germans aged from 5.79 to 59.95 years. Muscle area and cortical area were measured directly in vivo and data was analyzed using multiple linear regressions. Percent Standard Error of Estimate (%SEE) for muscle cross-sectional area estimation from cortical bone is 12.03% to 14.83%. This method was already successfully applied to a skeletal sample from the Linear Pottery Culture [2]. Our results were in line with previous analyses of the Neolithic sample and showed a significant difference between Neolithic and recent children in forearm muscularity. Here, we present the results of muscle cross-sectional area estimation for 13 adult Neanderthal radii from ten individuals and 20 adult Paleolithic modern human radii from 14 individuals. The major goal of the present study was to quantify variation among Neanderthals and Paleolithic modern humans in forearm muscularity and to test if the long held conviction of “stocky” [3: 676] Neanderthals with a “general muscular hypertrophy of the upper body” [4: 378] can be confirmed from their forearm muscle cross-sectional area size. Estimated muscle cross-sectional areas were standardized by radius length to derive at a surrogate for forearm strength and to incorporate the differences in limb proportions of Neanderthals and modern humans. Muscle cross-sectional area estimations were also standardized by estimated body mass to obtain information about the muscularity of the forearm in relation to the general physique and the appearance of the forearms in relation to the rest of the body. Results of these analyses are discussed in the context of previous assumptions about Neanderthal and Paleolithic modern human body build and strength.

**Acknowledgements:** We would like to thank all curators and institutions who granted us access to fossil specimens as well as everyone involved in the DONALD study.

**References:** [1] Slizewski, A., Schoenau, E., Shaw, C., Harvati, K., 2013. Muscle area estimation from cortical bone. *Anat Rec.* 296, 1695–1707. [2] Slizewski, A., Burger-Heinrich, E., Francken, M., Wahl, J., Harvati, K., 2014. Pilot Study for Reconstruction of Soft Tissues: Muscle Cross-Sectional Area of the Forearm Estimated from Cortical Bone for a Neolithic Sample. *Anat Rec.* Epub ahead of print. DOI: 10.1002/ar.22917. [3] Wolpoff, M., 1999. *Paleoanthropology*. McGraw-Hill, Michigan. [4] Cartmill, J., Smith, F.H., 2009. *The Human Lineage*. John Wiley & Sons, New Jersey.

Poster Presentation Number 66, Sa (16:00-18:00)

## Functional Equivalence within the Developing Masticatory System

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The primate skull changes considerably in shape and increases in size during postnatal development, and has a number of potentially competing systems and functions to accommodate or maintain as it changes, including the masticatory system and feeding. The functional efficiency of the masticatory system is determined by several factors including the mechanical advantage of the jaw closing muscles at a particular bite point (in-lever/out-lever), muscle force and dental morphology. With increasing length of the skull and dental eruption during ontogeny it may reasonably be expected that post weaning the lever arm lengths of the muscles will change predictably intraspecifically to maintain mechanical advantage or even the mechanical advantage of juveniles will be greater than that in adults to compensate for their reduced musculature. In the two taxa studied to date, the results have been conflicting. This study therefore tests whether mechanical advantage of the main masticatory muscles (temporalis and masseter) remain constant or change intraspecifically during ontogeny across a range of catarrhine primates with a variety of diets, and whether variance in mechanical advantage is related to the dietary differences. 3D coordinates data was collected for an ontogenetic series of *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus*, *Cercopithecus nictitans* and *Colobus satanas*. Origins and insertions for the masseter and temporalis muscle, temporomandibular joint (fulcrum) and bite point locations of the most anterior (I1) and posterior tooth in functional occlusion (M1, M2 or M3) were used to calculate the in-levers (moment arm for the jaw closing muscles) and the out-levers (load arm for biting at a given tooth). The associated mechanical advantage was subsequently calculated for each muscle over each bite point and compared within and between each species. Within each species mechanical advantage increases during ontogeny for the most posterior molar bite, whilst incisor bites show a more general maintenance of mechanical efficiency between juveniles and adults. This indicates that lower muscle forces in younger individuals could be compensated for by a relatively higher mechanical advantage during incisor bites. There are clear increases in mechanical advantage of the most distal tooth during ontogeny, especially for the more obdurate feeders (*C. satanas*, *P. pygmaeus*, *G. gorilla*) and interspecific differences in mechanical advantage between the adults also appear to reflect dietary differences. Sexual differences in the out-lever length are recorded but no significant differences in mechanical advantage, suggesting in-levers adjust to maintain functional equivalence in the more prognathic males. The results of this study suggest that mechanical advantage varies intraspecifically and interspecifically within primates. While species with a more obdurate diet develop a more efficient lever system, required for their specialized diet, juveniles do not possess an increased mechanical advantage. These findings may be due to less mechanically resistant feeding behaviors of juveniles in comparison with adults or suggest that juveniles cope with the mechanical demands of an adult diet through other mechanisms, such as the dental topography of unworn teeth and internal muscle architecture.



Poster Presentation Number 36, Fr (15:30-17:30)

### **Varsche Rivier 003: A Middle Stone Age site with Still Bay and Howiesons Poort assemblages in southern Namaqualand, South Africa**

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1 - University of California, Davis · 2 - Max Plank Institute for Evolutionary Anthropology · 3 - University of Wollongong · 4 - University of Washington · 5 - ASHA Consulting (Pty) Ltd · 6 - University of Cape Town · 7 - University of Tübingen

In southern Africa, the Still Bay (SB) and Howiesons Poort (HP) industries have become central to our investigations into the mode and tempo of human behavioral evolution and modern human origins. However, few sites exist that preserve both industries, where the most detailed queries about their chronological, technological, and ecological relationships could be best addressed. The newly identified site of Varsche Rivier (VR) 003 (southern Namaqualand, Western Cape Province, South Africa) provides such an opportunity, because it preserves both SB and HP industries within a longer sequence of Middle Stone Age (MSA) cultural history. We initially targeted this region for research because it is in the Succulent Karoo, outside of the well-documented coastal and montane zones of the Fynbos, and because it is situated within the Winter Rainfall Zone, where moisture was more available during the cooler phases of prehistory and therefore may have been occupied during MIS 2 or MIS 6 potentially yielding early LSA or early MSA assemblages. We first identified VR003 in 2009 with only a small test excavation (Steele et al., 2012). We returned in 2011 for a larger field season incorporating block and bulk sampling for micromorphological analysis and optically stimulated luminescence (OSL) dating. In addition to large assemblages of stone artifacts, the site also preserves fauna, ostrich eggshell, and pigments throughout the current sequence. VR003 appears to be a collapsed rockshelter, with a small remnant of the shelter preserved at the top; extending in front of the site is a 28 m long slope that rises 8 m from the slope base to the shelter. We have excavated 5 m x 1.5 m x 2.5 m on the slope and 1 m x 1 m x 1.2 m inside the shelter. Macro and micromorphological analysis of the sedimentary sequence reveals different formation processes and conditions on the slope - colluvial processes, bioturbation, moist conditions - from those inside the shelter - few post-depositional alterations, dry conditions. Inside the shelter, the sedimentary material, and the archaeological material contained within, is in primary context, while on the slope, the disturbances are more variable. Inside the shelter, we have uncovered HP material at the base of the unit, with late MSA above, and capped by late Holocene Later Stone Age. On the slope, the deepest materials are pre-SB, followed by unifacial points (n=5), bifacial points (n=25), and then backed artifacts (n=48). Based on the analysis of single-grains, eight of ten OSL samples provided reliable dates, with higher confidence in six of them. The sediments surrounding the HP assemblages each provided one sample (one inside the shelter and one on the slope), which were bracketed by other samples. These samples suggest that the HP industries were deposited 45.7-41.7 ka. While our results are stratigraphically consistent, they are substantially younger than any previously published HP chronologies. Within a regional context, the VR003 assemblages can be compared to Apollo XI, Spitzkloof, Diepkloof, Hollow Rock Shelter, and Klein Kliphuis, among others, to address questions concerning lithic technology, stone material exploitation, chronology (including transitions and hiatuses), ecology, and the innovation of complex behaviors.

**Acknowledgements:** Excavations were conducted under Heritage Western Cape Permit No. 2009-04-001 issued to Orton; landowners Petro and Louis Visser generously granted access and support. The US National Science Foundation, L.B.S. Leakey Foundation, the University of California, Davis, and the Australian National University have funded the research, along with additional support from our local institutions.

**References:** [1] Steele, T.E., Mackay, A., Orton, J., Schwartz, S., 2012. Varsche Rivier 003, a new Middle Stone Age site in southern Namaqualand, South Africa. *South African Archaeological Bulletin*. 67, 108-119.

Poster Presentation Number 63, Sa (16:00-18:00)

## Predicting jaw shape based on models of maxillomandibular integration

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Dentognathic morphology is one of the main aspects that characterize different hominin species. The masticatory apparatus shows differences in dental size, mandibular corpus robusticity, degree of prognathism and arcade shape. Some hominin species are only known by their upper or lower jaw morphology, and it would be beneficial if their matching lower or upper jaw shapes could be predicted and thus recognised in the fossil record. This type of predictions can be attempted using geometric morphometrics, based on statistical models describing the spatial and functional integration of mandibles and maxillae in extant humans and great apes. Here we examine the capability of a multiple multivariate regression model based on 3D landmarks digitized on computed tomographic scans of associated upper and lower jaws of adult extant *Homo* (pre-industrial), *Pan*, *Gorilla*, and *Pongo* to predict the dental arcade shape of mandibles from maxillae and vice versa. To assess whether this model can be used for a hominin species which has a jaw morphology not seen in extant taxa we also analyse two *Paranthropus boisei* fossils, the unassociated maxilla of OH 5 and the Peninj mandible: we first apply extant regression models to predict a lower jaw for OH 5, and compare the predicted lower jaw to Peninj against the backdrop of pairwise shape differences between mandibles within extant species; likewise we compare the maxillary prediction for Peninj to OH 5. We find that the predicted shapes of our extant sample fall within the actual range of intraspecific variation. Discriminant function analysis shows that the predictions are correctly assigned to the respective taxon. Using a model of integration combining all taxa, predicted arcades are accurate, but we get somewhat diverging shapes for the anterior teeth; the postcanine dentition is less affected. Our results indicate that integration patterns are highly conserved in extant hominids which allows us to effectively predict dental arcade shapes. The accuracy of our integration models holds the prospect that application to the hominin fossil record is a practical possibility to predict the matching gnathic morphology. A first evaluation will be done by presenting the findings for the *P. boisei* fossils.

**Acknowledgements:** We thank the following curators and museums for access to their specimens: Ingo Bechmann and Christine Feja, University of Leipzig, Leipzig; Ottmar Kullmer, Senckenberg Museum, Frankfurt/Main; Frieder Mayer and Nora Lange, Museum für Naturkunde, Berlin; Matthew Tocheri from the Smithsonian Institution, Washington, D.C.; the Ivorian authorities and Christophe Boesch, MPI-EVA, Leipzig. We also want to thank Lauren Schroeder for access to the laser scan of Peninj and Jean-Jacques Hublin for providing access to the CT-Scans. This research was funded by the Max Planck Society.

Podium Presentation: Session 3, Th (15:50)

## Small bones, big differences - A comparison of modern human and Neandertal ear ossicles

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Due to their minute size few middle ear ossicles are known from the hominin fossil record. Even for Neandertals only a handful of specimens are known. In fact, only one specimen - La Ferrassie 3 – preserves a complete ossicular chain, including the only complete malleus described so far. Studies of these Neandertal ossicles, using linear and angular measurements, have indicated differences between *Homo neanderthalensis* and *H. sapiens* [1, 2, 3, 4]. However, such analyses were marred by the small fossil sample size and the two-dimensional measurements do not capture the type of three-dimensional (3D) shape characteristics shown to distinguish the ear ossicles of extant hominids [5]. Here, we present a study of the 3D shape of Neandertal ear ossicles, including several previously undescribed specimens. The analysis uses a geometric morphometric (GM) measurement protocol based on 3D landmarks and semilandmarks obtained from high resolution CT images [5]. Landmarks were analyzed using principal component analysis after standardizing for position, orientation, and scale. Neandertals were compared to a large comparative dataset of modern humans and African apes. The results of the GM analyses show that the ossicles of all species in the sample can be distinguished by their shape (statistical significance  $P < 0.01$ ). Moreover the ossicles of Neandertals and modern humans are distinctly different and within the comparative context of the extant hominids the Neandertal ossicle morphology appears more derived than that of modern humans. Strikingly, Neandertals show less ossicular shape variation than extant species, despite the substantial time depth of the fossils. The GM analysis expands our knowledge of the morphological distinctiveness of Neandertals compared with modern humans. The differences in ossicle shape should be investigated further in a functional context, assessing the implications of the derived Neandertal morphology for the auditory characteristics of this species.

**Acknowledgements:** This research was funded by the Max Planck Society. We thank R. Quam, A. Balzeau, S. Flohr, I. Bechmann, C. Feja, F. Mayer, C. Funk, Y. Rak, I. Hershkovitz, J. Radovčić, B. Vandermeersch, M.S. Fischer, T. Schüler, C. Boesch and AST-RX for providing access to specimens.

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Podium Presentation: Session 9, Sa (11:30)

## The early Gravettian. New excavations at Dolní Věstonice-Pavlov

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Although Moravia offers a complex record of the Evolved Gravettian/Pavlovian between 31,5-28,5 ka cal BP ( $2\sigma$ ), evidence for earlier Gravettian stages was weak. Here we present new evidence of the early Gravettian from the Dolní Věstonice–Pavlov area and discuss its meaning for the question of Gravettian origin. Dolní Věstonice: The 2012 excavation at Dolní Věstonice IIa unearthed a central multilayer hearth (horizons 4-3c) and a sequence of AMS dates from the individual microlayers (36 – 31,5 ka BP); a peripheric zone with slightly more recent dates was associated to this instalation (horizons 3b-3a; dated 31-29,5 ka BP). Analyses of pollen, charcoal, fauna, and artifacts add to understand formation processes of this particular hearth and related development of the MIS 3 landscape. The charcoal record documents a cold and dry landscape with coniferous trees through the section. The pollen record confirms a parkland landscape with scattered presence of climatically demanding broadleaf trees (in horizon 3c). The presence of certain snail and mammal species, including red deer, indicate an episode of a restricted forest formation in the horizon 3c. The associated cultural development starts from undiagnostic Upper Paleolithic industry towards early and evolved Gravettian/Pavlovian lithic industries. An important evidence contributes the earliest assemblage of burnt clay pellets in this region. Pavlov: In 2013, we excavated four trenches (A-D) at the site Pavlov I-Southwest. Sequence of 8 C14 dates taken from sections in trenches A, B, and D demonstrate that the Gravettian cultural deposits formed gradually, within the time-span of 33,5 – 29,5 ka BP. A large volume of paleobotanical, malacozoological, osteological, and artefactual material is being recorded and is still being sorted. This sequence covers not only the Evolved Gravettian/Pavlovian (as recorded during previous excavation by B. Klíma), but also earlier, hitherto unknown Gravettian occupations below, and an EUP (Aurignacian) industry in trench D, dated 36,5 ka BP and marked by a change in raw material and typology. Comments on the Gravettian origin: Traditionally, the Gravettian origin in Europe has been considered as one of the changes within a continuous Upper Paleolithic development. Here we place the Gravettian in context of early modern human migrations into Europe and interpret it as the final stage of the Middle-to-Upper Paleolithic transition. Two major streams of technological expansion may be traced from Africa to northern Eurasia between 50-40 ky BP (i.e., prior to the Aurignacian and Gravettian): the Levallois-leptolithic and the backed blade/microblade technology. Sufficient attention has already been paid to expansion of the first stream from north Africa over eastern parts of Europe to central and north Asia. The second line with the backed blades/microblades and microliths may be traced in several varieties over the Mediterranean (Ahmarian, Dabba, Uluzzian, Chatelperronian, Protoaurignacian/Fumanian), showing a technological trend from larger blades/flakes towards fine blades. The anthropological context is controversial: whereas the early backed points in southern and eastern Africa and the Uluzzian appear to be products of modern humans, the Chatelperronian apparently occurs in context of late Neandertals. Migration, diffusion and acculturation models should be considered and tested, from case to case. Here we argue that the early backed blade expansion between 45-35 ka BP period becomes important if we search for the roots of the Gravettian after 35 ka BP - an entity securely associated with modern human fossil record.

**Acknowledgements:** This research is part of the EU programme FITEAMP CZ.1.07/2.3.00/20.0181, Formation of International Team on Evolutionary Anthropology of the Moravian Populations.

Podium Presentation: Session 2, Th (12:00)

## **Spruce and pine – new investigations on the wooden weapons of Schöningen, Lower Saxony (Germany)**

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Since 1994 the lower Palaeolithic site of Schöningen in Lower Saxony, northern Germany, excavated by H. Thieme is world famous for the findings of excellent preserved wooden tools and weapons. The site Schöningen 13 II provided a sequence of sediment cycles of a former lake shore dated to an interglacial about 300.000 years ago, which is assigned to OIS stage 9. Nine spears, one smaller throwing stick and one lance were found in level 4 (“spear horizon”) together with lots of animal bones with many traces of butchering. Horse was the prey of choice, but also other herbivores were hunted. While H. Thieme suggested a single major hunting event there is increasing evidence for repeated visits of the former lake shore during the late phase of the interglacial. Work is in progress to investigate a further part of level 4, which was detected during recent field work. Although field work in the 1990s was conducted under time pressure all wooden remains were documented and collected for future analysis. Since then hundreds of wooden remains were carefully stored in water by M. Lehman and team in the State Agency for Cultural Heritage of Lower Saxony. During the last years thousands of botanical macro remains have been identified providing the image of typical lake shore vegetation. In contrast the wooden weapons were exclusively made of spruce and pine (1x). They show signs of cooling growth conditions and were imported to the site. Since 2013 work is in progress by P. Richter and W. Schoch aiming on the systematic identification of further possible worked wooden objects from level 4. Among the remains there is a considerable number of other pieces of spruce and pine. The talk will present results of this ongoing analysis and discuss the evidence on the background of the weapons. Mapping of the spruce and pine remains is confirming their close relationship to human activities and is contributing to the better understanding of the taphonomical processes at the former lake shore. The talk will also discuss new worked wooden objects.

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Poster Presentation Number 6, Fr (15:30-17:30)

## X-ray microtomographic-based structural analysis of the dental remains from the Mousterian and Aurignacian levels of the Fossellone cave, Latium, Italy

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The Late Pleistocene deposit of the Fossellone cave (Monte Circeo, southern Latium, Italy), contains a stratigraphic sequence characterized by levels associated with Mousterian industry overlaid by strata with Aurignacian stone artefacts. A human mandibular fragment and three isolated lower permanent teeth, currently identified as LP4, LM1 and LM2, were recovered from the upper Mousterian level during archaeological excavations carried out in 1953-54 [1]. Previously known as Circeo 4, this set of specimens is now collectively named Fossellone 3 [2]. In the same excavation campaigns, from the Aurignacian levels were also recovered a human scapular portion (Fossellone 1) and a partial right maxilla (Fossellone 2) bearing the permanent RM1 and RM2 [3]. The specimens forming the Fossellone 3 group are more likely referable to a single juvenile individual, while the Fossellone 2 maxillary fragment and teeth sample an adolescent [1]. In order to verify their taxonomic attribution originally based on outer morphology, in 2012 two dental elements from Fossellone 3 (LM1 and LM2) and Fossellone 2 were imaged by X-ray microtomography at the Tomolab station of the Elettra – Sincrotrone Trieste laboratory (Basovizza (TS), Italy), according to the following parameters: 130 kV voltage, 61  $\mu$ A current, 1.75 mm of Al filter and a projection each 0.15 to 0.30° over a 360° sample rotation. The final volumes were reconstructed with an isotropic voxel size ranging from 6.6 to 18.0  $\mu$ m. Following a semi-automatic segmentation, tooth crown tissue proportions were assessed (including the relative enamel thickness index [RET]; see [4]) and enamel thickness distribution maps were computed. Both M1s (Fossellone 2 and 3) are moderately worn, while the corresponding M2s are almost unworn, thus allowing for a reliable quantitative assessment of 3D crown tissue proportions. In the case of the LM1 of Fossellone 3, the apical portion of the slightly worn protoconid, metaconid and entoconid dentine horns were reconstructed. Geometric morphometric analyses were performed on two sets of seven landmarks placed on the EDJ of all the investigated specimens. We comparatively used similar evidence from upper and lower permanent molars representing Neanderthals (N=32) and recent humans (N=44). Our analysis clearly sets the Fossellone 3 lower M2 (RET: 15.6) close to the Neanderthal average (LM2 RET: 15.4), but at the inferior limit of the modern human range (12.6-40.7). Conversely, the Fossellone 2 maxillary M2 (RET: 23.3) falls within the extant human variation (20.5-31.6) and exceeds that of Neanderthals (13.7-17.6). The enamel thickness distribution cartographies of Fossellone 3 molars reveal the typical Neanderthal repartition pattern, while those of Fossellone 2 show a relatively thicker occlusal enamel, as in modern humans. Results of the GM analyses of the EDJ shape show two distinct patterns of molar dentine horn height and position, the Neanderthal one being associated to a slightly higher EDJ topography and to a more mesiodistally elongated occlusal basin, while modern humans have relatively buccolingually larger crowns. Again, Fossellone 3 molars fall within (or very close to) the Neanderthal shape space and far apart from the recent human one, whereas Fossellone 2 is outside the range of both groups, but much closer to the modern conformation. In conclusion, our 3D analyses of the Fossellone dental assemblage confirm that it samples two distinct human groups, Fossellone 3 representing a Neanderthal and Fossellone 2 an anatomically modern human individual.

**Acknowledgements:** Istituto Italiano di Paleontologia Umana, Roma; M. Rubini & A. Zarattini, Soprintendenza per i Beni Archeologici del Lazio, Roma; EXACT Project funded by the Regione Friuli-Venezia Giulia.

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Podium Presentation: Session 6, Fr (13:50)

## The Appositional Articular Morphology of the Talo-crural Joint Reflects Substrate Use Within Species: An Examination of Three Closely Related Hominoid Species

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1 - University of Oregon

A mosaic of ankle morphology and evidence of rapid change punctuate the Plio-Pleistocene hominid fossil record. Previous studies using Singular Warp analysis have shown that in a diverse Catarrhine sample of talo-crural joints superfamilies respond to terrestrial or arboreal use with similar shape changes, and genera differ in shape in response to this same behavioral stimulus. Singular Warp analysis is an effective tool for examining the relation of ankle articular shape to substrate use. The current study examines the upper ankle joint shape of three closely related extant species and the effect of substrate use (behavior). The study group was 188 specimens (114 adults and 74 subadults) from three comparably sized adult hominid species *Pan paniscus*, *Pan troglodytes* with 3 subspecies, (*verus*, *troglodytes*, *schweinfurthii*), and *Homo sapiens* (6 adult populations), (20th Century City Dwellers, New Mexico Cliff Dwellers, [1000 BP], Egyptian Desert/Maritime, [1800-1600 BP], Alaskan Artic/Maritime, [500-1500 BP], California Coastal Hunter-Gatherers, [500-2500 BP]). Specimens of distal tibiae and matched tali were laser scanned and twenty-seven landmarks (15 talar and 12 tibial) were placed using Landmark Editor software. Generalized Procrustes analysis, Multivariate Regression, Relative Warps, and Singular Warp analysis were employed. Singular warp analysis found no trajectory of talo-crural joint shape in relation to developmental age. Rather, evidence for an epigenetic effect associated with individual substrate use was detected in the adults. All subadults clustered with more arboreal adults suggesting an ancestral arboreal adaptation. *Pan paniscus* had an arboreal profile, while *Pan troglodytes* was terrestrial with *Homo sapiens*. Differences within *Pan troglodytes* and *Homo sapiens* reflected differing substrate use. *Pan troglodytes* in the southern Cameroon had human contact (20000 yr, Baka), and were more arboreal than other samples, while *Homo sapiens* global substrate use and technology (footwear) profiles were manifest with the differences in shape in both the substrate involved and the effect of technology on substrate use. Singular warp analysis provides insights into the relation of talo-crural joint shape and behavior, with form reflecting substrate use. *Homo sapiens*, *Pan troglodytes*, and *Pan paniscus* demonstrate the differences in closely related taxa. *Pan paniscus* shows uniformity of shape related to an arboreal profile. *Pan troglodytes* demonstrate change due to environmental influences and *Homo sapiens* provide insights into the mechanism of shape change due to the behavioral effect, substrate use, as suggested in the fossil assemblage.

**Acknowledgements:** We are grateful to Will Harcourt-Smith and Eric Delson of the Department of Vertebrate Paleontology, AMNH for their assistance with many aspects of this project, and for providing some of the humans and great apes scans from the AMNH. We thank Eileen Westwig and Gisselle Garcia, AMNH, Yohannes Haile-Selassie and Lyman Jellema, CMNH, Terry Kensler, CPRC, Judith Chupasko, HMCZ, Tracy Damitz, FMNH, Linda K. Gordon NMNH, Darrin P. Lunde, NMNH, Angela Gill, Powell-Cotton Museum, Emmanuel Gilissen, RMCA, and Natasha Johnson of the P.A. Hearst Museum Department of Anthropology, UC Berkeley, for access to their collections, as well as, Tim White and Mike Black for help with the Hearst Museum. University of Oregon, NSF (BCS-0452538), IIS-513660, and NIH Grant No. P40 RR003640.

Poster Presentation Number 86, Sa (16:00-18:00)

## Kill Locality and Settlement: a comparison of two Magdalenian site types

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We present a comparative analysis of faunal assemblages from two distinct types of sites of the Magdalenian period, the kill-site of Roche de Solutré (Burgundy, France) and the settlement site of Gönnersdorf (Neuwied, Central Rhineland, Germany). The site at the base of the Roche de Solutré has been described as the “best-preserved example of a large-game kill-site in western Europe” [1], while excavations at Gönnersdorf have revealed some of the most complete late Upper Palaeolithic settlement features in western central Europe, interpreted as four distinct dwelling structures. Both localities produced rich assemblages of animal bones, including some 14,500 remains at Gönnersdorf [2] and 4,533 from excavations of the Magdalenian level at Solutré [3]. Focussing on the results of zooarchaeological analyses undertaken at both localities and presenting these data against a background of other evidence recovered at the sites (at Gönnersdorf including structural features comprising elements of rocks, lithic and organic artefacts, a major corpus of figurative art...), we investigate fundamental differences in the bone assemblages which could be related to the differential utilisation of the sites by Magdalenians. Although the faunas recorded in each case can be classified as diverse, horse dominates at both sites in terms of numbers of identified specimens (NISP), minimum numbers of individuals (MNI) and / or in terms of its importance in the subsistence strategies of the site occupants. Large numbers of individuals of horse were present, 45 at Solutré and 53 at Gönnersdorf. At both sites, the presence of adult horses, juveniles and foals, suggests that the animals which were killed and butchered were mainly living in family groups. A very different representation of parts of the horse skeleton was observed at the two sites; phalanges and teeth dominate at Gönnersdorf, while teeth, mandibles, scapulae and pelves dominate at Solutré. Both sites were characterised by low frequencies of human modification (cut marks, hammer stone-induced notches and use of raw material for a bone industry) on the horse bones. In the case of Gönnersdorf, this is very likely linked to poor preservation of bone surfaces. In contrast, the bones from Solutré were excellently preserved, a fact that led to speculation on the reasons for the discrepancy between the large numbers of horse and the lack of strong evidence of butchery (low intensity of exploitation or expertise of the butcher).

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Poster Presentation Number 17, Fr (15:30-17:30)

## Dorsal canting in human pedal and manual proximal phalanges does not covary: an alternative explanation for high dorsal canting in manual phalanges

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Several features of phalanges, such as the degree of dorsal canting, have been shown to be related to locomotory behaviour. In primates, increased dorsal canting in the manual phalanges is associated with increased quadrupedal behaviour, whereas more palmarly oriented proximal articular surfaces are associated with suspensory behaviour [1]. In pedal phalanges, the degree of dorsal canting has been used to infer bipedalism [2, 3, 4]. Covariation between the degree of dorsal canting in pedal and manual proximal phalanges, however, has not yet been studied, although the relatively high degree of dorsal canting in human phalanges relative to other anthropoids has been hypothesised to be caused by hand and foot bones being serially homologous with similar developmental pathways [1]. Here, this hypothesis is tested. To this purpose, phalanges of 50 associated adult modern human (*Homo sapiens*) hands and feet, stored at the Muséum national d'Histoire naturelle (Paris) and the Natural History Museum (London), were studied. Specimens from all continents (except, of course, Antarctica) were represented in the analyses. Proximal phalanges were digitised using a NextEngine surface scanner and converted to surface models using Geomagic. Three landmarks were digitized on the 3D surface models of the phalanges using Landmark, which were chosen to reflect the degree of dorsal canting. The angle between the long axis of the bone and the proximal articular surface was calculated using the Pythagorean Theorem. Bivariate correlation analyses were conducted onto the angles in SPSS. Pearson's correlation coefficients of the bivariate correlation analyses were negative, weak ( $\geq -0,177$ ) and insignificant ( $p \geq 0,148$ ) for every ray. This clearly indicates that dorsal canting of the manual and the pedal phalanges does not covary. As a consequence, the observed high dorsal canting in human manual phalanges requires an alternative explanation. Although the current data do not allow for a definitive answer, there are several possibilities. High degrees of dorsal canting in human manual proximal phalanges might be due to covariation with other elements than the pedal phalanges, such as the metacarpals, to assure proper functionality. This could be verified by digitising other bones in the hand and statistically testing for the potential presence of covariation. Alternatively, high degrees of dorsal canting in human manual proximal phalanges may be related to tool use. This could be tested either *in vivo* (Do people with higher degrees of dorsal canting display higher degrees of dexterity?) or on fossil material (Does the degree of manual dorsal canting parallel tool development through time?). Additionally, comparisons with other primates could be very informative, as the pattern of covariation may depend on locomotory habits, or the extent of covariation in pedal and manual dorsal canting may have been diminished at some point in the human evolutionary lineage relative to the general primate pattern and, potentially, the genus *Australopithecus*.

**Acknowledgements:** The authors are grateful to A. Froment, P. Mennecier, A. Fort, V. Laborde and L. Huet for help with the specimens stored at the Muséum national d'Histoire naturelle in Paris and R. Kruszynski for providing access to the skeletal material in the collections of the Natural History Museum in London. The authors would also like to thank A. Gossez for digitising part of the sample used herein and G. Berillon for valuable advice. This research was funded by the Centre national de la Recherche scientifique through the labex BCDiv ("Diversités biologiques et culturelles: Origines, Evolution, Interactions, Devenir").

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Poster Presentation Number 8, Fr (15:30-17:30)

## The "forgotten" Palaeolithic human remains from the site of Roc-en-Pail (France). Reassessment of the archaeological context and taxonomical diagnosis: a new Neandertal humerus

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Although discovered at the end of the 19th century and excavated in the mid-20th century, the site of Roc-en-Pail (Maine-et-Loire, France) remains largely unknown. It yielded a 4m deep archeological sequence with six layers providing Middle Palaeolithic industries as well as some traces of Upper Palaeolithic. In addition, three human remains were found in the late 1940's: a distal fragment of humerus, a fragment of maxilla and an isolated upper molar germ. In a short note published in 1950 [1], M. Gruet attributed these human remains to modern humans, despite their association with Mousterian industries. They were however never described in details nor reassessed since this short publication. Although the maxilla fragment is now lost, the upper molar and the humerus fragment are present in the collections of the natural history museum of the city of Angers. Lithics, fauna as well as notebooks from the 1940-50's excavations are also part of the collections. A new analysis of these human remains as well as a reassessment of their archeo-stratigraphic context was thus needed and possible. Our revision of the archeological sequence as well as the study of the excavation notebooks from the late 1940's allow us to present here a reassessment of the archaeological context of the human remains. Our results confirm the association of the human remains with Mousterian technocomplexes. The maxilla and the isolated tooth are well located in a Denticulate Mousterian layer. The location of the humerus is less accurate but the data suggest an attribution to a Quina type Mousterian layer. Next, we provide the results of a morphological analysis of the humerus. Our study includes 2D metrics and 3D geometric morphometrics. The humerus from Roc-en-Pail is compared to samples of Neandertals, Pleistocene modern humans associated with Upper Palaeolithic industries and recent humans (from historical periods). The fragment of humerus from Roc-en-Pail is a distal fragment that includes most of the distal epiphysis and a small portion of the diaphysis. The medial epicondyle is however missing. 2D metrics thus encompass linear measurements of the olecranon fossa, trochlea, capitulum and distodorsal pillars. The 3D geometric morphometric (GM) analyses are based on landmark configurations. For each distal epiphysis 18 homologous landmarks were measured [2]. For Roc-en-Pail, two landmarks located on the medial epicondyle were estimated by mean, regression and spline. These three methods of estimation give a very similar result. After Partial Procrustes superimposition, Principal Component Analyses using 16 or 18 landmarks were run. The 3D GM analyses, using 16 or 18 landmarks, discriminate well Neandertals from recent humans and Roc-en-Pail falls within the Neandertal range on both analyses. Our results show that the humerus from Roc-en-Pail shares with Neandertals a wide olecranon fossa and narrow distodorsal pillars, a capitulum rather short transversally, as well as a trochlea that is more horizontal than on Pleistocene and recent modern humans. All together, our results establish unequivocally Roc-en-Pail as a member of the Neandertal group. Ongoing work also includes morphological analyses of the upper molar, AMS dating of the stratigraphy and of the humerus, as well as DNA analyses.

**Acknowledgements:** We would like to thank the Natural History Museum of Angers and in particular Benoit Mellier for giving us access to the collections; the offices of regional archaeology "SRA Poitou-Charentes" and "SRA Pays-de-la-Loire" for supporting our research as well as Yves Gruet for giving us pictures taken by his father at the excavations. This research has also been partially funded by CGL2012-36682 grant.

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Podium Presentation: Session 7, Fr (13:30)

## Early Palaeolithic fire at a late Early Pleistocene hominin site: Cueva Negra del Estrecho del Río Quípar, Caravaca de la Cruz, Murcia, Spain

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Findings greatly suggestive of fire tended well inside the large rock-shelter of Cueva Negra del Estrecho del Río Quípar come from deeply-lying sediments dating from ca. 0.8 Ma. Magnetostratigraphic investigation situates the entire sedimentary sequence before 0.78 Ma (1) Biostratigraphic evidence (A.L.-J.) points to a time between 1 Ma and 0.7 Ma (2). The palaeoanthropological assemblage includes hominin teeth, a limestone hand-axe, and a wide range of small chert artifacts. Excavation of sediment lying 4.5 m beneath the top of the sedimentary sequence, 5 m behind the cave mouth, revealed evidence that fire may well have affected bone and Palaeolithic chert artefacts (M.J.W., A.A.-F., A.T.B.-L., M.H.-U., A.L.-J., M.L.-M., I.M.-L., J.O.-R.). Here there were uncovered both charred bone and abundant white calcined bone fragments showing the conjoined lengthwise long-bone spalling that is typical of circumferential shrinkage after thermal volatilization of organic components (cf. 3). Thermally-altered lustreless chert fragments here include a nodule cracked open by heat revealing both a pot-lid fracture and many small razor-sharp splinters still in place, like the petals of an open flower, and an artificially-struck flake similarly cracked open by thermal shock with sharp conjoinable fragments still in place together. Because the splinters had not been dispersed, these two finds can barely have been displaced more than a few centimetres after undergoing thermal shock. Thermoluminescence analysis is in progress (J.-L.S.). Geoarchaeological evidence (A.D.E., A.D.) is inconclusive to date (4). Sediment minerals were investigated using X-ray fluorescence, X-ray diffraction, and thermogravimetric analysis with mass spectrometry (T.R.-E). Taphonomic analysis (S.E.R.) and scanning electron microscopy and energy dispersive X-ray spectroscopy of bone fragments (S.E.R., Y.F.-J.) attribute discolouration to burning, not to post-depositional mineral staining, and both Fourier Transform infrared spectroscopy (F.B.) and electron spin resonance analysis (A.S.) imply firing temperatures ca. 550-600° C. It is suggested that the high temperature attained inside Cueva Negra may have been due to fire tended inside the rock-shelter. Hominins could have introduced smouldering brands, left behind by a forest fire outside, in order to establish and tend a fire where rain or wind would not extinguish it. They may well have been less afraid of fire outside than other animals they saw fleeing before it. That may have led them to play with fire, perhaps in order to drive animals into natural death-traps (e.g. swamps, cliffs) facilitating butchery and roasting. This by no means leads to an inference that they could reproduce or control fire at 0.8 Ma: that only may have been attained well after 0.5 Ma, as evidence of fire-pits or constructed hearths starts appearing in the Palaeolithic record. Evolutionary consequences for human physiology and cognition are discussed.

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Podium Presentation: Session 5, Fr (10:40)

## Cranial diversification in Neandertals and modern humans compared to common chimpanzees

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Evidence has been accumulating for the importance of neutral evolutionary processes in generating cranial differences between Neandertals and modern humans (reviewed in Ref. [1]). These findings build on pioneering work demonstrating that patterns of cranial differentiation among present-day human groups are consistent with neutral divergence [2,3]. With isolation between groups and complete neutrality (i.e., natural selection is not acting at all), genetic drift provides the mechanism and mutation provides the raw material for evolutionary divergence. But how unusual are the results for Neandertals and modern humans relative to other species? And how do comparisons with other taxa illuminate the evolutionary processes underlying cranial diversification in the Neandertal and modern human evolutionary lineages? Common chimpanzees (*Pan troglodytes*) provide a useful starting point for placing the Neandertal and modern human results in a broader comparative context, because, along with bonobos (*P. paniscus*), they are the extant species most closely related to humans. Of particular interest are comparisons of the western subspecies of common chimpanzee (*P. t. verus*) with the central (*P. t. troglodytes*) and eastern (*P. t. schweinfurthii*) subspecies, because the lineage leading to the western subspecies split from the lineages leading to the other two subspecies about the same time that the lineages leading to Neandertals and modern humans split from each other. To address these questions, I used 27 cranial measurements collected on a sample of 2524 humans, 20 Neandertals, and 237 common chimpanzees to estimate the Neandertal vs. modern human and the *P. t. verus* vs. other subspecies split times. Consistent with previous results based on a larger set of measurements (Weaver et al., 2008), the Neandertal vs. modern human cranial estimates are similar to published DNA-sequence estimates (e.g., Ref. [4]). In contrast, the common chimpanzee cranial estimates are much smaller than published DNA-sequence estimates (e.g., Ref. [5]). It appears that cranial differentiation has been unconstrained in Neandertals and modern humans compared to common chimpanzees, allowing it to proceed largely under the influence of neutral evolutionary processes. Cranial differentiation in common chimpanzees may have been restricted by stabilizing natural selection acting either directly on the aspects of cranial form included in the analyses or indirectly through limits on the amount of variation available for genetic drift to act on.

**Acknowledgements:** I would like to thank H. Hoekstra, J. Chupasko, D. Lieberman, M. Morgan, J. Rousseau, O. Herschensohn, R. Thorington, D. Lunde, E. Westwig, K. Botha, A. Gill, B. Wilkey, P. Jenkins, L. Tomsett, R. Portella-Miguez, J.-J. Hublin, C. Boesch, U. Schwartz, E. Gilissen, and W. Wendelen for access to and assistance with collections; the Ivory Coast authorities for allowing fieldwork in Tai National Park and the export of chimpanzee skeletal remains; the late W. Howells for generously sharing his data; and the L.S.B. Leakey Foundation for funding.

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Podium Presentation: Session 9, Sa (12:10)

## New insights from old artefacts: A quantitative reassessment of the LSA technology of the Central Kenyan Rift

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Africa is home to a plethora of localised Later Stone Age (LSA) lithic technologies. The Nakuru-Naivasha basin of the Central Rift Valley, Kenya, where almost a hundred years of archaeological research have led to the accumulation of a vast array of curated lithic assemblages [1][2][3], is no exception. Yet, despite the abundant collections from this area, little is known about the range and distribution of variation within and between these assemblages, their relationships to each other, their environmental context and, most importantly, their makers [4]. Identifying and describing variation is essential to understanding any industry, but only in explaining (or not) the variation observed can an understanding be gained about the people and processes that created it. Here, uni- and multi-variate statistics are used firstly to explore the variation of the LSA in this area, and secondly to investigate spatial, temporal and palaeo-environmental factors that may have influenced the composition and nature of the assemblages. This is followed by discriminant and cladistic analyses, which build data-driven hypotheses about the prehistoric people of the area and the population processes that may have led to the complex patterns of variation evident in their lithic technologies. The results strongly suggest that certain assemblage and artefact attributes exhibit high levels of environmentally determined variation or plasticity (for example, geometric microlith length, multiple regression,  $F_{7,20}=7.987$ ,  $p<0.001$ , adjusted  $R^2=0.727$ ). These environmental effects often transcend the boundaries between industrial classifications, suggesting that artefacts exhibiting such plasticity have greater cohesion with the environment within which they were produced than they do with their respective technologies, traditions or adaptive strategies. Assemblage characteristics or stone tool data that exhibit such associations are therefore inappropriate for forming hypotheses about the interactions of 'makers' of stone tool technologies, which also has implications regarding the variables upon which the classificatory phases of these specific industries have been based in the past. Overall, accounting for environmental influence on technological variation, ideas about population fragmentation during the late-Pleistocene and early-Holocene are supported, with patterns in lithic technological variation suggesting a prehistoric population structure with interactions similar to the groups or tribes seen in Eastern Africa today. However, this study may have wider methodological implications regarding the way in which stone tool attributes are used to delineate stone tool technologies globally. The Nakuru-Naivasha Basin exhibits a specific series of microenvironments, and thus the patterning identified in this study may not be a good example or guide to techno-environmental interaction effects elsewhere, but until such assessment is carried out on a greater diversity of geographic areas and across different modes of technology, the full potential impact of these effects for archaeological classification and human evolutionary patterns in general, remain a mystery.

**Acknowledgements:** This research was funded by a generous scholarship from St. John's College, Cambridge, with travel assistance from the Leakey Trust, the Bartle Frere & Mary Euphrasia Moseley Fund, the Smuts fund and an Anthony Wilkin Studentship from the Department of Biological Anthropology, University of Cambridge. I would also like to thank the National Museums of Kenya for research permissions and museum support, Dr. Charles Nelson for helpful advice and finally Professor Robert Foley and the staff and students of the Leverhulme Centre for Human Evolutionary Studies for their continual support whilst this research was being carried out.

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Poster Presentation Number 24, Fr (15:30-17:30)

## Shape, size and maturity trajectories of the human ilium and interpopulation differences in the ontogeny of sexual dimorphism

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The process of ontogeny plays a fundamental role in the emergence, magnitude and patterning of adult sexual dimorphism. Untangling the complex interaction between shape, size and age over the course of ontogeny is potentially difficult due to the large morphological variability in size and shape within different populations. This is a particular problem in the study of juveniles, for which few skeletal elements exhibit enough dimorphism to enable sex assignment and subtle age-size-shape differences may have a relatively marked influence on the success of the method applied. Morphological features of the ilium have consistently been more successful for juvenile sex determination than have techniques applied to other skeletal elements, however relatively little is known about the ontogeny and maturation of size and shape dimorphism in the ilium. This is due to the limitations of earlier methods and the difficulty in interpreting and comparing results between studies that have dealt with form, i.e. size and shape, in different ways. In this study, we use a geometric morphometric approach to quantitatively separate the ontogeny of size and shape of the ilium, and perform a series of analyses designed to provide insight into interpopulation differences in the onset, rate and patterning of sexual dimorphism in the ilium. We captured the shape of three traits using outline-based equidistant landmarks for a total of 191 ilia from Lisbon (Portugal) and London (UK) samples of known age and sex (ages 0-17 years). Collectively our results indicate that a) there is a clear dissociation between the ontogeny of size and shape in males and females, b) the ontogeny of size and shape are each defined by complex non-linear trajectories that differ between males and females, c) there are interpopulation differences in ontogenetic shape trajectories, which demonstrates population-specific patterning in the attainment of sexual dimorphism, and d) the rate of shape maturation and size maturation is typically higher for females than males. We find that male and female shape differences in the ilium are brought about by trajectory divergence, which supports a continual and absolute increase in the success of sex determination of both male and female ilia from birth to 15 years. Differences in the rate of size and shape maturation between males and females suggest that maturity may be an important variable in juvenile sex determination. Specifically, it would be expected that differences in male and female maturity may confound discriminant analyses by introducing variation not accounted for in age-based groupings, and that segmenting ontogeny into maturity groupings might improve classification success. Our results further highlight considerable variability in size and shape throughout ontogeny, and the cross-application of sexing methods to populations of different or highly biased age and sex composition, particularly at the youngest ages, is likely to be unsuccessful.

**Acknowledgements:** This research is supported by Swiss National Science Foundation (SNF) grants to LABW (PBZHP3\_141470 and P300P3\_151189).

Pecha Kucha Presentation: Session 4, Fr (8:30-9:30)

## **The cave, the skull and the women: female representation in Palaeolithic research**

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Most researchers are aware of sex biases in the study of human evolution, which were a product of contemporary 19th and 20th century social structures favouring the consideration of male experience as primary. “Early man”, “cavemen” and of course “Man the Hunter” notions developed, both created by and at the same time reinforcing popular and scholarly focus on supposed male activities as the most important. They also effectively cast our male ancestors as “default humans”, leading to the over-shadowing of female lifeways and even existence throughout the Palaeolithic. Something similar can be argued for the development of our own field; the most celebrated scholars of human evolution are predominantly male, despite the significant contributions of women from the very start of studying our deep past. In 2013 a project started to counter the imbalance in popular perceptions of geology, palaeontology and archaeology as lacking in women. “TrowelBlazers” developed organically through contact on social media, with the aim to host a website ([www.trowelblazers.com](http://www.trowelblazers.com)) that celebrates the contributions of both well-known women and those who have become overlooked. We produce short biographic articles that aim to be lighthearted yet respectful, as well as accepting submissions: c. 50% of our content is now crowdsourced. While we do not pretend to be historians of science, and rely to a great extent on previously published information, the TrowelBlazers project has been successful in demonstrating three things: There were many more women involved in archaeology, palaeontology and geology than is generally realised. Women were at the forefront of these sciences, including human evolution, from their inception. Far from being isolated figures, extraordinary networks of mentoring, training and collaboration existed between these women, with some key individuals and sites acting as “hubs”. In this talk we show how the 1930s excavations at Mount Carmel are one such node. We discuss the contributions of particular women who should be better known within our field, including the discoverer of the Tabun 1 Neandertal, a woman known only as Yusra. We trace some of the webs of connections we have mapped, with the legendary Dorothy Garrod as a centre-point. Finally we also consider how far we have come in balancing gender representation in the 21st century study of human evolution.



Poster Presentation Number 62, Sa (16:00-18:00)

## Comparative endostructural characterization of the Middle Pleistocene human dental remains from Fontana Ranuccio and Visogliano, Italy

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The penecontemporaneous Middle Pleistocene sites of Fontana Ranuccio (Latium) and Visogliano (Friuli-Venezia Giulia), set c. 450 km apart in central and northeastern Italy, respectively, have yielded some among the oldest human fossil remains testifying a peopling phase of the Italian Peninsula broadly during the glacial MIS 12, a period associated to one among the harshest climatic conditions even in Southern Europe along the entire Quaternary system. Fontana Ranuccio is located in the extensional tectonic Anagni's basin of the Latina Valley, c. 50 km southeast of Rome. The basin had been filled by lacustrine-alluvial sediments which, during the Middle Pleistocene (c. 528-487 ka), were covered by pyroclasts from the Alban Hills magmatic province (rev. in [1]). Together with spread Acheulean artefacts and mammal remains, the site, dated to  $458 \pm 5.7$  ka [2], has yielded three isolated human permanent teeth: a lower LI1 (FR-LI1), a lower RM2 (FR-RM2), and a lower LM2 (FR-LM2) [3]. Visogliano, c. 18 km northwest of Trieste, was discovered during excavations of two distinct loci of a karstic doline resulting from the collapse of a cave. According to the biostratigraphic and archaeological evidence, these loci are considered penecontemporaneous and have been recently dated to c. 440-480 ka by ESR/U series [4]. The human dentognathic assemblage from Visogliano, which has been recently revised for its anatomical inventory (in [5]), consists of a right mandibular fragment (V2) preserving the roots of the P4 and the M1, and five isolated upper teeth currently identified as a RP3 (V1), a LP3 (V4), a LP4 (V5), a RM1 (V6), and a RM2 (V3). In 2012, two teeth from Fontana Ranuccio (FR-LI1 and FR-RM2) and the six specimens from Visogliano were imaged by X-ray microtomography at the Multidisciplinary Laboratory of the ICTP and at the Tomolab station of the Elettra Synchrotron light source, Trieste, according to the following parameters: 100 to 130 kV voltage, 61 to 90  $\mu$ A current, and a projection each 0.15 to 0.20°. The final volumes were reconstructed with an isotropic voxel size ranging from 7.8 to 13.6  $\mu$ m, for the isolated teeth, and of 34.1  $\mu$ m for the mandibular fragment V2. In all specimens, the occlusal surface is from moderately to extensively worn, thus preventing any reliable quantitative assessment of 3D crown tissue proportions because of enamel removal. However, besides punctual measurements of radial enamel thickness, the virtual exploration of the enamel-dentine junction (EDJ) allowed the characterization in both tooth assemblages of a number of morphological features masked at the outer surface. Schematically, these include: a weak expression of the Carabelli's trait, an interrupted transverse ridge, and a complete oblique crest occurring in the upper RM1 V6 and RM2 V3; a tuberculum dentale on the lower FR-LI1; a metaconulid-type tuberculum intermedium, a high and uninterrupted mid-trigonid crest, and an interrupted distal trigonid crest on the lower FR-RM2. In addition, the upper premolars from Visogliano (V1, V4 and V5), as well as the upper and lower molars from both sites (V3, V6 and FR-RM2) exhibit two- to three accessory cuspules lying on the mesial marginal ridge, and also multiple accessory crests running from the respective marginal ridges towards the centre of the occlusal basin. While concerning two geographically scattered and quantitatively limited samples, our comparative study of the inner structural morphology of the dental assemblages from Fontana Ranuccio and Visogliano contributes the still debated question of the taxonomic status and evolutionary history of *H. heidelbergensis* and provides new evidence to comparatively assess the primitive vs. derived status of some features imprinted at the EDJ level with respect to the figures from other Middle Pleistocene European (notably, Atapuerca SH) and North African (Tighenif) samples.

**Acknowledgements:** Istit. Ital. Paleontol. Umana, Rome; Sopr. Beni Archeol. Friuli-Venezia Giulia, Trieste. EXACT Project funded by the Regione Friuli-Venezia Giulia.

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Podium Presentation: Session 9, Sa (11:10)

## A high-resolution chronostratigraphic framework for the Upper Paleolithic of southeastern Iberia

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Due to problems of integrity related to surface dynamics and post-depositional modification of cave and rock-shelter sequences, coupled with the paucity of sites excavated with modern techniques, the chronostratigraphy of the Upper Paleolithic of South-East Iberia remains controversial on a number of points, namely: (a) the regional presence of the Mousterian until the time range of the Early Aurignacian; (b) the chronology, and affinities (Aurignacian or Gravettian), of its earliest phases; (c) the existence of a Protosolutrean phase akin to that of the Atlantic façade; (d) the ordered succession (or lack thereof) of Upper Solutrean index fossils (Parpallò points, backed and shouldered points); (e) whether the Solutreogravettian is followed by the Badegoulian or by a Lower Magdalenian, as well as the timing of the transition to one or the other; (f) whether a Middle Magdalenian phase can be differentiated. Clarification of these problems has implications that reach beyond the region as some concern issues of modern human emergence and human biogeography of more general interest, namely: (a) the hypothesis that Neandertals persisted in parts of Iberia for a few millennia longer than elsewhere in Europe; (b) the role played by the Cantabrian Cordillera, the Iberian System and the Pyrenees in the generation of environments and adaptations that, despite similarities, set the culture-stratigraphy of South-East Iberia apart from that of Cantabria and southern France at key moments of the European Upper Paleolithic sequence; or (c) the extent to which, given these differences, the notion of an Iberian refuge contributing to post-LGM resettlement of central and northern Europe can be supported. Two adjacent rock-shelters excavated since 2007 in Mula (Murcia) — Abrigo de La Boja (ADB) and Finca de Doña Martina (FDM) — are now yielding the evidence necessary to settle many of these unresolved issues. Spanning 6 m (at ADB) and 4 m (at FDM), the two sites provide a sequence of some 40,000 years of occupation ranging from the Mousterian to the Epimagdalenian. The stratigraphic evidence is supported by >30 stratigraphically consistent radiocarbon determinations. Combined with the associated artefact assemblages, this information: (a) establishes the regional existence of an Evolved Aurignacian phase, dated to 32-33 ka 14C BP; (b) documents the chronostratigraphic entity of a Lower Solutrean phase with pointes à face plane but no laurel-leaves, dated to 21 ka 14C BP; (c) sets at 16.5 ka 14C BP the replacement of the Solutreogravettian by a Lower Magdalenian characterized by hypermicrolithic, marginally backed bladelets; (d) suggests human abandonment during the Oldest Dryas arid phase (at ADB, 30 cm of sterile deposits separate the Lower Magdalenian from the Upper Magdalenian, which post-dates 13.2 ka 14C BP and is contained in a paleosol representing a local manifestation of the Bölling-Allerød episode). At ADB, combustion features define an archeological stratification that can be resolved with centimetric precision, explaining the high-resolution nature of this record. The variation in distribution, make, and temperature reached in these features (mostly >500 °C, according to FTIR data) provides information on the spatial structure of individual occupation events (30 have been differentiated so far). Unlike bone, shell is well preserved, providing an abundant record of the use of marine shell ornaments in an area 90 km from extant coastlines. The evidence from phytoliths and charcoal provides information on the local environment and how its plant resources were exploited. For instance, during the LGM and the Tardiglacial, fuel was obtained from arid lignified plants (mostly juniper, with Ephedra, Artemisia and woody Fabaceae), while *Pinus nigra/sylvestris* were present and used during the Mousterian and the Upper Magdalenian. Phytoliths from Cyperaceae indicate the collection of plant material from a nearby watercourse.

Podium Presentation: Session 8, Sa (10:10)

### Explicit similarities and expected variability: the Initial Upper Paleolithic in Northeast Asia

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For a long time, the emergence of full-fledged Upper Paleolithic traditions has been regarded as a proxy for the first appearance of Anatomically Modern Humans (AMH) in Eurasia. Whether humans dispersed prior or after the development of a full 'Modern Behavioral Package' is a crucial question for the timing of the AMH dispersal in Asia [1]. A single dispersal across southern Asia is unlikely to account for the diversity of the Eurasian fossil and/or archeological record. Instead, it has been recently emphasized that several routes, multiple dispersal or other mechanisms such as gene flow should be considered [2]. In Eurasia, assemblages termed as Initial Upper Paleolithic (IUP) that combine Middle and Upper Paleolithic features usually predate the oldest AMH in the fossil record. In Northeast Asia, these assemblages are documented as early as the Greenland Interstadial 12 (circa 45 ka cal BP) in Siberia and in Mongolia. This situation leads us to ask whether the IUP represent an early AMH dispersal Northward from the Himalaya or an independent evolution of similar kinds of technologies. Using archeological data, we compare the defining features of the Initial Upper Paleolithic between the Altai and Northern China. This large-scale comparison follows methods suggested to quantify the degree of complexity observed within assemblages using the concept of procedural units developed by Perreault and colleagues [3]. To differentiate cultural transmission (dispersal) from convergence (independent invention), specific typo-technological markers have been defined [4] and recognized as culturally sensitive following the concepts of *intricate complexity* and *regional ubiquity* developed by Byrne [5]. The results obtained underline regional patterns of variability between assemblages but also highlight explicit similarities. Instead of representing technical convergences only, the shared features draw the contours of a Northeast Asian IUP techno-complex that predates the fully developed Upper Paleolithic in this region. Because the sudden appearance of such a techno-complex during the Greenland Interstadial 12 implies movements/contact over long distances, the results presented help move toward a better understanding of Late Pleistocene population dynamic. Considered in the context of recent advances in physical and molecular anthropology, archeological data provide new perspectives on the significance of the 'Northern Route' for the scenarios of AMH dispersal into Asia.

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