8TH ANNUAL MEETING OF THE

European Society for the study of Human Evolution

13-15 September 2018
FARO/PORTUGAL

ESHE

Journal of Human Evolution

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Journal of Paleolithic Archaeology

Harold L. Dibble
1951-2018

The Journal of Paleolithic Archaeology regrets the passing of Harold Dibble, one of the founding board members of our journal, a great colleague, and a generous friend.

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European Society for the study of Human Evolution

ESHE

8th Annual Meeting

Faro, Portugal, 13th-15th September, 2018

Proceedings of the European Society for the study of Human Evolution 7

Cover image: (1) Drawing from an early Solutrean engraved slab and
(2) Typical Solutrean point a face plan
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Dear Participants of the 8th Annual Meeting of ESHE,

Bem vindo a Faro!

We are happy to welcome you to this beautiful coastal European city for our 8th Annual Meeting of the European Society for the Study of Human Evolution. Two decades ago, there was no Palaeolithic in southern Portugal, in spite of 150 years of prehistoric research in the region. Today, however, Algarve is one of the main research areas in Palaeolithic and Mesolithic in Iberia due to the very recent and vibrant Interdisciplinary Center for Archaeology and Evolution of Human Behavior (ICArEHB) at the University of Algarve.

This year our excursion takes us to the Megalithic Monuments of Alcalar, the Palaeolithic site of Vale Boi, and the southernmost point of continental Europe – Cape Saint Vincent. We are lucky enough to be granted access to the main excavation area of Vale Boi where we will also be able to view iconic archaeological materials discovered over the past 15 years. The excursion will be further enriched by presentations from our guides Elena Móran, Rui Parreira, João Cascalheira, and Nuno Bicho.

Since our 2011 inception, ESHE remains strong in regard to both membership and abstract submissions. In 2018, we received 211 abstract submissions and expect to host approximately 300 participants at our meeting in the Universidade do Algarve. We were fortunate to secure the historic Museu Municipal de Faro for our pre-registration events and the enchanting Teatro Lethes for our public outreach keynote lecture, delivered by Dr. René Bobe. Finally, attendees of the closing dinner will dine with us at Tertúlia Algarvia, where they can be sure to enjoy lively conversation and local delicacies.

As a society, we remain dedicated to supporting our student members through travel grants, which allow them to travel to international meetings to present their research, and annual Poster and Pecha Kucha prizes, announced during the General Assembly. Although we faced unprecedented number of student travel grant applications in 2018, we place a great emphasis on devoting funds to the success of our students.

With the support of a Wenner-Gren Foundation Grant, we are thrilled to have launched two new initiatives at ESHE 2018: (1) on and off-site childcare to reduce the financial burden on participants with families and (2) travel grants for scholars and students affiliated with African Institutions to encourage further international collaboration. We are happy to report that the response has been a tremendous success and we look forward to listening to the needs of our members in the future in order to continue to reduce disproportionately-faced barriers to participation in our Meetings.

ESHE 2018 would not be possible without the tireless efforts of our local organizers Vera Aldeias, Lino André, Nuno Bicho, João Cascalheira, Célia Gonçalves, and our volunteer teams.

Furthermore, meeting preparation and the publication of our proceedings volume has been made possible by the work of the ESHE Board Officers and Board Members, particularly Philipp Gunz, Shannon McPherron, and Gerhard Weber.

With best regards

Jean-Jacques Hublin
President, European Society for the study of Human Evolution

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University of Algarve (UAlg)

https://www.ualg.pt/en

Founded on January 16th, 1979, the University of Algarve is a public institution for higher education located in the southern-most region of Portugal. The University of Algarve joined with the Polytechnic Institute of Faro, which makes the university somewhat unique in Portugal. It is comprised of four University Colleges and four Polytechnic schools, offering a range of quality undergraduate and postgraduate courses in four beautiful academic campuses.

The University's core research and teaching areas are science and technology, management and economy, earth and marine sciences, social sciences and more recently, health. Currently, UAlg offers 48 undergraduate (licenciatura) and 87 Graduate programs (65 MsC/MA and 22 Ph.D.). International, inter-personal and inter-institutional networks, and projects developed in cooperation with other universities, are reflected in its teaching and research activities so as to foster innovation and updated learning contents, project incubation, curriculum development, scientific research, and training. International projects are fully integrated into the life of the institution. UAlg is an important center for cultural, scientific and technological development, with strong regional, national and international ties, offering students the opportunity to explore various careers as they gain transferable skills. In the last three decades, the University of Algarve has consolidated established links with regional business and with the public and private organizations, encouraging the transfer of knowledge and contributing to sustainable development with an impact across the regional community.

Today, the student population is close to 8,000, c. 2000 of which are enrolled in Graduate programs. Recently, due to the internationalization strategy of the University of Algarve, there has been a significant increase of international students from more than 60 countries. The quality and diversity of European Masters and Doctorates, combined with post-graduate courses open to students from all over the world, justify the magnitude of this mobility.

The University has around 700 permanent teaching and research staff that developed a significant number of research projects and close to 200 fellowship grant holders, demonstrating a clear commitment towards R&D and innovation. At present, UAlg has well-established research centers in diverse fields such as marine sciences, biomedicine, electronics, chemistry, arts and communication, and archaeology.

Interdisciplinary Center for Archaeology and Evolution of Human Behavior ICArEHB http://www.icarehb.com

ICArEHB is a research center created in 2014, housed in the University of Algarve. It is funded and evaluated as Excellent by the Portuguese National Science Foundation (Fundação para a Ciência e Tecnologia). The core mission of ICArEHB is to develop an integrative understanding of past human adaptations. We seek to establish interdisciplinary perspectives to address key aspects of our human journey. Our research focuses on: African archaeology and Human Evolution; Prehistoric Coastal Adaptations; Development of Complex Societies; and History of Archaeological Science. ICArEHB unites a group of national and international researchers with a variety of expertise (Physical and Biological Anthropology, Primatology, Archaeology, Earth Sciences, Geoarcheology, Ethnoarchaeology, Paleobotany, Zooarchaeology, GIS and Ancient DNA, among others).

ICArEHB's research takes place in several archaeological contexts in Europe (Portugal, Spain, France, Germany, Bulgaria), Africa (Morocco, Kenya, Guinea-Conakry, Mozambique, Senegal, South Africa, Egypt) and in the Near East (Israel, Jordan). ICArEHB has three main laboratories that serve the ICArEHB community as well as external public services: the Laboratory of Archaeological Materials (LAM), the Laboratory for Analysis of Raw Materials and Ancient Tools (LARMAT), and the recently created Microscopy and Digital Archaeology Laboratory (MicroDial).

In addition to fundamental research, ICArEBH also engages in other avenues for research development, namely: academic and professional training; laboratory and applied research on experimental development; community and public outreach and education on archaeological heritage. Training includes two main target populations: higher education students (BA., MA. and Ph.D.) and professional archaeologists.

Funding is based on international grants from the American National Science Foundation, Archaeological Institute of America, Gulbenkian Foundation, National Geographic Society, Portuguese National Science Foundation, and the Wenner Gren Foundation, as well as by many non-scientific institutions.

Museu Municipal de Faro, *Praça Dom Afonso III 14*

http://www.patrimoniocultural.gov.pt/en/museus-e-monumentos/rede-portuguesa/m/museu-municipal-de-faro/

The construction of the old Convent of Our Lady of the Assumption, where the Museum is located, began in 1519 in the rich Jewish quarter of Faro. The construction was interrupted until Queen D. Catarina, wife of D. João III, sponsored the work. During its activity as a religious building, up to 30 nuns - typically originating from Algarvian families of good repute and high social status - could occupy the Convent. It was one of the four convents in the Algarve diocese.

In 1836, after the implementation of Liberalism and the consequent extinction of the Religious Orders in Portugal, the nuns left the convent. The building was sold in 1860 to private individuals who established a thriving cork factory. A century later, the building was acquired by the Municipality of Faro to install the Municipal Museum and Library. Classified as a National Monument in 1948, this is an admirable example of 16th century monastic architecture and one of the first examples of Portuguese proto-renaissance cloister typology.

The Municipal Museum of Faro was the second museum to be created in the Algarve. On February 2nd, 1894, the then Archaeological Museum and Lapidar Infante D. Henrique was officially created, honoring Henry the Navigator, on the occasion of the V Centenary of his birth. On October 9, 1897, it opened to the public in the presence of King Carlos and Queen D. Amelia. In 1913, already during the First Republic, the museum was moved to the Church of the Convent of St. Anthony of the Capuchos, where it remained until 1971, when it moved to the present premise: the old Convent of Our Lady of the Assumption.

The archaeological section is significant, integrating materials from Prehistory, Roman, and Medieval times. Among the most relevant artifacts are examples of the Roman period, a mosaic of the 2nd / 3rd centuries AD, the imperial busts of Hadrian and Agrippina, and a collection of epigraphs from Ossónoba (the Roman town prior to Faro). There is also a highly quality collection of great paintings from the 16th to the 19th centuries, composed mainly of religious specimens formerly belonging to the Algarve temples. The Faro Municipal Museum has been part of the Portuguese Museum Network since 2002. In 2005, it was awarded the APOM Prize for Museology - Triennium 2003/05, the best Portuguese Museum, awarded by the Portuguese Museum Association.

Teatro Lethes, *R. de Portugal 58*

https://teatrolethes.com

The edifice of the Theater Lethes was founded as a college of Jesuits by the Bishop of the Algarve, D. Fernando Martins Mascarenhas. The College of Santiago Maior was a place of learning, particularly religious studies, which granted it the unofficial name of the „first university of the Algarve". In 1759, the Jesuits were banned from Portugal, their assets were confiscated, and the College of Santiago Maior closed its doors. With the regional occupation by Napoleonic troops commanded by General Junot, the facilities of the old College were devastated and used to support soldiers. Years later, in 1843, the College was auctioned to Dr. Lázaro Doglioni, who publicly expressed the intention to build a theater in the same style as the S. Carlos theatre in Lisbon or the „La Scalla" in Milan. The Latin inscription on the facade of the building, *monet oblectando*, can be translated as „instructing through laughter", highlighting the cultural concerns of the promoter in the construction of this theater.

The theater opened its doors during the celebrations of Queen Maria II's birthday. In 1860, it was expanded by Dr. Justino Cúmano, the nephew of Lázaro Doglioni. On September 11, 1898, the so-called animatograph was installed in the Theater Lethes, as this was the most ample and distinct cultural space of the city. The interior was restored between 1906 and 1908 to improve acoustics and comfort. The decline of shows and, consequently, of the space, began in 1920, leading to the closure of the Theater in 1925. The property was sold to the Portuguese Red Cross, in whose possession it still remains today. On October 5th, 2012, through the Municipality of Faro and the Portuguese Red Cross, the Theater Lethes recovered its initial design. Today it is the home of the Theater Company of the Algarve - ACTA. ACTA hosts a diversity of events in addition to presenting shows of its own creation.

Wednesday, September 12th	
15:00	**Pre-Registration : Museu Municipal de Faro,** *Praça Dom Afonso III 14*
18:00	**Welcome Drink : Museu Municipal de Faro,** *Praça Dom Afonso III 14*
19:30	**Keynote : Teatro Lethes,** *R. de Portugal 58*

Keynote

The first three million years of human evolution: The ecology of our African ancestors

Human ancestors diverged from other apes in the Late Miocene of Africa, sometime between 6 and 8 million years ago. This was a time of major climatic and environmental changes, not only in Africa but also worldwide. In tropical latitudes, these environmental changes included significant expansion of savanna grasslands, but the earliest hominins remained closely tied to woodland habitats similar to those of their ape ancestors. An important adaptive shift in diet and locomotion occurred with the earliest species of Australopithecus, about 4 million years ago, as hominins began to shift their ecological setting toward more open environments. Australopithecus first appeared in eastern Africa, and then expanded its geographic range to the west and south, where it came to occupy a wide range of habitats. In this lecture, I provide new data and analyses on the ecology of Australopithecus relative to that of earlier hominin species, suggest how Australopithecus set the stage for the subsequent evolutionary success of the genus Homo, and discuss the potential of studying modern analogues for the environments of early hominins.

René Bobe, Ph.D.

René Bobe is a biological anthropologist and paleobiologist interested in the relationship between climate and evolution, with a focus on the environments and ecology of human origins in Africa. He studies fossil mammals that provide long-term records of ecological and environmental change. Bobe has been conducting fieldwork in eastern Africa for the past 24 years, and has ongoing projects at Gorongosa National Park in Mozambique, in the Afar Region and the lower Omo Valley of Ethiopia, and the Lake Turkana Basin in Kenya. He also conducts field research in Chilean Patagonia to explore the environments and evolution of early South American primates. Bobe has participated in important discoveries related to Australopithecus and early Homo, and his work has been key to interpreting the environments of early hominins.

Bobe is a Research Associate at the Institute of Cognitive & Evolutionary Anthropology, University of Oxford, and an Associated Researcher at the Interdisciplinary Center for Archaeology and Evolution of Human Behavior (ICArEHB), Universidade do Algarve. He is also the lead paleontologist of the Gorongosa Restoration Project in Mozambique. Bobe received his PhD from the University of Washington in Seattle.

Bus Schedule	
We are pleased to offer a shuttle service between Faro Bus Central Station and the ESHE 2018 Meeting. Buses are clearly marked with "ESHE Meeting" signs in the front window.	
Thursday	**Shuttles will leave Faro Central Station at 8:00 and leave the conference at 20:00**
Friday	**Shuttles will leave Faro Central Station at 8:45 and leave the conference at 20:00**
Saturday	**Shuttles will leave Faro Central Station at 8:45 and leave the conference at 19:00**

Thursday, September 13th	
8:30-9:30	**Meeting Registration**
9:15-9:30	**Official Meeting Opening**
Session 1 • Podium	
9:30	**Viviane Slon** - Direct evidence for admixture among Pleistocene hominins: The genome of a Neandertal/Denisovan offspring
9:50	**Philipp Gunz** - Neanderthal introgression sheds light on modern human brain globularity
10:10	**Dirk L. Hoffmann** - Speleothems associated with archaeological artefacts - how U-Th dating can be used to constrain the age of cave art
10:30	**Gerd-Christian Weniger** - The archaeological context of early rock art in Cueva Ardales (Spain)
10:50	**Tomos Proffitt** - Revisiting Panda 100: Reanalysis of the first archaeological chimpanzee nut cracking lithic assemblage and its relevance to understanding the emergence of hominin technology
11:10-11:35	**Coffee Break**
Session 2 • Pecha Kucha	
11:35-11:55	**Martin Hora** - Water loss during persistence hunting in recent Kalahari hunters and *Homo ergaster*
	Lucía Cobo-Sánchez - New evidence for early hominin hunting at Olduvai Gorge (Bed I): Analysis of the bone surface modifications of the DS archaeofaunal assemblage
	Questions
11:55-12:20	**Eve Boyle** - Identifying correlates of diet in the primate torso: A case study in iliac flare
	Julia Stuhlträger - Season's Eatings! Establishing reference data for revealing seasonality from tooth wear in chimpanzee molars
	Alastair Key - Predicting stone tool functional performance: a case study in handaxe loading
	Questions
12:20-12:45	**Naomi L. Martisius** - A non-destructive ZooMS methodology applied to Neandertal bone tools shows raw material selection
	Marion Prévost - Incised aurochs bone shaft dated to 130 kys at the Middle Paleolithic open-air site of Nesher Ramla (Unit III), Israel
	Thomas Terberger - The double pointed wooden stick of the palaeolithic site of Schöningen and its context
	Questions
12:45-14:15	**Lunch**

Session 3 • Podium	
14:20	**Marianne Brasil** - Early *Homo sapiens* postcranial fossils from Middle Awash, Ethiopia
14:40	**Marta Mirazón Lahr** - Recent palaeoanthropological investigations in West Turkana, Kenya: implications for the evolution of *Homo sapiens*
15:00	**Pontus Skoglund** - Genomic models of early modern human populations in Africa
15:20	**Gerhard W. Weber** - Early modern humans in the Levant
15:40	**Paul Bons** - Pitfalls and opportunities in pinpointing the origin of modern humans - a numerical study
16:00-16:30	**Coffee Break**
Session 4 • Podium	
16:30	**Thibaut Deviese** - Redating Palaeolithic human bones using a compound specific approach: Implications for understanding the Middle to Upper Palaeolithic transition in Eurasia
16:50	**Rachel Hopkins** - Testing the Danube-corridor hypothesis – New results from chronometric modelling
17:10	**Helen Fewlass** - New high-resolution 14C chronology for Bacho Kiro cave, Bulgaria spanning the Middle to Upper Palaeolithic transition
17:30	**Kévin Di Modica** - Reconsidering the Late Middle Palaeolithic in North-West Europe: Cultural variability, chronology, and implications for the Middle to Upper Palaeolithic transition
17:50	**Armando Falcucci** - The chrono-cultural narrative of the Fumanian Aurignacian supports the inapplicability of the Aquitaine Model on a supra-regional scale
18:15	**Poster Session 1**

Friday, September 14th	
Session 5 • Podium	
9:30	**Silindokuhle Mavuso** - The sedimentology of the Jacovec Cavern, Sterkfontein, South Africa: contextualising fossil deposits with high resolution sedimentological analyses
9:50	**Robin Crompton** - Ecomorphology of the *Australopithecus prometheus* skeleton, StW573 ~3.67 Ma, from Sterkfontein Caves, South Africa
10:10	**Amélie Beaudet** - Exploring the inner cranial anatomy of "Little Foot": a comparative study of the endocast, and of the bony labyrinth.
10:30	**Cinzia Fornai** - Unexpectedly high morphological variability in the *Australopithecus* sacrum. Implications for sexual and taxonomic diversity
10:50	**Clément Zanolli** - What is South African early *Homo*? New insights from the molar endostructural signature
11:10-11:35	**Coffee Break**

Session 6 • Pecha Kucha	
11:35-11:55	**Mareike Juliane Brenner** - Early MIS 5 lithic technology at Klasies River, South Africa
	Ron Shimelmitz - Back to Skhul Cave, Israel
	Questions
11:55-12:20	**Jonathan Reeves** - Using time-averaged cave deposits and geospatial statistics to demonstrate spatial structure in Neandertal behavior
	Andrew Sorensen - Simulating fire-affected archaeological lithic assemblages using the computer-based model 'fiReproxies'
	Wei Chu - Hi-tech rocks and rivers: An artifact transport experiment using RFID tags
	Questions
12:20-12:45	**Leonardo Carmignani** - Exploring the Middle Paleolithic blade and bladelet evolution: new evidence from the Bau de l'Aubesier rock shelter (France)
	Camille Lesage - New data on the Altai Middle Palaeolithic variability: The Levallois perspective
	Niccolò Castellani - Refining detection of adaptive introgression from Denisovan to Tibetan and Sherpa genomes. *Presented by Marco Sazzini
	Questions
12:45-14:15	**Workshop: How to Get Published in the Journal of Human Evolution** Location: *Anfiteatro D*
Session 7 • Podium	
14:20	**João Zilhão** - Neandertal fire
14:40	**Andrey Krivoshapkin** - Sel'Ungurian: A new variant of the Middle Paleolithic in Central Asia
15:00	**Kseniya Kolobova** - The Easternmost Neanderthals in Altay Mountains
15:20	**Mike Morley** - Site Formation at Denisova Cave, Siberia: preliminary micromorphology results
15:40	**Tom Higham** - Chronology of the Initial Upper Palaeolithic of eastern Eurasia
16:00-16:30	**Coffee Break**
Session 8 • Podium	
16:30	**Enrico Cappellini** - Dental enamel proteome sequences from Dmanisi (Georgia) enable molecular phylogeny of fauna remains beyond the limits of ancient DNA preservation
16:50	**Frido Welker** - Palaeoproteomic analysis of Early Pleistocene Gigantopithecus blacki.
17:10	**Markus Bastir** - Thoracic vertebral morphology of KNM-WT 15000
17:30	**Daniel García-Martínez** - Estimation of total lung capacity (TLC) in Neanderthals with physiological implications
17:50	**Rita Sorrentino** - Evolutionary timing and relationships of the talar facets: Implication for hominin talus.
18:15	**Poster Session 2**

Saturday, September 15th	
Session 9 • Podium	
9:30	**Sam Nicholson** - A 1.1 million-year palaeoclimate record of Arabia and Human Evolution
9:50	**Henry Lamb** - Regional differentiation in Late Pleistocene climate records from Ethiopia, and their implications for human origins
10:10	**Oliver Paine** - The effects of season and habitat on the nutritional properties of potential hominin plant foods in an eastern and southern African savanna
10:30	**Flavio Altamura** - Fossil footprints in the Gombore gully (Melka Kunture, Upper Awash, Ethiopia): A rare snapshot of Pleistocene life and environments
10:50	**Federico Lugli** - Mothers from the past: Gravettian vs. Epigravettian human mobility strategies at Grotta Paglicci inferred by Sr isotopes of deciduous tooth enamel
11:10-11:30	**Coffee Break**
Session 10 • Pecha Kucha	
11:30-11:55	**Sarah Freidline** - Modern human facial and mandibular growth at the micro and macroscopic levels: marrying bone modeling and geometric morphometric techniques
	Aurélien Mounier - Deciphering African Late Middle Pleistocene hominin diversity and the origin of our species
	Michael Hanks - A test of model predictions for the hominin occupation of Europe using dental non-metric data
	Questions
11:55-12:20	**Alexander Stoessel** - First experimental analysis of the bonobo and common chimpanzee middle ear function
	Alessandro Urciuoli - Analysis of the primate vestibular apparatus: a comparison of landmark-based and deformation-based 3D geometric morphometric approaches
	Ashleigh L. A. Wiseman - Assessing 3D kinematics across various substrates and speeds in modern humans and the implications for human evolution
	Questions
12:20-12:45	**William Sellers** - Analysing Primate Grip Shapes Using Geometric Morphometrics
	Tracy Kivell - Trabecular bone structure of the *Australopithecus afarensis* A.L. 438-1 metacarpals and implications for skeletal age and hand use
	Kimberleigh Tommy - Trabecular structure in the distal tibia of *Australopithecus africanus* from Sterkfontein Member 4
	Questions
12:45-14:15	**Lunch**
Session 11 • Podium	
14:20	**Nohemi Sala** - The Sima de los Huesos origin of hominin accumulation: The state of the art
14:40	**Alessio Veneziano** - Of teeth and algorithms: Machine learning reveals the taxonomy of Sima de los Huesos
15:00	**Suzanna White** - Quantifying Supraorbital Variation in the Middle Pleistocene Hominins
15:20	**Federica Landi** - Maxillary sinus growth and development in Neanderthals and Sapiens
15:40	**Nicole D. S. Grunstra** - Global or local: Where do we find phylogenetic signal in cranial shape?
16:00-16:30	**Coffee Break**

Session 12 • Podium	
16:30	**Collard Mark** - Rethinking demography's role in shaping the Palaeolithic archaeological record
16:50	**Matt Pope** - A New Interpretation of Short Term Group Behaviour at the GTP17 Horse Butchery Site, Boxgrove.
17:10	**Annemieke Milks** - Assessing hand-delivered wooden spears as effective hunting weapons using experimental, archaeological, and ethnographic evidence
17:30	**Geoff M. Smith** - Subsistence strategies throughout the African Middle Pleistocene: Zooarchaeological evidence for behavioural change and continuity across the Earlier to Middle Stone Age transition
17:50	**Fotios Alexandros Karakostis** - Neanderthals habitually performed precise manual activities
18:10	**General Assembly**
19:30	**Closing Dinner : Tertúlia Algarvia,** *Praça do Afonso III 13-15*

Sunday, September 16th	
Excursion	
Participants should wear comfortable clothing and shoes. Furthermore, as both archaeological sites are open-air, you are encouraged to bring a hat.	
8:30	**Departure from Faro Bus Central Station**
9:45	**Visit the Megalithic Monuments of Alcalar** near the city of Portimão with Elena Móran and Rui Parreira as guides
12:15	**Buffet lunch offered by Vila do Bispo Municipality at the Beliche Fortress**
14:00	**Sight Seeing at Cape Saint Vincent,** the southwesternmost point of continental Europe
16:00	**Visit to the Paleolithic site of Vale Boi,** includes observing the main excavation area, viewing some of the most iconic archaeological materials discovered over the last 15 years of excavations, and hearing a brief explanation by Nuno Bicho
17:30	**Departure**
19:00	**Arrival at Faro Central Station**

Thursday Posters

Odd numbers will present between **18:15-19:00** and even numbers will present between **19:00-19:45**.

1	**Guillermo Zorrilla-Revilla** - Reappraising the Gran Dolina TD6.2 Cannibalism from an energetic perspective
2	**Michael Walker** - The earliest European Acheulian: The significance of recent findings for human evolution in Europe
3	**Norman Fernández** -Cueva Negra del Estrecho del Río Quípar (Caravaca de la Cruz, Murcia, SE Spain): Intrasite analysis of a late Early Pleistocene Palaeolithic palimpsest
4	**Marianne Deschamps** - The short-term occupations of Cueva Antón: site function and techno-economic behavior of last interglacial Iberian Neandertals
5	**Telmo Pereira** - The earlier Mousterian in westernmost Iberia: geoarchaeology of the Cobrinhos site, in the Tejo River terrace staircase of Vila Velha de Ródão (Portugal)
6	**Mariana Nabais** - Systematic or opportunistic use of small prey in the Middle Palaeolithic? A view from Gruta da Figueira Brava, Portugal
7	**Joao Cascalheira** - A geometric morphometric approach to predict the chronological attribution of bifacial foliate technology at Olival do Arneiro (central Portugal)
8	**Milena Carvalho** - Assessing environmental change at Lapa do Picareiro (Portugal): A stable isotopes analysis using rabbits (*Oryctolagus cuniculus*) and red deer (*Cervus elaphus*) as paleoenvironmental proxies
9	**Cristina Gameiro** - The Pleistocene-Holocene transition: new data from the sites of Rôdo, Vau and Bispeira 8 (Vouga valley, Portugal)
10	**Joana Filipa Belmiro** - At the threshold of the Last Glacial Maximum in southwestern Iberia: new evidence from the site of Vale Boi (Portugal)
11	**Jonathan Haws** - The Middle-Upper Paleolithic Transition in Southern Iberia: New Data from Lapa do Picareiro Portugal
12	**Dirk Leder** - Late Pleistocene landscapes and human mobility in the southern Levant: Results of geoarchaeological research in the Wadi Sabra, Jordan, and the Dead Sea
13	**Eduardo Paixão** - Ground breaking technologies in the Middle Paleolithic of the Levant: High resolution functional analyses of Ground Stones Tools
14	**Pedro Horta** - Lithic bipolar technology through space and time
15	**Aldo Malagó** - Quantification of raw material properties and their influence on the morphology of lithic tools
16	**Karen Ruebens** - TIP-N-POINT: a regional and assemblage scale perspective on Neanderthal point technologies across Western Europe
17	**Paul Kozowyk** - Go with the flow: an assessment of Palaeolithic adhesive re-usability and application characteristics using oscillating shear rheology
18	**Lauren Bell** - Human or Neanderthal: A multi-disciplinary study in search of the makers of the Uluzzian technocomplex in Upper Palaeolithic Italy
19	**Klervia Jaouen** - Compound-specific amino-acid d15N measurements of two Neandertals indicate high trophic-level diets
20	**Eléa Gutierrez** - Weaning practices in early Montreal with dentine micro-sampling and nitrogen isotopic analysis
21	**Stefania Milano** - Environmental reconstruction in the context of the first *Homo sapiens* in Indochina (Tam Pà Ling site, NE Laos)
22	**Nicolas Bourgon** - Zinc isotopes as a dietary indicator for archaeology and paleontology: Insights from a Southeast Asian Late Pleistocene food web
23	**David M. Alba** - Bio- and magnetostratigraphic correlation of the Miocene primate-bearing site of Castell de Barberà: End of the controversy

24	**Vera Aldeias** - A Micro-Contextual Approach to Neandertal use of fire at Pech de l'Azé IV (Dordogne, France)
25	**Ilaria Patania** - Micromorphological Analysis of the Deposits at the Early Pottery Xianrendong Cave Site, China
26	**Bence Viola** - Morphology of the purported human remains from Sel'ungur cave, Kyrgyzstan
27	**Carlos A. Palancar** - Reconstruction of the atlas (C1) of the La Chapelle-aux-Saints Neanderthal through geometric morphometric techniques
28	**Asier Gómez-Olivencia** - New Neandertal fossils and first data of Middle Paleolithic bird and carnivore exploitation in the Cantabrian Region
29	**Adrián Pablos** - Those that were missing. A Neandertal foot phalanx from Galería de las Estatuas (Sierra de Atapuerca, Spain)
30	**Maria Giovanna Belcastro** - How much musculoskeletal variability did Neandertals accumulate? The study of the lower limbs entheses of the Neandertal sample from El Sidrón, Asturias, Spain.
31	**Rebeka Rmoutilová** - Extreme asymmetry of sacral alae in the Neandertal Regourdou 1 (Montignac-sur-Vézère, Dordogne, France)
32	**Luca Fiorenza** - Dental macrowear and cortical bone thickness analyses of the Neanderthal mandible from Regourdou (Dordogne, Southwestern France)
33	**Stanislava Eisová** - The Neanderthal endocast from Gánovce (Poprad, Slovak Republic)
34	**Libby Cowgill** - How large were Neandertal infants?
35	**A. Sofia Pereira-Pedro** - Comparison of parietal lobe morphology in modern humans and Neandertals
36	**Juliet Brophy** - New craniodental remains of the type specimen of *Australopithecus sediba* and a morphological assessment of the mandibular third premolars
37	**Almudena Estalrrich** - Toothpicking habit in early Homo. New evidence from OH62 (Olduvai Gorge, Tanzania)
38	**Zachary Cofran** - Bilateral symmetry of the temporal bone with implications for commingled fossil assemblages
39	**Cedric Boeckx** - The molecular evolution of human-specific facial traits and socio-cognitive profile: Insights from neurocristopathies
40	**Fabio Di Vincenzo** - Of teeth, feet and feed. The unexpectedly rapid evolution of mandibular shape in hominins
41	**Noemí Pérez-López** - Paranasal sinuses still have much to say: introducing the surface-volume index of frontal sinuses
42	**Martin Friess** - Shape variation in Middle and Late Pleistocene human calvariae
43	**Antonino Vazzana** - Digital reconstruction of the LB1 H. floresiensis cranium
44	**Noémie Bonneau** - CT-scan data of juvenile pelvises : application for 3D fossils reconstruction
45	**Kudakwashe Jakata** - Investigation of uncertainty in CT and the implications on human evolution studies
46	**Antonio Profico** - Arothron: an R package for virtual anthropology to build endocast and to perform digital reconstruction
47	**Costantino Buzi** - CA-LSE and AST-3D: two new digital tools for reproducing the inner cavities of skeletal elements
48	**Kimberly Plomp** - Adaptations for bipedalism in human vertebrae: A 3D geometric morphometric analysis
49	**Antonietta Del Bove** - Sexual dimorphism in human frontal bone: a landmark-based approach.
50	**Alexandra Schuh** - Ontogeny of the human maxilla: A study of intra specific variation using surface histology and geometric morphometrics
51	**Stephanie Melillo** - Reconstructing the shoulder girdle from skeletal remains
52	**Guillermo Bravo Morante** - Predicting age at death from the shape of the human pubic symphysis by bandpass filtering of bending energy

53	**Yann Heuze** - Potential effects of muscularity on nasal cavity nasal airways and paranasal sinuses form
54	**Tarah N. Marks** - Evidence for climatic adaptation in human nasal turbinate morphology
55	**Ella Been** - Spinal posture and pathology: evolutionary aspect
56	**Natalia Morales** - The importance of the environment in the modification of craniofacial architectural relationships in *Homo sapiens*
57	**Gabriele Macho** - Did the environment drive hominin life history evolution?
58	**Andrej Evteev** - The level of correlation between mid-facial craniometric, neutral genetic and climatic distances completely depends on the scale of comparison
59	**Gizéh Rangel de Lázaro** - Ontogenetic changes of diploic channels in modern humans, and a comparison to fossil hominins
60	**María Asunción Cabestrero-Rincón** - A new methodological approach in the study of the differential evolution of cerebral and cerebellar fossae in recent *Homo*. Additional Data.
61	**Catherine Taylor** - Quantifying curvature in bones without landmarks: A study of primate clavicles
62	**Kevin Rosenfield** - The evolution of fertility signals in primates: An agent-based modeling approach
63	**Thomas Püschel** - Inferring locomotor behaviours in Miocene New World monkeys using talar morphology as proxy
64	**Florian Bouchet** - The inner craniodental anatomy of the *Papio* specimen U.W. 88-886 from the Early Pleistocene site of Malapa, Gauteng, South Africa
65	**Johan Arif -** The Pongo in the Pleistocene period in Java: Their earlier presence in the fossil record?
66	**Miguel Prôa** - Primate evolution by random genetic drift: Comparing linear and geometric morphometrics of the cranium in testing cercopithecine divergence
67	**Thomas O'Mahoney** - Analysis of changes in body mass through ontogeny in a captive *Pan troglodytes* sample
68	**Lisa Schunk** - Understanding edge angle variability and morpho-functional design of Late Middle Palaeolithic Keilmesser assemblages
69	**Tina Lüdecke** - Dietary versatility of early Pleistocene hominins

Friday Posters

Odd numbers will present between **18:15-19:00** and even numbers will present between **19:00-19:45**.

1	**John Graham** - Do rhetorical devices work? A text analysis of research paper titles in Neanderthal studies 1970-2017
2	**Frederick Coolidge** - Evolutionary implications of the Sense of Numbers
3	**Simon Maxwell** - Sporadic sampling not climatic forcing drives early hominin taxic diversity
4	**Julia Galway-Witham** - Palaeanthropology as nomothetic science: falsifiable predictions from modern human evolution research
5	**Tegid Watkin** - An Investigation into Metacarpal and Proximal Phalangeal Torsion in Homo sapiens and Non-Human Primates and its Application for Manual Manipulation
6	**Zewdi J. Tsegai** - Trabecular bone ontogeny in the forelimb and hindlimb of chimpanzees
7	**Sandra Martelli** - The postnatal ontogeny of the hominoid pharynx and its relationship with cerebellar expansion
8	**Tara Chapman** - Fossil hominids on the move: New developments in fossil hominid biomechanical analysis
9	**Marco Vidal-Cordasco** - Energetics of carrying loads in neandertals and modern humans
10	**Ana Bucchi** - Stress distribution in the thumb proximal phalanx in Chimpanzee and *Homo* species during simulated stone-tool use

11	**Maria Mednikova** - Heat or cold adaptation in pleistocene humans: Evidence of vascular system development in tubular bones
12	**Christine Tardieu** - Walking on all fours: Modifications of the locomotor system in quadrupedal humans
13	**Kevin Turley** - Phylogenetic perspectives on Catarrhine talo-crural joint morphology and phenotypic plasticity: A phylomorphospace approach
14	**Olalla Prado-Nóvoa** - Evaluating the load-carriage economy in males and females. Insights into the foraging strategies of palaeolithic hunter-gatherers
15	**Barbara Grant** - How are lower limb motions, oxygen consumption, muscle activity and plantar pressure modified in humans when walking over substrates of varying compliance?
16	**Carla Figus** - Unravelling morphological changes of the human talus during growth
17	**Mark Grabowski** - Body size estimates of Miocene fossil apes and predicting mass across deep time
18	**Tesla Monson** - Allometric variation in modern humans and the relationship between body proportions and elite athletic success
19	**Christiana Scheib** - Ancient human parallel lineages withing North America contributed to a coastal expansion
20	**Francesco Montinaro** - The European heritage of American populations
21	**Diane Martin-Moya** - A 3D geometric morphometrics study of the influence of non-neutral factors on different parts of the skull: Insights on the settlement of America hypothesis
22	**Eva Zaffarini** - Environmental transition and human childbirth
23	**Gregorio Oxilia** - A multidisciplinary approach to reconstruct Upper Palaeolithic and Mesolithic dietary habits: human adaptation to Pleistocene-Holocene environmental change in northeastern Italy
24	**Jörg M. Habermann** - Gorongosa by the sea: Miocene coastal environments of central Mozambique and their primate land-use potential
25	**Robert Anemone** - Pixels or image-objects? Comparing the performance of predictive models for fossil location
26	**João d'Oliveira Coelho** - 'Finding the needle in a haystack': automating spectral remote searching for hominin fossil sites in Gorongosa, Mozambique
27	**Mario Modesto-Mata** - Successfully reconstruction of hominin crown heights from Gran Dolina-TD6 and Sima de los Huesos (Atapuerca, Spain)
28	**Maire Malone** - Dental development, stress, and dietary transitions in the Ngogo chimpanzees
29	**Sireen El Zaatari** - Hominin dentition from the Hohlenstein Stadel cave
30	**Shara Bailey** - Temporal and geographic variation in crown shapes of permanent upper first molars of Early to Late Pleistocene Homo
31	**Laura Buti** -3D enamel thickness in Neandertal and modern human permanent incisors
32	**Cecilia García-Campos** - An early enamel thickness decrease in the permanent canines of the European populations from Atapuerca
33	**Laura Martin-Frances** - Tooth crown tissue proportions and enamel thickness in Early Pleistocene Homo antecessor molars (Atapuerca, Spain)
34	**Jason Gellis** - Tooth root phenotypic variation in modern human populations
35	**Inga Stolbovaya** - Prediction of third molar impaction based on 2D geometric morphometric analysis.
36	**Chrisandra Kufeldt** - The influence of diet on enamel growth
37	**Michael Anthony Berthaume** - Molar biomechanics and dietary ecology of *Australopithecus africanus* and *Paranthropus robustus*
38	**Alessandro Riga** - A reappraisal of the human remains from the Upper Palaeolithic – Mesolithic levels of Riparo Fredian (Tuscany, Italy)
39	**Alexandra A. de Sousa** - The role of gene family size in human brain evolution

40	**Lia Betti** - Climatic challenges shaped the pattern of the Neolithic expansion into Europe
41	**Suzanne Freilich** - Who do you think you are? First results of Neolithic and Bronze Age Balkan genomes shed light on the dynmaics of European ancestry
42	**Lehti Saag** - Demographic processes in the territory of Estonia from the earliest inhabitants to modern times
43	**Mateja Hajdinjak** - Patterns of ancient DNA preservation in a Palaeolithic human tooth from Les Cottés cave, France
44	**Paula Tralma** - Baboon genetics and potential introgressive hybridization at Gorongosa National Park, Mozambique
45	**Mussa Raja** - The geoarchaeology of the Late Stone Age sites of Machampane River, Massingir, Mozambique
46	**May Murungi** - MSA occupation at the east coast and interior of South Africa: plant use, vegetation and climate at Sibudu and Bushman Rock Shelters
47	**Ahmed Hamid Nassr** - Early Stone Age archaeology in Sudan, from the new sites discoveries at Hudi depression east of Atbara River
48	**Jennifer Parkinson** - Renewed paleoanthropological investigations in the Albertine Rift, Western Uganda
49	**Irene Solano-Megías** - The Sanzako: an almost unknown techno-complex in the Mumba Rockshelter (Lake Eyasi, Tanzania).
50	**Emma Loftus** - An online open-access database for southern African radiocarbon dates
51	**Jennifer Leichliter** - Early Hominin environments in Southern Africa: A Micromammalian perspective
52	**Catherine Claudia Bauer** - What lies beneath? New insights on the Předmostí (-) canid skull specimen and associated materials using µCT scan data
53	**Andrei Sinitsyn** - The Gorodtsovian as a particular cultural phenomenon of the Eastern European Upper Palaeolithic
54	**Anton Lada** - Kostenki: The easternmost point of the European Aurignacian
55	**Marine Frouin** - The (very) late Middle Palaeolithic-like assemblage at the Betovo site (Russia)
56	**Maryam Heydari** - Dating the Middle to Upper Palaeolithic transition in Northern Iran: An OSL-based chronology for the open air site of Mirak using dedicated Bayesian modelling
57	**Nikoloz Tushabramishvili** - Middle to Upper Paleolithic Transition : New Data about Utililization of Bone Raw Materials based on the Finds from Ortvala Klde and Bondi Caves and unexpected discovery in Ortvala Klde (South Cauca)
58	**Samantha Brown** - The FINDER project: Identifying hominin bones in the Altai Mountains using collagen fingerprinting
59	**Mathieu Duval** - First direct ESR dating study of the Homo antecessor from Atapuerca Gran Dolina TD-6 (Spain)
60	**Antonio Benítez-Burraco** - Playing patterns in Prehistory as a proxy for language structure: Neanderthal versus Modern Human Children
61	**Suramya Bansal** - Practical and interpretive implications of experimental hand imprints
62	**Gianpiero Di Maida** - *Mare nostrum, ars nostra*. A review of the classic Graziosi's theory of a Mediterranean province for Lateglacial rock and mobile art
63	**Amanpreet Kang** - Disentangling the mysteries of the origin of our species: A regional analysis of the ornaments of Middle-Upper Palaeolithic Europe
64	**Penny Spikins** - Healthcare provisioning in evolutionary context
65	**Tara Dieringer** - A review of Neandertal Extinction theories
66	**Amelia Bargallo** - Searching for novices in the prehistororic record
67	**Philip Allsworth-Jones** - Coleman's Bay Cave: A recently discovered Taino site in the Hellshire Hills (Jamaica)
68	**Marina Martínez de Pinillos** - What does the trigonid crest pattern tell us on the Arago dental sample?

Abstracts

European Society for the study of Human Evolution

Faro, Portugal
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Poster Presentation Number 23, Th 18:15-19:00

Bio- and magnetostratigraphic correlation of the Miocene primate-bearing site of Castell de Barberà: end of the controversy

David M. Alba[1], Miguel Garcés[2], Marta Pina[3,1], Isaac Casanovas-Vilar[1], Josep M. Robles[1], Salvador Moyà-Solà[1,4], Sergio Almécija[5,1]

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Castell de Barberà (CB; Barberà del Vallès, Catalonia, Spain) is one of the few fossil sites from the European Miocene where both pliopithecoids (*Barberapithecus huerzeleri*) and hominoids (cf. *Dryopithecus fontani*) are recorded [1-3]. Located on the left bank of the Ripoll River, CB was excavated by a team led by M. Crusafont from 1965 to 1981, leading to the recovery of a rich vertebrate fauna.

From a geological viewpoint, the CB deposits belong to the middle to late Miocene Upper Continental Complexes of the Vallès-Penedès Basin (NE Iberian Peninsula). The late Aragonian (MN7+8) age originally proposed for CB soon after its discovery was accepted by most (albeit not all) later authors, despite the subsequent report of fragmentary hipparionin remains [4] and the more recent find, among the classical CB collections, of a *Hippotherium* molar—which would unambiguously signal a Vallesian (MN9) age (see discussion in [1]). On the later basis, CB was recently correlated to the *Hippotherium – Cricetulodon hartenbergeri* interval subzone of the Vallès-Penedès Basin (11.18–10.3 Ma) [5]. Yet, uncertainties about the provenance of the *Hippotherium* material and similarities between latest Aragonian and early Vallesian rodent assemblages have thus far precluded settling the longstanding debate about the age of CB. Additional fieldwork at CB was until recently hindered by the vague published indications about its exact location, coupled with decades of vegetation growth.

With the aid of heavy machinery, prospections and excavations were resumed at CB in 2014–2015 with a three-fold aim: (1) determining the exact location of the classical locality; (2) performing paleomagnetic analyses to clarify its age; and (3) finding additional fossils. With the aid of the late J.V. Santafé, it was possible to locate the classical main fossiliferous horizon (ETRS89 UTM coordinates: 31N 428314 E – 4596862 N), labeled 'layer D' and being located at about midheight of a short (20 m-thick) stratigraphic section dominated by silty claystones from the distal facies of the Castellar del Vallès Alluvial Fan System. Although the classical bone accumulation was exhausted, additional fossil remains were recovered from this and other strata, and paleomagnetic samplings were performed there and in another nearby section (300 m upstream).

The in situ recovery of a *Hippotherium* humerus from layer D in 2015 unambiguously confirms the Vallesian age of CB. In turn, magnetostratigraphic analyses indicate two magnetozones in the classical section (layer D being correlated to the normal one) and four in the other nearby section. Their most parsimonious lithostratigraphic correlation indicates the presence of six different magnetozones in the composite magnetostratigraphic section. Alternate correlations, implying four or five magnetozones, cannot be entirely ruled out—due to potential local changes in sedimentation rates and/or an intervening fault. However, the presence of at least four different magnetozones within a sequence of just 50–80 m in thickness (representing >400 kyr, based on average sedimentation rates for the basin) excludes the correlation of any of the sampled normal magnetozones with the long normal subchron C5n.2n (11.056–9.984 Ma), characteristic of the early Vallesian, and supports instead a correlation of layer D with C5r.1n (11.188–11.146 Ma), where the Aragonian/Vallesian boundary is situated [5].

In conclusion, recent fieldwork allows us to provide, based on bio- and magnetostratigraphy, an earliest Vallesian estimated age of 11.2 Ma for CB. Thus, it would be roughly coeval with Creu de Conill 20 (interpolated age: 11.18 Ma), which represents the first appearance datum of hipparionins in the Vallès-Penedès Basin [5]. Such accurate dating of CB will allow to better contextualize at a basin scale the faunal and paleoenvironmental changes that enabled the coexistence of pliopithecoids and hominoids at some particular sites during the late Miocene.

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Poster Presentation Number 24, Th 19:00-19:45

A Micro-Contextual Approach to Neandertal use of fire at Pech de l'Azé IV (Dordogne, France)

Vera Aldeias[1], Harold Dibble[2], Paul Goldberg[3], Dennis Sandgathe[4]

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Long assumed to be a fundamental technological achievement essential for human adaptation, pyrotechnology is increasingly the subject of Paleolithic research, both in documenting the evidence for fire in sites [e.g. 1] and in developing new methods for analyzing fire residues [2, 3]. Recent studies have shown that the use of fire varied considerably during the Middle Paleolithic (250–40 ka) of southwest France, with significantly less evidence of fire during colder periods even though it was regularly used during warmer periods [4-9]. These findings suggest that fire did not immediately assume the importance it now has, highlighting the questions of how Neandertals used fire and its role in their overall adaptation. Here we present a new project to re-excavate numerous combustion features contained in Layer 8 (MIS 5c) at Pech de l'Azé IV [10, 11]. Our goal is to understand variability in fire signatures by characterizing combustion zones in terms of their surficial features, and their subsurface attributes, which reflect alterations of sediment and objects within the three-dimensional volume affected by the heat. Employing a micro-contextual approach, the excavations will be performed at a much finer scale than typically done for archaeological deposits of this age and will benefit from the application of several recently developed techniques for analyzing prehistoric fire residues. Our methodology will be based on the removal of individual blocks of sediment (10 cm thick), with further work carried out under laboratory conditions. Some of these blocks will be resin impregnated and used for micromorphology sampling, while others will be excavated. In addition to proveniencing artifacts, all sediments will be provenienced and collected directly into 5 cl vials, permitting multiple samples to be taken from any particular micro-context. Further analyses (FTIR, lipid analyses, TL, and magnetism) provide data on fire attributes, including temperatures achieved, depth of heat penetration, presence/absence of organic residues, and the type of fuel used. Our preliminary excavation results are presented here, showing the complexity of fire signatures and the challenges we have when integrating different microarchaeological approaches. This research studies the sediment itself at the same level of detail as is normally given to artifacts, and provides a means of more accurately reconstructing the deposit and its components in their original associations.

References:[1] 1. Roebroeks, W. and P. Villa, On the earliest evidence for habitual use of fire in Europe. Proceedings of the National Academy of Sciences of the United States of America, 2011. 108(13): p. 5209-5214. 2. Mentzer, S., Microarchaeological Approaches to the Identification and Interpretation of Combustion Features in Prehistoric Archaeological Sites. Journal of Archaeological Method and Theory, 2014. 21(3): p. 616-668. 3. Goldberg, P., C.E. Miller, and S.M. Mentzer, Recognizing fire in the Paleolithic archaeological record. Current Anthropology, 2017. 58(S16). 4. Sandgathe, D.M., et al., On the Role of Fire in Neandertal Adaptations in Western Europe: Evidence from Pech de l'Azé and Roc de Marsal, France. PaleoAnthropology 2011: p. 216-242.[2] 5. Sandgathe, D.M., et al., Timing of the appearance of habitual fire use. Proceedings of the National Academy of Sciences of the United States of America, 2011. 108(29). 6. Aldeias, V., et al., Evidence for Neandertal use of fire at Roc de Marsal (France). Journal of Archaeological Science, 2012. 39(7): p. 2414-2423. 7. Goldberg, P., et al., New evidence on Neandertal use of fire: Examples from Roc de Marsal and Pech de l'Azé IV. Quaternary International, 2012. 247(1): p. 325-340. 8. Dibble, H.L., et al., How Did Hominins Adapt to Ice Age Europe without Fire? Current Anthropology, 2017. 58(S16): p. S278-S287.[3] 9. Sandgathe, D.M., et al., Identifying and Describing Pattern and Process in the Evolution of Hominin Use of Fire. Current Ahtropology, 2017. 58(Supplement 16). 10. Dibble, H.L., et al., A Preliminary Report on Pech de l'Azé IV, Layer 8 (Middle Paleolithic, France). PaleoAnthropology 2009: p. 182-219 11. Dibble, H.L., et al., Excavations at Pech de l'Azé IV. Monograph. 2017: Cave and Karst Systems of the World Series. Springer.

Poster Presentation Number 67, Fr 18:15-19:00

Coleman's Bay Cave: a recently discovered Taino site in the Hellshire Hills (Jamaica)

Philip Allsworth-Jones[1], **Ana Luisa Santos**[2], **Rick van Veen**[3], **Byron Wilson**[3]

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The Pre-Columbian settlement of Jamaica was the work of the people commonly referred to as Taino, the word which they themselves used to distinguish themselves from the Caribs. Upwards of 265 Taino sites have been identified in the island, of which 64 were previously recorded as caves [1]. At least 42 burials have been found in open-air sites and 126 individuals are said to have come from the caves, not all of which are still available for study [2]. Hellshire is a relatively inaccessible part of the southern Clarendon parish, where up to six sites were previously recognized [3]. During field work which was part of a project aimed at the study and conservation of the Jamaican iguana, some human remains were observed in 2008 in a previously unknown small cave in the vicinity of Coleman's Bay. No excavation was undertaken, but the remains visible on the surface were transported for study to the Jamaica National Heritage Trust in Kingston. They have been identified as belonging to a minimum number of four individuals, three adults and one juvenile. The morphology of one male adult cranium reveals clear signs of intentional modification, a common Taino cultural practice [4]. Other bones belonging to adult individuals included a mandible and several long bones. The juvenile was identified on the basis of fragmentary cranial remains and long bones which permitted an estimation of age, less than 15 years old if a girl or 17 in the case of a boy. Some pathological features were noted on several of the bones recovered. The location and nature of the Coleman's Bay site is similar to many others classified as burial caves, for example the "deep cave" on Great Goat island, and the commingled state of the remains suggests that this was, like the others, a secondary burial place. The remains so far are undated, but they probably belong to the "White Marl" period in the island, i.e., approximately in the interval between about 1000 and 1550 AD. The discovery of this site confirms that the Hellshire Hills, relatively remote as they are, nonetheless form an integral part of the Taino settlement of the island.

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Podium Presentation Session 9, Sa 10:30

Fossil footprints in the Gombore gully (Melka Kunture, Upper Awash, Ethiopia): A rare snapshot of Pleistocene life and environments

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Gombore is a gully of the Melka Kunture archaeological complex in the Upper Awash Valley of Ethiopia. In recent years fossil footprints were brought to light within layers with middle Acheulean lithic industry, or stratigraphically related to them. This is the first time that Pleistocene ichnosurfaces are reported from Ethiopia. Many animal footprints belong to species underrepresented or not represented at all in the fossil record, producing a diversified picture of the prevailing animal community. Overall, hippos, bovids, suids, equids, birds, and possibly a small carnivore and a large lizard are all documented. Hippo footprints are numerous and excellently preserved. This enabled to make casts recording the outer appearance of the leg and foot. A 700.000-year old hippo trail was also discovered and documented [1]. We believe that it was the result of tramping following established trails from resting places to grazing spots, indicating the long ancestry of a behaviour still observed today. Hominins also left direct evidence, i.e. cranial remains, and footprints. The fossil remains, at 850 ka [2], are assigned to a direct ancestor of *Homo heidelbergensis* [3], the species that we assume produced the 700ka-old footprints of a group including both adults and young children. The associated archaeological and palaeontological record confirms that stone knapping was taking place *in situ* and that lithic tools were used for butchering hippo carcasses at the site. Most notably, young children – possibly as young as 1-year old, and maybe even less - were standing and witnessing [4]. At 0.85 Ma, furthermore, footprints of young hominins have been found in layers without any associated archaeological record [5]. Footprints are a first-hand source to reconstruct past environments. They provide direct evidence of the behavioral patterns of extinct species, including hominins. We underline that during fieldwork attention should be routinely provided to ichnological evidence, in order to identify and investigate this precious but fragile record with a specific methodology and a documentation protocol supported by technologies such as laser scanning and photogrammetry. Corresponding author: Margherita Mussi [margherita.mussi@uniroma1.it]

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Poster Presentation Number 25, Fr 18:15-19:00

Pixels or Image-Objects? Comparing the performance of predictive models for fossil location.

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Since vertebrate fossils are rare and difficult to locate in the field, paleontologists and paleoanthropologists have recently followed the lead of archaeologists in developing and testing predictive models for fossil location. Modern geospatial tools, datasets, and analytical models provide an opportunity for interdisciplinary collaboration between geospatial scientists and paleoanthropologists in the search for more efficient, more effective, and less costly ways to locate and collect fossils. These interdisciplinary collaborations are especially useful when determining where to direct surveying efforts in spatially large sedimentary basins, like those that are common in western North America. Using a variety of artificial intelligence approaches, we have developed and ground-truthed predictive models for locating fossil mammal sites from Paleocene and Eocene deposits in the Great Divide Basin of southwestern Wyoming, USA. Here we compare the performance of a pixel-based Artificial Neural Network (ANN) predictive model [1] with a GEographic Object-Based Image Analysis (GEOBIA) approach [2] that segments images into multi-pixel image objects. Multispectral images from the Landsat 8 Operational Land Imager (OLI) were used along with GIS data such as slope, surface geology, and watershed boundaries to identify potentially productive localities. The spectral and spatial characteristics of the GEOBIA image objects that represent a single highly productive locality (Carnegie Museum Locality 4026) were used to extract similar image objects throughout the basin. The ANN classification process divided the basin into five land cover classes: barren, forest, scrubland, wetland and localities on a pixel by pixel basis. The methodologies are fairly simple segmentation and classification schemes that were both shown to lead to moderate success in locating fossils in the field. To verify the models, a field crew searched 14 potential localities in a previously unsurveyed part of the basin, nine of which contained mammalian fossils, and five that did not. The GEOBIA model correctly predicted six of the nine productive localities, but missed three. The ANN model was less conservative than the GEOBIA model and incorrectly highlighted three non-productive localities. Although both models had similar overall percentage accuracies, the more conservative GEOBIA model was less likely to direct the field crew to non-productive areas. The GEOBIA methodology of analyzing high resolution imagery has the potential to improve paleontological and paleoanthropological field surveys. With further refinement of this methodology, more accurate predictive models can be developed and the success rate of fossil recovery can be greatly increased. The use of these kinds of models can lead to the recovery of more fossils and a greater understanding of life in the past [3].

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Poster Presentation Number 65, Th 18:15-19:00

The Pongo in the Pleistocene period in Java: Their earlier presence in the fossile record?

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There is an argument that tropical rain forest existed in Java from the Late Pleistocene on the basis of the find of fossilized Pongo teeth in Punung Pacitan in East Java. However, several finds of isolated fossilized Pongo teeth from Sangiran support the existence of tropical rain forest being present from the Early-Middle Pleistocene.

In this paper, we will discuss the possibility that the existence of Pongo in Java from the Early Pleistocene based on the finds of two isolated Pongo teeth, JA-53 and JA-39 from Sangiran, and the implications for the palaeoenvironmental change.

To reconstruct their position in the context of stratigraphy, LA-ICP-MS was used to measure the concentration of rare earth elements. The results shows that the enamel and root of JA-53 have relatively high concentrations of Sr and Ba, and that the root has a higher content of Pb, Zn, U, Ni, Fe & Co compared with the enamel. This indicates that J-53 may come from the Early Pleistocene layer of the upper part Pucangan (Sangiran) Formation.

Morphometric comparison is carried out to with the Late Pleistocene *Pongo pygmaeus palaeosumatrensis* from the three caves namely from Lida Ajer (Payakumbuh), Sibrambang and Djamboe (Tapisello) in Sumatra. The result shows the dimension of JA-53 and JA-39 are bigger and are the mandibular first incisor and female mandibular canine, respectively. In the scheme of Pleistocene faunal succession in Java, those two isolated teeth are members of Cisaat Fauna.

The traditional view is that the Early to Mid-Pleistocene was dry, open woodland habitat, a habitat that arboreal creatures such as living Pongo are not adapted. Therefore, the existence of Pongo in the Early Pleistocene is contradictory with that argument.Therefore, was the two possibility are proposed here (i) tropical rain forest presumed already established from the Early Pleistocene to Early-Mid Pleistocene, but than disappeared at the end of the Mid Pleistocene. After that rainforest raised again in Late Pleistocene; (ii) there were open woodlands-rainforest mosaics in the Early to Mid-Pleistocene in Java.

Poster Presentation Number 30, Fr 19:00-19:45

Temporal and geographic variation in crown shapes of permanent upper first molars of Early to Late Pleistocene *Homo*

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1 - New York University · 2 - Max Planck Institute for Evolutionary Anthropology · 3 - University of Bologna

The shapes of the upper permanent first molar (M1) and the upper deciduous second molar (dm2) have been shown to be remarkably similar within individual hominins (Bailey et al 2014a). Both teeth have proven to be taxonomically diagnostic when comparing *H. sapiens* and *H. neanderthalensis* (and members of their lineage). Additional studies have suggested that the shape of *H. erectus* upper dm2 is more similar to those of the former compared to the latter, supporting the derived status of *H. neanderthalensis* (Bailey et al 2014b). In this study we examined geographic variation of the upper M1 crown shapes of early to late Pleistocene hominins, with a particular focus on temporal variation within geographic regions. Our aim was to investigate regional continuity during this time period. To this end, our samples included 11 Asian *H. erectus*, 7 African *H. erectus*, 3 Dmanisi, 3 European Early Pleistocene *Homo*, 5 European Middle Pleistocene *Homo*, 7 African Middle Pleistocene *Homo*, 3 Asian Middle Pleistocene *Homo*, 18 *H. neanderthalensis*, 9 early *H. sapiens*, 19 Upper Paleolithic *H. sapiens* and 80 recent *H. sapiens* individuals. Digital photographs of occlusal images of upper M1 crowns were used and crown shape was quantified using pseudolandmarks representing the crown outline. A principal components analysis was used to explore the pattern of morphological variation across the upper M1 sample. As expected, *H. erectus* upper M1 crown outlines fall completely outside the range of *H. neanderthalensis*, confirming earlier results based on a smaller sample of upper dm2s. Moreover, the distinction between *H. neanderthalensis* and *H. sapiens* is confirmed - these are the only groups that show minimal (two individuals) overlap in crown shapes. All other groups overlap substantially with the recent and fossil *H. sapiens* samples. There appears to be some regional continuity from the Early to Late Pleistocene: the three European Early Pleistocene individuals plot closest to the European Middle Pleistocene and *H. neanderthalensis* samples and three of the five European Middle Pleistocene *Homo* individuals fall within the *H. neanderthalensis* range of variation. In addition, two of the three Middle Pleistocene Asian specimens plot within the range Asian *H. erectus* and the remaining individual falls closest to this range. On the other hand, the African Middle Pleistocene *Homo* sample overlaps with both African and Asian *H. erectus* with no particular affinity to either group. In fact, its closest morphological affinity is with *H. sapiens*. The three Dmanisi individuals plot closest to African *H. erectus* individuals. It is worth noting that the early *H. sapiens* individuals plot within the range of, not only recent *H. sapiens*, but also African and Asian *H. erectus*, as well as European and African Middle Pleistocene *Homo*. This fact underscores the need to include Middle Pleistocene *Homo* in any assessment of the 'modernity' of purported early *H. sapiens* individuals.

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Poster Presentation Number 61, Fr 18:15-19:00

Practical and interpretive implications of experimental hand imprints

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This research experimentally investigates and theoretically situates the distinct impression and expression of hand imprints (prints and stencils) in rock art studies, an area of common interest to anthropologists and archaeologists. Hand imprints are one of the earliest components of rock art iconography where hands are not merely a physical instrument (like a brush), as they become a direct element of the image. At different human evolutionary stages, one consistent artistic and creative act that has been observed is that of imprinting hands. Intentional hand prints and hand stencils can be made in palm-downwards or palm-upwards orientation; they can be plain or decorated – where the patterns can be made before (on the hand) or afterwards (on the print). These imprints can be intentionally modified or left as a replica of the hand. This hominin act, which cuts across spatial and temporal boundaries, showcases essential behavioural and cognitive characteristics and in-turn requires a holistic understanding.

In order to explore the anthropology of hands and archaeology of hand imprints, the various intricacies involved in the present experiment have been helpful in digging out the underlying anatomical mechanics and adaptive chemistry of hands. These imprints, apart from expressing *laterality* in terms of left or right orientation of hand, also showcase hand ability, skill and preference linked to the broader concept of handedness. This opens interpretive challenges due to the undercurrents of *mixed handedness* and *ambidexterity* along with an *embedded socio-cultural matrix*, if any. Inherently, the significance of imprinting hands is an omnipresent and persistent question.

Following an approach from practice to theory, the exercise of replicating ways of making plain and decorated hand prints and hand stencils sheds new light on how best to theoretically situate them. Although it may not answer the 'question', but it can be used as a means to an end. The syncretic web of *embodiment* and *lateralized symbolism*, along with *haptic* and *embodied cognition* lenses, supports a framework for this qualitative and quantitative trait. The hand motif can have multiple symbolic meanings varying from one society and culture to another in historical and contemporary times. As a result of its diverse contextual and detailed dynamic manipulation, hand imprints definitely hold much more than meets the eye.

I would like to thank my supervisors Prof. David Pearce and Dr. Geoffrey Blundell for their guidance on my research master's project from which this poster presentation stemmed off. I would also like to thank Dr. Sam Challis for his handy suggestions and remarks. The financial assistance and research support from the University of the Witwatersrand and the South African Archaeological Society is hereby acknowledged.

Poster Presentation Number 66, Fr 19:00-19:45

Searching for novices in the prehistororic record

Amelia Bargallo[1], **Tomos Proffitt**[1], **Ignacio de la Torre**[1], **Marina Mosquera**[2]

1 - UCL · 2 - URV-IPHES

Social learning informs us of the cognitive abilities to acquire knowledge transmitted between generations as adaptive strategies (Tomasello et al. 1993). In the archaeological record, the transmission of knowledge and skills are identified through repetitive patterns, however, the majority of these only remain in the best-preserved archaeological material: the lithic tools that hominins made to survive. Lithic technological analysis, the study of stone remains from archaeological sites, is therefore an essential discipline to characterise cognitive evolution. In other words the lithic remains are critical not only as an expression of human cognition, but also as a means to reach it. This will provide more information about the cognitive evolution of our ancestors (Whiten, 2000). To address these questions we designed the Learning of Prehistory of Knappinbg Stone project (PREKARN). The PREKARN project aims to identify stone knapping learning in the archaeological record. To achieve this goal we have designed: firstly, an experimental program to identify and interpret technological traits associated with novice flint-knappers. Secondly, the application of these results to the archaeological record to understand the knappers' process in acquiring technical knowledge. This project aims to ascertain how hominins learnt through the combined study of both quantitative dimensions and qualitative (the management and know-how or 'savoir faire' (Pelegrin, 1988)) attributes of lithic assemblages. The first step of PREKARN is the experimental program. With the aim to defining and identifying, the varying technological characteristics involved in the process of knapping learning. We have designed a robust morphotechnological methodology to identify the technological traits associated with novice modern flint-knappers. In this communication, we present the first part of the PREKARN project consisting of experimental project development, definition of the morphotechnological attributes used and will present preliminary statistical patters regarding the differing levels of learnings by novice knappers.

Cognitive archaeology Experimental archaeology Lithic stoneLearning

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Podium Presentation Session 8, Fr 17:10

Thoracic vertebral morphology of KNM-WT 15000

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In Neandertals, the thoracic vertebrae appear to reflect their relatively shorter and wider trunk shape [1]. They differ from modern humans by greater dorsal transverse process orientation (TPO), more dorsal spinous process orientation (SPO), and relatively shorter vertebral bodies, particularly at lower vertebral levels. Dorsal TPO and its effect on rib-position and orientation were suggested to contribute to a larger lower Neandertal thorax. Relatively shorter vertebral body heights reflect a reduced trunk length in Neandertals. SPO might relate to neck posture, head carriage, and overall back posture. These anatomical features were interpreted in terms of bioenergetics and body shape [1]. Alternatively, these features could reflect primitive vertebral morphologies retained from earlier members of the genus *Homo*. In this context, the thoracic vertebrae of the Nariokotome Boy (KNM-WT 15000; hereafter, WT15k), a juvenile male *H. erectus*, are important. Researchers initially reported more dorsal SPO in WT15k than in humans and TPO within the modern human range [2]. However, other researchers showed that TPO changes during ontogeny [3], and remaining growth changes could therefore affect TPO in WT15k. Here, we test the hypotheses that late ontogenetic growth can explain differences between WT15k and modern humans. We applied 3D geometric morphometric (GM) analyses of 419 vertebrae (T1-T12) of a sex balanced sample of European and Sub-Saharan African adults and juveniles (M2 erupted). We measured 111 landmarks and semilandmarks on curves using a template that characterises basic and relevant anatomical features of vertebral morphology [4]. We also used this template for 3D GM reconstruction of missing elements following recently published methods [4]. Our results reveal general features related to seriality and ontogeny and specific features in which WT15k differs from *H. sapiens*. Ontogenetic changes in thoracic vertebrae affect the size and length of the processes, and the overall height of the vertebrae. In these features, WT15k falls in the range of *H. sapiens* juveniles. However, we find support for the hypothesis of Brown and colleagues [2] that WT15k has greater dorsal SPO than *H. sapiens*, regardless of its ontogenetic status. We also find that TPO is considerably more dorsal in WT15k than in *H. sapiens*, again, regardless of age. Assuming similar late ontogenetic modifications in thoracic vertebrae of *H. sapiens* and *H. erectus*, this analysis suggests that if WT15k had grown to adulthood, the size and length of its processes would have increased, but their orientations would not have changed significantly. WT15k differs further from *H. sapiens* by a shorter height of the vertebral bodies and a relatively smaller vertebral foramen, the latter previously found by other researchers. These observations point to a different pattern of vertebral morphology of the WT15k. Correlated patterns of SPO and TPO favour the hypothesis of an integrated set of vertebral features, although this needs to be assessed more thoroughly. Our results further suggest that these primitive thoracic morphologies are shared by *H. erectus*, Neandertals and possibly *H. naledi*, [5], supporting a symplesiomorphic suite of characters in this region of the spine. While this would not necessarily challenge the bioenergetic interpretation of the Neandertal thorax, it could be considered an exaptation in Neandertals retained and modified from a generally primitive trunk and body structure of early *Homo*. The more lateral TPO and caudal SPO of *H. sapiens* would then be derived, perhaps as part of a suite of trunk features unique to our species.

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Poster Presentation Number 52, Fr 19:00-19:45

What lies beneath? New insights on the Předmostí (-) canid skull specimen and associated materials using µCT scan data

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The well-known Gravettian open-air site of Předmostí I in the Czech Republic has yielded large amounts of archaeological and anthropological material, such as modern human remains, portable art and industry and a huge amount of mammoth specimens. The second most abundant animal species is represented by large canid specimens of either wolves or possible early dogs. It is reported that one of the latter specimens was found within the human burial zone of the site, thus possibly indicating a close relationship between the possible early dogs and the humans inhabiting the site. Among these possible early dog specimens is one of particular interest. The Předmostí (-) cranium was found in articulation with the mandible, held together by sedimentary breccia. A conspicuous fragment of a bone (probably a piece of mammoth rib) protrudes from between the front teeth of the specimen, clearly extending further into the muzzle. The unusual position suggests that it has been inserted intentionally. The solid sediment that fills and covers part of the specimen has so far inhibited detailed studies of the Předmostí (-) specimen. In this study we focused on obtaining more data with a µCT-scan of the specimen. The scan revealed the full shape of the bone fragment protruding from the mouth, but also additional objects within the brecciated sediment that fills the oral cavity. The virtual segmentation of the objects permitted to discern that the total number of specimens held inside the mouth cavity amounts to four: the previously described rib fragment, two complete bones (probably a bone belonging to the autopodium and one from the upper thoracic area of yet undetermined animal species), as well as a worked piece of ivory. All four elements are perfectly aligned and are roughly located at the level of the tongue between the maxilla and the mandible. This suggests that the objects were placed into the mouth of the specimen either peri- or shortly post-mortem when all the soft tissue was still present and the head was then deposited. The incomplete infill with sediment of the oral cavity indicates only partial burial. Furthermore, the position of the objects is quite remarkable. The first object between the teeth is oriented lengthways, followed by the second object across, the third object then again lengthways and finally the last one again across. This orientation underlines the hypothesis of an intentional placement of the objects as well as a covering-up by sediments in the ground shortly after death of the specimen. In addition, our findings suggest the existence of a special relationship between the modern humans inhabiting the site of Předmostí and the possible early dog specimen Předmostí (-), potentially shedding new light on the early initial steps of the domestication process of the wolf already during the Upper Palaeolithic before the Last Glacial Maximum.

Podium Presentation Session 5, Fr 10:10

Exploring the inner cranial anatomy of "Little Foot": a comparative study of the endocast, and of the bony labyrinth.

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The *Australopithecus* specimen StW 573 ("Little Foot") was discovered in 1997 in Member 2 of the Sterkfontein Formation [1]. Besides its exceptional degree of preservation and completeness, the StW 573 skeleton is remarkable for its geological age with absolute dating having provided an age of 3.67 million years [2]. Accordingly, "Little Foot" represents one of the oldest examples of *Australopithecus* in the southern African fossil record and adds an invaluable contribution to our understanding of human evolutionary history [3]. In this context, here we present unreported inner morphostructural information from the complete cranium of StW 573. In particular, we focus our study on the endocast and the bony labyrinth, both providing crucial evidence for advancing discussion on the palaeobiology of *Australopithecus*.

Our comparative sample incorporates specimens of *Australopithecus*, *Paranthropus* and early *Homo* from Sterkfontein, Swartkrans and Makapansgat currently housed at the University of the Witwatersrand (Johannesburg, South Africa) and the Ditsong National Museum of Natural History (Pretoria, South Africa), and two samples representing extant *Homo* and *Pan* from the Pretoria Bone Collection (Pretoria, South Africa) and the Royal Museum for Central Africa (Tervuren, Belgium), respectively. Both manual and automatic segmentation techniques were used to virtually reconstruct the endocast and the bony labyrinth. We applied a semi-automatic technique for detecting the vascular and sulcal pattern and a landmark-based geometric morphometric method for investigating labyrinthine morphology [4,5].

Although the dorsal part of the endocranial surface is plastically deformed in a number of locations, the endocast of StW 573 preserves clear imprints of the middle meningeal arteries and of the frontal sulci. These offer the opportunity for direct comparisons to vascular and sulcal patterns of other well-preserved South African fossil endocasts such as *Paranthropus* (e.g., SK 1585) and *Australopithecus* (e.g., Sts 60). The three semicircular canals and the cochlea of StW 573 are relatively complete. Geometric morphometric analyses indicate that the external shape of its bony labyrinth approximates the condition exhibited by the comparative *Australopithecus* specimens included in our study (e.g., Sts 5, StW 578). Palaeobiological implications of our comparative assessment of "Little Foot" inner cranial anatomy add an important perspective for the reconstruction of the evolution of early human ancestors in South Africa.

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Poster Presentation Number 55, Th 18:15-19:00

Spinal posture and pathology, evolutionary aspect

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Humans are the only living hominoid that habitually stands upright and walks on two legs. The adoption of erect posture as the habitual posture posed substantial changes on spinal morphology and biomechanics. One of the major morphological changes is the increased curvatures found in the human spine. There is an ongoing debate whether humans "pay" for becoming bipedal by suffering from a high prevalence of back pain and spinal pathology. The purpose of this paper is to explore the interaction between sagittal spinal posture, spinal pathologies, back pain and health-related quality of life. If indeed, individuals with larger spinal curvatures suffer from a higher prevalence of spinal pathologies it will support the notion that humans are "paying" for becoming bipedal by experiencing spinal pathology and back pain. If, on the other hand, individuals with smaller spinal curvatures suffer from a higher prevalence of spinal pathologies, than it could suggest that humans that are less adapted for bipedalism are "paying" for not becoming fully adapted for bipedalism. If increased or decreased spinal curvature is not related to higher prevalence of back pain and spinal pathologies, than back pain and pathology in humans most probably results from other factors not related to the acquisition of erect posture and bipedalism.

Methods: In order to answer this question, we explored the interaction between sagittal spinal posture, spinal pathologies, back pain and health-related quality of life, based on existing literature.

Results: Our findings indicate that there is an interaction between spinal posture and spinal pathology. This interaction is not a simple one-way relationship between posture and pathology, but rather a more complex one. Different interactions exist between pathology and posture; some spinal pathologies associate with low pelvic incidence and low lumbar lordosis (disc degeneration and herniation), some pathologies associated with high pelvic incidence and high lumbar lordosis (spondylolysis and isthmic spondylolisthesis), other pathologies associate with either high or low pelvic incidence (facet joint osteoarthritis), or with a combination of high pelvic incidence and low lumbar lordosis (degenerative spondylolisthesis). Even when we consider back pain and quality of life, the picture is complex. We found that more neutral postures (moderate pelvic incidence and spinal curvatures) associate with higher quality of life and less pain. The extreme postures with high or with low curvatures associate with lower quality of life and a higher incidence of back pain.

Conclusions: We found that spinal posture closely correlates with spinal pathology. Individuals with well-aligned spine - within the neutral zone (moderate spinal curvatures and line of gravity close to the acetabulum) -will have a better quality of life, less back pain, and less spinal pathology. Individuals out of the neutral zone, with accentuated or with decreased pelvic incidence and spinal curvatures, are at a higher risk for developing spinal pathology, back pain and reduced quality of life. All of this indicates that humans are "paying a price" for adopting an erect posture and bipedalism, both the accentuated human morphology and the "not fully adapted" human morphology have more spinal pathology and back pain than the average population.

Poster Presentation Number 30, Th 19:00-19:45

How much musculoskeletal variability did Neandertals accumulate? The study of the lower limbs entheses of the Neandertal sample from El Sidrón, Asturias, Spain.

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The Neandertal sample of El Sidrón (Asturias, Spain; about 49,000 y.) consists of more than 2,500 human remains deriving from a single archeological deposit. All of the skeletal parts are represented and at least 13 individuals (one infant, two juveniles, three adolescents, and seven adults) have been identified. The lower limbs are represented by 166 specimens in various state of conservation [1,2]. The aim of the work is to study the variability of the muscular and ligament imprints (entheses) and joint features of the lower limbs (femurs, tibiae, patellae) of those Neandertals utilizing our scoring standardized methods developed on modern European samples [3]. Actually, we recorded the entheseal changes of the m. gluteus maximus, vastus medialis and lateralis (femur), of the m. soleus and of the patellar ligament (tibia) and of the quadriceps tendon and insertion sites of the m. vastus medialis and lateralis (patella). The fragmentary status of the specimens allowed recording the features of the standard on nine femurs, four tibiae and five patellae. In previous studies of the Neandertals of Krapina (Croatia, 130,000 y.) a particular morphology of the entheses of the muscles gluteus maximus and vastus lateralis exceeding the modern human variability has been observed [4,5]. Therefore, a comparison of the muscular imprints of some muscles (gluteus maximus, vastus medialis and lateralis) among the Neandertal of El Sidrón, those of Krapina (Croatia, 130,000 y.) and modern European identified (for sex and age) collections (subadults and adults), all studied with the same methodologies, has been carried out. This allowed us to appreciate the range of variability within the Neandertals of El Sidrón and more generally between Neanderthals and modern Europeans. Finally, some features more frequent in the youths and young adults in the modern sample (e.g. the persistence of the epiphyseal scar and the so-called Allen fossa in the anterior face of the femoral neck) contribute to provide additional information about the age-at-death of some Neandertal specimens of El Sidrón. Our results on some musculoskeletal features show that the Neandertal European variability seems wider compared to that of the modern Europeans. This higher variability at least for some features, could contribute to characterize different European Neandertal populations. The results need to be confirmed enlarging the Neandertal samples and more generally those of Middle and Upper European Pleistocene.

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Poster Presentation Number 18, Th 19:00-19:45

Human or Neanderthal? A multi-disciplinary study in search of the makers of the Uluzzian technocomplex in Upper Palaeolithic Italy

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The arrival of anatomically modern humans (AMH) in Europe and the demise of Neanderthals in the transition from the Middle to the Upper Palaeolithic (MP-UP) have long been causally linked. Towards the beginning of this transition, archaeological evidence attests to the appearance of new technocomplexes, but controversy surrounds the identification of their makers. The Uluzzian technocomplex is a poorly understood lithic industry dating to between 45-40ky BP, with few confirmed sites to its name, and all confined to Italy and western Greece (Klissoura) [1]. Two teeth found in Uluzzian levels of the site of Grotta del Cavallo (southern Italy) and previously attributed to Neanderthals, were positively identified as AMH in 2011, supporting the notion that moderns made this industry as early as 45,000 cal. BP [2]. However, a number of archaeologists oppose this finding based on doubts over the stratigraphy and taphonomy of the site, claiming that further investigation is needed to make concrete conclusions [3]. The makers of the Uluzzian remain to be confirmed with more definitive evidence. This paper aims to fill this gap by analysing Uluzzian fragmentary bones from Castelcivita (n=295) and an unpublished site, Riparo Broion (n=743), using a similar approach to that of Welker et al. [4] and Brown et al. [5]. The sites are from the north and south of the Italian peninsula. This multidisciplinary approach involves the use of ZooMS (Zooarchaeology by Mass Spectrometry), a method of collagen fingerprinting to identify bone assemblages to a species-, genus- or family-level. aDNA sequencing will be applied to those identified to the family 'Hominidae' to ascertain whether it is a Neanderthal or AMH, as ZooMS is unable to make this distinction. ZooMS has also proven to strongly correlate with collagen preservation, a useful indicator for radiocarbon dating and aDNA sequencing. As bone diagenesis at Castelcivita has been established as poor based on previous attempts to radiocarbon date bones from the cave, %N content will be assessed in conjunction with the ZooMS samples. For radiocarbon dating and aDNA sequencing to proceed, a %N value of around 0.7% would be sufficient. In addition to the two Italian sites, a parallel study will also be undertaken on bone retouchers discovered in three Belgian cave sites from the same period: Trou du Diable, Trou Al'Wesse and Engihoul Cave. A large number of these bone retouchers (n=128) have been tested and shows great potential for further hominin finds in Europe based on the identification of retouchers at the nearby cave site of Goyet, as Neanderthal and even AMH in origin. The aim of the research is to identify a hominin/s but, of course, this might well not eventuate. In addition to this, using the highest collagen-yielding samples taken from Castelcivita, hydroxyproline and ultrafiltration pretreatment methods will be applied for AMS radiocarbon dating to improve the chronology of the Uluzzian layers. The ZooMS data will also be compared with the faunal dataset for Riparo Broion from the Mousterian and Aurignacian layers to seek an understanding of changes in subsistence between the different cultural complexes. In addition, the Belgian retouchers will be identified to species/genus, the first time this has even been achieved. This will tell us a great deal regarding the range of faunal remains used as retouchers and determine whether the selection process was random or directed.

This project is a soon-to-be-completed dissertation for a Masters in Archaeological Science at the University of Oxford, and is funded by the Palaeochron project led by Prof. Tom Higham. Thanks are owed to the staff in the Research Laboratory for Archaeology and the History of Art for their wisdom and aid in the labs.

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Poster Presentation Number 10, Th 19:00-19:45

At the threshold of the Last Glacial Maximum in southwestern Iberia: new evidence from the site of Vale Boi (Portugal)

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The archaeological site of Vale Boi is one of the main references for prehistoric human occupation in Southern Iberia [1]. Excavated since 2000, it has revealed, in the several intervened loci, a complex stratigraphy with a complete Portuguese Upper Paleolithic sequence [2]. Since 2012, a new group of units in the Terrace loci have been excavated with the intention of understanding with greater detail the intricate stratigraphy associated with the earlier levels of occupation. This work has isolated a series of archaeological horizons that had not been identified before. One of these horizons was radiometrically dated to c. 20.8-20.3 ka BP, an age corresponding in other regions to the beginning of the Solutrean techno-complex. However, the artefacts collected from this horizon did not reveal the presence of the typical invasive retouch or bifacial elements that characterize the human adaptations to the Iberian Last Glacial Maximum (LGM). It revealed instead a group of elements attributed to the Proto-Solutrean phase, including Vale Comprido points, one of the type fossils associated within this techno-complex. In this poster we present the results of the lithic artefacts analysis from this archaeological horizon, as well as the 3D spatial analysis of the materials and its relation to the rest of the deposit. Spatial analysis results show that, contrary to the litho-stratigraphic units located above, which are mostly composed of colluvial sediments coming from the slope, Proto-Solutrean horizons are well-demarcated within the stratigraphy, due to their higher propensity for horizontality, higher concentrations of organic remains, and a notably denser presence of stone artifacts. The technological analysis of lithic materials revealed significant changes in the management and exploitation of the abiotic resources, when compared with the published data for the Gravettian and Solutrean [3][4]. The introduction of different raw materials, namely the use of Dolerite for Vale Comprido point and blank production, the high frequency of retouched tools and lower occurrence of cortical elements seem to point towards a change in the occupation patterns of the territory, that may have been related to the environmental changes that occurred during this first phase of the LGM. Finally, the correspondence of Vale Comprido materials with radiocarbon dates of c. 20.8 ka and 20.3 ka BP, does not match, according to traditional chronological subdivision [5], the traditional dates for the Proto-Solutrean elsewhere, implying that that technology may have lasted until much later in southern Portugal than in the rest of Western Iberia.

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Poster Presentation Number 60, Fr 19:00-19:45

Playing patterns in Prehistory as a proxy for language structure: Neanderthal versus Modern Human Children

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Large vocabularies and complex syntax are features commonly found in many modern, widespread languages like English and Russian. These linguistic features require a high cognitive demand on the part of the language user, and are thought to result from a longer learning period during childhood, as well as from enhanced teaching efforts by adults. Putting it differently, complex languages might have emerged only after the expansion of human childhood and the enhancement of human sociability, which increased language learning opportunities for children. This change, in turn, supported the child-directed enhancement of linguistic input which helps to ensure children's mastery of complex linguistic systems. Although differences in the cognition of Neanderthals are inferred from variances in their skull and brain anatomy, presumably impacting on their linguistic communication systems, we cannot rule out the possibility that their socialization patterns also shaped the structure of their languages. In this paper, we investigate the use of playing behavior as a proxy for language structure in the Palaeolithic. We infer aspects of Neanderthal and Modern Human childhood from their symbolic material culture and explore whether the shorter childhood experienced by Neanderthals (with the implied restrictions on time to experiment and innovate) may have had an impact on the structure of their languages. We will consider several lines of evidence: i) typological research supporting the view that some structural features of languages might be aesthetically-motivated; ii) the effect of conventionalised play (as in nursery rhymes and games) and spontaneous play on language acquisition; iii) the effect of a prolonged childhood on language learning and teaching; and iv) the nature of language deficits observed in cognitive disorders entailing abnormal playing patterns. We conclude that the increased playing behaviour likely exhibited by Late Pleistocene Modern Human children as compared to Neanderthal children might result from their longer childhood, and ultimately, from human self-domestication, which most likely was exacerbated in Late Modern Humans.

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Poster Presentation Number 37, Fr 18:15-19:00

Molar biomechanics and dietary ecology of *Australopithecus africanus* and *Paranthropus robustus*

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Diet is the most influential single parameter in primate evolution. In hominins, it is hypothesized to be a driving factor in craniomandibular and dental adaptations, driving some clades to become more robust while others become more gracile. Dietary reconstructions of the South African Plio-Pleistocene hominins *Australopithecus africanus* and *Paranthropus robustus* point towards largely overlapping, but distinct dietary ecologies. Specifically, *A. africanus* consumed more savanna resources, used its incisors more, and ate foods that wore its molars less, as is evidenced by carbon isotopes, dental microwear, and dental topography. The larger masticatory muscle attachment sites, thicker molar enamel, and lower, more bulbous cusps have led some to argue that *P. robustus* had molars adapted to consuming more mechanically challenging foods, but the relationship between dental form and function remains largely untested. To test for differences in molar function, replicas of 32 lower second molars (n=17 *A. africanus*, n=15 *P. robustus*) showing low levels of wear (quantified using Scott's wear score) were 3D printed and placed in a universal tester, where the force (Newton) and energy (Joules) to fracture a proxy food item (gelatin blocks) was recorded. As fracture is a stochastic process, we ran five trials per specimen. We constructed Bayesian mixed effect linear models to normalize for the random effects of specimen and dental wear and investigated species level differences in force and energy to fracture. Results show *P. robustus* required 27% more force and 17% more energy to fracture the gelatin blocks, presumably because the *A. africanus* molars concentrate energy and bite force around a crack tip, instigating crack initiation, more efficiently than *P. robustus*. These results indicate that, for a given diet, *P. robustus* would have needed larger chewing muscles to expel more force and energy during mastication, and larger teeth/thicker enamel to resist these higher masticatory forces. This decrease in masticatory efficiency in *P. robustus* may indicate the consumption/mastication of high calorie foods that do not require high chewing efficiency (e.g., animal protein) or that the changes in craniomandibular and dental complexes do not represent dietary adaptations.

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Poster Presentation Number 40, Fr 19:00-19:45

Climatic challenges shaped the pattern of the Neolithic expansion into Europe

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Recent ancient DNA evidence gives strong support to the hypothesis that the Neolithic transition in Europe was driven by the rapid dispersal of Near Eastern farmers, and not solely by cultural diffusion. On the other hand, the steady accumulation of archaeological data suggests an irregular pace of expansion, with a marked slowdown at higher latitudes. This decrease in expansion speed in Northern Europe has been alternatively explained by 1) stronger resistance from local foraging communities, possibly characterised by higher population densities at higher latitudes, 2) a shift from demic to cultural diffusion, or 3) a direct effect of colder climatic conditions on the subsistence of agricultural populations. In this study, we test the hypothesis that climate played an important role in determining the pace of arrival of agriculture throughout Europe. We assembled a large database of 1,375 archaeological dates of first arrival of food production across the continent, to quantify the expansion dynamics. We expanded the freely available dataset of Early Neolithic radiocarbon dates for Europe and the Near East published by Pinhasi et al. [1], by updating the existent entries and adding new ones from studies published between 2005 and 2015. We confirm the presence of a parallel slowdown along most of the expansion axes, and specifically the axes that crossed a climatic threshold in terms of quality of the growing season. The climatic threshold associated with the decrease in expansion speed relates to summer temperatures and the number of Growing Degree Days (GDD) available over the year, suggesting that the crops cultivated by early farmers might have struggled in higher latitudes. This same threshold is also reflected in the amount of mixing between incoming farmers and local hunter-gatherers, as estimated from ancient DNA, suggesting that lower or more unreliable crop production in these regions might have led to closer interactions between the two groups. By combining archaeological, palaeoclimatic and genetic information, we propose a coherent picture of how climatic challenges affected the spread of farming into Europe and the degree of interaction with hunter-gatherer communities.

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Poster Presentation Number 39, Th 18:15-19:00

The molecular evolution of human-specific facial traits and socio-cognitive profile: Insights from neurocristopathies

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Changes in facial anatomy in modern humans have been argued to be indicative of a modified socio-cognitive profile. Specifically, it has been pointed out that anatomically modern humans exhibit a suit of characteristics commonly associated with the range of anatomical changes that domesticated species display (1). Accordingly, aspects of modern human anatomy could be illuminated by studies of the "domestication syndrome", which has been claimed to arise from a neural crest deficit (mild neurocristopathy) (2). While Darwin already suggested that humans had gone through a process of self-domestication, the genomics revolution, particularly the reconstruction of ancient genomes, offers unprecedented opportunities to test hypotheses such as that of self-domestication (1). Here we build on our detailed work on neurocristopathies such as Williams Syndrome (2), where patients are hypersocial, to open up new ways of elucidating key aspects of the molecular circuitry critical for the evolution of modern social cognition and facial morphology. By combining our results from stem cell modeling of neurodevelopmental disorders (2) and detailed paleogenomic comparison between ancient and modern humans (4), we zoom in on a specific gene, BAZ1B, that shows a mutation enrichment in modern humans compared to archaics, and is one of the top candidate genes for Williams Syndrome. We have engineered Williams Syndrome induced pluripotent stem cell lines to validate, by disruption or rescue, the gene regulatory network hubs that we identified as key downstream mediators of the Williams Syndrome genes critical for sociality and facial morphogenesis, and study the overlap between this network and specific genes showing mutation enrichment in our modern lineage. Among these we find not only BAZ1B, but also several of its targets. These enable us to reconstruct specific biological pathways that helped shape our 'modern' face and core aspects of our modern behavior, including our ultra-sociality. Our study serves to demonstrate that we can exploit paleogenomics to test predictions for complex phenotypes like social cognition, when combined with carefully chosen model systems for specific, if atypical, developmental phenotypes such as Williams Syndrome.

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Poster Presentation Number 44, Th 19:00-19:45

CT-scan data of juvenile pelvises : application for 3D fossils reconstruction

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Hominin pelvic fossils are rare, and many belong to juveniles or adolescents, including MLD 7/8/25 and Sts 14 (*Australopithecus africanus*) [1], MH 1 (*A. sediba*), KNM-WT 15000 (*Homo erectus*) [2, 3], as well as U.W. 101-1088 and other fragments attributed to *Homo naledi* [4]. The interpretation of their morphology is complicated because the complete ossification of the hominin hipbone occurs late in development. The cartilaginous parts, which provide the connectivity between the different pieces of the hipbone in the pelvis of children and juveniles, are typically absent in osteological collections, with the hipbone being generally preserved as separated bones, i.e., the ilium, the ischium, and the pubis, in addition to the unfused sacral segments. The cartilage of the triradiate suture, where the ilium, ischium and pubis meet in the acetabulum, but also the symphyseal fibrocartilage and the cartilage of the sacro-iliac joint progressively ossify with increasing age. Without knowledge of these cartilaginous features and the relative positioning of the bones *in vivo*, it is difficult to have an overview of the geometry of the entire pelvis [5], and functional interpretations and assessment of sex characteristics are hampered. In order to improve our understanding of pelvic growth, both in terms of ontogeny and phylogeny, consideration of the different bones of the pelvic girdle as a whole is crucial. With the rapid development of three-dimensional imaging, it becomes increasingly important to have precise age-normative data. However, three-dimensional data on the post-natal growth of the entire pelvis are currently scarce because of the limited availability of forensic or clinical CT scan data of subadults. In this study, CT scan data of a sample of 68 children and juveniles aged 0 to 20 years were analysed that preserve the relative three-dimensional orientations of the bones and the cartilaginous geometry as observed *in vivo*. The CT scans were acquired during clinical routine for reasons unrelated to this study using a Siemens Scanner definition bitube. Using this singular sample, we focus here on the development of the triradiate suture. This information is essential to improve the three-dimensional reconstruction of juvenile fossils such as the pelvis of KNM-WT 15000 [2, 3]. Moreover, it has important implications for biomechanical modelling, such as via finite element analysis (FEA).

The data acquisition was performed in collaboration with the department of radiology of the Hospital La Timone (Marseille, France). Financial support was provided by the Swiss National Science Foundation grant No. 31003A_176319.

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Podium Presentation Session 3, Th 15:40

Pitfalls and opportunities in pinpointing the origin of modern humans — a numerical study

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Hominin evolution and the concomitant process of emergence and spread of anatomically modern humans (AMH) is characterised by diversification and migration waves, with more or less interbreeding with other local hominins (such as Neanderthals in Europe and Denisovans in Asia), depending on the preponderance of assortative mating. Our stochastic numerical model (presented at the ESHE meeting in Leiden, 2017) shows that such migration waves tend to follow power-law area distributions: for every large wave there are many more small ones. In the absence of outside forcing, such as climate variations, the largest migration waves are most likely to emanate from the largest compact populated area, which was the African continent by the middle/late Pleistocene. The second-most likely origin of migration waves is East Asia (China). Our stochastic simulations result in bushy trees due to parapatric differentiation, but also show a range of many small and a few large, distinct reduction in diversity events as a result of population movements and bottlenecks. In addition to natural selection and/or genetic drift, speciation could also result from the accumulation of multiple mutations. The emergence of new (sub-) species can be the result of the accumulation of multiple mutations, but also natural selection and/or genetic drift. Mutations may occur at various locations in space and can spread by Fisher-type diffusion. When sufficient mutations have accumulated in a population, giving it an evolutionary advantage over neighbouring populations, a large migration wave may occur. One advantage of the model is that the presence of each mutation can be traced in space and time. This reveals the spatio-temporal patterns of the emergence of new (sub-) species at the origin of large migration waves. Unfortunately, the fossil record severely under-samples these patterns, which hampers our attempts to constrain the hominin phylogenetic tree. By sampling a limited number of individual model populations (where each can be regarded as a "virtual" fossil) in space and time and subjecting these to standard phylogenetic analyses, we simulate the effect of possible events in the human fossil record. The simulations show that, when sampling is sparse, it is difficult to accurately pinpoint the site and timing of a migration wave initiation. Populations accumulate the mutations that finally contribute to the development and emergence of a wave ancestor. Afterwards, populations gradually differentiate from that ancestor again. As long as the fossil sample size is small, each newly discovered specimen from a new location and age may significantly modify the interpreted phylogeny or the inferred ancestor and origin of the migration sweep. The fossil record is not only sparse, but also strongly biased by archaeological visibility, geological and taphonomic conditions. The problem is aggravated by repetitive exploration in areas where fossils have been found, for example East Africa. Several such biased sampling scenarios were simulated. Increasing sample size by biased sampling does not necessarily improve the level of confidence that the inferred phylogeny is correct (cf. the Popperian analogy that counting more white swans does not increase the validity of the hypothesis that all swans are white). Our simulations thus suggest that the available, sparse fossil record and the bias towards East African exploration may influence paleoanthropological interpretations towards an overestimation of the role this geographic area and environment had on hominin evolution, while tending to discount East Asian contributions. Further research and hominin discoveries in this part of the world could strongly alter our understanding of where modern humans originated and how they expanded across the planet.

Poster Presentation Number 64, Th 19:00-19:45

The inner craniodental anatomy of the *Papio* specimen U.W. 88-886 from the Early Pleistocene site of Malapa, Gauteng, South Africa

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Cercopithecoids represent an essential component of the Plio-Pleistocene ecosystem [1]. However, despite the abundance of the cercopithecoid fossil remains in African Plio-Pleistocene deposits, the chronological and geographic contexts from which the modern baboon lineage (i.e., *Papio hamadryas* ssp.) emerged are still debated or simply unknown [2]. The recently discovered U.W. 88-886 *Papio* (*hamadryas*) *angusticeps* specimen from the *Australopithecus sediba*-bearing site of Malapa, Gauteng, South Africa, may represent the first modern baboon occurrence in the fossil record [3]. Given the implications of U.W. 88-886 for our understanding of the evolutionary history of the *Papio* lineage and of cercopithecoids in general, we use micro-focus X-ray tomography in this study to investigate the inner craniodental anatomy of this critical specimen and provide additional evidence to discuss the origins of modern baboons.

U.W. 88-886 was scanned by X-ray microtomography at the Palaeosciences Centre of the University of the Witwatersrand in Johannesburg (South Africa) with a spatial resolution of 44.4 μm. As comparative material, we investigated 7 fossil papionin taxa (N=10) selected from different stratigraphic units at Kromdraai, Makapansgat, Sterkfontein, Swartkrans and Taung, currently housed at the University of the Witwatersrand in Johannesburg and at the Ditsong National Museum of Natural History in Pretoria (South Africa) [4, 5]. Additionally, we considered a representative sample of 12 extant species from the American Museum of Natural History in New-York (USA), the Muséum d'Histoire Naturelle of Toulouse (France), the Muséum National d'Histoire Naturelle of Paris (France), the Royal Museum for Central Africa in Tervuren (Belgium). Because of their potential for providing taxonomic and phylogenetic-related information, we explored (i) the sulcal imprints from the endocranial surface and (ii) the tissue proportions and the topographic distribution of the dentine in the distobuccal root of the right upper third molar. The endocast and the root of the right upper third molar were virtually reconstructed by combining semi-automatic and manual segmentation techniques. The sulcal imprints were automatically detected from the endocast [5]. We computed absolute (ADT) and relative (RDT) dentine thickness and virtually rendered the topographic distribution of the dentine by using color maps.

The sulcal pattern in U.W. 88-886, including the occipito-temporalis, subcentralis anterior and temporalis medius anterior and posterior sulci, is similar to the pattern revealed in the endocasts of extant *Papio* and extant *Theropithecus* specimens. The ADT (2,76 mm) and RDT (187,88 mm) values fall within the variation observed in extinct (2,34-3,59 mm) and extant (150,47-224,09 mm) *Papio* specimens, respectively. In terms of dentine thickness distribution, the relatively thick mesiobuccal aspect is compatible with the condition reported in this study for extinct *Papio* specimens.

Consistent with the description and metrical analyses of the external cranial morphology by Gilbert et al. [3], the overall inner craniodental anatomy of U.W. 88-886 approximates the condition of Plio-Pleistocene and modern *Papio*, thus supporting an attribution to *Papio* (*hamadryas*) *angusticeps*. Interestingly, the absolute dentine thickness and distribution in U.W. 88-886 fit more closely the condition of extinct *Papio*, while the sulcal pattern and relative dentine thickness are more similar to the condition of extant *Papio*. Besides providing additional evidence for characterizing the South African fossil papionin craniodental anatomy, our study sheds new light on the polarity of craniodental features in the papionin lineage.

The Evolutionary Studies Institute Fossil Access Advisory and L. Berger for access to the U.W. 88-886 specimen; S. Potze, J. Cuisin and G. Fleury for comparative material; G. Clément and M. Garcia-Sanz for acquisitions at the MNHN; B. Duployer at the CIRIMAT; L. Bam and J. Hoffman at Necsa; J. Braga and J. Dumoncel for scientific discussion; the Occitanie Region and the French Ministry of Higher Education and Research for funding.

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Poster Presentation Number 22, Th 19:00-19:45

Zinc isotopes as a dietary indicator for archaeology and paleontology: Insights from a Southeast Asian Late Pleistocene food web

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Measurement of nitrogen stable isotope ratio of bone collagen (δ15N) is an established method for dietary reconstruction and trophic level assessment. It is unfortunately limited by the preservation of protein (1). With recent developments in mass spectrometry, however, the application of non-traditional stable isotope systems (e.g. Ca, Cu, Fe, Mg, Sr, Zn) is now possible, opening up new research avenues to trace diet in archaeological contexts. Recently, the use of the zinc (Zn) isotopic composition (66Zn/64Zn, expressed as δ66Zn) of bioapatite (dental enamel) have been explored and represents a promising dietary indicator similar to what δ15N yields (2,3,4,5). Contrary to δ15N, the δ66Zn of an animal's body tissues decrease along the food chain, the higher the trophic level of an animal is (2,3,4,5). Zinc is incorporated in the enamel bioapatite and thus has a better long-term preservation potential compared to collagen-bound nitrogen.

Here we report the measurements of zinc (δ66Zn), carbon (δ13C) and strontium (87Sr/86Sr) in enamel bioapatite of mammals from the Southeast Asian Pleistocene fossiliferous site of Marklot, Xoneuna city, northeastern Laos. A total of 66 specimens, belonging to 22 different mammal taxa, were analyzed in this study. Our aim here is to assess if δ66Zn values and trophic level differences, observed in modern food webs, are also preserved in fossil assemblages. The large range of taxa, exhibiting a broad range of dietary habits, present at Marklot offer a unique opportunity to study zinc isotopes as a dietary proxy on fossils. The potential influence of the bedrock geology on δ66Zn values will be assessed by strontium isotope analysis. The combined use of δ66Zn and δ13C, carried out for the first time, will also be explored in order to attain a higher level of food traceability, both for carnivorous and herbivorous diet. Finally, various diagenetic tests (Zn concentration profile, Zn concentration and stable isotope composition mixing line) will be presented to assess the impact of post mortem taphonomic processes on the preservation of diet-related zinc isotope values.

As expected, trophic level differences in δ66Zn values are observed, with herbivores and carnivores having high and low δ66Zn values, respectively, separated by omnivores in between. The impact of the bedrock geology on δ66Zn values appears to be very limited, at the very least on a regional scale. The combined study of δ66Zn and δ13C enabled a clearer distinction between food sources, effectively differentiating distinct diets (i.e. amount of ingested animal or plant matter and its type of carbon source from C3 versus C4 biomass) through δ66Zn values within a similar δ13C range, and vice versa. Finally, the clear trophic spacing as well as the diagenetic tests performed both demonstrate that the impact of post mortem taphonomic processes on the preservation of diet-related zinc isotope values is, at the very least, negligible if not entirely absent. Our results shed light on the variations at play behind zinc isotopic values in enamel bioapatite. They also demonstrate the validity of Zn isotopes and their potential as an additional new dietary and trophic level tracer in archaeology and paleontology.

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Pecha Kucha Presentation Session 2, Th 11:55-12:20

Identifying correlates of diet in the primate torso: A case study in iliac flare

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Two particularly influential hypotheses—the expensive tissue hypothesis [1] and the cooking hypothesis [2]—suggest that differences in torso shape between *Australopithecus* and *Homo* reflect a reduction in gut size following a substantial increase in diet quality in the latter genus. Intuitively, this assumption make sense because animals that eat diets rich in green plants have relatively large guts, and animals that primarily rely on animal prey have relatively small guts [3]. However, before accepting the hypothesis that differences in torso shape among hominin species reflect substantially different diets there should be comparative evidence from extant primates that torso shape carries a dietary signal.

One of the features assumed to reflect diet and gut size differences in hominins is iliac flare, or the lateral expansion of the upper ilium relative to the lower ilium [1]. Several studies have shown that the upper ilium scales with positive allometry and is influenced by locomotion [e.g., 4], but across primates it is unclear how lower ilium width scales with body size, and how lower ilium scaling affects iliac flare. If the hypothesis described above is correct, it would be expected that species with relatively larger guts (e.g., *Alouatta* spp., colobines, *Gorilla* spp.) will have greater iliac flaring than other species. Here, we use phylogenetic generalized least squares (PGLS) regression to test how upper and lower ilium widths, and the ratio of these two measurements ('iliac flare') scale with body mass in 37 anthropoid species (N = 192 individuals). PGLS regression was also used to examine the relationship between iliac flare and gut size for the 24 species in the sample for which these data are available. Data on gut size (the summed surface area of the stomach, small intestine, caecum, and colon) and body mass were collected from the literature [3,5].

Our results support previous observations that upper ilium width has a positive allometric relationship with body mass. However, lower ilium width scales isometrically with body mass, so when the two effects are combined it results in differences in iliac flare, but there is no relationship between flare and body mass when apes are excluded. These results suggest that posture and locomotion are more likely to influence iliac flare variation across primates. Flaring among the pronograde quadrupeds in this sample does not seem to be constrained by body size or gut size, but the relationship within the apes suggests that flaring could be an indicator of gut size among more orthograde primates. But this result may also reflect a relationship between gut size and body mass, or the influence of locomotion on the ilium.

Data on gut size from wild, adult individuals is limited, so future analyses will explore how dietary proxies other than gut size (e.g., percent feeding time on specific food items) co-vary with torso dimensions, while accounting for body size and locomotion.

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Podium Presentation Session 3, Th 14:20

Early *Homo sapiens* postcranial fossils from Middle Awash, Ethiopia

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The emergence of anatomically modern humans has long been an active area of inquiry within the realm of human evolutionary studies. However, our understanding of early modern human anatomy and evolution has always been limited by the known fossil record, which at present samples our lineage's evolution irregularly across geography and through time. As an additional complication, the fossil record is overwhelmingly craniodental, and postcranial fossils are usually fragmentary and isolated, often constraining studies of skeletal biology such as body size and proportions. Considering these limitations, additional fossils, and particularly individual skeletons, are necessary to further resolve the details of early modern human evolution.

The Middle Awash project has recovered an early *Homo sapiens* partial skeleton from a Middle Stone Age archaeological context at Halibee, preliminarily dated to 100 kyr [1]. Much of the skeletal anatomy is preserved, including portions of the vertebral column, shoulder and pelvic girdles, all long bones, and several hand and foot elements. In addition to this single skeletal individual are various isolated fragmentary postcranial elements (n=5 individuals) from the same sedimentary package. These fossils are associated with a very rich Middle Stone Age assemblage and are part of a large and diverse faunal assemblage, situating the fossils within behavioral and ecological contexts.

Inferring the relationships between Middle Pleistocene fossils and later modern humans has been complicated by the sparse and erratic nature of the Pleistocene fossil record, particularly in the case of the postcranial evidence. The chronological and geographic position of the Halibee fossils makes them crucial for understanding the evolution of modern human anatomy, as it places them within a population ancestral or closely related to anatomically modern humans. These fossils therefore provide a lens through which we can examine the evolution of modern human anatomy.

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Poster Presentation Number 52, Th 19:00-19:45

Predicting age at death from the shape of the human pubic symphysis by bandpass filtering of bending energy

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In forensic anthropology, establishing the biological profile is the first and most crucial step toward successful identification. One of the most difficult parameters to estimate with accuracy is age at death. For this purpose, we exploit the state of development of the pubic symphysis, due to its robustness, to be extended by parallel analyses of other remains (cranial sutures, dental wear, fourth rib state) when available. Our proposed method is based on contrasts between the process of osteogenesis in the first 30 years of life and the later degenerative processes of aging, during which the shape of the symphyseal surface changes notably. A purely visual classification of this progression is unreliable. The use of a surface scanner to model the pubic symphysis makes it possible to carry out this task objectively even when faced with fragmentary remains.

For this demonstration we used an Artec Spider (Artec Group) to analyze a sample of more than 600 individuals aged between 14 and 82 years from the collection of the Laboratory of Anthropology at the University of Granada, all of them Mediterranean and from the last century; Each pubis was landmarked following a 102-point template of two fixed landmarks on the top and the bottom of the symphysis along with 100 surface semilandmarks. From the male sample of valid 102-point representations we selected the 381 specimens within Procrustes distance 0.05 of the side-specific average, rotated to the standard GMM basis of partial warp scores, and then, separately by side for ages under 60, correlated age with summed squared PW amplitudes over a wide range of plausible bandpass filters omitting the uniform term. Peak correlations were -0.51 both for the PW1-PW6 band on the right side and for the PW1-PW7 band on the left side, and the geometry of singular warps PW by PW was virtually identical between the two analyses. Thus, there is a strong age signal in symphyseal surface shape that is not a reduced roughness per se but rather a flattening at large scales. These results are already better than with the currently standard methodology. The method is implemented in a version of the easy-to-use R statistical software package, making it easy to combine with other modern geometric morphometrics methods.

Further work will extend these analyses to females, improve the accuracy of surface digitization, and generalize to other forensic anthropological tasks.

Pecha Kucha Presentation Session 6, Fr 11:30-11:55

Early MIS 5 lithic technology at Klasies River, South Africa

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Middle Stone Age research mostly focuses on innovative periods, such as the Howiesons Poort technocomplex. But what were the technological traits leading to these phases of innovation? The analysis of MSA assemblages dating to MIS 5 could be the key to that question. Klasies River contains an extensive MSA sequence and the current Witness Baulk excavation allows for an in depth and detailed investigation of variability. In this paper two phases are recognized within the MSA II or Mossel Bay technocomplex, the pre-MIS 5c phase occurring in layer SMONE; and the earlier phase in layer BOSONE, that appears to be a transitional industry. Within the two phases that are discussed, a common tradition occurs, but with variability in core reduction sequences and end product morphology. The stability of one main reduction sequence in each phase speaks for a long-term technological tradition at this locality. Antecedents to technological elements of MIS 4 already occur in rudimentary forms during MIS 5, e.g. be in the persistent presence of platform blade cores and a small amount of narrow-faced bladelet cores. They can be viewed as roots which lead to the later innovations seen widespread throughout South Africa. Porraz and colleagues [1] propose the hypothesis, that a ”coexistence of multiple, distinct technological traditions” during MIS 5 lead to the burst of innovation during MIS 4-3 in the Still Bay and Howiesons Poort techno-complexes. This model suggests a regional origin of later MSA techno-complexes without a major new population influx [1:3376]. Other researchers like Douze and colleagues [2] also see MIS 5 technology as the root of later innovations in the MSA. Additionally, they [2] conclude that assemblages from different sites on the south and west coast of South Africa (Klasies River MSA II, Pinnacle Point 13B, Diepkloof MSA Mike and Blombos Cave M3 phase) show a common regional techno-complex, that is observably different from other sites. The characterization of this proposed techno-complex described for the Cape region is based on similarities in raw material usage, a dominant parallel core reduction method in combination with other reduction methods of lesser importance, the predetermination of blanks (mostly points) and a minor proportion of retouched tools, of which notches and denticulates are dominant [2]. This detailed study focussing on core reduction sequences and blank morphology of MIS 5 lithic assemblages from Klasies River aims to characterize the variability as well as stability. The results are used to test the proposed hypothesis of Porraz and colleagues [1] of distinct local long-term traditions in technology during MIS 5.

Supervisor Prof. Sarah Wurz, University of the Witwatersrand and the National Research Foundation.

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Poster Presentation Number 36, Th 19:00-19:45

New craniodental remains of the type specimen of *Australopithecus sediba* and a morphological assessment of the mandibular third premolars

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Recent excavations at Malapa, South Africa, have recovered a left mandibular fragment and two associated premolars that can be refit to the previously recovered mandibular fragments of Malapa Hominin 1, the holotype specimen of *Australopithecus sediba*. Additionally, the new mandibular fragment refits with another mandibular fragment that is partially exposed in a block of matrix and presently undergoing preparation. In contrast to the only other known P3 of *A. sediba* (UW88-129 of MH2), the new P3 (UW88-246) is unworn, allowing for additional assessment of the crown outline form (size and shape) of this tooth type for *A. sediba*. The crown outlines of a sample of fossil hominin mandibular P3s were analyzed using elliptical Fourier analysis. A principal component analysis on P3 crown outlines of *A. sediba* illustrates that UW88-246 and UW88-129 plot close to the range of *Homo naledi* when the teeth are size standardized. These results suggest similarities in mesiodistal elongation and overall symmetry about the mesiodistal axis among these teeth. UW88-246, in particular, has a distally extended talonid similar to *H. naledi*. In terms of shape, the mesiolingual corners are more pronounced in *A. sediba* and *H. naledi*, and not abbreviated as is typically seen in *H. habilis*, *H. erectus*, and some *A. africanus* specimens. UW88-246 plots closest to STW 14 while UW 88-129 plots closest to UW101-1261and STS 47. These specimens are more molarized than other hominins in the sample. When the teeth are not size standardized, UW88-129 plots closer to the *H. naledi* sample than UW88-246 due to its smaller size; UW88-246 plots within the large intraspecific range of *A. africanus* while UW88-129 does not. The newly recovered premolar supports previous results indicating that *A. sediba* shares similarities with *A. africanus* and *Homo*, specifically *H. naledi*. Implications of the similarities between *A. sediba* and *H. naledi* will also be explored further in this presentation.

Poster Presentation Number 58, Fr 19:00-19:45

The FINDER project: Identifying hominin bones in the Altai Mountains using collagen fingerprinting

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The recovery of Pleistocene human fossils in general is extremely rare, especially so in Central and Northern Asia where those discovered are often too fragmentary to allow for a secure identification. This is most easily demonstrated by the problem of the Denisovans. Since their initial discovery in 2010, their geographical distribution, genetic history, and admixture into Neandertals and modern humans has been widely researched and discussed however at present they are known only from a single phalanx bone and three teeth from one site.

Using Zooarchaeology by Mass Spectrometry (ZooMS), the ERC-funded FINDER project (finderc.org) aims to address this problem by targeting assemblages of fragmented and morphologically unidentifiable bone assemblages. Recent publications have already illustrated the usefulness of applying ZooMS to the search for hominin bones [1,2,3]. Over the course of the next five years, the FINDER project will dramatically expand upon these studies, through the screening of 40,000 fragmented bones from 20 archaeological Eurasian sites using ZooMS. In doing so, this project aims to move the focus of the search for Pleistocene human remains away from morphologically identifiable fossils to the vast numbers of fragmented and non-diagnostic bones regularly excavated from archaeological sites.

Here we describe preliminary results from the Altai sites of Denisova and Strashnaya caves. These represent the first two sites intensively studied as part of the FINDER project's search for Pleistocene human remains. Both caves are key in understanding the interplay of ancient hominin populations in Northern Asia and significant, if rare, Pleistocene human remains have already been located here [4, 5].

Thousands of fragmented bones from Denisova and Strashnaya caves which had been previously excavated and stored, as they could not be taxonomically identified on the basis of their morphology, have now been analysed using ZooMS at the newly-established facilities of the Max Planck Institute for the Science of Human History, Jena, Germany. Such large scale identification of previously unutilised bone fragments opens research up to a variety of scientific methods. In order to investigate these fragments to their full potential, the FINDER project will apply a variety of techniques to examine them further, including stable isotopes to investigate diet and consumer-resource systems, radiocarbon dating to secure a direct age estimate of the bone samples, and DNA analysis to understand the genetic history of the individuals analysed.

The European Research Council and The Institute of Archeology and Ethnography, Novosibirsk.

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Poster Presentation Number 10, Fr 19:00-19:45

Stress distribution in the thumb proximal phalanx in Chimpanzee and *Homo* species during simulated stone-tool use

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The use of stone tools is not restricted to humans, as it has been reported in other primate species [e.g. 1]. However, hand anatomy varies greatly in morphology and muscular architecture in Hominoidea [2], [3], with the human hand exhibiting derived traits which have been suggested to facilitate certain manipulative characteristics linked to the production and use of tools. The scientific understanding of manipulative activities and manual dexterity in humans has a long history of debate, and several aspects remain to be learned regarding the involved biomechanics. Here, we explore stress distributions in the active hand under simulated scenarios of hammer stone use in chimpanzees (*Pan troglodytes*) and humans. Three-dimensional (3D) models of chimpanzee and human thumb proximal phalanges were created based on CT images. Using Finite Element Analysis (FEA), we calculated the stress distribution at the moment of impact between the tool and a rigid substrate, using data on muscle recruitment and hammer masses published by Marzke et al (1998) [4]. Two hammer sizes were simulated (400g and 780g). When a small hammer was simulated for humans, von Mises stresses revealed that the peak stress occurred in the center of the palmar surface of the phalanx body, decreasing towards the dorsal surface and the distal and proximal portions. The lowest stress values were found in the joint areas and dorsal part. The stress values found for the chimpanzee were lower and more evenly distributed over the bone and, similarly to the human, did not affect the joint areas. When a larger hammer was used, significant reductions were found in bone stress values, in both species. Surprisingly, under both these loading configurations, our findings indicate that the human phalanx is subject to higher peak stresses, although average stresses are lower than in the chimpanzee phalanx. This is particularly evident when simulating the use of the smaller stone hammer. Based on these results, we conclude that the human phalanx is more fragile than the chimpanzee's during these activities. This is contrary to as expected since the morphology of the human hand has been largely interpreted as a response to selective pressures related to tool use and production. We discuss possible explanations for our results and how they fit what we know about the evolution of the human hand.

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Poster Presentation Number 31, Fr 18:15-19:00

3D enamel thickness in Neandertal and modern human permanent incisors

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The study of enamel thickness distribution in living and extinct hominoids for taxonomic, dietary and phylogenetic purposes has concentrated on the permanent teeth, particularly postcanines, benefiting from novel 3D methodologies [1]. Growing attention on the anterior dentition [2] has fostered the application of a recent protocol [3] to investigate the 3D enamel thickness in Neandertal (NEA) and modern human (MH) unworn to variously worn upper and lower permanent incisors. This research aims to: 1) provide new data to discriminate between the two groups and 2) to explore enamel thickness distribution in NEA and MH incisors. MicroCT data of 88 upper (UI1=48; UI2=41) and 120 lower (LI1=54; LI2=n=64) permanent incisors from Neandertals (upper=38; lower=35), Upper Paleolithic (UPMH, upper=8; lower=13) and recent modern humans (RMH, upper=37; lower=80) at different wear stages (1 to 5 according to [4]) were segmented in Avizo 7 to reconstruct 3D digital models of the teeth. The cervical line was digitized on each 3D model in Geomagic Design X to separate the crown from the root. Volumes of enamel and of crown dentine, and the enamel-dentine junction (EDJ) surface were measured to compute 3D Average Enamel Thickness (AET) and 3D Relative Enamel Thickness (RET) indices.

Permutation tests for 3D AET values do not differ between NEA and MH (=UPMH+RMH) for all four incisor positions. Among lower incisors, mean values for 3D RET in LI1 significantly differ between the two groups for worn teeth at wear stages 4 and 5 (both $p<0.05$). For LI2, NEA and MH show significantly different 3D RET values at wear stages 1-2, 3 and 5 (all $p<0.05$).

By contrast, the upper central incisors do not differ in 3D RET values between the two groups at wear stages 3 and 4 ($p=0.13$; $p=0.34$, respectively). Due to the different sample assemblages for wear stages 1-2 and 5, statistical comparisons were not possible. The lateral upper incisors do not show significant difference between 3D RET values at wear stages 1-2 and 4 ($p=0.17$; $p=0.3$, respectively). The limited sample size for wear stages 3 and 5 only allow for a qualitative investigation, which revealed the same non discriminant result. Our preliminary results suggest that 3D RET could successfully discriminate between NEA and MH lower incisors, including worn teeth. However, while worn LI1 can be used for discrimination, due to the small sample size of unworn LI1 caution is needed when using this incisor position. The consistent findings of LI2 allow us to consider this tooth position the most effective of the four to discriminate between NEA and MH, ranging from unworn to moderately worn teeth. In comparison, both upper incisors positions do not discriminate between the two groups. Interestingly for unworn UI2, the sample is consistent for the permutation test yet 3D RET do not discriminate between NEA and MH ($p=0.1669$). In most of the tooth positions, NEA show statistically greater values for both enamel and dentine volumes, with MH showing greater variability among the single values.

We can propose that for some reasons to be determined, even though the amount of enamel and dentine volumes are generally greater in NEA, upper and lower incisors follow different configurations which results in different 3D RET discrimination. A better understanding of the enamel distribution in the incisor teeth will provide insight to better explain the results of 3D RET, as will further investigation to determine if incisor dental tissues scale with allometry. Notwithstanding, as worn teeth are more frequently found in the fossil record [5], the discriminant power of 3D RET for lower incisors may be considered as a useful tool for taxonomical purposes.

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Poster Presentation Number 47, Th 18:15-19:00

CA-LSE and AST-3D: two new digital tools for reproducing the inner cavities of skeletal elements

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The study of human evolution is currently benefiting of the availability of 3D models of unique specimens from the fossil record, as well of skeletal specimens coming from modern collections; such technologies are among the aspects on which the cutting-edge field of Virtual Anthropology relies on [1]. The possibility to work on digital specimens, actually surface meshes defined by a system of coordinates, brings along several well-known advantages, in terms of avoidance of the risks of damages, availability of the specimens themselves and ease in collecting and processing greaterdatasets. In addition, the amount of information extractable from a single specimen is increased, thanks to an easier magnification and the access to inner structures unavailable to the observation on the physical object. In the context of paleoanthropology the attention to such details in fossils dates back to Taung child's natural endocast described by Dart [2]. The inner structures and cavities of a skeletal element can often have a crucial diagnostic value. Thanks to the tools of Virtual Anthropology, in the last few years there has been an increase in the number of studies and works concerning the inner cavities: aside from the endocast, paranasal sinuses, trabecular bone and inner ear are some of the structures that are being investigated. For the study of the inner structures is usually applied a protocol which envisages the segmentation, a manual 'filling' by using masks of the cavities in sequential CT scans [3], to eventually obtain, through triangulation, a 3D mesh of the segmented area. Such protocol is time-consumingand requires an arbitrary closure of holes or gaps by the operator, thus determining the generation of some topological artefact; moreover, to be carried out, the segmentation needs expensive software (e.g. Amira, Mimics, Geomagic). In this communication, we present two new methods,Computer-Aided LaserScanner Emulator (CA-LSE) and Automatic Segmentation Tool for 3D objects(AST-3D) developed in the open source statistical environment Rand hence available for free. The two methods can overcome the issues related to manual segmentation, as time consumption and replicability, by respectively carrying out the reconstruction of the external surface and, by subtraction, of the inner ones (CA-LSE) and vice versa (AST-3D). The amount of time needed to obtain a 3D mesh is significantly reduced and the same structure can be reconstructed by different operators with irrelevant or no differences at all. We applied the methods to different specimens as example of their potentialities: a modernhuman skull from the Natural History Museum collections of the University of Florence (Italy), a malleus from a Middle Ages individual from Portico D'Ottavia (Rome, Italy), and a Neanderthal deciduous tooth from the Krapina sample (Croatia). Both the methods CA-LSE and AST-3D are embedded in the packages "Arothron" and "Morpho" [4].

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Poster Presentation Number 60, Th 19:00-19:45

A new methodological approach in the study of the differential evolution of cerebral and cerebellar fossae in recent *Homo*. Additional Data.

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In modern humans the occipital lobes contain the primary visual cortex which receives and processes visual stimuli, and also has movement and color recognition functions. The cerebellum is considered to be deeply involved in accurate and precise motor control, in coordination and advanced manipulation tasks [1], and probably in some cognitive and behavioral functions [2]. The external surface of this region is largely influenced by muscle attachments, which in turn are directly connected to bipedalism and cranial base angulation, whereas the internal surface of the bone reflects the shape and development of the contained structures. A cerebrum-cerebellum reorganization in fossil Anatomically Modern Humans (fossil AMH), with changes in the relative position of cerebellar and occipital lobes is characteristic of recent evolution [3]. The higher position of the endinion relative to the inion may indicate a reshuffle of the cerebrum-cerebellar complex. Therefore, the cerebral and cerebellar fossae can provide information related to differential evolution. However, the methodology to obtain occipital fossae's depth is not explicitly described in the scientific literature and moreover, the location of the deepest part of both types of fossae is quite inconsistent [4]. There is therefore a lack of information about this part of the bone. We propose a methodology based on endocranial landmarks that create a plane with which to measure the position of the deepest part of the fossa: it represents a curvature maxima –concavity- associated with local structures, so these new landmarks could be included in Bookstein's Type II landmarks [5]. This methodology can be used either in isolated occipitals or in crania with many missing areas, as well as in complete crania. Our hypothesis is that this information about occipital fossae may better differentiate the specimens in recent *Homo* evolution. We performed univariate, bivariate and multivariate statistical analysis (Principal Components Analysis) on raw and size-corrected data. We have added more specimens to a previous study, following the same methodology. We look at the differential evolution in recent *Homo* species, which present a more vertical occipital area than ancient fossils. Our results corroborate this derived trait; additionally, we observed a tendency towards a relative decrease in the depth of the cerebral fossae and maintenance of the cerebellar ones.

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Podium Presentation Session 8, Fr 16:30

Dental enamel proteome sequences from Dmanisi (Georgia) enable molecular phylogeny of fauna remains beyond the limits of ancient DNA preservation

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To make recovery of deep time genetic information routine, it is necessary to figure out a simple procedure to inexpensively obtain extended and reliable protein sequence coverage from a ubiquitous and abundant starting material. Dental enamel is the hardest tissue in vertebrates, frequently recovered and identified at palaeontological sites [3]. Teeth are therefore a key piece of evidence for fossil mammalian ecology and evolutionary studies. We present a novel analytical approach using high-resolution, high-sensitivity tandem mass spectrometry (MS) that retrieves a population of peptides that are "mapped" to extant enamel protein reference sequences. The reconstructed sequences are then aligned and compared with homolog sequences from extant species using conventional phylogeny procedures. From most of the fauna specimens analysed, limited peptide fragments of collagen type 1-alpha 1 and 2, as well as collagen type 3-alpha 1, were identified from bone and dentine, while extended stretches of amelogenin, enamelin, and ameloblastin were identified in enamel samples. To our knowledge, such an extended coverage, from samples of similar age and geographic origin, has never been achieved before. Glutamine deamidation, a spontaneous modification extensively observed in ancient samples, was surprisingly high [4]. This observation is a strong indicator of the authentic ancient endogenous origin of the sequences retrieved. Another element supporting authenticity is the tissue-specificity of the proteins identified. Enamel proteins are not expressed in other tissues, they never appear among regular random laboratory contaminants, and they are not detected in ordinary saliva proteomes. Finally, they were absent in any extraction and injection blanks involved in the study. Enamel protein sequencing also provides valuable information for paleontological reconstructions. As the amelogenin gene is located on the non-recombining regions of the X and Y chromosomes, identification of amelogenin X and Y isoform-specific peptides provides a tool to determine the biological sex of ancient animal remains [5]. We demonstrate palaeoproteomics provides access to genetic evidence older than 1 Ma, enabling molecular investigation of major, so far intractable, evolutionary processes.

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Pecha Kucha Presentation Session 6, Fr 12:20-12:45

Exploring the Middle Paleolithic blade and bladelet evolution: new evidence from the Bau de l'Aubesier rock shelter (France).

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The appearance of blade phenomenon in Europe is part of a broader technological change which marks the shift from the Lower Paleolithic to the Middle Paleolithic - roughly 350,000 to 200,000 B.P. Within the European continent, incipient traces of blade production are located in the northern European Plane during MIS 8 and 7 [1]. Blade technology then reappears more clearly during MIS 5 with a more widespread including the central south of France and few sites in eastern Europe [2, 3]. At the end of the Middle Paleolithic (MIS 4–3), blade production is attested in a larger area comprising for the first time southern Europe [4]. Around the same period production bladelets partially overlap this last phase of the Middle Paleolithic blade production [5]. More in general current data suggest that the first evidence of blade technology appear essentially in the northern European plane during the MIS 8-7 while bladelets production is limited to the final part of the Middle Paleolithic. During this large time-span, covering roughly 200.000 years, laminar technology seems to be a discontinuous presence that disappears replaced by more traditional flake reduction strategies. This scenario suggests an end-off event without evolutionary continuity. We report new evidence of blade and bladelet production found at Bau de l'Aubesier, contributing to renovate the debate about the emergence and the evolution of elongated items during the European Middle Paleolithic. The lithic industries, analysed by a technological approach, highlighted a co-variation in both flake, blade and bladelets reduction strategies. Although the blade variability recognized at the Bau de l'Aubesier share certain features with the contemporaneous reduction strategies present in northern Europe, original patterns characterize the specific techno-cultural baggage of the Neanderthal group that occupied the site from the end of the MIS 7 to the MIS 5. Our results show: (a) that Middle Paleolithic blades technology in southern Europe cover a time-span of 100 ka from the end of MIS 7 to MIS 5. (b) that blade production at Bau de l'Aubesier is not an epiphenomenon, but it is a continue co-presence in parallel with the production of flakes. (c) that blade production observed throughout the sequence show a large variability of reduction strategies that cannot be reduced to a univocal model (d) that the diachronic change at Bau de l'Aubesier affect both the flake and blade production with an interconnected evolutionary trajectory (e) that the unexpected production of bladelets found in level IV temporally extends the first evidence of this type of production to the MIS 5 period. The results at Bau de l'Aubesier suggest that the trajectory of technological changes in material culture is far from homogeneous and monolithic in time and space. The scenario that emerges at Bau de l'Aubesier is characterized by a complex technological evolution that affected both the reduction strategies and the end-products. Blade and flakes technological lineage show both elements of stability and innovation that mutually influence each other in long-term evolution. Trough the time, human groups that inhabited Bau de l'Aubesier shared technological behaviours anchored to the tradition but at the same time also displayed specifics distinctive features. The origin of this variability reflects in our opinion the alternation of different techno-cultural traits.

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Poster Presentation Number 8, Th 19:00-19:45

Assessing environmental change at Lapa do Picareiro (Portugal): A stable isotopes analysis using rabbits (*Oryctolagus cuniculus*) and red deer (*Cervus elaphus*) as paleoenvironmental proxies

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Neanderthals and anatomically modern humans (AMH) adapted to a series of environmental changes during the Late Pleistocene that affected their subsistence strategies, technology, mobility and settlement patterns. Explanatory models such as the Ebro Frontier Model propose that Neanderthals were adapted to woodland environments while AMHs preferred open landscapes. Late Neanderthal survival in southern Iberia may have been possible due to relatively mild conditions during MIS 3, while Heinrich Events, especially H4, created harsh climatic conditions that may have reduced Neanderthal populations below survival thresholds. Thus, reconstructions of paleoenvironmental conditions to which Neanderthals and AMHs were subjected are key to understanding the adaptive behavior of both groups. Here, we present a preliminary environmental reconstruction using data from Lapa do Picareiro (Portuguese Estremadura). This site contains evidence of late Neanderthal survival after H4 as well as AMH occupations after 34 ka cal BP. At Picareiro, the European wild rabbit and red deer are two commonly encountered taxa throughout the site's stratigraphic sequence, providing adequate samples of red deer and rabbit tissues representing both human and non-human accumulations. Recent studies demonstrate that leporid bone carbonate and collagen act as good paleoenvironmental proxies linking δ13C and δ15N values with temperature variables, while δ18O values correlate with mean annual precipitation and relative humidity [1]. Ratios of δ13Capatite sampled from leporid tooth enamel, on the other hand, can shed light on seasonal shifts between C3 and C4/CAM vegetation [2]. Due to their generalist feeding strategy and relatively short life spans and small territories, isotope ratios of leporid bone and enamel provide proxies for local low-lying vegetation, temperatures, mean annual precipitation and relative humidity, essentially representing "snap shots" of local environmental conditions. As a ubiquitous species among western European Paleolithic archaeofaunas, isotopic analyses of red deer tooth enamel are common and present the opportunity for comparison with similar paleoenvironmental studies conducted in other Paleolithic sites. This paper presents preliminary carbon, oxygen and nitrogen isotope results from European wild rabbit (*Oryctolagus cuniciulus*) tooth enamel and bone collagen in addition to carbon and oxygen isotope ratios from red deer tooth enamel from Middle and Upper Paleolithic deposits of Lapa do Picareiro. These data are compared to isotope ratios obtained from red deer (*Cervus elaphus*) tooth enamel samples recovered from other sites to assess similarities and differences in paleoenvironmental changes during the Pleistocene in Europe; we then compare the isotopic results to other paleoclimate indicators from Picareiro such as magnetic susceptibility and sediment particle size.

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Poster Presentation Number 7, Th 18:15-19:00

A geometric morphometric approach to predict the chronological attribution of bifacial foliate technology at Olival do Arneiro (central Portugal)

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Except for the Lower and Middle Paleolithic, the use of bifacial technology for stone tool production occurs in two other moments during prehistoric times in Iberia: the Solutrean and across the Final Neolithic and Chalcolithic periods. During both timeframes, bifacial technology was mostly used to manufacture projectile points and tools likely used as knives/daggers. Additionally, during Late Prehistory, some of these tools are thought to have been used as sickle blades. Despite its utter importance in each of these moments, the characterization of bifacial methods within and between both periods is still vaguely explored. One of the most relevant questions in this regard is the differentiation between the technology of foliate-like implements between both periods, to which traditional typological classifications have failed to fully discriminate. The similarities between foliate pieces recovered from Solutrean and Neo-Chalcolithic contexts raises, in fact, a problem with the identification and individualization of each phase when absolute chronology results are not available, and in cases when contextual information from excavations is rather reduced. This is the case of a series of sites discovered and excavated in the early 20th century in the Rio Maior region (central Portugal), whose chronological attribution is still a subject of debate. Previous works by Zilhão [1] and Forenbaher [2] either assumed that the assemblages are all dated to Late Prehistory, or offer differentiating criteria that are only valid for some contexts or for some subtypes of the foliates. The recent discovery of typical Solutrean artifacts (stemmed and winged points) within some of these collections, however, allowed to reopen the debate and reassess some of those sites as Pleistocene. This is the case of Olival do Arneiro, where between 1943 and 1944, a sequence of close to 1.5 meters deep over an excavation area of more than 700 square meters was exposed by Manuel Heleno and his team [3]. This resulted in one of the largest and most complete (in terms of reduction sequence) assemblages of bifacial artifacts of western Iberia. Drawing upon recent developments in the application of Geometrics Morphometrics to lithic assemblages, particularly the methods proposed by Iovita [4, 5], in this poster we use Elliptical Fourier Analysis (EFA) to assess the morphometric variability of bifacial implements of Olival do Arneiro, and how it compares with other assemblages that are securely attributed to the Solutrean or to the Neo-Chalcolithic timeframe. For this study, 3D models from over 200 pieces were obtained through photogrammetric methods. A series of landmarks were then placed on each artifact and parametrized using EFA to describe the outlines of the main orthographic views. A combined application of Principal Component Analysis and Analysis of Variance to the obtained descriptors revealed that no statistically significant difference occurs between the finished artifacts of Olival do Arneiro and other Solutrean artifacts. Complementary metric analysis of the same set of artifacts confirm that, while no difference is evident between artifacts securely attributed to the Solutrean and those coming from Olival do Arneiro, a relevant number of foliates from Arneiro are expressively different than other well-known Neo-Chalcolithic assemblages. Naturally, the integration of Olival do Arneiro within the scope of the Solutrean has relevant implications for a better understanding of the dynamics of human adaptations to the Last Glacial Maximum, and for the study of bifacial technology throughout Prehistory in Western Iberia. It not only significantly contributes to the increase, in number, of bifacial Solutrean implements currently known in the region, as well as for a better representation of the production strategies of these artifacts, that in most cases are truncated by segregation patterns of the reduction sequences in presently known sites.

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Pecha Kucha Presentation Session 6, Fr 12:20-12:45

Refining detection of adaptive introgression from Denisovan to Tibetan and Sherpa genomes

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The possibility to generate high-coverage whole genome sequences from Denisovan and Neanderthal remains enabled unprecedented depiction of the landscape of archaic introgressions experienced by *H. sapiens* populations. For instance, as regards Denisovans two distinct waves of admixture with modern humans have been recently inferred: one occurred between an archaic population distantly related to the Altai Denisovan specimen and the ancestors of modern South Asians and Papuans, while another one plausibly involved a different Denisovan population and left appreciable traces in the genomes of modern East Asians [1]. In the ancestors of Tibetans and Sherpa from the Himalayas [2] this latter admixture resulted also into adaptive introgression of a 32.7 kb Denisovan haplotype at *EPAS1* that confers reduced susceptibility to mountain sickness to these populations, being however insufficient to explain their complex phenotype evolved to cope with reduced oxygen availability at altitude (i.e. hypobaric hypoxia) [3]. Moreover, although a recent study identified other genomic regions than *EPAS1* showing unusual proportions of Denisovan admixture in Tibetans, none of them was proposed to have contributed to Tibetan/Sherpa high-altitude adaptation [4]. Nevertheless, both the genetic bases of adaptive traits evolved by Tibetans and Sherpa and the full spectrum of possible Denisovan adaptive introgressions experienced by them remain to be fully elucidated. This is in part due to the conceptual and methodological limitations of the studies conducted so far, which are mostly based on the assumption that adaptation to high altitude was achieved by means of hard selective sweeps at few alleles with large phenotypic effect and that also adaptive introgression is generally mediated by such a selection model (i.e. if beneficial, introgressed archaic DNA is subjected to hard selective sweeps after its introduction in the genome of modern humans). Conversely, emerging evidence is corroborating the hypothesis that polygenic adaptation mediated by soft selective sweeps at multiple related loci with individual small phenotypic effect has played a more substantial role than hard selective sweeps in recent human evolution [5]. According to this view, we tested for the occurrence of polygenic adaptation in high-altitude Himalayans by using a dataset of Tibetan and Sherpa whole genome sequences and a combination of complementary haplotype-based selection statistics to inform innovative gene network analyses. Being suitable to detect also genomic signatures ascribable to weak positive selection at multiple genes of the same subnetwork, this approach enabled us to infer adaptive evolution at loci belonging to interconnected functional pathways overall contributing to modulate angiogenetic processes. These findings thus pinpointed a series of soft selective sweeps neglected so far, which likely shaped the augmented tissue blood perfusion observed in Tibetans and Sherpa, uncovering the genetic determinants of a key biological mechanism that drove adaptation to hypobaric hypoxia in high-altitude Himalayans. Then, we compiled a list of chromosomal intervals putatively subjected to archaic introgression in Tibetans and Sherpa by integrating previously observed candidate regions [4] with those pointed out by a combination of tests evaluating the potential excess relatedness between the putatively admixed population (i.e. Tibetans and Sherpa) and the source of introgression (i.e. Denisovan) and explorative summary statistics aimed at quantify alleles that are uniquely shared between them. Enrichment of the newly identified candidate genes and/or functional pathways mediating Tibetan/Sherpa polygenic adaptation to hypobaric hypoxia will be finally tested against the obtained set of introgressed genomic regions to draw the as exhaustive as possible picture of the contribution of Denisovan admixture to the adaptive history of high-altitude Himalayan populations.

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Poster Presentation Number 8, Fr 19:00-19:45

Fossil hominids on the move: new developments in fossil hominid biomechanical analysis

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Fossil biomechanical analysis is difficult as the only materials available are the bones of the skeleton. Muscle moment arms (the shortest perpendicular distance from the line of action of a muscle to the joint centre of rotation), are however important in how this relates to mechanical advantage. A larger moment arm could give a higher mechanical advantage. This could mean less of a metabolic cost to perform locomotion and an enhanced locomotor performance. If we take the case of Neandertals for example, this could have been important, as due to the greater robusticity of their skeleton, greater body weight and climate, they may have expended more energy than modern day humans. There are relatively few studies on moment arms in Neandertals with both mechanical advantages and disadvantages being found. Moment arms in Neandertals have previously largely been estimated from measurements taken on individual bones and muscle attachments. However this study used a complete virtual reconstruction of a Neandertal based on the Spy II Neandertal remains (Chapman et al., 2015), fused this skeleton to a walking movement from a modern human using the musculoskeletal software 'lhpFusionBox' and analysed the major muscle moment arms of the lower limb in an entire gait cycle using a direct moment arm with a helical axis. It is not possible to know how particular fossil hominids would have walked but the method allows you to see if their joint morphologies would have enabled them to walk or move in a similar way to modern humans. The Neandertal model was found to have a joint entirely compatible with modern human gait. The majority of moment arms were found to be greater than modern humans when moment arms were normalised by muscle lengths, however, there were some important differences, such as the smaller Achilles tendon moment arm in the ankle joint. The lhpFusionBox software was originally designed for clinical studies relating to modern humans but developments are being made facilitate fossil hominid analysis within the project 'Neandertal_3D', this includes the use of automated measurements, the importation of OBJ files (which are important to see muscle attachments) and improvements in the simulation of muscles for fossil hominids. The reconstructed skeleton and software are also to be made available to the greater public.

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Pecha Kucha Presentation Session 6, Fr 11:55-12:20

Hi-tech rocks and rivers: An artifact transport experiment using RFID tags

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Rivers sediments are valuable and frequent archaeological archives, although the associated fluvial processes inevitably modify the spatial and morphological integrity of archaeological sites and artifacts, particularly under Pleistocene periglacial conditions. However, the specifics of the underlying modifying mechanisms remain only partially understood. Previous experimental archaeological work into lithic artifact modifications has focused on ephemeral rivers in semi-arid conditions, temperate braided rivers, and laboratory simulations, and it remains unclear if archaeological artifacts are subject to downstream fining [1,2]. It is also unclear how artifacts are morphologically modified during their entrainment. A main limitation of these past experiments is that they have mainly relied on "release and catch" methods where experimental artifacts were painted and subsequently recovered through visual surveys. These methods limit the types of rivers which can be examined and reduce recovery rates. It also biases assemblage recovery and prohibits the possibility for microwear analysis.

To rectify this, we conducted a real-world experiment to determine how fluvial entrainment influenced artifact assemblages using an RFID tag methodology. This involved water jet cutting replica lithic artifacts of various Central European raw materials and tagging them with Passive Integrative Transponders. These replica assemblages were then released into a free-flowing gravel-bedded river in Mid-Wales (UK) where they were then re-located seven months later with a GPS equipped RFID tag reader. Nine replica artifacts were additionally recovered at the end of the experiment and analyzed for microwear traces. We then related artifact attributes and flow regimes to transport distance data and final deposition (i.e. recovery) points to determine artifact dispersal patterns and the primary determinants of artifact entrainment and transport distance. In sum, our results are twofold: First, we demonstrate that RFID is an effective technique for experimental taphonomic investigations; and secondly that fluvial entrainment patterns of artifact assemblages in gravel bedded rivers do not follow conclusions from previous studies, and that it may generate characteristic micro wear signals. Future work includes investigating longer entrainment timescales and transport distances for artifacts and understanding similarities and differences in entrainment patterns between lithic and osseous materials.

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Pecha Kucha Presentation Session 2, Th 11:30-11:55

New evidence for early hominin hunting at Olduvai Gorge (Bed I): Analysis of the bone surface modifications of the DS archaeofaunal assemblage

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Bone surface modifications are critical to the understanding of the formation of any faunal assemblage and in particular in discussions on the socioeconomic function of Oldowan sites. The analysis of surface modifications mainly includes hominin butchery (cut marks and percussion marks) and carnivore (tooth mark) damage. Both the frequency of their occurrence, as well as their anatomical placement must be addressed in order to interpret hominin and carnivore access to carcasses. We present a comprehensive and thorough study on the bone surface modifications identified in DS (1.84 Ma, Bed I, Olduvai Gorge) that includes univariate, bivariate, and multivariate approaches, as well as several innovative machine learning analyses. Available actualistic experiments that have modeled different types of access to carcasses by hominins provide the necessary frame of reference and are used here to establish reliable inferences. Particular emphasis is placed on cut marks, since they provide direct evidence of the type of access to carcasses by hominins, and they are indicative of different butchering activities. Cut mark frequencies have therefore been additionally compared to a referential set of Paleolithic sites where the acquisition of small and medium-sized carcasses by hominins is almost unanimously interpreted as hunted. Cut mark location is further assessed through the Hot Zone approach. All analyses are presented in comparison to surface modification data obtained from FLK Zinj. The findings of this study reveal that hominins were having primary access to completely fleshed carcasses. The anatomical placement of cut marks indicates that hominins were removing complete muscles from the bones, rather than flesh scraps. The high rates of percussion marks show that most bones were broken by hominins. Furthermore, a low degree of carnivore activity is evidenced by relatively low tooth mark frequencies. Based on this analysis, DS can unambiguously be classified as an anthropogenic accumulation and it constitutes further compelling evidence of early hominin systematic exploitation of ungulate carcasses probably acquired through hunting. Future taphonomic analyses will address skeletal part profiles, site formation, fragmentation, and mortality profiles.

Poster Presentation Number 38, Th 19:00-19:45

Bilateral symmetry of the temporal bone, with implications for commingled fossil assemblages

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In a few key hominin assemblages, such as the Neandertals from Krapina and *Homo naledi* from Rising Star cave, several individuals are represented by various parts of the body. Commingling of the fragmentary remains, however, obfuscates whether different parts belong to the same individuals. The ability to associate right and left halves of a skull could facilitate the reconstruction of individuals despite a lack of bony contact between fragments. Association of remains also affects estimates of minimum number of individuals, which has been used to infer demography of fossil taxa. The temporal bone preserves relatively well in fossil samples, and its complex anatomy results in numerous identifiable landmarks. The temporal is therefore ideal to test whether bilateral symmetry can be used as a criterion to associate fragmentary cranial remains.

I first use geometric morphometrics to test the hypothesis that intra-individual antimeric temporal bone variation (i.e., bilateral asymmetry) is lower than that between individuals in a human sample. This hypothesis predicts that an individual's right and left temporals are more similar in shape, measured as Procrustes distance (PD), to one another than to temporals from other individuals. I then examine variation in the Krapina temporal bone sample, and test hypothesized associations of these remains.

Results support the hypothesis that individuals' right and left sides are more similar to one another than to other temporal bones. Among human antimeres, the median PD is 0.09 (range: 0.07-0.17), while among non-antimeres the median PD is 0.159 (95% CI: 0.12-0.23). That antimeric PDs are significantly lower than non-antimeric PDs suggests that the principle of bilateral symmetry may be useful to associate temporal bones in commingled assemblages.

With regard to fossils, I test two *a priori* hypotheses of association. The first hypothesized pair is Krapina 17 and Krapina 39.3, which are of similar size and immaturity. The association of these fossils would be advantageous for cranial reconstruction as Krapina 17 includes a nearly complete parietal bone and 39.3 includes some of the occipital bone. The second hypothesized association is between the C cranium and the Krapina 39.1 left temporal. These pairings preserve 11 and 12 landmarks, respectively, about half the full set of landmarks preserved in the complete human sample. Within the human sample, the reduced k=11-12 landmark sets recapitulate the symmetry pattern as the full set of 22 landmarks, indicating that bilateral symmetry can still be assessed in more poorly preserved fossil remains. Krapina 17 and 39.3 are more different in shape (PD=0.202) than all human antimeres (range: 0.07–0.17), falling at the median of non-antimeres, and therefore are probably not the same individual. Krapina C and 39.1 (PD=0.091), in contrast, are more similar in shape than all human antimeres (range: 0.091-0.233), and therefore likely come from the same individual.

These results point to the high utility of temporal bone symmetry in the association of fragmentary cranial remains from commingled assemblages. The principle of bilateral symmetry should be explored further as a means of analyzing fossil assemblages.

Poster Presentation Number 2, Fr 19:00-19:45

Evolutionary Implications of the Sense of Numbers

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Numerosity, which has been labeled the 'number sense' [1], is said to consist of two core cognitive processes: subitization, which reflects the ability to differentiate quickly between one, two, and three things (e.g., sounds, objects, etc.) and small/large set differentiation [2]. Since both of these core processes have been demonstrated in human infants as young as 6 months old and in monkeys [3], numerosity is obviously independent of the faculty of language and has deep evolutionary roots. Just as there are cerebral cortices devoted to sensory perception, which are topographically represented by specific neurons, so does numerosity, as it has been amply demonstrated that the intraparietal sulcus, located in the superior portion of the parietal lobes is topographically organized to process the two aforementioned core processes [4]. Further, color perception or any other primary sense does not require learning on the part of humans, but it does require the learning of phonetic labels (e.g., this color is blue, this color is red, etc.). So too does numerosity, that is, labels are learned for numbers (e.g., one, two, three, eins, zwei, drei) but the perception of these numerical entities has a firm genetic and dedicated neurological basis. There are at least three other interesting evolutionary implications for the origins of numerosity. One, it may be surmised that it was in an organism's survival and reproductive interest to be able to discern instantly between one, two, or three food amounts or between one, two, and three predators. While these arithmetic assessments appear to be processed primarily in the parietal lobes, the analysis of this information is fed-forward along the superior longitudinal fasciculus to the prefrontal cortices for an evaluative decision as to their inherent interest to the organism and a decision about whether and/or how to act upon that information. The same is true of small/large set differentiation as it would have been useful for an organism to differentiate quickly between trees with smaller amounts of fruit from ones with larger amounts of fruit. The second important evolutionary implication of numerosity is that it may serve as the inchoate basis for abstractive thinking. An English mathematician long ago and astutely noted, "... the first noticeable fact about arithmetic is that it applies to everything, to tastes and to sounds, to apples and to angels, to the ideas of the mind and to the bones of the body... This is what is meant by calling mathematics an abstract science" [5; p. 3]. According to [1] and [4], the topographic representation of numbers is also highly similar to the topographic representations of sensory and motor operations. On this basis, it is suspected that numerosity may serve as the lower-level cognitive basis for higher-level abstractions such as symbolic thinking and number and letter sequencing. A third evolutionary implication of numerosity is the superior parietal lobe expansion in *Homo sapiens*, which may have occurred only within the past 100,000 years. This would place the epicenter of that expansion in the nearly exact same area as the topographically organized neurons dedicated to numerosity. Thus, it appears likely that archaeological artefacts representative of counting or calculating, such as the engraved ochre at Blombos cave (77,000 years ago), the lunar- or menstrual-marking devices at Abri Lartet (33,000 years ago) and Abri Blanchard (30,000 years ago), and the engraved Tai plaque (14,000 years ago), may be due, at least in part, to the expansion of the topographically-organized neuronal areas responsible for numerosity.

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Poster Presentation Number 34, Th 19:00-19:45

How large were Neandertal infants?

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Low neonatal weight is associated with a variety of negative health outcomes, including increased mortality, and low body mass and small stature in older children has been linked to nutritional stress in numerous studies. The evaluation of infant size in fossil populations could yield interesting insights into childhood health and patterns of growth in the past, but is complicated by possible differences in developmental pattern and rate among human ancestral species. This analysis evaluates Neandertal size in between birth and age four relative to seven diverse Holocene populations (N = 206) and Late Pleistocene anatomically modern humans (N = 52). Body mass, body mass relative to femur length, and percentage of body mass attained were compared to Holocene and Pleistocene human skeletal samples; subsequently, Neandertal infant age was adjusted by accelerating dental development by 15% to determine if faster dental development in immature Neandertals would affect comparisons of their body mass. Body mass variables were regressed on age to control for differences in age composition between samples, and residuals were compared using Kuskal-Wallis non-parametric comparisons with post-hoc Benjamini-Hochberg corrections.

Results of this analysis indicate that Neandertal body masses are indistinguishable from those of similarly aged Holocene modern human children, and that they are only slightly (non-significantly) heavier than average when standardized by femoral length. However, when Neandertal body masses are compared to adult body mass, they have the smaller percent of growth attained at all age than any modern human sample. These results did not differ regardless of whether a modern human dental development rate or an accelerated dental development pattern was used in the analysis. If both immature and mature fossil body masses were correctly assessed here, this suggests a different pattern of growth between modern humans and Neandertals, where Neandertals remain small relative to final adult size during the first years of life.

Podium Presentation Session 5, Fr 9:50

Ecomorphology of the *Australopithecus prometheus* skeleton, StW573 3.67 Ma, from Sterkfontein Caves, South Africa

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An uniquely complete skeleton of a female *Australopithecus*, StW573 dating to about 3.67 Ma, discovered and excavated painstakingly over 20 years now offers the first unambiguous information on limb length and joint morphology in any australopith. A hindlimb distinctly longer than the forelimb, a clear carrying angle at the knee, a right-angled relationship between the shaft and talar trochlea of the tibia, and broadly human-like footbones albeit with a somewhat abducted hallux, combine with a mobile elbow joint and hand that could exert powerful grips and which bears evidence that suggests stabilization of the pollex similar to that in gorillas. Together these features suggest that this early hominin was an effective fully upright biped, capable of efficient terrestrial walking over long distances which nevertheless often foraged in an arboreal context, as is consistent with a mesic palaeoenvironment of gallery forest with tropical vines. Hand and foot function however were almost certainly functionally equivalent to our own, as is predicted by Dynamic Systems Theory, where functional abundance is expected of complex, multi-joint systems. The species is identified as *Australopithecus prometheus* not *Australopithecus africanus*. This is supported by a very distinct proximal femoral morphology, with a short neck and large head, similar to our own and that of *Homo ergaster*, and opposed to the long femoral neck but short head that typifies *Australopithecus africanus*, and suggests a distinct abductor mechanism, similar to that in *Homo*. The age of this specimen is not greatly dissimilar to the partial skeleton of *Australopithecus* from Woranso Mille, and size and aspects of morphology are again not dissimilar. That a probably substantially arboreal hominin was nevertheless capable of very effective erect terrestrial bipedalism (an hypothesis which, along with the distinction in the abductor mechanism from *Australopithecus africanus*, is currently being tested *in silico* using the open-source forwards dynamic modelling software GaitSym) should not be surprising given clear evidence that indigenous humans such as the Batek continue to be arboreal foragers. Thus, far from early human ancestors being compromised terrestrial bipeds, or compromised arboreal climbers, they were, like ourselves, competent in both palaeoenvironments. This locomotor plasticity is of course typical of great apes as a whole, and confirms the overall conservatism of Hominini, despite the later appearance of hominins with apparently short hindlimbs (cf. *Australopithecus africanus* AL 288-1).

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Poster Presentation Number 49, Th 18:15-19:00

Sexual dimorphism in human frontal bone: a landmark-based approach.

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To determinate sex in human remains is among the main basic answer for any further anthropological study. The determination of sex from human bone is important both in forensic and archaeological context. The most common way to determinate the sex of skull is by traditional anthropology approaches, consist in evaluating in grading scale the respective different shapes by macroscopic analysis. Sex dimorphism provides important clues about the taphonomy, morphology, behavior, and life history of human evolution. The principal dimorphic characters are: inclination of the frontal bone, glabellar morphology, supra-orbital ridges, and presence or absence of the frontal tuberosity, mastoid process, zygomatic arches and occipital bones [1]. In this communication, we report the results of the analysis of sexual dimorphic traits on the frontal bone using a Geometric Morphometric approach (GM). We selected this anatomical region because the prominence of supraorbital ridges and the presence or absence of the frontal tuberosity are all considered to be valid indicators of sex in human cranium. The material of study consists in a 3D model of modern crania of known sex of humans which lived in XIX sec. We used (30 males and 30 females) 60 adult crania, 36 from European contest and the other 24 from modern Americans. The sample was acquired through computed tomography (CT) scanning and photogrammetry forming part of Lynn Copes digital Collection (Copes, 2012) and the collection of the Museum of Anthropology "G. Sergi" of Sapienza University of Rome. In order to capture the cranial shape, we took 3D Landmark coordinates on skulls, in particular for each anatomical point located on dimorphic region. In addition, we studied 4 different regions of the frontal bone by defining curves and surface semi-landmarks: the superior temporal lines, the glabellar region, the super orbital torus and the frontal squama. Preliminary results encourage to continue the research further, because Geometric Morphometric analysis (GM) results efficient to evaluate the effective presence or absence of dimorphism in the frontal bone. The Procrustes ANOVA of the shape variation showed that as the major traits of the frontal bone influenced by sex are the supraorbital torus and the entire frontal bone morphology. The glabellar region, the frontal squama, the temporal lines and the cranial shape (Landmark only) are not statistically significant. Preliminary conclusion confirm the existence of dimorphism traits of frontal bone and the importance of sub-models to evaluate the difference of female and male shape. In the future, we will continue to increase the sample to conduct the statistical analysis in different population and on several anatomical trait that result sexually dimorphic.

We thank Prof. Giorgio Manzi for the access to the collection of the Museum of Anthropology "G. Sergi" (Sapienza University of Rome)

References:[1] (Acsàdi & Nemeskéri, 1970)

Poster Presentation Number 4, Th 19:00-19:45

The short-term occupations of Cueva Antón: site function and techno-economic behavior of last interglacial Iberian Neandertals

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The basal part of the Cueva Antón Middle Paleolithic sequence consists of two units within sedimentary sub-complex AS5, luminescence-dated to MIS-5a, ca.80,000 years ago: layers III-b/d and III-i/j [1-3]. During excavation, distinct lenses of occupational debris were observed within layer III-i/j and designated, from top to bottom, III-/j1, III-/j2 and III-/j3, all of which associated with fire features and forming spatial scatters with some overlap. Layer III-b/d consists of a single lens, separated from III-i/j1 over most of the excavated area by the archeologically sterile, cross-bedded sands of layer III-e/h. To assess the stratigraphic integrity of the four assemblages produced by the excavation of AS5, we conducted an intra- and inter-level refitting study. We confirmed the geoarcheological observation based on which the different assemblages formed discrete behavioral packages with, however, III-i/j2 having more diffuse boundaries. Our subsequent analysis of the preservation of the original spatial patterning therefore focused on III-b/d, III-i/j1 and III-i/j3. We looked at the spatial distribution of the components of each refitted unit and found that most link items retrieved within adjacent grid units, suggesting little, if any, post-depositional, non-anthropogenic scatter. This evidence is in good agreement with the pristine preservation of fire features, especially in III-i/j1. In the three assemblages, formal tools are mostly sidescrapers, even though a few Mousterian points were also found. These tools were imported and are all made on flints of a diverse, both local and non-local provenience. Locally available limestone cobbles were exploited to produce flakes that for the most part remained unretouched, leaving behind fairly complete chaînes opératoires, especially in III-b/d. On-site reduction of flint is illustrated in III-i/j by refits displaying the last phase of reduction (core and discarded debris) minus the intended product, which is often missing. The predominant reduction method is Levallois on flint as well as on limestone. Coupled techno-typolological and use-wear analysis of formal tools and a sample of unretouched material (in total, 150 items) revealed a very consisted relation between tool type and activity. Especially, work on skin was carried out with sidescrapers of identical edge shape and retouch angle. Other types of sidescrapers were used on wood or for bone defleshing. Typological points bear no evidence of wear indicating that they would in fact consist of convergent sidescrapers instead of projectile tips. Typical impact marks were found on thin blanks featuring a 1 to 2 cm-long cutting edge opposite a blunt, unmodified surface, suggesting that they laterally hafted projectile components. The exceptional preservation of the Cueva Antón MIS-5a occupation floors provides a window into non-time-averaged Neandertal behavior surprisingly akin to ethno-archeologically studied short-term camp sites left behind by hunter-gatherers [4].

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Poster Presentation Number 39, Fr 18:15-19:00

The role of gene family size in human brain evolution

Alexandra A. de Sousa[1], Alin P. Acuna Alonzo[2], Jimena Monzon-Sandoval[2,3], Atahualpa Castillo Morales[2,3], Kathryn H. Maher[2], Humberto Gutierrez[3], Araxi O. Urrutia[2]

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Gene duplications have been linked to increased brain size and related morphological features in primates (Keeney et al., 2015). Gene families are groups of related genes created by duplication events that share a common ancestor and can have subtly different but related functions. For example, gene loses and gains in the opsin gene family determine the colour sensitivities of photoreceptor cells in the retina. These changes have been proposed to be associated with differences in foraging patterns among primate species (Jacobs, 2009). Olfactory receptor genes form the largest gene multifamily in the vertebrate genome; It also shows differences in size that can have a huge impact on species sensitivity to odours (Niimura, 2012). Recently, it has been suggested that gene families could in fact play a more central and general role in brain connectivity, adding to the breadth of closely related synaptic functions, with implications for the range, complexity, and flexibility of species behavioural repertoires (Grant, 2016). In order to better understand the role of gene family size in brain evolution we have carried out a series of correlational studies. We compared gene family size to several brain size-related measures in a sample of mammalian species for which complete genomes sequences were available. Further, we used gene functional annotations to investigate the functions of gene families that contributed to the relationships. Our findings have revealed that variations in gene family size are related to relative neocortex size, and that genes within these families are more prominently expressed in the human neocortex during early compared with adult development (Castillo-Morales et al., 2016). We have also uncovered a relationship between brain cellular composition and gene families related to synaptic transmission. Our work has implications for understanding the ultimate and proximate genomic mechanisms that might have lead to specialisations of the human brain. Future research could investigate more particular relationships between gene family size and aspects of brain organization with more specific functions.

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Podium Presentation Session 4, Th 16:30

Redating Palaeolithic human bones using a compound specific approach: Implications for understanding the Middle to Upper Palaeolithic transition in Eurasia

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The 'PalaeoChron' project is investigating the chronology of the dispersal of early anatomically modern humans (AMH) outwards from Africa and into Eurasia between 60-30,000 years ago. The study of this key period, during which Neanderthals and other archaic humans interacted with AMH and then disappeared to extinction, relies on the power of radiocarbon dating for the chronological framework underpinning it. There is a huge onus on reliable dating, but this is extremely challenging due to the overwhelming effects of even trace (approx. <1%) amounts of carbon contamination on archaeological bone samples coming from the archaeological environment and/or conservation treatments applied to the specimens. Our experience has shown that human fossils, in particular, often produce ages that are underestimated because they are often preserved with a range of substances including varnishes and glues which can be difficult to completely remove. To overcome this, as part Palaeochron, we have been (re)dating all Palaeolithic human bone samples using a compound specific approach which consists of isolating hydroxyproline from the collagen using preparative liquid chromatography prior to the AMS measurement. This has seen a dramatic improvement in our ability to decontaminate samples and obtain accurate results on Palaeolithic human bones. This presentation will include an introduction to the different pretreatment methods for archaeological bones, their advantages and their limitations [1, 2]. It will also present results from a selection of dated human bones from Upper Palaeolithic sites in France, Belgium, Croatia, Mongolia and Russia. By comparing the dates obtained after different pretreatments, we will show that, in many cases, the dates obtained by non-compound specific approaches are underestimated by up to several thousands of years. Such error can significantly affect our understanding of the dispersal of anatomically modern humans across Eurasia and the disappearance of archaic groups.

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Poster Presentation Number 65, Fr 18:15-19:00

A Review of Neandertal Extinction Theories

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A perennial mystery in anthropology has been the extinction of Neandertals and explanations abound: An ecocultural model [1] proposes that endogenous factors, related to cultural differences between Neandertals and *Homo sapiens* (*Hs*), resulted in interspecific competition for resources in favor of the latter. Dietary response differences [2] have been hypothesized stating that Neandertals did alter their diets in response to paleoecological conditions at the entrance of *Hs* into Europe. However, they [2] hypothesized that *Hs* were less likely to have changed their diets for climatic reasons but altered them in response to advances in technology. The result was resource exploitation and subsistence strategy differences, again in favor *Hs*. An extinction model based on genetic diversity differences [3] between the two human types noted that the Neandertal nuclear genome was 'considerably' less diverse than invading *Hs*, which may have resulted in less Neandertal immunity to novel pathogens. Interestingly, however, these authors also found that Neandertals had similar or even higher levels of genetic diversity than *Hs* in 12 major histocompatibility complex genes, which they acknowledged actually weakened their model. A provocative cannibalistic hypothesis [4], using an agent-based computer modeling simulation, claimed that cannibalism might have adaptive qualities when resources appear in scarce clusters. In their simulations, cannibalistic tendencies were always selectively favored because a cannibalistic group gains additional resources, and it reduces competition from lower cannibalistic-tendencied groups. However, when a non-cannibalistic competitor (*Hs*) enters the same environment, the modeling results showed individuals still benefit from cannibalism, but it eventually results in the extinction of the whole species. A modified Assimilation Model [5] proposed that Neandertals disappeared morphologically about 40,000 years ago, however, they had and still have a persistent genetic influence in many extant humans, as much as 9% in Romanians, 8% in Melanesians, and about 2.0% in Eurasians. Thus, characteristics of their biology remain in many extant humans. However, often ignored or glossed over in Neandertal extinction theories is brain morphology. There are an increasing number of paleoneurological studies, which demonstrate morphological brain differences between Neandertal and *Hs*. The first of these studies established that there was a parietal expansion in *Hs* that resulted in a smaller, more globularly-shaped brain, and that this parietal expansion may have occurred only within the last 100,000 to 35,000 years. If brain shape influences cognitive phenotypic behavior, at least to some extent, then the latter findings may explain the archaeological similarities between Neandertals and *Hs*, at least up until the 40,000-year extinction date. Other paleoneurological studies have documented cerebellum differences (larger in *Hs*), which has been empirically demonstrated to have consequences for fine-motor movements, abstraction, and creativity. A recent study found olfactory bulb differences as well (larger in *Hs*), which has been shown to have implications for differential smell sensitivities, reproduction, and disease immunity. In some respect, it is interesting that brain morphological and cognitive phenotypic differences (as a consequence of those morphological differences) may underlie most Neandertal extinction theories. Biology places a firm leash upon culture. Cultural complexity [1], technological complexity [2], cognitive flexibility and foresight [4], gender and age division of economic labor, and ability to resist assimilation [5] may all be wholly or partially explained by cognitive phenotypic differences as a result of brain morphology differences, and the latter appears to be a more parsimonious theory.

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Poster Presentation Number 62, Fr 19:00-19:45

Mare nostrum, ars nostra. A review of the classic Graziosi's theory of a Mediterranean province for Lateglacial rock and mobile art

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1 - Neanderthal Museum - Mettmann · 2 - GS Human Development in Landscapes - Kiel

Following his researches on the Grotta di Cala dei Genovesi rock art record (today on the small island of Levanzo, off the western coast of Sicily), Graziosi [1, 2] elaborated the existence of a Mediterranean province of art, in contraposition with the classic areal of the Cantabria. To support this theory, Graziosi highlighted different specific characteristics, like for instance the absence of particulars inside the figure (secondary anatomy traits), and a consequent higher simplicity in both the single figures' representation and the overall narrative [1: 50]. This «provincia mediterranea» – as the name suggests – would also include the "coeval" Iberian record, as Graziosi found a closer similarity in the Mediterranean basin, and explicitly with the Ebbou, Parpallò and Pileta caves, other than with «an immense and multiform clutter of figures that cover the rocks of North Africa, Nile valley until the shores of the Atlantic Ocean» [1: 50]. In the years following these statements though, the chronology of the Iberian Lateglacial art (with Parpallò *in primis*) became progressively more specific and, conversely, the idea that the Iberian Lateglacial rock art might constitute a part of a Mediterranean province became obsolete [3: 105 ff]. Despite the fact that the «provincia» of Graziosi lost a constitutive element, a prominent part of the Italian researchers remained substantially anchored to that interpretative framework, until very recently [e.g., 4]. The scope of this brief presentation will be that of trying to look with fresh eyes at the matter: using the data collected in the past years on the Sicilian record, I am going firstly to discuss the issues embedded within the Graziosi's contribution (in relation with the "material culture / ethnicity in archaeology" discourse [5]), and then I will attempt to suggest an alternative interpretative framework, by using a wider spectrum of information available (rock and mobile art, lithics, funerary rites, aDNA).

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Podium Presentation Session 4, Th 17:30

Reconsidering the Late Middle Palaeolithic in North-West Europe: Cultural variability, chronology, and implications for the Middle to Upper Palaeolithic transition

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This study focusses on the Late Middle Palaeolithic (LMP) and the "transition" towards the Upper Palaeolithic in North-West Europe. The considered time frame ranges from the recolonization of the northern latitudes by Neanderthal populations at the onset of the Marine Isotopic Stage 3 (MIS 3) some 60,000 years ago, to their replacement by Anatomically Modern Humans (AMH) around 40,000 years ago. During that 20,000-year period, a dozen of techno-complexes is recorded, suggesting a cultural variability greater during the MIS 3 Middle Palaeolithic than during the MIS 5. Our results bear on the origin, the chronology, the geographical distribution, and the significance of this variability. Some of these techno-complexes are fragmented on geographic areas barely overlapping each other. The Mousterian of Acheulean Tradition (MAT) and the Denticulate-Discoid group occupy a geographic area covering mainly France, the Bouts-Coupés is exclusively attested in Great-Britain, and the Keilmessergruppen (KMG) as well as the Blattspitzengruppe are mostly located in Germany (1). In Belgium and Northern France, multiple industries related to the Mousterian lato sensu are represented. In addition, two techno-complexes are often referred to as "transitional" between the LMP and the Aurignacian in North-West Europe: the Chatelperronian at the southern fringe of the area, and the Lincombian-Ranissian-Jerzmanowician (LRJ) techno-complex in northern Europe (2). Our data suggest that this variability partly have roots in a recolonization of North-West Europe by distinct Neanderthal populations bearing their own culture, some coming from Eastern Europe (KMG) and some migrating North from South-West Europe (MAT, Denticulate-Discoid). The Bouts-Coupés Mousterian which occurs in Great-Britain could be the northernmost signature of Neanderthal migrations from South-West Europe. It also opens to the possibility that this geographical fragmentation is somehow related to a lower population density at the end of the Middle Palaeolithic, with distinct populations isolated on a broad geographical scale. On a chronological perspective, our data suggests that the MTA, the Denticulate-Discoid and the Bouts-Coupés related with South-West Europe extinguished quite early in the MIS 3, prior to the Greenland Interstadial 12 (GI 12), while the Mousterian and the KMG lasted longer. Later, between 44,000 and 40,000 years ago, new and original techno-complexes developed or reached North-West Europe, recomposing a new cultural variability at the dawn of the Middle Palaeolithic: the Mousterian with bifacial tools, the LRJ and the Chatelperronian. Recent data from Trou du Diable (Belgium) also suggest that the typical Mousterian lasted up to 41-40,000 years ago, an age similar with the youngest Neanderthals (Spy cave, Belgium). Regarding these data, the Mousterian appears to be contemporaneous with the "transitional" techno-complexes, and the earliest Aurignacian evidence North of the Alps (Willendorf, Austria; Geissenklosterle, Germany). This spatio-temporal overlap between the Neanderthals, the LRJ and the Mousterian opens to the possibility that the LRJ may not be of transitional character (i.e. does not imply a contact between Neanderthal and AMH) but could be regarded as one among the Middle Palaeolithic cultural facies at the very end of the Middle Palaeolithic. In this view, the Middle Palaeolithic ends around 40,000 years ago with no transition but a rapid shift to the Upper Palaeolithic.

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Poster Presentation Number 40, Th 19:00-19:45

Of teeth, feet, and feed. The unexpectedly rapid evolution of mandibular shape in hominins

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Members of the hominins – the 'australopiths' and the species of *Homo* –possess short and deep mandibles, and relatively small front teeth. This is believed to form an adaptation to life in open habitats and the consumption of though foods. With the appearance of *Homo*, the functional meaning of the mandible has been presumably deemphasized, thanks to technological innovations culminating with the control over fire. Hence, the selective pressure on *Homo* mandible should have been weakened in the process. To verify this hypothesis, we analysed mandibular shape variation in a large sample of primates by applying geometric morphometrics (GMM) to the primate mandible shape under a new phylogenetic comparative method (PCM) approach. We assembled a dataset of 735 primate mandible images belonging to 211 different species, and built a phylogenetic tree for those species. We implemented and applied a new PCM, RRphylo, to the shape data ordinated by GMM. RRphylo allows calculating the rate of shape evolution for all the branches in the phylogenetic tree, and verifies the existence of shifts in the rate across the phylogeny. Contrary to our expectations, we found that mandible shape evolution in hominins is exceptionally rapid as compared to any other primate clade, and that the direction of shape change (from the ape ancestor) is no different between australopiths and *Homo*. We deem some biomechanical constraints related with the acquisition the upright posture (bipedalism), loss of honing complex, and canine reduction, which is shared by all members of the clade, could be responsible for such surprisingly high evolutionary rates. This exaptive condition occurred early in hominin evolution, and generated "cascading effects" that were recruited for a number of different adaptations along and across the history of the human clade, in response to the rapid environmental changes recorded in Africa from the Upper Miocene through the Plio-Pleistocene. This study reveals the evolution of mandibular mandible shape in bipedal hominins has strong morpho-functional and ecological significance attached.

Poster Presentation Number 26, Fr 19:00-19:45

'Finding the needle in a haystack': automating spectral remote searching for hominin fossil sites in Gorongosa, Mozambique

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Modern geospatial technologies such as remotely sensed imagery, handheld devices to capture coordinates and geographic information systems, have been applied to different research questions in palaeoanthropology that share a spatial component [1]. Even fossil surveys aimed at discovering new fossil assemblages containing hominins have been guided by military maps, aerial photography and satellite images [2]. With recent advances in computer science, cheaply available computer power, and free access to satellite imagery of reasonable resolution, some examples of computational techniques implemented to automate that demanding visual analysis have begun to emerge in the literature [3]. When fossil localities are known within a region, unsupervised machine learning techniques can be applied onto satellite images to detect new localities with similar spectral patterns, as demonstrated by Conroy [4]. A similar framework is currently being tested in the southernmost tip of the East African Rift System, in Gorongosa, Mozambique. This area represents part of a large geographical gap between the East and South African sites containing the majority of the known African hominins. In a first step, a freely available atmospherically corrected scene of Landsat 8 OLI from 28/06/2017 with 30x30 m resolution, covering a portion of central Mozambique, was downloaded from USGS Earth Explorer. Next, the satellite image was cropped to a small area known to contain Mio-Pliocene deposits, corresponding to approximately 25 km2, in the Mazamba formation (Gorongosa, Mozambique). A multidimensional matrix containing the brightness values for the first 7 spectral bands was processed through k-means, an unsupervised learning algorithm that can split the satellite image into different clusters (k = 8). One of the clusters overlapped all fossil sites containing vertebrate remains previously recorded in the area. However, a considerable range of this same cluster remains mostly unexplored. Moreover, this cluster represents only 4.7% of the total area of the satellite image analysed, thus highlighting priority targets for prospection. With this preliminary study we expect to directly contribute to discovering the first hominin fossils in Mozambique. However, even with an approach that is not taxon-specific, the task of increasing the number of vertebrate fossil sites from the Pliocene and late Miocene in this part of Africa is of paramount importance. Only with larger samples and new fossil assemblages, particularly in current geographic and temporal gaps, can we ground truth current hypothesis on the palaeocological and evolutionary settings of the early hominins.

The Paleo-Primate Project Gorongosa would like to thank the Gorongosa Restoration Project, the National Geographic Society, the John Fell Fund, and the Leverhulme Trust, the generous support with starting this interdisciplinary endeavour. The first author would also like to thank the Portuguese Foundation for Science and Technology (FCT) — Grant SFRH/BD/122306/2016 — and the Boise Trust Fund for supporting his doctoral project and fieldwork. Our work is only possible due to the visionary approach of Greg Carr and the dedicated staff from Gorongosa National Park, guided by Dr. Mateus Mutemba. We are very grateful to all the Park rangers, our students, and colleagues across all our institutions who have been very enthusiastic about this project.

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Poster Presentation Number 59, Fr 18:15-19:00

First direct ESR dating study of *Homo antecessor* from Atapuerca Gran Dolina TD-6 (Spain)

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We present here the details of the first direct Electron Spin Resonance (ESR) dating study of *Homo antecessor*, the earliest known hominin species identified in Europe. The analysis of a tooth (ATD6-92) from TD6 unit of Atapuerca Gran Dolina (Spain) was carried out following a "semi non-destructive" procedure, similar to that recently employed to directly date the *Homo naledi* and *Homo sapiens* teeth from the Rising Star Complex (South Africa) and Misliya Cave (Israel), respectively [1, 2]. This procedure has been designed to cause minimum damage to the teeth, by combining ESR measurements of enamel fragment with high resolution Laser Ablation ICP-MS U-series of dental tissues. Additional magnetostratigraphic data were collected within TD6 for independent age control.

Our dating results are consistent with previous studies of TD6 unit and associated fossil remains and support the Early Pleistocene age of *H. antecessor*. Additionally, this work illustrates the challenge of dating fossil human teeth by means of ESR. It identifies the specific pitfalls inherent to this application, in particular the systematic µCT-scanning of human remains, or the existing uncertainty arising from the absence of the original surrounding environment, which complicates the dose rate reconstruction. Other sources of uncertainty are common to standard ESR dating applications to large mammal fossil teeth, such as the spatial variation of uranium-series isotopes distribution in dental tissues, the variability of the water content over time, or the potential preferential creation of unstable NOCORs in the radiation-induced ESR signal. Pre-screening of fossil remains using laser ablation IPC-MS appears to be essential prior to any subsequent analysis in order to evaluate the suitability of the sample for combined US-ESR dating, although it does not preclude future complications in the dating process [3].

The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007–2013) under REA Grant Agreement nº PIOF-GA-2013-626474, and from the Australian Research Council Future Fellowship grant FT150100215. Aspects of this study have received financial support from the French State in the frame of the "Investments for the future" Programme IdEx Bordeaux, reference ANR-10-IDEX-03-02. Atapuerca Research Project is supported by the project number CGL2015-65387-C3-3-P of the MINECO (FEDER, UE), The Consejería de Cultura y Turismo of the Junta de Castilla y León, and the Fundación Atapuerca.

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Poster Presentation Number 33, Th 18:15-19:00

The Neanderthal endocast from Gánovce (Poprad, Slovak Republic)

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A natural Neanderthal endocast was found in 1926 during quarrying of a travertine knoll in Gánovce, near Poprad, Slovakia. A young Czech paleoanthropologist, Emanuel Vlček, was the first who recognized that the endocast did not belong to a modern human, but rather to a Neanderthal [1]. During his career, Vlček published several analyses of the cast. He provided a metric analysis of the specimen, a radiological study, and a morphological analysis including a geometrical comparison based on vault outlines and superimposition criteria [2,3]. However, he wrote mostly in Czech or German, and thus most of his work remains unknown or inaccessible for current scholars. This study is aimed at summarizing the information available on the Gánovce endocranial cast, and at providing a metric evaluation of its morphology following a multivariate approach. The cast of the endocranium was naturally formed by travertine and it has been dated to 105 ka BP [4]. It is partially covered by attached mineralized bone fragments of cranial vault, mostly on the left and upper parts of the endocast. The volume of the endocast is about 1320 cc. The endocast has particularly well preserved inferior and occipital parts, with apparent *juga cerebralis*, *foramen magnum*, dural venous sinuses, and even short segments of the middle meningeal vessels imprints. Here, we perform a multivariate analysis of its main diameters, further confirming its Neanderthal morphology. The computed tomography technique and digital anatomy tools are used to model and reconstruct the endocast, so it can be further studied and measured. The endocast is particularly wide and flat, with an exceptional frontal width. The dural venous sinuses are present on the occipital part and on the basis of the cast. The superior sagittal sinus runs into the confluence of sinuses, and paired transverse and sigmoidal sinuses are visible. Moreover, the endocast shows an occipito-marginal sinus, not described previously, which represents an infrequent vascular trait. The morphology of the Gánovce endocast suggests once more that the Neanderthal endocranial phenotype had already evolved at 100 ka [5].

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Poster Presentation Number 29, Fr 18:15-19:00

Hominin Dentition from Hohlenstein Stadel Cave

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The site of Stadel Cave in Hohlensein is famous for the ivory carved "Lion Man" figurine, a half lion/half human figurine, which was discovered during the 1939 excavations and dates to the Aurignacian Period [1]. In terms of hominin remains, this site has also yielded the only hominin fossil associated with Mousterian industry in the Swabian Jura region. This fossil is a femoral fragment which was recovered in 1937 and which in 2017 was confirmed to belong to a Neandertal based on its mtDNA sequence [2]. More recently, the resumed excavations in the Stadel Cave between 2008-2013 uncovered additional hominin remains, namely 2 hominin teeth: a lower left deciduous canine (LLdc) in 2009 and a lower left third premolar (LLP3) in 2011. Both teeth were recovered from sieved sediments from the Aurigancian layer A (sub-layer Ao) and the Late Middle Paleolithic layer C respectively. Yet, since both these layers were previously excavated in 1939 and contained back-fill from these early excavations, the attribution of these fossil dental remains to the specified layers remains uncertain. Here, we preset morphological assessment and comparative analysis of these two teeth in an attempt to shed light on their affinities.

The two hominin teeth had their crowns fully formed but their roots were only slightly developed. They were judged to belong to two individuals: the deciduous canine to a child around 6-12 months of age and the premolar to a child around 5-7 years of age based on modern population standards of crown and root development. Their crown morphology is described in detail in [3]. In short, both teeth show unremarkable morphology lacking the features or the combination of features that are usually common in Neandertals (especially in the case of the LLP3). In this regard, both teeth are best attributed to modern humans.

Metric analysis was restricted to their crown dimensions, since they both had less than 0.1 mm of their roots formed. Mesio-distal and bucco-lingual diameters were measured and compared to respective data for Neandertals, Upper Paleolithic modern humans, and recent modern humans taken from the literature [4-5]. The metric analyses suggest that both teeth are modern human and not Neandertal, with the LLdc plotting closer to the means of the recent human sample than the Upper Paleolithic sample and the LLP3 plotting closest to the Upper Paleolithic sample [3]. We tentatively attribute the LLdc to Aurignacian modern humans arguing that it represents an unusually small Aurignacian specimen since the coloration of this tooth is consistent with the reddish brown color seen on all faunal fragments from the Aurigancian (as well as Middle Paleolithic) layers and distinct from the whitish and yellowish colors seen on the faunal remains recovered from the Magdalenian and Neolithic layers. More in-depth analysis of this tooth is planned to better clarify its affinity. The LLP3 coloration is reddish brown and therefore also consistent with either the Middle Paleolithic or Aurignacian sediments. Yet, the metric analysis largely aligns this tooth with the Upper Paleolithic modern humans rather than Neandertals. We therefore conclude that this specimen most likely derives from the Aurignacian backfill of the 1939 excavation of Layer C.

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Poster Presentation Number 37, Th 18:15-19:00

Toothpicking habit in early *Homo*. New evidence from OH62 (Olduvai Gorge, Tanzania)

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The use of grass stalks and maybe some other materials as toothpicks has been described as probably the oldest human habit [1]. Extensive toothpicking activity leads to the generation of toothpick grooves also known as interproximal grooves (mesial, distal or both sides of the teeth are affected). The surface of the grooves shows numerous parallel bucolingually oriented microstriations, as produced during toothpicking due to the presence of abrasive particles (i.e. from silica phytoliths) on the probing material, presumably grass-stalks. This dental wear trait has been described profusely in all *Homo* species, mostly in *H. sapiens* and *H. neanderthalensis* [2, and references therein]. Toothpick grooves have been reported for *Homo habilis* on the distal sides of the ULP3 and URP3 of L.894 from Omo Shungura Formation in Ethiopia [3] and on OH60, a LRM3 attributed to early *Homo* [4, and probably, due to specimen morphology, *H. erectus*, see the reference for the complete study]. In this study we present the second ever reported toothpick groove for a *Homo habilis* specimen. The interproximal groove was discovered on two dental fragments of the maxilla of Olduvai Hominid 62 (OH62), a partial skeleton of an adult individual attributed to *H. habilis*, "Dik-dik hominid", which was recovered in 1986 by Tim White from lower Bed I (dated around 1.8 Ma) in Olduvai Gorge [5]. Although the groove is fragmented, both its location (at the tooth cervix) and the presence of parallel microstriations covering the groove's surface corroborate the identification as a toothpicking groove. This new evidence for toothpicking habit in OH62 could be related to a palliative intention, as this individual has a severe occlusal wear degree and resorption of the alveolar bone increasing the interproximal space and thus allowing the inclusion of food particles that could have caused discomfort, causing the individual use grass-stalks to remove them, as well as a sign of an increase in meat food consumption by these early hominids.

We thank the National Museum in Dar es Salaam (Tanzania) for access to the specimens at their care. We are grateful to Audax Mabulla for his help. A. E. is a Juan de la Cierva postdoctoral fellow. This project is funded by the Spanish Ministry of Economy and Competitivity: CGL2012-36682 and CGL2016-75109-P.

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Poster Presentation Number 58, Th 19:00-19:45

The level of correlation between mid-facial craniometric, neutral genetic and climatic distances completely depends on the scale of comparison

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Significance. The question of congruence between genetic and craniometric biodistances in humans is essential for reconstructing relationships between ancient populations or individuals using morphometric data. First studies of this issue revealed moderate to high and significant correlations between the two types of distances at the global level. Geographical distances are often used as a proxy for genetic distances and show moderate or high correlations with craniometric distances, again at the global level. But later research has shown that those correlations can vary substantially depending on a number of factors: cranial samples and polymorphisms used, part of the skull studied and, importantly, on the scale of comparison (i.e. global, continental, regional or intracemetery). The role of climate as an alternative factor shaping the human face has been assessed in numerous studies also showing the fluctuating nature of the association between cranial morphology and climate. *Material and methods*. We employ 35 male cranial samples from North Eurasia (mid-facial measurements), corresponding mtDNA and Y-chromosome samples (from the same populations, not the same individuals), matrices of geographical and climatic distances between the populations in order to systematically assess the influence of the scale of comparison on the association between different interpopulation distance matrices: continental vs. sub-continental vs. regional. *Results*. At the continental level, when the populations from both West and East Eurasia were analyzed together, mid-facial craniometric distances were equally strongly correlated with mtDNA (0.67), Y-chromosome (0.60) and geographical (0.65) distances while a much weaker association with climatic distances (0.41) was observed. These values are very similar to those published previously for global cranial samples. When sub-continental datasets, i.e. West (20 samples) and East (15 samples) Eurasians, were analyzed separately, correlations with genetic and geographical distances dropped dramatically: mtDNA – -0.01 and 0.22; Y-chromosome – 0.42 and 0.45; geographical – 0.32 and 0.20 (Europe and Asia, respectively). Simultaneously, climatic distances became more strongly associated with morphological ones: 0.46 in Europe and 0.53 in Asia. This latter finding supports many previous studies reporting higher association between facial morphology and climate at the continental scale compared to the global scale. Finally, we considered three regional subsets of samples: North Asia (10 populations, all were demonstrated to be cold-adapted), Northeast Europe (10 populations, also all cold-adapted) and West and South Europe (10 populations, adapted to temperate or Mediterranean climates). At this scale, all correlations between craniometric distances and either genetic or geographical distances remain low or become even lower than at the sub-continental scale (range from -0.17 to 0.38). One exception is mtDNA distances in North Asia (0.54). But the association with climate is low as well, ranging from 0.05 in Northeast Europe to 0.30 in North Asia. Thus at the regional scale, when populations from the same climatic zone are studied, mid-facial craniometric biodistances between the populations remain largely unexplained by either their neutral genetic relationships or climate. *Discussion*. Certainly, the main explanation of the results of this study seems to be the sampling strategy, where morphological and genetic data are obtained from different individuals. The smaller are the differences between populations (both morphological and genetic), the more important is the effect of sampling. But in our opinion, other important factors are the genetic basis of craniofacial variation and epigenetic effects, internal rather than external, affecting the path from genotype to craniofacial phenotype.

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Podium Presentation Session 4, Th 17:50

The chrono-cultural narrative of the Fumanian Aurignacian supports the inapplicability of the Aquitaine Model on a supra-regional scale

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Given its chronological position and geographic spread, the Aurignacian is perhaps one of the most important techno-complexes of the Upper Paleolithic. The cultural and economic changes that occur in this period mark a turning point in the history of human evolution that is perceived as evidence for the spread of modern humans into Europe. Few human remains found in stratified sites strongly support this scenario [1]. However, it is still not clear whether this techno-complex represents a rather homogeneous phenomenon and if its development across time was triggered by environmental and climatic deteriorations that occurred during H4. Careful investigations and reassessments of key sites are the best way to disentangle the complex population dynamics that characterized the Early Upper Paleolithic and to investigate modern humans' adaptations to changing environments. The long-established archaeological research in southwestern France has permitted the identification of different phases of the Aurignacian, both on typological and technological grounds [2], that have been subsequently extended to the rest of the European sub-continent. The oldest phases are known under the terms Protoaurignacian (PA) and Early Aurignacian (EA). According to some, they represent two distinct routes of modern humans' dispersal along natural paths such as the Mediterranean boundaries and the Danube basin [3]. To others, they are considered as diachronic stages reflecting different settlement dynamics (i.e. a pioneering phase opposed to an established phase). In the north of Italy, a recent assessment of the PA technology at the site of Fumane Cave has permitted us to critically address the technological definition of this techno-complex [4]. We have demonstrated that the clear-cut subdivision between PA and EA is an archaeological construct, thus discouraging the direct application of the Aquitaine Model. With the aim of shedding new light on the complex cultural dynamics that characterized the Early Upper Paleolithic, here, we present a detailed comparison of the PA and Aurignacian at Fumane Cave. The presence of several layers that pre- and post-date the H4 has permitted us to address the current techno-typological definitions and to test the hypothesis of a shift in the technological behaviors of hunter-gatherers' societies. To do that, we performed an extensive analysis of the lithic artifacts recovered from five cultural units (A2, A1, D3base, D3balpha, and D3ab) together with a revision of the organic tools and ornamental objects recovered at Fumane. Overall, our results show that bladelets are the first goal of production in all the studied assemblages and that they do not originate from reduced blade cores, but from a broad range of independent and simultaneous reduction strategies, among which carinated technology seems to increase towards the top of the sequence. Retouched bladelets are the most common tool types and their slight decrease in the youngest phases coincides with the increase of end-scrapers. Tools commonly associated to the EA, such as Aurignacian blades, are rare. Excavators recovered split-based points only in the youngest assemblages. The appearance of split-based points within a rather coherent technological spectrum that encompasses all of the features associated to the PA, suggests that technological innovations were shared between groups of foragers well established in their landscapes. The adoption of the term Fumanian Aurignacian [5] is thus considered the best solution to express both the strong local signature and the well-established networks of foragers that inhabited northeastern Italy.

Research at Fumane is coordinated by the Ferrara University in the framework of a project supported by the Ministry of Culture - Veneto Archaeological Superintendency, public institutions (Lessinia Mountain Community - Regional Natural Park, Fumane Municipality), Foundations (Leakey Foundation, Spring 2015 Grant), and private associations and companies. The doctoral studies of Armando Falcucci are founded by the state of Baden-WuÈrttemberg and the University of Tuebingen.

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Poster Presentation Number 3, Th 18:15-19:00

Cueva Negra del Estrecho del Río Quípar (Caravaca de la Cruz, Murcia, SE Spain): Intrasite analysis of a late Early Pleistocene Palaeolithic palimpsest

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Preliminary analysis indicates a stratigraphical palimpsest at Cueva Negra del Estrecho del Río Quípar, a rockshelter containing Palaeolithic artefacts (including a handaxe; from low in Unit II), burnt bone and chert (in Unit VI), and final Early Pleistocene (0.78-0.99 Ma) palaeomagnetic and palaeontological evidence from 5m-deep fluviolacustrine sediments [1-5].

A grid of 1x1m squares allows excavation of their 0.5x0.5m subdivisions in ≤5cm-deep spits until sedimentary discontinuity is encountered when a new unit is assigned as a precaution. A stepwise excavation strategy is followed. A total station provides geolocational recording of 3D coordinates and orientation, dip and azimuth of major axes of all lithics ≥2cm, bones ≥3cm and stones ≥10cm. We present preliminary intrasite analyses of lithic data from units II (15m2) and VI (6m2), respectively near the top and bottom of the sequence, in a pilot study to test the suitability of our analytical approach.

Apart from the handaxe, most lithics are <6 cm, mainly of chert (flint), limestone, quartzite, or quartz (and a radiolarite scraper). A few primary and many secondary rock outcrops have been identified and compared with excavated samples by laser-ablation ICPMS [5]. Most excavated material came from nearby outcrops, though a little may derive from 30 km away. In secondary outcrops, frangible parallelepiped chert nodules abound that are unsuitable for removal of conchoidal flakes, hence fragments and spalls dominate the excavated finds, impeding reconstruction of reduction sequences. Unipolar, bipolar, multipolar, orthogonal and centripetal removals occurred, including repetitive flaking preceding flake-removal. Secondary knapping (mainly unifacial retouch) occurs on flakes and fragments (notched, denticulate and pointed pieces, stubby pieces with awl-like spurs, keeled planoconvex "limace" slugs, and scrapers); a few retouched pieces are "microlithic" (<3cm).

Here we use lithic technomorphology, metrical measures, taphonomy, raw material characteristics, horizontal and vertical distributions, and refitting possibilities. Our aim is to explore spatiotemporal relations taking into account sedimentary facies and accumulation or dispersal of finds. The data-base allows a multimensional GIS approach to their archaeostratigraphical analysis with spatiotemporal resolution good enough for detection of micropalimpsests and discrete episodes of occupation. Statistical methods used include Gaussian distribution analysis, Wiener-Kolmogorov prediction, Ripley's K function, nearest-neighbour analysis, Moran's I for spatial autocorrelation, and kernel PCA pattern analysis; multivariate analyses of lithic orientation and dip could throw light on knapping procedures.

Demonstrable differences between assemblages imply distinct sedimentary and occupational episodes; thus in unit II (which is high up) we have identifed two occupational horizons, corresponding to distinct sedimentary inputs, demonstrating a palimpsest of discrete activities. By contrast, much lower down, no indications of a palimpsest structure were detectable in unit VI where the oldest Palaeolithic finds come from, though the small area excavated to date cautions against overinterpretation. Nevertheless, statistical data for the two units seem robust, notably as regards grouped patterns, appropriate for sediments showing little alteration, and minimal postdepositional disturbance permitted most lithics to remain lying flat; our observations agree with geoarchaeological evidence of fluviatile sedimentation deposited with low transport energy in a geologically short time [1], perhaps MIS-21 [2].

Our pilot study is a prelude to extensive analysis at the site. We present it for discussion among colleagues concerned with stratigraphical analysis of Palaeolithic remains at sites where palimpsests may well exist.

To Gonzalo Linares, Ignacio Martín Lerma, Gabriel García, Antonio López, Ángel Buitrago, Jon Ortega, Consuelo Martínez, Azucena Avilés and Sociedad de Estudios Historiológicos de las Tierras Altas del Quípar, Argos y Alharabe.

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Podium Presentation Session 4, Th 17:10

New high-resolution 14C chronology for Bacho Kiro cave, Bulgaria spanning the Middle to Upper Palaeolithic transition

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Since it was excavated in the twentieth century, the Middle-Upper Palaeolithic cave site of Bacho Kiro in Bulgaria has been well known for its Initial Upper Palaeolithic stone artefact assemblage of the so-called 'Bachokirian' technology (layer 11) [1]. Radiocarbon dating carried out in the 1980s and 1990s yielded a wide range of ages for this distinctive layer which appear to have been affected by modern carbon contamination to varying degrees [2]. Excavations at the site since 2015 have uncovered a wealth of new archaeological material, permitting re-analysis of the site with the latest archaeological techniques.

We present the results of an extensive program of radiocarbon dating of bone collagen carried out on newly excavated material. Careful sample selection was combined with rigorous methods of sample pretreatment (ultrafiltration of bone collagen). Organic preservation at the site was found to be outstanding with many samples having greater than 10% collagen preservation. AMS measurements carried out at ETH Zurich utilising the latest developments in instrumentation (Automated Graphitization Equipment (AGE) III and the MIni CArbon DAting System (MICADAS)) [3, 4] produced a radiocarbon chronology spanning the entire sequence at exceptional levels of precision. A Bayesian model for the site demonstrates Upper Palaeolithic occupations spanning 42,000 - 28,000 14C BP and layers at the base of the sequence containing the Middle Palaeolithic dating to >51,000 BP with a clear temporal gap between the two stratified assemblages. The results provide a tight constraint for the layer containing the Bachokirian industry which has been generally attributed to *Homo sapiens*.

Moreover, a small aliquot (ca. 80 mg material) of human bone recovered via ZooMS from an upper layer of the site was extracted and dated using both a graphite target (ca. 2 mg collagen) and the gas ion source of the AixMICADAS (<0.3 mg bone collagen). The results confirm the suitability of the gas ion source of the MICADAS for dating small aliquots of highly precious archaeological bone at high precision and accuracy [5].

The re-excavation of Bacho Kiro is a joint project between the National Institute of Archaeology and Museum, Bulgarian Academy of Sciences, Sofia and the Human Evolution department of the Max Planck Institute for Evolutionary Anthropology, Leipzig. This work was funded by the Max Planck Society. Graphitization and AMS dating in Switzerland were funded by ETH Zurich. The AixMICADAS was acquired and is operated in the framework of the EQUIPEX project ASTER-CEREGE (PI E. Bard) with additional matching funds from the Collège de France, which also supports the salaries of the authors from CEREGE. We would like to thank all the excavators who have worked at Bacho Kiro since 2015.

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Poster Presentation Number 16, Fr 19:00-19:45

Unravelling morphological changes of the human talus during growth

Carla Figus[1], Nicholas B. Stephens[2], Rita Sorrentino[3,1], Daniele Panetta [4], Maria Giovanna Belcastro [3,5], Timothy M. Ryan[2,6], Stefano Benazzi[1,7]

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The human talus, being located between the lower limb and foot, plays an essential role in distributing the weight of the body during locomotion. One of its most important functions during this process is in allowing for foot movements while efficiently dividing weight between its anterior and posterior portions, where it articulates with the navicular and calcaneus, respectively [1]. As such, the talus plays a pivotal role in the different stages of human locomotion, from crawling, to initial bipedal acquisition, to full striding bipedalism at age 8 [1]. Unfortunately, little is known about the morphological changes of the talus during the first years of life, when infants acquire upright posture and gait maturation. Using a (semi)landmark based approach we analyse an ontogenetic sample of modern human tali with the aim of exploring the morphological variation of the talus during growth. From this we assess if the variation may then be related to the acquisition and transition to full bipedal locomotion, which might ultimately provide insight into the evolution of hominin bipedalism. The sample consists of 21 juvenile tali aged between 1.5 years and 11 years: 12 individuals from the Collection of Bologna, Italy (sex and age at death known) [2]; five from the archaeological sample of Roccapelago (Italy) [3]; four from the archaeological sample of Norris Farms #36 (Illinois, USA). All specimens were microCT scanned with a resolution of 20-40 μm. Avizo 9.3® (Visualization Sciences Group, SAS) was used to evaluate the quality of and pre-process the reconstructed scan data (e.g. crop or resample). Segmentation of the image data was performed using the MIA-clustering method [4] and then processed in Medtool 4.2 (Dr. Pahr Ingenieurs.e.U) to obtain 3D meshes of each talus. A template of 11 landmarks, 61 curve semilandmarks and 144 surface semilandmarks was created in Viewbox (dHAL Software) and applied to the 21 tali. The (semi)landmark configuration was superimposed by Generalized Procrustes Analysis, and semilandmarks were allowed to slide against recursive updates of the Procrustes consensus [5]. Finally, a form space Principal Component Analysis was carried out to explore talar shape variation during growth. Data were processed in R 3.4.3 (The R Foundation for Statistical Computing, 2017). The first three PCs explain 92.9% of the total variation. Most of the morphometric variation is explained by PC1 (89.8%), i.e. ontogenetic allometry, where negative scores account for small, sub-parallelepiped talar morphology (the youngest individuals), while positive scores account for an elongation of the entire body of the talus, due to the development of the neck, and a clear growth of the lateral malleolar facet, while the posterior side of the trochlear facet is not well defined yet. The anterior calcaneal facet is well developed since the youngest phases (negative scores), while the posterior calcaneal facet becomes larger, less triangular, and more concave towards PC1 positive. PC2 (1.7%) and PC3 (1.4%) describe only subtle morphological differences. Negative values of PC2 account for a longer lateral ridge, that shortens along positive values, due to the growth of the talar head, development of the neck, trochlea, and lateral malleolar facet, with a more concave aspect of the lateral side. It is also possible to discern a narrowing of the sulcus tali and a clear medial rotation of the talar head. PC3 negative scores show a more compact shape, that becomes higher along positive values with the development of the posterior calcaneal facet and head. This study is part of an ongoing project focusing on ontogenetic changes. Here we present preliminary results showing how external talar morphology varies during the early stages of human bipedalism. Future analyses will combine external morphological analyses with an assessment of trabecular bone architecture, thus providing a more holistic vision of these changes during development.

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Poster Presentation Number 32, Th 19:00-19:45

Dental macrowear and cortical bone thickness analyses of the Neanderthal mandible from Regourdou (Dordogne, Southwestern France)

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Tooth wear is one of the most studied features in archaeology and anthropology for reconstructing diet, food processing and cultural habits of ancient human populations and extinct human groups. In particular, occlusal wear facets (those areas visible macroscopically, and characterised by polished surfaces with well-delineated margins, that are created by the contact of opposing dental arches during mastication) can be extremely useful to detect information about diet and non-masticatory behaviours [1]. The aim of this study is to analyse the macrowear pattern of the complete Neanderthal mandible of Regourdou 1 (Dordogne, Southern France), using a sophisticated and well-established method known as Occlusal Fingerprint Analysis [2]. In addition, because asymmetric masticatory loads in the mandible could generate local variation in cortical bone thickness [3], we will explore whether there is any correlation between dental macrowear, cortical bone distribution and root dentine thickness in the mandible of Regourdou 1. The anterior dentition of Regourdou 1 shows a more advanced degree of wear than the postcanine teeth, with large dentine exposure and rounded labial wear, a typical pattern found in many Neanderthal specimens. The posterior dentition is characterised by an asymmetric wear pattern, with the right side significantly more worn than the left half [4]. In contrast, the left lower P3 shows a more advanced degree of wear than the right premolar, with a mesio-distally elongated dentine exposure and semicircular enamel facets. The analysis of this unique pattern excludes the possibility that this type of wear is created by normal chewing behaviours, but it rather indicates tooth-tool uses for food processing and/or manufacturing of objects during daily task activities. The occlusal macrowear analysis also suggests that Regourdou 1 had a mixed-diet, typical of those populations living in temperate deciduous woodlands, with an intake of animal and plant foods [5]. Moreover, although there are no major differences in lingual cortical bone distribution between the left and right sides, the left buccal aspect of the mandible is substantially thicker than its right counterpart. Similarly, the virtual unrolled root of the left P3 has a thicker dentine layer than measured on the opposite right third premolar. These results show a certain degree of asymmetry in cortical bone topography and dentine tissue in Regourdou 1, that seems to be correlated with its dental macrowear pattern. Although this study is limited to one individual, future analyses based on a larger sample size may further assist us to better understand the existing relationship between mandibular architecture, occlusal wear and the masticatory system in humans.

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Podium Presentation Session 5, Fr 10:30

Unexpectedly high morphological variability in the *Australopithecus* sacrum. Implications for sexual and taxonomic diversity

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The human pelvis shows a high sexual dimorphism owing to its central role in the parturition of large-headed newborns [1]. Accordingly, the typical female sacrum is said to be relatively broader than that of males, with a relatively smaller, more dorsally positioned superior articular surface. In contrast, great apes have a spacious birth canal and a correspondingly less sexually dimorphic pelvis. Yet, the evolution of modern human pelvic sexual dimorphism is unknown and its analysis is complicated by uncertain taxonomic attribution and incompleteness of the fossil remains.

Here, we explore the morphological variability of the sacrum in hominin fossils and compare it to that of modern humans and extant great apes. We used a geometric morphometric approach based on a dense configuration of landmarks and curve and surface semilandmarks on the first two sacral vertebrae of StW 431 and Sts 14 (presumed male and female *Australopithecus africanus*, respectively), A.L. 288-1 (supposedly a female *A. afarensis*), and Shanidar 3, a male Neanderthal. An additional analysis focused on the first sacral segment to include KSD-VP 1/1, a presumed male *A. afarensis*. Virtual reconstruction was necessary for some of the fossils. The comparative sample included 90 modern humans from a broad ethnical background, 51 *Pan*, 32 *Gorilla*, and 31 *Pongo*, with a balanced sex distribution.

A principal component analysis of the Procrustes shape coordinates demonstrated a clear separation of humans from great apes in both analyses. Within modern humans, no significant sexual dimorphism was found, although the coronal curvature of the ventral surface of the sacrum tended to be more pronounced in females than in males, while the relative expansion of the superior articular surface to alar width was at best a fair indicator of sex. Sacral curvature and height-to-width proportions were not sexually dimorphic. The great ape taxa overlapped extensively with each other, while the sexes did not separate in any of these taxa. The Shanidar 3 Neanderthal sacrum grouped with modern humans. All australopithecines were morphologically more similar to modern humans than to the great apes. A.L. 288-1, Sts 14 and KSD-VP 1/1 grouped closely, while StW 431 separated clearly and plotted closer to the great apes. The morphological difference between Sts 14 and StW 431 was already evident visually: Sts 14 has wide sacral alae with well-developed, but flat upper lateral angles relative to a small S1 corpus, while StW 431 has relatively narrow alae with dorsally projecting upper lateral angles. To quantify these shape differences, we carried out a permutation test of the Procrustes distances. This showed that the morphological divergence between these two *A. africanus* sacra significantly exceeded the range of variation of modern humans ($p<0.01$). Our results for StW 431 and Sts 14 cannot be explained merely by sexual dimorphism. Even though the degree of pelvic and sacral morphological heterogeneity in relation to body size and phylogeny is not yet fully understood, it is reasonable to expect that sexual dimorphism in extinct hominins would not exceed that observed in modern humans. The *A. africanus* hypodigm has variously been interpreted as belonging to one single but highly variable species, or, alternatively, as representing two or more hominin species [2]. These claims were mostly based on dental and craniofacial remains [3]. Nonetheless, differing morphs were also postulated on the basis of postcranial elements [4]. The partial sacra of Sts 14 and StW 431 therefore provide additional arguments for assessing the morphological variability within that assemblage. We conclude that the degree and pattern of sacral shape differences observed between the two specimens are compatible with the hypothesis of two different *Australopithecus* species at Sterkfontein Member 4 [5].

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Pecha Kucha Presentation Session 10, Sa 11:30-11:55

Modern human facial and mandibular growth at the micro and macroscopic levels: marrying bone modeling and geometric morphometric techniques

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Adult facial morphology is achieved through bone growth and displacement during ontogeny. Bone growth primarily occurs through the process of bone modeling (BMod) which is the cellular activity of osteoblasts, bone forming cells, and osteoclasts, bone resorbing cells, responsible for the building up of new bone tissue. These activities can be identified on bone surface. The distribution of BMod fields are indicative of the direction of bone movement during ontogeny. It is generally assumed that BMod patterns at a microstructural level correspond to large-scale morphological changes, but few studies have investigated this relationship [1, 2].

In this study, we explore the relationship between BMod patterns during ontogeny and facial and mandibular shape, form (shape and size), and ontogenetic age. We test whether variability in bone formation and resorption during ontogeny is also reflected in semilandmark geometric morphometrics (GM) data by evaluating three of the main results found by Martinez-Maza and colleagues [3]: 1) in the face, growth is most variable in the nasomaxilla, 2) in the mandible, growth is most variable in the ramus, and 3) there is more variation in subadults than in adults.

We utilized previously mapped patterns of bone formation and resorption fields [3] of a cross-sectional ontogenetic sample of human skulls of known sex and calendar age. Surface scans of the same specimens were acquired, and landmarks and curve and surface semilandmarks were digitized on three-dimensional reconstructions of the scans. Variation in facial and mandibular growth was explored by means of a principal component analysis in form space, including the geometric size (as the natural logarithm of centroid size) of each specimen, and Procrustes variance was calculated to quantify form variability. Temporal patterns of development (i.e., shape) and growth (i.e., form) maturation were also explored and compared to the BMod data.

Our GM results support the first two conclusions by Martinez-Maza and colleagues [3]: the most variable region of the face during ontogeny is the nasomaxillary region, followed by the zygomatic, and the upper face; the mandibular ramus is slightly more variable than the corpus. The results of their third finding—subadults express more variation than adults—is only upheld in the nasomaxillary region. Our results suggest a correspondence between constant patterns of bone formation and decreased variation in form. Like in humans, the upper face and mandibular corpus of great apes is predominately bone forming during ontogeny [5]. This may reflect the existence of phylogenetically preserved constraints, likely associated with developmental processes [5]. Whereas, anatomical regions that are more variable, like the nasomaxilla, may be less developmentally constrained and subject to greater evolvability.

This study demonstrates how BMod and semilandmark (GM) techniques can be combined to create informative growth models. We present novel methods for quantifying and visualizing bone modeling patterns, and show how partial least squares analysis can be used to interpret covariation between bone growth at the micro- and macroscale. Integrating GM techniques into the interpretation of bone modeling studies enables one to examine bone growth through displacement. At the same time GM studies can benefit from the direct evidence of bone growth activity provided in bone modeling studies.

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Poster Presentation Number 41, Fr 18:15-19:00

Who do you think you are? First results of Neolithic and Bronze Age Balkan genomes shed light on the dynamics of European ancestry.

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Genome-wide ancient DNA from twenty-eight individuals from Neolithic and Bronze Age north-eastern Croatia has been generated to directly reconstruct ancestry and assess evidence of genetic substructures in order to better understand what impact Neolithic immigrant populations had on local hunter-gatherer groups and their genetic composition, and to characterise biogeographic relationships with other ancient and modern populations.

The Neolithic transition greatly transformed the structure of European societies, as migrating peoples brought with them new agricultural practices, a sedentary way of life, and their own cultures and genetic ancestry. The Balkan Peninsula is key in our understanding of these processes, as it was an important crossroads for communication and trade with Anatolia, Western and Northern Europe. Limited availability of Balkan specimens means we still do not know the full extent of interactions between locals and migrant farmers, and impacts on intra-population genetic signatures over time in this region.

The aims of this study include direct assessment of nuclear single nucleotide polymorphisms (SNPs), and uniparental markers to investigate admixture, sex-specific mobility patterns, biogeographic origins and phenotypic traits over two time periods. Further aims are to analyse geno-geographic associations in relation to modern and other ancient samples from across Eurasia, and to infer demographic patterns of migration and impacts on human genomic diversity.

The Neolithic site of Beli Manastir-Popova Zemlja contains almost forty inhumations from the Starčevo culture, the oldest Neolithic farming population to settle permanently in northern Croatia. Individuals are buried in contracted position with ceramic vessels placed by their head. In addition, the geographically proximate Bronze Age site of Jagodnjak-Krčevine contains inhumations from the Transdanubian Encrusted Pottery culture, accompanied by a variety of grave goods.

Sampling of aDNA from twenty-eight well-preserved human skeletal remains from these archaeological sites was conducted in clean rooms where the petrous portion of the temporal bone was targeted for its high DNA yield. Extracts were built into libraries and screened for DNA content, followed by whole genome shotgun sequencing to above 1X coverage. Stringent quality control measures and sequence alignment were carried out, followed by bioinformatic methods to identify single nucleotide polymorphisms and perform further downstream analyses of genomic variation and ancestry.

All sampled specimens contained high endogenous aDNA content up to 72 per cent, and exhibited typical damage patterns consistent with ancient DNA preservation. In addition to mitochondrial and Y-chromosome haplogroup assignment, principal components analysis for nuclear SNP data showed typical clustering of Bronze Age samples, while two of the Neolithic specimens were situated apart from the remainder of their assemblage. Results of admixture analysis and other measures of genetic variation and ancestry will be presented to help clarify the origin of these individuals and to distinguish genetic continuity and change in this region.

These results for Neolithic and Bronze Age burials in northern Croatia present an initial phase within a broader study to investigate the early development of social status and identify intra-population genetic substructures in relation to patterns of social differentiation as seen in the archaeological record in this understudied area. Analysis of carbon and nitrogen stable isotopes from bone collagen, and strontium from dental enamel is also being performed on the same individuals to shed further light on the interaction between social inequality, genotype, phenotype and nutrition on a backdrop of population migrations and the arrival of agriculture into Europe.

Poster Presentation Number 42, Th 19:00-19:45

Shape variation in Middle and Late Pleistocene human calvariae

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In this study we investigated the outer shape variation in a taxonomically and geographically diverse assemblage of Middle and Late Pleistocene human calvariae using a 3D geometric morphometric (GM) approach. The sample includes fifty specimens commonly attributed to "early" *Homo, H. erectus s.l., H. heidelbergensis, H. neanderthalensis* and fossil *H. sapiens*. Relevant to this analysis is the ca. 1 Ma old UA 31 cranium from Buia, discovered in 1995 in the Dandiero basin of the Eritrean Danakil depression [1]. This nearly complete fossil, whose endocast preserves a general plesiomorphic *H. erectus* phenotype [2], is reported to display a blend of *H. erectus* -like and derived morphoarchitectural features more commonly found in Middle Pleistocene fossils [3]. A total of 24 standard landmarks and 432 semilandmarks were extracted from surface models. Following standard procedures, missing landmarks were estimated using Thin-plate Spline interpolation. Landmark configurations were thus rendered symmetrical and semilandmarks were allowed to slide using bending energy as criterion. Residuals of the Procrustes superimposition were used for all multivariate statistical analyses. Among the results, the PCA shows the most important contrast between *H. sapiens* and *H. erectus, H. heidelbergensis* and Neandertals occupying an intermediate position. In this regard, as partially expected, UA 31 shares some shape features with *H. erectus*, while being relatively removed from the bulk of the group. This result suggests a particular combination of calvarial features that is not commonly found in other hominins analyzed here. In fact, like other *H. erectus s.l.* calvariae, the specimen from Buia exhibits a relatively elongated vault with a marked supraorbital torus; however, it is distinguished from other *H. erectus* representatives analyzed here by its narrow yet relatively convex vault. A subsequent between-group PCA, with the Buia specimen unassigned, confirms the greatest group difference between *H. sapiens* and *H. erectus*; in this case, however, the UA 31's calvaria is marginal to the *H. erectus* range, with an intermediate position between *H. erectus* and Neandertals. Whether the calvarial morphology of Buia resembles that of any other hominins not included in this study (e.g., the calvaria from Daka, Ethiopia, chronogeographically close to UA 31) remains to be investigated through extended sampling. The outlook for this is limited by the scarcity of sufficiently well-preserved remains from comparable chronological timeframes. Until further light can be shed on calvarial shape variation around the end of the Early Pleistocene, our data suggest a high degree of variability among Middle Pleistocene hominins and, possibly, an earlier than previously thought onset of neurocranial expansion.

We acknowledge the Department Homme et Environnement (MNHN) for partially funding this project. For access to specimens, we are thankful to: The National Museum of Eritrea, The Natural History Museum London, Naturhistorisches Museum Wien, Institut Royal des Sciences naturelles de Belgique, Museum national d'Histoire naturelle Paris. We are indebted to E. Trinkaus, Washington University, and Robert Franciscus, University of Iowa, for providing access to hominin casts.

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Poster Presentation Number 55, Fr 18:15-19:00

The (very) late Middle Palaeolithic-like assemblage at the Betovo site (Russia)

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The open-air site of Betovo, in the Upper Desna basin, has been the focus of interdisciplinary research since its discovery in 1971. The site is 8 km upstream of Khotylevo 1; one of the largest Middle Palaeolithic (MP) sites in the region. Betovo was excavated by Lev Tarasov's expedition over 11 years and yielded a cultural layer with numerous lithics and faunal remains. In 2009, the Upper Desna Expedition of the Institute for the History of Material Culture of the Russian Academy of Science (St. Petersburg) resumed fieldwork in a test pit adjacent to Tarasov's trench. The lithic assemblages found at Betovo are characterized by MP-like technological and typological features - primary flaking including unipolar and orthogonal reduction is attested by a series of flat cores, while the debitage includes some Levallois features. The retouched assemblage (retouched flakes, side scrapers, some points) is also MP in appearance. The retouched collection also includes some fragments of bifacial bi-convex and plano-convex points (there is only one whole bifacial symmetrical plano-convex point, from Tarasov's previous excavation). The site also produced the youngest radiocarbon dates known for MP-like assemblages in this region, between 32 - 24 ka BP [1,2], which make the site important for our understanding of Palaeolithic variability in Eastern Europe and human dispersal during the Late Pleistocene.

In 2016, new excavations took place a few meters upstream from the original sections with the objectives of clarifying the stratigraphy, reassessing the lithic industry and establishing its age and relationship with local climatic and palaeoenvironmental change. The site was excavated over an area of 18 m^2 and to a depth of more than ten metres, and two distinct Middle Palaeolithic-like cultural horizons were identified. We collected sediment samples for single-aliquot and single-grain optical dating. This technique gives an estimate of the time elapsed since the sediment grains were last exposed to daylight, and analysis of individual quartz grains can be used to obtain ages from samples that consist of mixtures of grain populations due to incomplete bleaching or post-depositional disturbance for example. For AMS radiocarbon dating, we collected animal bone samples from the field in direct association with the two cultural layers. The comparison between single-aliquot and single-grains OSL ages reveals no major post-depositional disturbance through the sequence. The OSL ages are also in agreement with the published and newly obtained 14C ages. We outline our ongoing dating program at Betovo and the implications of this chronology for the ages of the cultural remains, and for human presence during the Late Pleistocene in the western part of the Russian Plain.

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Poster Presentation Number 4, Fr 19:00-19:45

Palaeanthropology as nomothetic science: falsifiable predictions from modern human evolution research

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Modern palaeoanthropology has many of the hallmarks of 'science'. It draws on a wide suite of technical methodologies including, but not limited to, geometric morphometrics, Bayesian statistics, and ancient genomics. Few palaeanthropologists would deny that they are 'scientists'. But there are some important senses in which palaeoanthropology is unlike other sciences: it is distinct from physical science in that its empirical evidence is 'historical' in nature, and cannot be conjured up in the laboratory but must be found, often by chance, in the ground. It is distinct from the life sciences, in that its subjects of study are limited in number, fragmentary, and necessarily subject to sampling bias by the process of fossilisation. And, more broadly, it is distinct from 'mature' paradigmatic sciences in that it possesses no unanimously accepted palaeoanthropological theory upon which new theories are built. How, therefore, should we think about palaeonthropology as a science?

Modern science can broadly be categorised into nomothetic and idiographic fields [1]. The former appeals to regularities and natural laws in order to describe the world, while the latter seeks to give non-reductive causal accounts of contingent historical events. Gould [2] famously seemed unsure as to whether (a) palaeontology is fine as an idiographic science, or (b) palaeontology would improve its scientific credibility if it operated under a nomothetic approach. Since, arguably, palaeontology shares many of the same features as palaeoanthropology, Gould's dilemma applies equally well to both disciplines.

More recently, Turner [1] has suggested that palaeontology (and equally palaeanthropology) might be understood as employing a third approach to science – a fusion of idiographic and nomothetic protocols. However, there remains support for the claim that these 'historical sciences' would fare better if they imposed on themselves a nomothetic framework [3].

In this work we make tentative first steps towards imposing such a framework by considering one of the basic hallmarks of falsificationist, nomothetic science: 'risky' predictions [4]. By employing a hypothetico-deductive model of scientific hypothesis formulation, we consider the following questions: what might a 'risky' prediction look like for a modern palaeoanthropological theory, and which predictions might the mainstream theories of our discipline generate? We draw upon both the philosophical and palaeoanthropological literature to construct falsifiable predictions with reference to case studies from recent human evolution research and suggest how these could be used to inform future inquiry.

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Poster Presentation Number 9, Th 18:15-19:00

The Pleistocene-Holocene transition: new data from the sites of Rôdo, Vau and Bispeira 8 (Vouga valley, Portugal)

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Archaeological work carried out during 2014/2015, in the scope of the Ribeiradio-Ermida Hydroelectric project, allowed the identification of three Prehistoric archaeological sites in the Vouga valley: Rôdo, Vau and Bispeira 8. Subsequent excavation and preliminary analysis suggest that these three open air sites demonstrate a broad spectrum of diachronic human occupation during the Upper Pleistocene and confirms the presence of Pleistocene human occupation in the Vouga valley; these open-air sites become even more relevant if we consider that, until its identification, this region constituted «a deserted area» between two of the most important regions for the study of Upper Pleistocene in Portugal: the Estremadura and the Côa valley. This poster summarizes the state of research and presents data concerning: site formation processes, paleobotany, anthropogenic features, raw material supply and lithic technology. The Rôdo is located on a flat surface, corresponding broadly to a fluvial terrace, sloped towards the current riverbed of Vouga, encompassing the convex sector of a meander, inserted in the embedded valley of the river. This platform results from the long process of the river incision (the formation of different terrace levels) articulated with slope erosion. The site designated as Vau is located in the valley of Teixeira river, a tributary of Vouga and evidence of human occupation is located in a meander where a fluvial beach has formed. The geomorphological dynamics of the site are similar to Rôdo, i.e, the site was formed within the process of the Teixeira's incision and by slope erosion. Bispeira 8 is located upstream of Rôdo, at a higher elevation. At this location, there are no clear terrace evidence and it seems that site formation is only explained by slope dynamics. Both sites - Rôdo and Vau- presented some stone features, undeniably connected to human use, which may be interpreted as fireplaces; nevertheless, the complexity of site formation processes does not allow, for the moment, the identification of specific activity areas. At Bispeira 8, negative structures were also identified and some of them might have been used as fireplaces. Considering the nature of the archaeological remains retrieved, we may suggest that these sites, probably, result from multiple but short human occupations during a long diachronie. Concerning the artefacts recovered, in all three sites the majority of stone tools were produced using local raw materials (quartz and other coarse grained rocks), often cobbles collected in the nearby alluvial gravels. Débitage suggests the use of simple and expeditive, though efficient, techniques to produce flakes (scarcely transformed into scrapers, notches or denticulates) or simple chopping tools. Allochthonous flint and other siliceous rocks were used to produce flakes and bladelets but transformation rate into retouched tools is low. Bladelet reduction sequences are simple, with little or no investment in preparation and often take advantage of the natural shape of the volumes. The percentage of retouched tools, including fossil indicators as microliths, is very low, thus making crono-cultural attribution more difficult. Nevertheless, the Rôdo human occupation can be attributed to Late Magdalenian or Azilian; the Vau site seems to have been occupied during Gravettien, Late Magdalenian and Azilian and Bispeira 8, probably during Late Magdalenian or Azilian. Although preliminary, these results allow some conclusions about resources management, mobility and land use by the late Pleistocene hunter-gatherer groups that created the Côa Valley art. This work aims to a better understanding of human adaptations, in reaction to environmental changes in a regional scale and consequently a better characterization and understanding of the Iberian Peninsula during Pleistocene-Holocene transition.

Poster Presentation Number 32, Fr 19:00-19:45

An early enamel thickness decrease in the permanent canines of the European populations from Atapuerca

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Dental traits are considered to be highly heritable, selectively neutral and evolutionary conservative, representing a useful tool in taxonomic and phylogenetic studies (1). Dental tissue proportions, in general, and the enamel thickness, in particular, have been of considerable interest over the past century. Despite all research work carried out on posterior dentition (2–4), the variation in dental tissue proportions within the genus *Homo*, and specifically the origin of the two enamel thickness tendencies that appeared in Neanderthals and modern humans during Middle Pleistocene is poorly understood. This is mainly due to the absolute scarcity of data on early European populations. In this context, large tooth samples of well-defined populations, such as those of the archaeological complex collections from Sierra de Atapuerca in Spain, could contribute to fill this gap. This study aims to discuss the meaning of the possible similarities and differences in the dental tissue proportions between Gran Dolina (n=3) and Sima de los Huesos (n=32) samples, the Neanderthal dental remains of Krapina (Croatia) (n=18) as well as between a recent modern human sample from Europe and Africa (n=126). To do so, microtomographic imaging analytical techniques were applied to a sample of permanent canine teeth belonging to these populations, as well as the enamel and dentine volumes (2) and surfaces (5) were measured. Finally, the mean values of each measurement were compared among taxa. Our results show that Early and Middle Pleistocene populations from Atapuerca exhibit large coronal and root dimensions in their permanent canines, as well as a thinly enamelled pattern, which has been traditionally considered an autapomorphic Neanderthal trait. Therefore, these results might support an early enamel thickness decrease, which is already observed 800 kyr ago in *Homo antecessor* and maintained in later groups such as Sima de los Huesos and Neanderthal populations during the Middle Pleistocene. This tissue pattern seems to be the result of the dentine-pulp complex expansion and the increase in the complexity of the EDJ surface in these taxa's canines. Likewise, a greater role of the coronal dentine component seems to be accompanied by larger roots, and might be related with more bone robustness. Future studies on dental tissue proportion of the posterior teeth belonging to Sima de los Huesos and Gran Dolina individuals could help to increase the amount of information available on the taxonomical distinctive patterns of these populations.

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Podium Presentation Session 8, Fr 17:30

Estimation of total lung capacity (TLC) in Neanderthals with physiological implications

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Introduction: Neanderthals were highly-encephalized and heavy-bodied hominins with wide trunks formed by a wide pelvis and a wide central-lower thorax [1] [2] [3]. It has been recently proposed, in the light of bioenergetics, that, in order to maintain the metabolism of a heavy and highly-muscled body, Neanderthals would have needed a large amount of oxygen [4]. This would have been provided by a powerful and large ribcage [1] [2] [3], which should be obviously reflected in their respiratory parameters. Among the respiratory variables, total lung capacity (TLC), understood as the maximum amount of air that lungs can house has been used in modern humans as a good approach for addressing variation in oxygen intake [5]. We use 3D geometric morphometrics (3DGM) combined with physiological parameters (TLC) to calculate TLC for a female (Tabun 1) and a male (Kebara 2) Neanderthal in a comparative framework with modern humans. Materials and methods: We used respiratory parameters and CT reconstructions of ribcages that belonged to 22 adult individuals from the Hospital Universitario La Paz (Madrid, Spain). Fossil specimens comprise 3D surface scans of original costal remains from the Neanderthal male Kebara 2 (Israel, 60 ky) and the Neanderthal female Tabun C1 (Israel, 122 ky), focusing in diaphragmatic ribs. For the comparative human sample, TLC was measured and their individual ribs were CT-scanned and segmented using the software 3DSlicer. Final 3D costal models were digitized in Viewbox4 software following the protocol of [3]. Size data of costal elements were measured as centroid size. Linear regressions of costal size on TLC by level were performed in the comparative sample and used to estimate TLC in fossil specimens using their CS values. Results: linear regression analysis showed that the rib size was correlated with TLC at levels 7-10 ($r2=0.38$, 0.55, 0.59 and 0.60 respectively; $p<0.01$). Estimations of TLC in fossil specimens yielded larger average values (around 20%) for Kebara 2 and Tabun C1 than the mean of their corresponding modern human samples. Discussion and conclusions: TLC is a good approach in order to address respiratory and energetic demands not only in modern humans [5] but also in fossils hominins [4]. However, TLC measurement is a hard challenge when we face the fossil record. Our results are indicate that individual ribs sizes are correlated with lung capacities. Our results for Neanderthals show that their TLC, estimated using the size of lower ribs, was larger than in their corresponding human counterparts, which is consistent with their expected high daily energy expenditure proposed by previous studies [4]. This would be linked to the high cost of maintaining large- brained and highly-muscled bodies alongside the need of elevated activity levels related to their subsistence tasks [4]. This larger muscle mass would have provided them further with a greater thermogenic capacity and also greater insulation against cold compared to modern humans, which could be understood as an exaptation [4].

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Poster Presentation Number 34, Fr 19:00-19:45

Tooth root phenotypic variation in modern human populations

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Teeth have been central to studies of hominin variation and evolution. Their resistance to chemical and physical destruction means they are well represented in the fossil record. Teeth can provide information on diet, health, age, and sex. Importantly, tooth development and morphology appear to be under strong genetic control, and thus reflect phylogenetic patterns and adaptive outcomes. However, most research has focused on tooth crowns, rather than the complete dental system including roots. The scarcity of research was largely due to the inaccessibility of tooth roots for metrical and morphological assessment. Early studies required x-rays, which are problematic when visualizing root structures that are often curved or layered one on top of another. Other methods are destructive, requiring the sectioning of bones and fossils. The development of Computerized Tomography (CT) allows researchers to bypass destructive techniques and the limited imaging of x-rays, and has transformed the potential for studying variation in tooth roots. These new research technologies allow for novel investigations into human diversity. To what extent does variation in root morphology reflect population relationships? Is the variation sensitive to diet and functional demands? These questions require the development and application of a systematic definition of phenotypic variation in human tooth roots. The research presented here provides a definition of the range of phenotypes of human tooth roots, and some preliminary analyses of the patterns of variation in these phenotypes. Using CT scans, we analyzed the maxillary and mandibular dental arcades of individuals (n=858) from osteological collections housed at the Smithsonian Institution National Museum of Natural history, American Museum of Natural History, and the Duckworth Collection at the University of Cambridge Leverhulme Centre for Human Evolutionary Studies. Teeth were assessed for root and canal count, and root and canal shape and form. Problematically, canals do not always match with the number of roots, and some teeth have multiple canals within a single root. To address such complexity we developed a novel method of classification that captures the human tooth root 'phenotype set.' Each phenotype provides information on (a) root and canal count; (b) root and canal shape; and (c) the combined, to describe overall count, shape, and form. The phenotypes within the overall set can be treated as combined units (for example root and canal count together) or separated and analyzed by their constituent parts. Our method is easily applicable to fossil hominins and non-human primates. This paper presents the initial results of the analyses. Questions addressed include: What is the range of variation of human tooth roots and their internal structures? How does this variation differ at the global, regional, and population level? Are there patterns of tooth root-based phenetic affinities between populations? Are population specific tooth root phenotypes the product of selection or drift? We discuss the observed patterns of variation in recent human populations. Frequencies of the root, canal and combined phenotypes varied considerably globally; for example, among South East Asian and Inuit population there was a high frequency of unique phenotypes. Results also suggest that that unusual root forms (Ento-, and Exomolaris, Tomes', C-shaped) have a higher expression rate in populations found outside of Sub-Saharan Africa. Additionally we report strong signals for sexual dimorphism in several root phenotypes.

Poster Presentation Number 28, Th 19:00-19:45

New Neandertal fossils and first data of Middle Paleolithic bird and carnivore exploitation in the Cantabrian Region

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The site of Axlor is located on the northwest slope of the Urrestei mountain (Dima, Biscay, Basque Country). Axlor was discovered in 1932 by the Basque prehistorian J.M. Barandiarán. The first archaeological excavations took place in 1967, and encompassed a total of eight field seasons until 1974 [1]. These excavations revealed a sequence of nine layers (I-IX), in which Middle Paleolithic lithic assemblages were found in levels III to VIII. Ultra-filtered dates obtained from red deer with anthropogenic marks from level IV have yielded results that go beyond the radiocarbon limit [2]. In levels III-V the faunal assemblage is dominated by red deer, large bovids, Iberian wild goats and, to a lesser extent, horses [3]. There are clear differences in terms of the technological characteristics, percentage of ungulate taxa consumed, and type of occupation of the cave between the upper Quina Mousterian levels (III-VI) and the lower Levallois Mousterian levels (VII-VIII) of the sequence [4]. The current human fossil record known for Axlor is limited to five Neandertal dental remains with a maxilla fragment from the same individual (a young adult) which were recovered from level III-IV [5], though only three of them are curated at the Arkeologi Museoa. In 2005, the re-assessment of the whole Barandiaran collection (coordinated by J.E. González Urquijo) resulted in the recognition of three additional human remains: two teeth and a cranial fragment. Additionally, some other remains were isolated by P. Castaños as potentially human. More recently, we have reassessed the whole faunal collection from Barandiarán's excavation of the site of Axlor. This review has resulted in: 1) the identification of an additional human remain among the faunal remains, 2) the positive identification of a cranial remain among the elements isolated by P. Castaños, and 3) finding the first evidence of bird and carnivore exploitation by Neandertals in the Cantabrian region. All the human fossil remains were studied macroscopically and were micro-CT scanned. The faunal remains were studied using an Olympus SZX10 (stereoscopic zoom microscope) to examine the surface modification on bone remains. The following taphonomic parameters were studied: physical alterations, biological alterations and fracturation type. The evidence of bird and carnivore exploitation comprises cut-marks in two golden eagle remains (a femur in level IV and a tibiotarsus in level V), one raven (an ulna in level IV), one wolf (a radius in level V) and one dhole remain (a femur in level III). Neandertals at Axlor exploited at least a golden eagle and a dhole for dietary purposes. Neandertals were top predators who basically relied on middle- to large-sized ungulates for dietary purposes, but there is growing evidence that supports their consumption of plants, leporids, tortoises, marine resources, carnivores and birds. The Iberian Peninsula has provided the most abundant record of bird exploitation for meat in Europe, starting in the Middle Pleistocene. However, the bird and carnivore exploitation record was hitherto limited to the Mediterranean area of the Iberian Peninsula. Regarding the unpublished human remains found during Barandiarán's excavations, they comprise an adult tooth, two deciduous teeth and two cranial fragments besides the already published three teeth (upper P4, M1 with a maxilla fragment and upper M3 -most probably level IV-) [5]. The new adult tooth is a complete lower right incisor with a marked tuberculum dentale that was found in level V. The two deciduous teeth comprise an upper left first deciduous incisor found in level V and a left upper deciduous second molar found in level IV. The two cranial fragments comprise a larger (c. 6 x 4.5 cm) parietal fragment which was found in level VIII and a smaller occipital fragment from level III. With the new findings, Axlor is currently the site with the largest amount of human fossil remains in the easternmost Cantabrian region.

We would like to thank the Arkeologi Museoa and its staff for allowing us access to these fossils. This research has also received support from the Spanish Ministerio de Economía y Competitividad (project CGL2015-65387-C3-2-P-MINECO/FEDER), Research Group IT1044-16 from the Eusko Jaurlaritza-Gobierno Vasco and Group PPG17/05 from the Universidad del País Vasco-Euskal Herriko Unibertsitatea. Thanks also to A. Rodríguez-Hidalgo, D. Garate, and our colleagues from BBP, UCM-ISCIII, EHU-UPV for stimulating discussions. Thanks also to J. Pastor for permitting us to access the extant dhole osteological collection curated at the Museo Anatómico (Universidad de Valladolid). C.N.-L. is the recipient of a Ph.D. fellowship from the Gobierno de Aragón (DGA) co-financed by the European Social Fund (FSE).

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Poster Presentation Number 17, Fr 18:15-19:00

Body size estimates of Miocene fossil apes and predicting mass across deep time

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Humans are relics of an adaptive radiation of apes that flourished in the early Miocene. Thus, reconstructing the paleobiology of these early apes is a necessary step to understanding the earliest phases of human evolution. While estimates of body size in Miocene apes can potentially provide new information on locomotion, life history, and dietary requirements, previous attempts have generally used limited comparative samples of extant apes and were often conducted on a case-by-case basis following new fossil discoveries. The choice of a comparative training sample is profoundly important because it directly impacts body mass predictions, and this choice becomes more difficult for fossils that may have fundamentally different Bauplans than any living taxa. Here we present a new approach for estimating fossil body mass that incorporates phylogeny, accounts for measurement error, and combines interspecific and intraspecific allometric scaling. We use this approach and linear measurements based on postcranial traits from a wide comparative sample of over 30 extant primate species to produce new and comprehensive body mass prediction equations. We then use these equations to predict body mass for over 50 individual Miocene ape fossils and calculate averages for taxa including *Morotopithecus*, *Sivapithecus*, and *Oreopithecus*. Results suggest that early apes varied substantially in body size until around 10 Ma, after which the majority of (recovered) fossil ape taxa appear to have been larger bodied. Substantial size variation within *Proconsul* supports generic distinction of *Ekembo*. Finally, estimated body masses for *Ardipithecus* and *Orrorin* are higher than our previous estimates using a modern human comparative sample, but consistent with our results using a chimpanzee comparative sample. Overall, these findings suggest body mass was highly evolvable in hominoids since the Miocene, and our results add to the comparative lens through which to view the emergence of the earliest hominins.

Poster Presentation Number 1, Fr 18:15-19:00

Do rhetorical devices work? A text analysis of research paper titles in Neanderthal studies 1970-2017

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The journal article as artefact has been the subject of considerable research. Often this has had a pedagogic dimension, with the aim of explaining or extending editorial guidelines and assisting writers improve their papers and increase their chances of having the work published. Other studies have explored thematic trends within the discourse, although these have often been based on a limited number of journal sources and have been focused on articles as a whole. Surprisingly, there has been relatively little examination of article titles themselves, and none within physical anthropology. The work presented here is an analysis of titles of electronically available research papers directly concerned with the study of Neanderthals. The corpus comprises over 3,000 titles of research articles identified from two of the most commonly used academic databases, Web of Science and Scopus, covering the period 1970-2017. Titles were individually checked for relevance prior to coding then analysed using #LancsBox 3.0 [1] and SPSS. The data presented here suggest that titles may be assigned to one of two broad categories: *indicative*, delineating the research reported on; and *conclusive*, describing the research focus and also summarising the findings of the research. This is in line with previous diachronic studies of titles in other fields, although an increase in conclusive titles over the period was determined. A further dimension was identified – the use of rhetorical figures such as questions, puns, alliteration and other techniques of word play, with interrogative titles in particular arguably forming an additional category. The analysis described here evidenced a diachronic increase in the use of titular questions in the corpus, suggesting that this and other rhetorical devices are intended to enhance the reach of the title through piquing the reader's curiosity. The relationship between titular rhetoric and citation metrics was explored. It is proposed that the observed increase in conclusive, interrogative and rhetorical titles is not only evidence of a reaction to growing competition and compulsion to publish ("publish or perish"), but may also be interpreted as signalling subtle changes in article content and the broader discourse.

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Poster Presentation Number 15, Fr 18:15-19:00

How are lower limb motions, oxygen consumption, muscle activity and plantar pressure modified in humans when walking over substrates of varying compliance?

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The transition to terrestrial bipedalism represents a defining episode in the evolutionary history of our species, but its first appearance in the hominin fossil record is strongly debated. To understand how, when and why upright bipedalism evolved we have long relied on the shape of fossil footprints to infer locomotor behaviour used by our ancestors. However, the shape of footprints may vary according to the mechanical properties of the substrate. Indeed, differences in dynamic underfoot deformation likely also lead to differences in lower limb kinematics and kinetics, such that a single animal may utilise different limb motions and produce different footprint shapes in substrates with dissimilar rheological properties.

To better understand how limb kinematics and kinetics are altered in response to substrates with different mechanical properties we compare- peak pressure, oxygen consumption, muscle activity and lower limb motion in healthy human subjects walking on a range of artificial substrates of varying compliance. Each participant performed a total of 40 walking trails, 10 trials on four different surfaces at a self-determined comfortable walking speed. Whole-body kinematics were recorded using surface marker motion capture, oxygen consumption measured using a wearable metabolic system, muscle activities recorded using surface electromyography (EMG) and plantar pressures recorded using pressure-sensing insoles placed within standardised minimalist ("barefoot") shoes.

Preliminary analysis of lower limb kinematics and kinetics from this data set reveals systematic responses to walking on substrates of varying compliance. Participants displayed significantly increased ankle joint ranges of motion when moving across more compliant substrates, as well as longer stance phase times. On compliant substrates, data suggest a systematic decrease in peak plantar pressures as a result of larger contact areas and longer stance phases durations. Analysis of EMG data demonstrates a statistically significant increase in ankle plantar flexor use when walking on substrates of increased compliance. Also, energy expenditure is greater on more compliant substrates.

If plantar pressure is used as a proxy for footprint depth then these results are consistent with recent qualitative analyses that gait changes in humans when walking on sand with varied compliance. Furthermore, these results suggest caution should be taken when comparing fossil footprints that varied considerably in overall depth, as, like humans, early hominins would be expected to have altered their gait characteristics when walking across a range of natural surfaces.

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Podium Presentation Session 11, Sa 15:40

Global or local: Where do we find phylogenetic signal in cranial shape?

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The primate head consists of different functional units, such as the braincase, the orbits, and the jaws, which are adapted to their specific function in the species' ecological environment. Because of these adaptive histories, overall cranial shape does not reliably reflect phylogeny. However, the relative extent to which different cranial bones realize these functional units may have little, if any, adaptive value. For example, we may expect similar overall upper jaw shape in primate lineages with similar nutritional strategies, but the relative sizes of the premaxilla, the maxilla, and the palatine may differ considerably without functional impact. The relative dimensions of the constituting bones may thus carry stronger phylogenetic signal than the structure's overall shape. In other words, we expect that local rather than global shape variation carries the higher phylogenetic signal. To test this expectation, we conducted a geometric morphometric analysis of 70 midsagittal landmarks taken on CT scans of 16 papionin species, plus two other Old World monkey taxa (*Cercopithecus mitis* and *Colobus guereza*). Papionins, especially baboons (*sensu lato*) and mangabeys, are characterized by a stark incongruence between morphological and molecular similarities [1]; molecular approaches have considerably revised papionin taxonomy [2,3]. Indeed, we found that the shapes of the individual cranial bones – considered separately – vary more than overall cranial shape. In other words, the larger the spatial scale, the smaller the shape variation we observe. To explore phylogenetic signal, we considered the shape of the cranial outline (presumed to best reflect the "functional shape" of the cranium) separately from the inner landmarks that delineate the different bones after the latter were warped to the same outline shape across all species. As expected, the "residual shape" of these inner landmarks, expressing the relative dimensions of the bones and thus their individual contribution to overall shape, showed a clearly higher correlation with an independent molecular phylogeny than cranial outline shape. This supports our hypothesis that the relative extent to which different bones realize the shape of functional cranial units are, at least partly, hidden from selection. As a form of developmental systems drift [4], they seem free to evolve and thus more reliably reflect phylogenetic history than overall cranial shape. Our findings also have implications for the study of the human fossil record. With the advancement of 3D imaging techniques, inner cranial morphology, and thus local shape variation reflected in sutures and synchondroses, of fossils can be mapped and used in phylogenetic reconstruction.

This research was supported by the FWF grant P29397 to P.M.

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Podium Presentation Session 1, Th 9:50

Neanderthal introgression sheds light on modern human brain globularity

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One of the features that distinguishes modern humans from our fossil relatives and ancestors is a globular shape of the braincase [1]. Neurocranial globularity comprises a round and expanded posterior cranial fossa (which houses the cerebellum), and more bulging parietal bones [1,2,3,4]. Comparisons of present-day humans with fossil *Homo sapiens* have shown that globular endocranial shape evolved over a long period of time within the *Homo sapiens* lineage [2,3]. In modern humans this characteristic phenotype emerges during perinatal development [4]. Endocranial globularity has therefore been linked to evolutionary changes of early brain development [2,3,4]. However, in the absence of fossil brain tissue the underlying neuroanatomical changes as well as their genetic bases remain elusive. Here we pioneer an interdisciplinary approach that brings together paleoanthropology, comparative hominin genomics, large-scale neuroimaging from thousands of present-day humans, and neural gene expression data, to shed new light on modern human brain globularity.

First, using geometric morphometrics on computed tomographic (CT) scans we quantified the endocranial shape differences between modern humans and Neanderthals based on a dense mesh of semilandmarks, and used the distinctive mean group differences to develop a metric for brain globularity. We then applied this morphometric approach to structural magnetic resonance imaging (MRI) data (n=4,468) from large cohorts scanned in Nijmegen (Netherlands) and Greifswald (Germany). For each individual we computed a globularity score, which we showed with repeat scans to be robust and reliable. Next, based on palaeogenomic data we characterized the DNA of these same adults, using genetic polymorphisms to identify introgressed Neanderthal fragments [5] that each person carried. With these polymorphisms we could test each Neanderthal allele for association with the globularity score, specifically asking whether the allele promotes a more archaic brain shape in modern humans. To this end we performed a meta-analysis of 50,057 archaic single-nucleotide polymorphisms (SNPs) with a minor allele frequency of at least 0.01, covering 42% of the known, high-confidence Neanderthal haplotypes. Finally, we tested whether the SNPs that showed strongest association with archaic brain shape regulate the expression of nearby genes in the brain and other tissues, using the GTEx database of expression quantitative trait loci (eQTL) data.

Our results uncovered a number of Neanderthal alleles that seem to push the brain toward a less globular, i.e. more elongated shape. These alleles affect the neural expression of nearby genes that regulate multiple aspects of brain growth, and so may help identify molecular pathways affecting modern human brain shape and function.

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Poster Presentation Number 20, Th 19:00-19:45

Weaning practices in early Montreal with dentine micro-sampling and nitrogen isotopic analysis

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The weaning process is a critical stage of an infant's life, which corresponds to the period when breastmilk progressively decreases and the consumption of other food increases. In addition, as infants lose the immune system of their mother, they tend to "catch" diseases more quickly, and that is why a peak of mortality around one year of age is often observed [1]. The timing of weaning can also affect the health of both the mother and the child. However, decisions when to stop breastfeeding can reflect a large variety of complex socio-economic conditions. For example, during the 18th-19th century in North America, weaning usually started around the age of 14 months, but with probably considerable variation amongst social classes [2].

Life conditions in "colonial" Quebec were probably harder in the city than in the countryside due to various factors (e.g. population density, housing, water pollution). It could have contributed to higher mortality, especially amongst infants. Here, we explore the differences and similarities in weaning practices between two colonial populations. They lived in slightly different habitats, both located on the island of Montreal, which may have had possible selective effects on mortality. The paleochemical reconstruction was done on individuals that both survived or died during childhood. It aims to explore the possible effects of stress on weaning (e.g. shortened duration of breastfeeding, poor post-weaning diet) [3].

By analysing the paleochemical composition of dental tissues, which do not remodel during life, one can explore this weaning process for both adults and infants. The micro-sampling of dentine and the isotopic analysis of nitrogen allows us to observe the trophic enrichment between an infant and its mother. This methodology enables one to reconstruct the weaning process at an individual level [4].

Permanent and deciduous first molars were sampled from both immature individuals (N=30) and adults (N=17) from two cemeteries: Notre-Dame (1691 – 1796) and Pointe-aux-Trembles (1709 – 1843). These two sites represent respectively an urban and a rural group. After having sectioned the teeth longitudinally, an average of five micro-samples (corresponding to different ages between birth and around six years old) were collected from the dentine. Then, they were analysed for nitrogen isotopes (15N). Six third molars of women in reproductive age were also included in order to have an average value of the maternal diet.

A dietary biography was reconstructed for each individual on a site basis, in order to evaluate the weaning process and its timing. The results were compared between the two sites and with historical data. Preliminary results suggest the following: (i) there is a statistical difference between the urban (Notre-Dame) and the rural site (Pointe-aux-Trembles); and (ii) the deciduous molars show enriched values (δ15N: around 12-14‰) compared to permanent molars (δ15N: around 9-10‰). Fluctuations of δ15N could be associated to physiological stress [5], occurring especially amongst infants, which may be correlated to their shorter lifespan. Moreover, as several authors have observed a difference between boys and girls during weaning [3], our results are also discussed in relation to the cultural practices that reflect sex and/or socio-economic differences.

In conclusion, the weaning process in Quebec and especially in Montreal during the colonial period is poorly understood geochemically. Hence, this research allowed to explore the subject and propose hypotheses.

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Poster Presentation Number 24, Fr 19:00-19:45

Gorongosa by the sea: Miocene coastal environments of central Mozambique and their primate land-use potential

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Two field seasons of geological and paleontological surveys by the Paleo-Primate Project Gorongosa (PPPG) at Gorongosa National Park (GNP), central Mozambique, have resulted in the discovery of the first fossil sites from the Urema Rift, the southernmost and youngest continental section of the East African Rift System (EARS). *In situ* and surface fossils derive from the Lower Mazamba Formation that is estimated to be of Miocene age [1]. Given the paleontological potential of this formation for filling major gaps in the African fossil record [2], a thorough understanding of its paleoenvironmental evolution is of paramount importance. We compiled detailed datasets using sedimentological logging and facies, petrographic, paleocurrent, and geochemical analyses to reconstruct environmental contexts of the fossils and provide a better understanding of the complex interactions between rift tectonics, relative sea-level changes, and paleoecosystem patterns of the Gorongosa area. Regional stratigraphic relationships, sedimentary facies, facies architecture, and the emerging fossil record suggest a paleoenvironmental mosaic of estuarine and riverine-forest/-woodland systems, which represent the first Miocene coastal habitats identified in the EARS. Receiving continental sediment from granitic source terranes west of today's Urema Graben, estuarine sequences accumulated prior to rifting as compound incised-valley fills on a low-gradient coastal plain following transgression. Although we postulate a pre-rift scenario with environments that should have been and still are widespread along the East African coast, it is only through rifting, regional uplift, and subsequent exposure of the Mazamba Formation that provide us with this unique window into the Mio-Pliocene continental-margin ecosystems of central Mozambique. Modern environmental analogues have widespread significance in human land use and they are extremely productive habitats for marine and terrestrial fauna, including primates [3]. Thus, our discoveries suggest that the Miocene coastal landscapes of Gorongosa were ecologically-attractive habitats for primates, providing relatively persistent maritime climate and ecosystem conditions, year-round freshwater availability due to the combined maritime and orographic influences on rainfall regimes [4, 5], and food both from terrestrial and marine sources. Further research at GNP, including surveying, dating, and multi-proxy analyses to contextualize past and recent conditions, will help find additional fossil sites and provide refined chronostratigraphic and environmental constraints. The integrated approach of the PPPG will also help structure our understanding of the ancient East African margin, Neogene climate and sea-level histories, rift evolution, and their intricate relationships and environmental impact in general.

The Paleo-Primate Project Gorongosa would like to thank the Gorongosa Restoration Project, the National Geographic Society, the John Fell Fund, and the Leverhulme Trust, for the generous support with starting this interdisciplinary endeavour. Our work is only possible due to the visionary approach of Greg Carr and the dedicated staff from Gorongosa National Park, guided by Dr. Mateus Mutemba. We are very grateful to Dr. Solange Macamo, Dr. Mussa Raja at Universidade Eduardo Mondlane, and to all the Park "fiscais", to our students, and colleagues across many institutions who have been very enthusiastic about this project. J.M.H. benefitted from a grant provided by the Foundation for Science and Technology (FCT, Portugal), and acknowledges support by Nuno Bicho, Helga de Wall, Michel Bestmann, Lars Scharfenberg, and Harald Stollhofen.

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Poster Presentation Number 43, Fr 18:15-19:00

Patterns of ancient DNA preservation in a Palaeolithic human tooth from Les Cottés cave, France

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The scarcity of human fossil remains from the beginning of the Upper Palaeolithic in Europe [1], and the small number of individuals from which genome-wide data has been obtained to date [2,3], make it difficult to reconstruct the genetic history and the level of interaction between early modern humans and late Neandertals. A particular challenge stems from the small amounts of nuclear DNA preserved and the high proportions of microbial DNA contamination in the specimens of this age. However, it was recently shown that the preservation of aDNA may vary within the same human tooth even within a few millimeters distance [4]. Here we confirm the micro-local variability of ancient DNA (aDNA) preservation on another human tooth from Les Cottés cave, and the aDNA extracted already provides new insights into the peopling of Europe by early modern humans.

The human molar investigated here comes from the backdirt of previous excavations and cannot be associated with a particular archaeological context. However, given that the archaeological sequence at the site spans the Middle to Upper Palaeolithic transition with a complete and well-dated stratigraphy containing Mousterian, Châtelperronian, Protoaurignacian and Early Aurignacian, it is possible that the tooth comes from one of these layers. In order to determine to which hominin group it belongs, we removed 17.6 mg of dentine for DNA extraction. After the enrichment of libraries for mitochondrial DNA, we recovered 36,785 unique mitochondrial fragments. The frequencies of cytosine (C) to thymine (T) substitutions at the ends of these fragments were 35.3% and 34.5%, indicating that ancient hominin DNA is preserved in the specimen. However, these frequencies increased to 52.4% and 54.8%, respectively, when filtering for fragments that have a C-to-T substitution at their opposing end, suggesting that recent human DNA contamination is also present in the specimen.

After restricting the analyses to putatively deaminated DNA fragments, we were able to reconstruct 97% of the mitochondrial genome of the specimen. Interestingly, the reconstructed genome falls within the variation of modern humans and basal to the haplogroup R, a macrohaplogroup that includes Ust'-Ishim, Fumane 2 and other pre-agricultural Europeans. Furthermore, using 10 securely dated ancient modern humans as calibration, we estimated the tooth to be 46,060 years old, albeit with wide confidence intervals (95% HPD: 31,098 to 62,221 years BP).

Attempts to analyze the nuclear genome of the specimen by direct sequencing were hampered given that only 0.04% of the sequences aligned to the human reference genome, a result that can be explained by overwhelming microbial DNA contamination. We estimated that not more than 0.2 human genomes were recovered in this first sample and that 89% of the nuclear sequences derived from modern human contamination, which thus made this sample poorly suited for further analyses.

However, to investigate whether sampling other parts of the specimen may improve the yield of ancient human DNA, we removed three additional samples of 18, 20 and 25 mg of dentine from three different spots. Importantly, to minimize the impact of contamination, we treated each new powder aliquot with 0.5% sodium hypochlorite solution [5]. The resulting DNA extracts varied by several orders of magnitude in their content of nuclear genomes (0.06, 0.17 and 4.3-fold genomes, respectively) as well as the levels of present-day human contamination (13%, 0.2% and 0%). We are currently reconstructing large parts of the nuclear genome from the extract that yielded most ancient DNA, and first analyses indicate that the tooth belonged to a male individual. Further analyses that illuminate the relationship of this individual to ancient and present-day populations are underway.

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Pecha Kucha Presentation Session 10, Sa 11:30-11:55

A test of model predictions for the hominin occupation of Europe using dental non-metric data

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As the Middle-Late Pleistocene fossil record has expanded over the last few decades, the emerging pattern of phenotypic variability has raised important questions about the occupation of Europe by hominin populations and their relationship with other hominin groups outside Europe. There are currently four prominent models proposed to characterise the patterns and processes of hominin occupation of Europe: the Accretion Model [1], the Source and Sink Model [2], the Organismic Model [3], and the Multiregionalism Model [4]. The models differ in the level of isolation experienced by European hominin populations over time and in the key evolutionary forces, such as selection and genetic drift, which shaped the phenotypic variation exhibited by the fossil record. This research tested predictions for two variables, character variability and cladistic diversity, which are expected to vary based on these theoretical model differences in a way which should be exhibited in the fossil record. The research was conducted on a large dataset of dental non-metric characters from Pleistocene populations in Europe, Africa and Asia. Non-metric dental characters were chosen for their demonstrated heritability [5] and to maximise the size of the dataset. A large dataset was critical both to test changes in character variability over time and to allow a cladistic analysis at a population level, appropriate given the low confidence in taxonomic assignment for so many of the specimens analysed. The results suggest that there is no support for the prediction that character variability decreased during the Middle and Late Pleistocene in Europe [1,3] but that when sample size is taken into consideration, few significant changes in variability can be detected and are as likely to show an increase in variability as a decrease. The results of the cladistic analysis provide no positive support for any of the theoretical models evaluated. The results suggest that the relationships between Middle and Late Pleistocene European hominins are not linear with respect to time or geographic distance. The results are not robust to permutations of the data, suggesting that the cladistic evaluation of the existing fossil record presented here is highly sensitive to the addition of new data.

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Poster Presentation Number 11, Th 18:15-19:00

The Middle-Upper Paleolithic Transition in Southern Iberia: New Data from Lapa do Picareiro, Portugal

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The transition from Middle to Upper Paleolithic in western Eurasia remains a hotly debated and intensely researched archaeological problem. Recent developments in radiocarbon dating and genetics have permitted some refinements to our understanding of the spatiotemporal process but many issues remain unresolved. For the Iberian Peninsula, Zilhão's 'Ebro Frontier' model of late Neanderthal survival and subsequent replacement by anatomically modern humans has held sway for over two decades. Unfortunately, this and other models remain open to debate because of persistent problems with stratigraphic integrity, depositional hiatuses, and dating uncertainties at the relevant Middle-Upper Paleolithic transitional sites. New radiocarbon results from these sites have overturned their status and some have questioned the idea of late Neanderthal survival after 40 kya. Here we present new data on the Middle-Upper Paleolithic transition from Lapa do Picareiro, a cave with about 10m of sediments spanning 50,000 years of the Late Pleistocene. The sequence includes almost 2m of deposits dated between 40 ka cal BP, claimed by Higham et al. [1] to mark the end of the Mousterian, and 30 ka cal BP, the latest occurrence argued by Finlayson and Carrion [2] for southern Iberia. Our 2014-18 excavation of Lapa do Picareiro has revealed the presence of an Upper Paleolithic occupation stratigraphically positioned between a Middle Paleolithic occupation dated 47-45 ka cal BP and an undiagnostic archaeological level dated 36-38 ka cal BP. The lithic assemblage is characterized by a carinated endscraper or bladelet core and a dozen unretouched bladelets all made on chert. The occurrence of these elements indicates a previously unknown Early Aurignacian presence in central Portugal. Magnetic susceptibility data suggest the occupation took place during the H4 cold event. These finds complicate recently published scenarios by Wood et al. 2013 [3], Zilhão et al. [4] for sites in southeastern Spain and Angelucci and Zilhão [5] for the nearby Gruta da Oliveira. Taken together, the emerging chronostratigraphic scenario allows for several possibilities including a northern Iberian transfer of the Aurgnacian technocomplex through Euro-Siberian ecosystems that extended along the west coast of Iberia during cold phases of the Late Pleistocene. The finds do not necessarily discount models for late Neanderthal survival in southern Iberia after H4, but suggest the distinct possibility of coexistence with modern humans.

The authors wish to thank the National Science Foundation for supporting this collaborative research at Picareiro since 2014 with grants to Haws (BCS-1420299, 1724997) and Benedetti (BCS-1420453, 1725015). Previous work was funded by the Wenner Gren Foundation for Anthropological Research, the National Geographic Society, and the Archaeological Institute of America. We also thank all of the undergraduate and graduate students who have helped excavate the site.

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Poster Presentation Number 53, Th 18:15-19:00

Potential effects of muscularity on nasal cavity, nasal airways, and paranasal sinuses form

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The association between the form (i.e. shape and size) of the bone nasal cavity (NC), soft-tissue nasal airways (NA), and paranasal sinuses as well as the potential effect of body size and composition on the aforementioned structures can be best assessed using large and well-documented samples of CT images of living individuals. However, to date, these relationships remain poorly descripted especially when considering soft tissues. To these ends, we developed a comprehensive protocol including volume and dimensions of the NC, volumes of the NA and paranasal sinuses, and some dimensions of the neck musculature which is usually visible in head and neck CT images. The latter was used as a proxy for the degree of muscularity of an individual. A pilot study based on that protocol was carried out on a sample including 14 adult individuals from Moscow and an outer group of 5 adult individuals from Bordeaux. In the sample from Moscow, the muscle thickness at the atlas was moderately or weakly positively correlated with all NC/NA volumes and dimensions and, surprisingly, strongly negatively correlated with the length of the NC. It was also highly positively correlated with the volume of the frontal sinuses. Volumes of the lower two thirds (i.e. excluding the ethmoid labyrinth) of the NC and NA were weakly correlated, confirming previous results [1]. NC and NA volumes were strongly correlated with NC height, and moderately correlated with its width. However there was no correlations between either NC or NA volume and NC length. The volumes of the sphenoid and maxillary sinuses were rather independent from other variables (the latter only showed moderate correlations with height and length of the NC) while the frontal sinus volume displayed moderate correlations with the volume of the NC, neck muscle thickness and NC height. These associations probably reflect the well-known relationships of the frontal sinus volume with the size and robusticity of the skull. Interestingly, when the French individuals of both sexes were added to the sample, the resulting correlation matrix was similar but not identical to the matrix of the Russian sample alone (Mantel test 0.7, $p = 0.0002$) which points towards the presence of marked inter-population differences and sexual dimorphism in the studied variables.

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Poster Presentation Number 56, Fr 19:00-19:45

Dating the Middle to Upper Palaeolithic transition in Northern Iran: an OSL-based chronology for the open air site of Mirak using dedicated Bayesian modelling

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The open-air site of Mirak, which is located in the north part of the central Iranian desert and south of the Alborz Chain Mountains, is of the importance for our understanding of human dispersal during the Upper Pleistocene. This site has yielded lithic artefacts attributed to both the Middle and Upper Palaeolithic, which make it remarkable in this region. [1] Moreover, the evidence for the Middle to Upper Palaeolithic transition remains scarce in this area, and its chronology much debated. To establish a numerical chronology for the site of Mirak, luminescence dating was applied to sediment samples taken from two excavation areas. Quartz and Feldspar grains were extracted following standard laboratory procedures, then green OSL and post-IR IRSL at 290 °C (pIRIR290) [2] measurements were performed on multi-grain aliquots using standard SAR protocols [3]. Beta dose rates were determined from high resolution gamma spectrometry; the measured concentrations in radioelements were converted in dose rates. Gamma and cosmic dose rates were measured in situ with Al2O3 dosimeters. The quartz OSL signal is composed by a combination of both a fast component (prone to dating) and a medium component (not suitable for the SAR protocol), which led us to simulate OSL with green, rather than with blue light. The radioactivity measurements performed with high-resolution gamma spectrometry showed important disequilibria in the U-series, especially in the northern excavation area, which could be linked to water circulation in the sediment. Conversely, such disequilibria were not observed in the main excavation area. The comparison between K-feldspar IRSL and quartz OSL signals indicate significant age overestimations by IRSL signals: we interpret this as the result of the sedimentation process. Indeed, the layers for which the age overestimation is most significant, were flood deposits (in flood plains); such deposits correspond to low levels of light exposure of the sediment, and thus may lead to an insufficient resetting of the hard-to-bleach. On the opposite, easier-to-bleach green-stimulated OSL signals provide internally consistent ages ranging from 20 to 50 ka. The internal consistency of these ages, regardless of the varying degrees of light exposure highlighted by the quartz-feldspar comparison, make us confident that the quartz OSL ages are reliable. Newly developed Bayesian models, specifically designed for the modelling of OSL chronologies [4,5], have been used to derive the chronology, by including our knowledge of both stratigraphic constraints and systematic, shared uncertainties between samples.

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Podium Presentation Session 7, Fr 15:40

Chronology of the Initial Upper Palaeolithic of eastern Eurasia

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The term 'Initial Upper Palaeolithic' or IUP was coined initially with reference to the site of Boker Tachtit, Israel (specifically level 4) and to the earliest Upper Palaeolithic levels at Ksar Akil, Lebanon, but has more recently been associated with a wide range of sites across Eurasia that share a similar technological approach, namely Levallois-like features in the methods used in blade production[1]. In stratigraphic terms, the IUP is always the earliest manifestation of the industries of the Upper Palaeolithic, and often associated with forms of 'modern' type behaviour, such as bead manufacture and the presence of modified osseous bone points. Despite the wide geographic and temporal spread of IUP industries, some researchers [2] have suggested that the IUP may represent the material remains of the initial dispersal of anatomically modern humans. Thus far, however, it has been impossible to determine whether these industries are related to one another bioculturally, in terms of being spread for example by the same group of people, or they represent a case of convergent evolution and the result of a similar response by human groups to their environment or to the stone they were using to fashion into tools.

In order to test hypotheses for the development of the IUP it is important to have some idea of chronology, to assess, for example, whether or not there is local development of industries or whether they were geographically synchronous or not. In this paper we present new radiocarbon and OSL data from some of the most important IUP sites and use Bayesian modeling approaches to test these alternatives. We will report new results from some of the key IUP sites in the Transbaikal and Altai regions of Russia. The sites include those of Kammenka [3] and Khotyk, as well as Kara-Bom [4,5], Denisova Cave and Ust-Karakol. We applied rigorous pretreatment chemistry methods to bone samples from these, and other sites, which demonstrate an improved decontamination of the bone collagen, and more reliable AMS determinations. We show that previous determinations are substantially variable and, in the main, much too recent compared with the new determinations. We will describe the new chronometric Bayesian models we have produced and compare the results with other contexts on the wider scale including Haua Fteah, Ksar Akil and Ucagizli.

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Podium Presentation Session 1, Th 10:10

Speleothems associated with archaeological artefacts - how U-Th dating can be used to constrain the age of cave art

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U-Th (or 230Th/U) dating is a well established, accurate, and precise method with a wide range of applications in earth sciences, palaeoclimate research, and archaeology which can, for example, be used to date speleothem formations. Speleothems are often found associated with archaeological excavations or artefacts. Where a stratigraphy can be unambiguously established between archaeology and the speleothem formation, U-Th dating provides a powerful chronological tool and can be used to constrain minimum and/or maximum ages for associated archaeological finds. U-Th dating has been applied to provide age constraints for palaeolithic cave art in Spain [1,2]. The recently published results caused a debate including criticisms of methodological principles. While sound and constructive criticism of the results is welcome, given that their implications are profound, some criticisms are based on elementary mistakes, especially concerning speleothem formation processes and application of U-Th dating. In order to stave off confusion in the academic community, we will provide an overview on speleothem formations typically found associated with cave paintings and reiterate details of our methodology and reliability of U-Th dates. We will address important questions such as: how do the speleothems form, how can a stratigraphic relationship be established between speleothems and cave art and what age constraints can be established by dating the speleothems. We will provide details of our sampling strategy and execution in the cave as well as analytical details and interpretation of results. We also address limitations of the method due to potential biases for U-series dating such as so-called 'open system' or detrital contamination. We will present and discuss examples of results on cave art from Spain including La Pasiega, El Castillo, Ardales, Maltravieso, Fuente del Trucho or Tito Bustillo and demonstrate reliability of recently published minimum ages of Iberian cave art revealing Neanderthal origin.

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Podium Presentation Session 4, 16:50

Testing the Danube-corridor hypothesis – New results from chronometric modelling

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Recent research has shown the need for a reliable, high-resolution chronology to understand the complexity of the spatio-temporal distribution of Neanderthals and anatomically modern humans (AMH) during the transitional period between the Middle to Upper Palaeolithic. One region that has yet to benefit from the developments in dating sciences and the application of Bayesian modelling approaches is eastern Europe. Our research focuses on producing a more robust chronological framework for this region, especially the key area of the Danube fluvial corridor, which has been suggested as one of the conduits for early modern humans on their dispersal route into western Europe (e.g. [1]). We present new radiocarbon data and models that expand the picture that has emerged from recent studies conducted in western Europe. These results place the chronology for AMH dispersal on more secure footing, thereby refining our understanding of the regional variability and complexity of the Middle to Upper Palaeolithic biocultural shift.

This work is the result of four years of intensive doctoral research within the University of Oxford's PalaeoChron ERC project. We applied recent improvements in radiocarbon dating methodologies and analysis, such as ultrafiltration [2], single amino acid dating [3], and KDE modelling [4]. Two strategies were pursued for sample selection. First, key sites with a deep stratigraphic record were targeted, e.g. Kozarnika and Temnata (Bulgaria), to initially establish site specific high resolution chronologies using Bayesian modelling. Second, type fossils, such as osseous spear points (e.g. from Dzeravá Skala in Slovakia, Istállóskő and Jankovich in Hungary) and human remains (both Neanderthal and AMH), were directly dated to establish regional spatio-temporal boundaries, i.e. dating the appearance and disappearance of an industry or species. Furthermore, published dates from Eurasian sites were evaluated, and, where deemed reliable, used as comparisons and incorporated into larger regional models.

The resulting chronology paints a picture of complex spatio-temporal biocultural distributions, with instances of possible alternating occupations. It indicates several surprising temporal consistencies over large geographical areas, marking the period around 43-41k cal BP as crucial to AMH cultural appearance. At the same time, our research questions some of the previous assumptions made about cultural units (e.g. the Szeletian) in the region, and proposes to investigate osseous points as a chronological indicator in their own right – independent from lithic industries.

This research was made possible through the financial support from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013) / ERC grant agreement no. [324139] "PalaeoChron" awarded to Professor Tom Higham. The archaeological fieldwork in Bulgaria was further undertaken within the framework of an international cooperation between the National Institute of Archaeology of the Bulgarian Academy of Sciences (N. Sirakov) and the UMR5199 CNRS PACEA (J.-L. Guadelli), which was financially supported by the Advisory Committee of the Archaeological Researches abroad of the French Ministry of Europe and Foreign Affairs (Mission "Paléolithique de Bulgarie" - dir. J.-L. Guadelli), by the CNRS (Centre National de la Recherche Scientifique) and by Landjoff Ltd. We would also like to thank our (local) colleagues for their support and help in accessing the material for radiocarbon dating. Following the flow of the Danube: Walpurga Antl-Weiser, Maria Teschler-Nicola, Christine Neugebauer-Maresch (Austria), Alena Šefčáková, L'ubomíra Kaminská (Slovakia), Mihály Gasparik, Klára Palotás, László Makádi (Hungary).

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Pecha Kucha Presentation Session 2, Th 11:30-11:55

Water loss during persistence hunting in recent Kalahari hunters and *Homo ergaster*

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Persistence hunting has been suggested to be a key strategy for meat acquisition in human evolution. Several features of the modern human morphology and physiology such as linear body shape and high sweating capacity have been proposed to be adaptations to persistence hunting or other endurance walking and running behavior. Although profound sweating enables humans to lose large amount of heat through evaporation from the skin, it also results in the loss of body water content. Since water content especially in form of blood plasma is crucial for the heat flow from the body core to the skin, substantial water loss may undermine the heat dissipation ability of the hunter. As such it has been proposed, that great water requirements of human thermoregulation in the heat may pose a limit on the duration of persistence hunt prior to invention of water containers [1–3]. In the present study, we aim to assess human water losses during persistence hunting using mathematical modeling and published spatio-temporal and environmental data on observed persistence hunts of recent Kalahari hunters. Accounting for the differences in body size and shape, we will estimate water loss also in *H. ergaster* subjected to the identical hunting conditions. Published body mass and stature of an average !Kung San male (49.4 kg; 160.4 cm) and adult KNM-WT 15000 (76.7 kg; 178 cm) were used to model the recent Kalahari hunter and *Homo ergaster*. Metabolic heat rate was estimated from body mass and velocity using published model for walking [4] and newly derived model for running (mean absolute error: 7%). The water loss was estimated using a newly developed two-node model of human thermoregulation during locomotion which accounts for metabolic heat rate, respiratory and cutaneous evaporation, convection, solar radiation, and reradiation from the body surface. We used published data on four experiments on running and cycling in hot conditions (duration: 1–4 hours; ambient temperature: 35–45 °C; relative humidity: 42–60%) for validation of the model estimates of water loss (mean absolute difference: 0.6 % of body mass). Finally, we simulated nine previously observed persistence hunts performed by Kalahari hunters [5]. Although hunters carried water during these hunts and in all but one hunt they were also able to refill their water containers when needed from the accompanying vehicle, we simulated the hunts without any water carrying and ingestion. Our results show that when water refill was available, the recent Kalahari hunter would lose on average 6.1 l (min–max estimates: 4.1–8.7 l) of water per hunt (which equals to 12.4% [min–max: 8.2–17.5%] of his body mass). Such high water losses would exceeded even the values documented for the winners of the Olympic marathons (9.8% body mass reduction) and would hardly be sustainable without partial rehydration. For the remaining hunt during which the hunters had not the option to refill their water containers, the covered distance is not known and only the duration is documented. We, thus, simulated this hunt at a range of aerobically sustainable velocities (2 to 5 m/s). For the Kalahari hunter, the estimated water loss during this hunt is positively linearly related to velocity ranging from 2.7 l (5.6% of body mass) at 2 m/s (covered distance: 13.7 km) to 4.6 l (9.4% of body mass) at 5 m/s (covered distance: 34.2 km). Thus, at the slower velocities from this range, the hunt could be accomplished without drinking i.e., without the need to carry water. The water losses estimated for *Homo ergaster* are on average 2 l higher than those for recent Kalahari hunter but when adjusted to body mass, the losses are about 1.4 % of body mass lower. We conclude that at favorable conditions, persistence hunt could be successfully accomplished without the need to carry water. However, water containers would substantially increase the coverable distance and thus the chances of the hunter.

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Poster Presentation Number 14, Th 19:00-19:45

Lithic bipolar technology through space and time

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The ability to modify the environment as a means of adaptation is one of many behaviors that separate humans from other species. Throughout time hominins used several strategies, to increase their adaptability to different settings. Tool production, modification, and use played an incremental role in these strategies and the non-linear evolution of lithic technology reflects this. As time went on, stone artifacts became a necessity for hominins as a tool for resource exploitation. Among all kinds of lithic technology, the bipolar method is recurrent in prehistoric assemblages all over the world. In this paper we propose to highlight the importance of this method as a marker of variability and evolution of resource exploitation strategies, its dynamics in the Paleolithic archaeological record, and discuss its implications for technical traditions and cognitive variability. To reach this goal, we looked at data from a diverse set of regions where the technology has been identified and described, across different chronological and ecological contexts. Since at least 1.75Ma, hominins were employing bipolar techniques for quartz knapping in Olduvai [1]. In China, during the Acheulean, this technology was used for large cobble reduction for blank production and in later periods (29k BP) for high quality flint nodule reduction [2]. During the Mousterian there is evidence that Neanderthals employed bipolar reduction techniques for quartz [3]. In Africa during the MSA in addition to knapping, a different take on the bipolar concept (working material on a hard surface) was applied by modern humans, in the form of wedging for working hard organic materials. During the LSA both uses have a considerable rise throughout Southern Africa, as bipolar knapping was incremental for lithic miniaturization strategies [4]. During the Upper Paleolithic in Southwestern Iberia bipolar technology was used to further enhance the effectiveness of carcass processing, bone marrow extraction, antler working, possible small raw material nodule reduction and grease rendering techniques. The bipolar method allowed for further enhancement of resource exploration, in the form of a simple action that can achieve several purposes. This method was used for knapping small and large volumes of raw materials that would otherwise be less efficient with free hand methods. The same concept applied for wedging, allowed for further efficiency when working hard organic materials, which would be incremental for carcass processing, and wood, antler and bone tool production. Bipolar methods do not require specific tools, as any core can be reduced bipolarly and any rock used as a wedge. Furthermore, older tools, with numb edges could still be recycled and useful whether as cores or wedges by using this method. Throughout time hominins recognized the advantages of applying these techniques in a wide array of settings. The concept of putting a lithic object on a hard surface and hit it in order to break it by applying a bipolar force could be considered an expedient low-cost strategy, of little cultural significance, but an expression of a behavioral response with regards to the use of stone tools. Importantly, current data shows no evidence of bipolar wedging techniques in non-modern human assemblages. While cognition does not seem to be the cause, we simply cannot discard the possibility that this function was not identified in earlier occupations due to lack of research. Despite this, and based on the data available, we propose that bipolar technology, in all its different applications, should be regarded as a latent solution [5] in stone tool technologies. It can be considered an interesting marker for the evolution of stone tool use and efficiency evaluation by hominins. Even though we can currently recognize its function, we still require new and more comprehensive perspectives to evaluate its role as a cultural marker or in the definition of technological traditions.

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Poster Presentation Number 45, Th 18:15-19:00

Investigation of uncertainty in CT and the implications on human evolution studies

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Computed tomography (CT) is now widely used in the study of human evolution. The CT technique gives access to information about the internal and surface structure of a specimen through the use of X-rays. However, some of the studies involve taking dimensional measurements of some features of the specimen where it is important to determine the uncertainty in these measured values. This is an area which has been receiving a lot of attention because of the use of CT for dimensional measurements in other fields and the approaches used have been either experimental or computational [1-3]. The experimental approach makes use of a measurement standard whilst a computer simulation is used for the computational method. Some of the sources of uncertainty include edge detection errors, specimen positioning errors, beam hardening, scatter, reconstruction algorithm and X-ray focusing errors. These all contribute to give a final value of uncertainty. A measurement is deemed unreliable when the value is comparable to the uncertainty. A 200 mesh transmission electron microscopy (TEM) grid has been used as a measurement standard. The TEM grid has dimensions of a 35 μm bar width, 90 μm hole width, 0.0225 mm rim width and a 20 μm thickness and measurements of these features performed using scanning electron microscopy (SEM) showed values comparable to the manufacturers specifications. However, the CT scanning dimensions obtained showed varying amounts of deviations for each of the features. Using the TEM grid, we have investigated the uncertainty in edge detection and the positioning of a specimen by CT scanning trabecular bone at a resolution of 10 μm by generating X-ray's using an electron accelerating voltage of 70 kV and a current of 120 μA. All computed tomography measurements were performed using a Nikon XT H 225/320 LC dual source instrument. An estimate in the uncertainty in the edge detection was found to be about one and a half voxels which means that the value obtained in the determination of the morphometric index TbTh is reliable. A comparison of trabecular thickness obtained from CT and SEM will also be presented.

1. The DST-NRF Centre of Excellence in Palaeoscience. 2. The Evolutionary Studies Institute

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Poster Presentation Number 19, Th 18:15-19:00

Compound-specific amino-acid $\delta^{15}N$ measurements of two Neandertals indicate high trophic-level diets

Klervia Jaouen[1], Michael Richards[2], Adeline Le Cabec[1], Frido Welker[3], William Rendu[4], Jean-Jacques Hublin[1], Marie Soressi[5], Sahra Talamo[1]

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Isotope and zooarcheological analyses of Paleolithic food webs have suggested that Neandertal subsistence was primarily relying on large mammals. This general conclusion is however more and more debated. The interpretation of the elevated nitrogen isotope ratios in bone collagen is particularly discussed: similar values could result from mammoths, young animals, putrid meat, cooked food, freshwater fish, carnivore, or mushroom consumption. Additionally, analyses conducted on dental calculus suggested that isotope studies underestimate the contribution of plants in Neandertal diets [1,2]. Recently, compound specific isotope analyses demonstrated their potential to decipher the dietary signature of ancient hominin collagen [3,4]. Using nitrogen isotope ratios, this technique can provide an accurate estimation of the trophic level of any living organism, whatever the environmental context is. Moreover, using carbon isotope ratios, it can reveal the existence of freshwater or marine fish consumption [5]. We conducted these analyses on two Neandertals, which were characterized by exceptionally high N isotope ratios in their bone or tooth collagen. The samples come from Les Cottés and from Arcy-sure-Cur in France and were both directly dated to the middle of the MIS 3. We will present carbon and nitrogen isotope ratios conducted on single amino acids of collagen samples, for these two Neandertals and the associated fauna.

In the light of these results, we will discuss the Late Neandertal adaptation as carnivores: we will examine if high nitrogen isotope ratios can solely be explained by mammal meat consumption, without necessarily involving processing of the food (cooking, fermenting), specific (mammoth, young animals, mother milk) or additional (freshwater fish, mushroom) dietary protein sources. We will also consider some limits of this new isotope technique, such as the uncertainty on the beta factor used for trophic level assessment. We will finally suggest additional proxies for the estimation of the trophic position of past hominins.

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Poster Presentation Number 63, Fr 18:15-19:00

Disentangling the mysteries of the origin of our species: A regional analysis of the Ornaments of Middle-Upper Palaeolithic Europe.

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This poster presents the methodology and results of a regional analysis of the ornaments of Middle-Upper Palaeolithic Europe. This research focusses on the overarching conceptual question concerning hominid cognition. It asks whether a regional analysis of items of personal adornment can trace behavioural patterns in the archaeological record. In recent years, there has been increased interest in ornaments of the Palaeolithic and their relation to hominid cognition. However, a region-wide analysis of ornaments retrieved from sites within Europe is still absent from scholarship to date. This study sets out to rectify this omission by consulting legacy data in order to compile a database cataloguing known ornaments excavated in Europe. Collecting the European data in a single catalogue will give us a clearer picture of dispersal routes of Anatomically Modern Humans. Not only can this assist in tracing patterns of behaviour, but it also maps the contact and circulation of items of adornment across Middle-Upper Palaeolithic Europe. As such, this study contributes a much needed new perspective to the wider discussion about the development of behavioural modernity.

Podium Presentation Session 12, Sa 17:50

Neanderthals habitually performed precise manual activities

Fotios Alexandros Karakostis[1], **Gerhard Hotz**[2], **Vangelis Tourloukis**[1], **Katerina Harvati**[3]

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Previous research has concluded that the habitual manual behavior of Neanderthals relied on the systematic performance of power, rather than precise, manual grasping. However, this viewpoint comes in severe contradiction with a growing body of archaeological evidence suggesting that the cultural behavior of Neanderthals was more sophisticated than previously thought [1, 2, 3]. Here we investigate the habitual manual behavior of Neanderthals and early modern humans using a reference sample with uniquely detailed lifelong occupational documentation of the individuals [4] and a precise three-dimensional multivariate analysis of manual muscle attachment surface area measurements [5]. This method was previously shown to provide clear separation across individuals with distinct lifelong occupational differences [4]. The results of our analyses showed that the multivariate entheseal patterns of Neanderthals overlap exclusively with those of lifelong precision workers. They involve a group of entheses corresponding to muscles interacting closely for precision grasping using the thumb and the index finger. By contrast, early modern humans presented both power- and precision-grasping entheseal patterns, reflecting a greater occupational variability among specimens. These results represent an original and reasonable connection between Neanderthals' cultural remains and hand bone morphology, demonstrating that their everyday activities were mainly of a precise nature. These findings challenge a fundamental and traditional viewpoint on Neanderthal behavior and subsistence strategies, comprising the first evolutionary study relying on a reference sample with uniquely detailed long-term occupational documentations. Our results demonstrate that the multivariate patterns among muscle attachment markings, the only skeletal features directly related to the musculotendinous system, can provide vital information surrounding the physical activities of past human populations and extinct hominins.

Special thanks should be given to the following institutions and/or researchers for providing us with access to fossil specimens and/or 3D data: Tel Aviv University (Dr. I. Hershkovitz), National Museum of Natural History in Paris (Dr. D. Grimaud-Hervé, Dr. F. Detroit, and Dr. M. Friess), Italian Ministry of Cultural Heritage and Activities (as well as the Museo Archeologico Del Finale and Dr. V. Sparacello for collecting data from the specimens of Arene Candide), Natural History Museum in London (Dr. C. Stringer, Dr. R. Kruszynski and Ms. Julia Galway-Witham for collecting data from the specimen Tabun), Museum of Natural Sciences in Brussels (Dr. P. Semal), Dolni Vestonice Museum (Dr. J. Svoboda), Smithsonian's Division of Mammals (Dr. K. Helgen) and Human Origins Program (Dr. M. Tocheri). Furthermore, the hand bones of Nazlet Khater 2 were scanned thanks to the ANR project "Big Dry" (ANR-14-CE31). We would like to thank the coordinator, Pr. François Bon and the partners, Dr. Isabelle Crevecoeur, Dr. David Pleurdeau, Dr. Joséphine Lesur and Dr. Chantal Tribolo for granting us access to the numerized material of Nazlet Khater 2. We are also deeply grateful to the volunteers of the "Citizen Science Project Basel Spitalfriedhof" (University of Basel) for their fundamental work on the unique documentation of the modern reference collection used in this research. For this research project, F. A. K received funding from the German Academic Exchange Service and the A. G. Leventis Foundation. K. H. is supported by the German Research Foundation (DFG FOR 2237); KH and VT are supported by the European Research Council (ERC CoG 724703).

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Pecha Kucha Presentation Session 2, Th 11:55-12:20

Predicting stone tool functional performance: a case study in handaxe loading

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Archaeologists and anthropologists often seek to reconstruct how efficiently lithic artefacts could have been used by Plio-Pleistocene hominins. Two analytical routes are typically used to investigate this. The first examines the morphology of stone tools recovered from the archaeological record and interprets how efficiently or effectively they could have been used. The second relies on reconstructing the biomechanical capabilities and comparative tool-use abilities of fossil hominins. Beyond the invaluable data derived from artefact and fossil morphologies, both routes rely heavily on experimental programs undertaken using modern human subjects. Here, we examine the influence of both tool-form attributes and biometric variation on the functional performance of Acheulean handaxes. Specifically, we investigate the impact of 13 tool-form attributes and eight biometric traits on the working forces applied through the cutting edge of 457 replica tools. Using an established protocol for recording loading levels during stone tool use, we record normal force (kgf) along the length of each handaxe's edge while it is being applied by a modern human. The relative contribution of tool-form and biometric attributes to handaxe loading levels are examined independently and on a comparative level. Results identify significant relationships between handaxe loading levels and both tool-form attributes and biometric traits. However, in terms of working forces applied, tool-user biometric variation was found to have a substantially greater impact relative to tool-form attributes. This difference is demonstrated here by up to a factor of ten, despite tool forms being relatively more variable. Results are discussed in light of the co-evolutionary relationships between stone tools and hominin manual anatomy, and the comparative strength of selective pressure acting on each. We also stress the importance of identifying the working loads and cutting stress that are achievable when using hand-held stone tools, and the variables that influence this capability.

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Pecha Kucha Presentation Session 10, Sa 12:20-12:45

Trabecular bone structure of the *Australopithecus afarensis* A.L. 438-1 metacarpals and implications for skeletal age and hand use

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The A.L. 438-1 partial skeleton of a large adult *Australopithecus afarensis* individual from Hadar, Ethiopia, dated to approximately 3 million years, comprises associated left and right upper limb bones, a frontal bone, and mandible [1, 2]. Included in this partial skeleton are complete left and right second metacarpals (Mc2) and a left third metacarpal (Mc3). Their external morphology is consistent with that of other *A. afarensis* metacarpals, with a relatively short, straight shaft and an asymmetrical head shape that are similar to humans, but with aspects of the metacarpocarpal articular morphology that are similar to great apes. In combination with a long forearm, the A.L. 438-1 upper limb morphology has been interpreted as retaining some African ape symplesiomorphies, but with selection for manual manipulation being more important than selection for arboreal behaviours [2]. Microtomographic (micro CT) scanning of the metacarpals revealed excellent preservation of the internal cortical and trabecular structure, which provides further insight into hand use in this specimen and *A. afarensis* generally.

High-resolution micro CT scans for the A.L. 438-1 metacarpals were segmented using MIA-clustering [3] and a whole-bone approach [4] was applied to quantify and visualise bone volume fraction (BV/TV) and degree of anisotropy (DA) of the trabecular structure throughout the metacarpal. These trabecular data were interpreted within a comparative context of extant great apes (orangutans, n=12; gorillas, n=12; chimpanzees, n=12; bonobos, n=10), recent humans (n=55), and fossil hominin Mc2 and Mc3 specimens associated with *Australopithecus africanus*, Neanderthals, and early *Homo sapiens*.

Results provide insight into both the skeletal age of A.L. 438-1 and this individual's potential hand use. Although the external morphology of the metacarpals is consistent with mature adulthood, the trabecular structure within the metacarpal head preserves a remnant of the epiphyseal line. This epiphyseal line, although less pronounced than in A.L. 438-1, is found in several Taï Forest chimpanzee specimens between 12-25 years of age. All of the A.L. 438-1 metacarpals have high BV/TV, which is similar to African apes and *A. africanus*, but unlike the much lower BV/TV of later *Homo* and recent humans [5]. The distribution of BV/TV is concentrated ulnarly within the Mc2 heads and is more asymmetrical than that of the Mc3 head, a pattern that is also found in other hominins and African apes. All of the A.L. 438-1 metacarpals show much higher BV/TV underlying the palmar portion of the metacarpophalangeal articulation than is seen in *A. africanus* and later hominins, and is most similar to *Pongo*. The BV/TV within the A.L. 438-1 metacarpal bases suggest high loading across the trapezium-Mc2 and capitate-metacarpal articulations.

The presence of an epiphyseal line within the trabecular structure of metacarpal heads suggests that A.L. 438-1 was a young adult, whereas the associated heavily worn molars indicate an older adult [2]. The relatively advanced occlusal wear may suggest that, as a young adult, this *A. afarensis* individual consumed a highly abrasive diet. The *A. afarensis* metacarpal trabecular pattern is consistent with high-magnitude loading of the palm in a flexed-finger posture, greater than that of *A. africanus* and *Homo*. If manipulation was a stronger selective pressure on the *A. afarensis* forelimb skeleton [2], then the trabecular structure of the A.L. 438-1 metacarpals may reflect use of flexed-finger postures during manipulative activities and/or high-magnitude loading of the hand during infrequent arboreal grasping. Analyses of internal cortical and trabecular structure of the associated upper limb remains are needed to provide a more holistic reconstruction the upper-limb use in the A.L. 438-1 individual.

This research was made possible through the support and effort of Bill Kimbel, Zeray Alemseged and David Plotzki, the collaboration of the National Museum of Ethiopia, and permission from the Authority for Research and Conservation of the Cultural Heritage. This research is supported by the Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, the Institute of Human Origins, Arizona State University, California Academy of Sciences, and European Research Council Starting Grant 336301.

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Podium Presentation Session 7, Fr 15:00

The Easternmost Neanderthals in Altay Mountains

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The Chagyrskaya Cave (51°26'32.99", 83°09'16.28") is located in the pre-mountains of the north-western part of the Altay region, Russia. The cave faces north and is situated at an elevation of 353 metres above sea level and 19 m above the Charysh River. It consists of two chambers with a total area of c. 130 m2. The stratigraphic sequence (max 3.5 m thick) is subdivided into Holocene, and Pleistocene sediments. Based on OSL analysis of the samples from layers 5-6c/2 the final MIS-4 and beginning of MIS-3 age has been proposed [1]. Layers 6a-6c/2 were accumulated under the condition of continental arid climate. Dry steppe communities were widespread. The Human occupations associate with continental dry conditions. [2]. The Human remains originate from the following layers: 5-6c/2. The cultural deposits of Chagyrskaya cave contain the most numerous collections of Neanderthals remains in Northern Asia [3]; more than 72 pieces of cranial and post-cranial parts from several different ages individuals. During the 2007-2017 seasons, excavation was conducted at the entrance and central chamber of the cave; the excavated area is about 39 m2. The Paleolithic occupations in the Chagyrskaya cave demonstrate high density of artifacts and bones. The animal remains from layers 6b and 6c accumulated due to the specialized bison (Bison priscus) hunting activities of Neanderthals [2]. The layers 6a, 6б, 6в/1 and 6в/2 contain the abundant stone artifacts: more than 90000 pieces. The local source of raw material – pebbles from river valley – was used for artifacts production. At present time, the technological and typological characteristics of Chagyrskaya cave artifacts are based on the results of detailed attributive studies of layer 6/B1 assemblage. The artifact categories composition is characteristic for on-site model of cores reduction and tools production. Obtained results demonstrate that Chagyrskaya cave assemblages is a manifestation of separate and unique Middle Paleolithic variant in Altay and has no technological and typological similarities to regional Levallois-Mousterian techno-complex.

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Poster Presentation Number 17, Th 18:15-19:00

Go with the flow: an assessment of Palaeolithic adhesive re-usability and application characteristics using oscillating shear rheology

Paul Kozowyk[1]

1 - Leiden University

The use of adhesives for hafting stone tools nearly 200,000 years ago marked a major transition in human technology. Adhesives are the first 'plastics' and could be melted, moulded, and even recycled to suit different joint configurations and uses. Stone tools could be more securely added to handles thus improving their efficiency and practicality. The production of adhesives required forethought and planning, as well as expertise and knowledge of the resources available in the landscape [1]. Many different natural materials have been employed throughout prehistory, ranging from plant exudates to bitumen from petroleum seeps. Neandertals produced tar through the destructive distillation of birch bark; a transformative process more complex than simply collecting naturally occurring sticky substances like pine resin [2]. Very little is known about the natural adhesive materials that were used throughout the majority of the human past, and it is still unclear why birch bark tar appears to have been favoured during the Palaeolithic. Previous experiments have shown that small changes in filler quantity and particle size can affect the shear strength of resin-based adhesives [3], [4]. However, there are many more properties that are important for a material to be a successful adhesive. Handleability is also important in order to easily manipulate and apply the adhesive. As is the adhesive's ability to perform well over its effective use temperature and frequencies (for example, high vs. low load rate applications). To study these properties, oscillating shear rheological measurements were taken using a HAAKE MARS III rheometer on replica birch bark tar and pine resin adhesives over a sweep of frequencies from 0.1 to 10 Hz and temperatures from 0 to 130 °C. Results provide a possible explanation as to why Neandertals were destructively distilling birch bark to produce tar, rather than harnessing naturally occurring pine resin. Birch bark tar is less affected by changes in temperature, has a longer working time, and does not degrade during heating as easily as pine resin, making birch bark tar more suitable for re-use. Despite high initial production costs, it may have been more economical to distil tar from birch bark than to collect any other natural adhesives.

I wish to thank Dr. Geeske Langejans, 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 PhD is funded by the Research School of Archaeology, the Netherlands (ARCHON).

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Podium Presentation Session 7, Fr 14:40

Sel'Ungurian - a new variant of the Middle Paleolithic in Central Asia

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Since the beginning of 21st century, a new stage began in investigations of the Central Asian Paleolithic. The main concern is to re-study the key regional sites, applying modern excavation techniques and up-to-date laboratory methods (including chronometric dating) in order to clarify the rationale and chronology of the local cultural sequences. This research allowed some crucial corrections about the chronological and cultural interpretations of the lithic industries in western Central Asia. Here we present the first results obtained during our re-excavation of Sel'Ungur cave – usually assumed to be one of the earliest Paleolithic sites in Central Asia, described in the late 1980s as belonging to the early Acheulian technocomplex. Sel'Ungur cave is the most important pre-Upper Paleolithic site for our understanding of the Pleistocene inhabitants of Central Asia, as did not only yield rich lithic collections found in stratified context but also numerous fossil faunal and even some hominin remains. Re-started at 2014, the new excavations at the site have provided enough evidence to refuse an Acheulian interpretation of site's assemblages. Based on detailed technological and typological analyses of the new lithic collection we argue that Sel'Ungurian complex fits better into the early stage of the regional Middle Paleolithic cultural variability. The previously available U-series date of around 126 ka (albeit without a reliable stratigraphic and spatial context), the new TL date 112±19 ka establishing the lower limit, paleontological analyses of newly obtained material as well as the re-examination of the available information on macro- and microfaunal remains excavated in the earlier excavations, as well as the re-study of the anthropological finds support this assessment. It is very important that among the local Middle Paleolithic industries, the Sel'Ungur assemblage differs from all known techno-complexes in the specific features of core reduction (radial, orthogonal and unipolar knapping aimed to obtain short and wide flakes) and tool types (plano-convex bifacial tools, tools made on bifacial thinning flakes, thick transversal scrapers with direct or alternate retouch, Tayacian points, and Mousterian tranchets) combined with the absolute absence of Levallois technology. Taking into account the above mentioned specific technological and typological features of the lithic assemblage accompanied by the new geological and paleontological data, it is possible to assume that Sel'Ungurian assemblage may be defined as a new, early variant of the Middle Paleolithic in western Central Asia.

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Poster Presentation Number 36, Fr 19:00-19:45

The influence of diet on enamel growth

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Old World Monkeys, family Cercopithecidae, are the most speciose and diverse clade of living anthropoid primates, but very little is known about their enamel growth beyond the papionins. They are divided into two sub-families, the more folivorous Colobinae and the more frugivorous/omnivorous Cercopithecinae. The distinction within this clade is based on dietary adaptations, which is important since accelerated dental development has been suggested to be a result of dietary differences [1] [2] [3]. Here we test the hypothesis that aspects of enamel formation are influenced by dietary preference by evaluating the rate, duration, and pattern of enamel development in Cercopithecidae primates. The sample consists of 91 histological thin sections from 25 species. Enamel microstructure traits were quantified in the protoconid and the hypoconid cusps in the second mandibular molar (M2). Comparisons were restricted to the same tooth, the M2, and the same cusps due to variation in timing of enamel secretion, enamel thickness, and cusp-specific formation times [4]. Histological sections were examined using polarized light microscopy to quantify the following traits: (1) daily enamel secretion rate, (2) perikymata, (3) periodicity, (4) cuspal and lateral formation times, (5) crown formation time, (6) enamel extension rate. Preliminary results suggest the rate of enamel growth in the Colobines appears to be slower, but the duration of crown formation is similar to the more frugivorous Cercopithecinae monkeys of similar body size. There is also variation in the rate of enamel extension between the Asian and African colobines. Diet and phylogeny may influence enamel formation and should be considered when reconstructing aspects of fossil life history. Research on dental development in great apes and modern humans provides models of growth for fossil hominins, but very little is understood about enamel and dentine development in other primate clades. Investigating larger samples of taxa allows for a broader interpretation of primate dental ontogeny and provides a comparative context in which to evaluate changes or continuity in dental development along the hominin lineage.

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Poster Presentation Number 54, Fr 19:00-19:45

Kostenki: the easternmost point of the European Aurignacian

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Kostenki remains the most eastern known point of the European Aurignacian. Kostenki's Aurignacian is represented by two sites: Kostenki 14-Horizon "in Volcanic Ash" (HVA) and Kostenki 1-III. Kostenki 1-II has also been described as Aurignacian, but it is currently thought to be connected to the redeposition of Kostenki 1-III [1]. The Aurignacian appears in Kostenki around 39.3-41.0 ka calBP, based on a date of 35,080 ± 240 (OxA-19021) [2] from Kostenki 14-HVA. Current data indicate that Kostenki 1-III is younger (c.35.8-36.5 ka calBP) based on a series of radiocarbon dates of 31-33 ka BP [3]. However, the occurrence of lenses of volcanic ash in Kostenki 1-III suggests a shorter chronological range between two sites than is suggested by the radiocarbon dates. The Kostenki Aurignacian is significant in part due to the in situ preservation of the cultural layers, which include fireplaces and other structures. In addition, the association of the Kostenki Aurignacian and the volcanic ash provides a unique example of paleolithic settlement immediately prior to and following this significant natural event. Although the Aurignacian affiliation of Kostenki 1-III and Kostenki 14-HVA cannot be questioned, the assemblages of these sites possess some local features distinguishing them from each other, as well as from Aurignacian assemblages of Western and Central Europe. Differences between the two assemblages occur in their respective ratios of tool types. The assemblage from Kostenki 1-III is dominated by microliths, followed by end-scrapers and burins, and then by splintered pieces and carenoid end-scrapers. Pieces in other categories are only few. The assemblage of Kostenki 14-HVA is also dominated by microliths, but this is followed by splintered pieces and only then by end-scrapers and burins. Carenoid pieces are represented only by isolated pieces. Differences between the two cultural layers can also be discerned in the microblade production technique. Microblades in Kostenki 14-HVA were obtained from carenoid end-scrapers, while microblades of Kostenki 1-III were obtained from both carenoid end-scrapers and burins, including nosed scrapers, which are not present in Kostenki 14-HVA. Both assemblages share some tool-types, such as retouched blades, simple end-scrapers and burins. A distinctive feature of the Kostenki Aurignacian assemblages is dorsally retouched microblades, which are the most prevalent microlith, as well as several specific tool-types, such as clivers and other cutting tools, and side-scrapers with alternate retouch [1]. The two sites' bone industries and personal ornaments show similarities mainly in undiagnostic tools and ornaments that are present throughout the Upper Palaeolithic – awls, points and pendants from the teeth of polar fox and freshwater mollusks (Theodoxus fluviatilis, Neritidae). Interestingly, perforations in similar tooth pendants were made using different methods – in Kostenki 1-III holes were drilled, while in Kostenki 14-HVA they were pierced. Other types of personal ornament are present either at one site or another. In Kostenki 14-HVA, personal ornaments are represented by tubular beads with engraved circular ornamentation. Ornaments from Kostenki 1-III comprise two sea-mollusk pendants and a rod of mammoth ivory with the lines of stippled dots. Ornamented bone artefacts from Kostenki 1-III comprise a diamond-shaped point and rod of mammoth ivory, both with circular ornamentation. To sum up, the assemblages from the two sites share more features in common in their stone tool assemblages than in their assemblages of bone artefacts and personal ornaments. Overall, the Kostenki Aurignacian is characterized by the presence of some local features, alongside a prevalence of traits generic to the European Aurignacian.

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Podium Presentation Session 9, Sa 9:50

Regional differentiation in Late Pleistocene climate records from Ethiopia, and their implications for human origins

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Understanding the causes, processes, and evolutionary consequences of climate change in Africa requires well-dated continuous proxy-climate records from a variety of terrestrial environments and at a range of time scales. Here, I compare two high-resolution lacustrine core and seismic records from Ethiopia: a 150,000 year record from Lake Tana in the northwest highlands, and a 500,000 year record from Chew Bahir in the south Ethiopian Rift, and consider the implications for understanding regional climate drivers, and human origins and dispersal.

Both the Lake Tana and Chew Bahir core records are well dated, principally by luminescence ages supplemented by Ar /Ar ages on tephras and radiocarbon. For climate proxies, we use Ca/Ti and K derived from high-resolution XRF scans of the continuous cores, 92 m and 280 m long respectively, with a variety of other palaeoenvironmental indicators for the Chew Bahir cores.

The Lake Tana record shows varied climate towards the end of the penultimate glacial, followed by an abrupt change at 132 ka (MIS 6 to 5e transition) to relatively stable moist climate lasting 37 kyrs during the last interglacial (MIS 5e to 5c). Subsequent abrupt transitions to shorter stable moist intervals occurred during MIS 5a through MIS 3, notably at 82 ka (MIS 5a). These conditions, variable but predominantly arid environments abruptly changing to relatively stable moist and long-lasting environments, could have favoured selection for behavioural versatility, demographic increase, and range expansion in early modern human populations. The palaeoclimate record thus supports emerging evidence for early and multiple AMH dispersals within and beyond Africa. Despite its shallow depth, Lake Tana shows little evidence of complete and prolonged desiccation during the last glacial, suggesting that human populations could have survived climate extremes in highland refugia.

Chew Bahir is one of six sites in eastern Africa currently under investigation as part of the Hominin Sites and Paleolakes Drilling Project (HSPDP). It is a 30 x 70 km area of playa mudflats overlying >4 km of unconsolidated sediments in the Broadly Rifted Zone between the Main Ethiopian and Kenya-Turkana Rifts. It lies 80 km east of Omo-Kibish, site of 195 ka Homo sapiens fossils, the earliest known from eastern Africa. In November 2014, we drilled duplicate 280 m cores, aiming to determine the major climatic and environmental changes during the last 500 kyrs, and to test the hypotheses that periods of directional change or heightened climatic variability drove key events in human cultural and biological evolution.

The composite Chew Bahir core record represents >90 percent recovery, verified through multi-proxy inter-core correlation, and analysed with high-resolution μXRF, XRD, stable isotope, biomarker and sedimentological data. An initial age model, based on radiocarbon and OSL ages and three 40Ar/39Ar single-crystal K-feldspar ages, shows that the record extends to 550 ka. The mineralogical, geochemical, and colour reflectance data document pronounced hydroclimatic variability at millennial and sub-millennial timescales, with evidence of both orbital and high-latitude forcing. This variability is similar to Indian Ocean sea-surface temperature and atmospheric CO2 variations, as a consequence of orbital (mostly precessional) forcing, and to wet-dry oscillations elsewhere in northern and eastern Africa.

Contrasts in the timing of climate transitions between Tana and Chew Bahir point to spatial variability in the environmental history of the region, which may have contributed to the biological and cultural development of early human populations in eastern Africa, echoing pan-African differentiation in both climatic and human history.

Numerous colleagues contributed to both data collection and interpretation of the data presented here. They include Helen Roberts, Sarah Davies, Richard Bates, Dei Huws, Mike Marshall, Frank Schaebitz, Martin Trauth, Verena Foerster, Asfawossen Asrat, Christopher Bronk Ramsey, Melanie Leng and Andy Cohen, as well as other members of the Hominin Sites and Palaeolakes Drilling Project (HSPDP) team.

Podium Presentation Session 11, Sa 15:20

Maxillary sinus growth and development in Neanderthals and Sapiens

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Several studies have focused on how the human maxillary sinus varies as a structural consequence of variations in nasal and related facial structures [1,2]. Further work has focussed on the causes and consequences of differences in maxillary sinus form in Neanderthals and *H. sapiens* [3,4] but less emphasis has been placed on the ontogeny of the maxillary sinus, its developmental interactions with diverse cranial regions and how these may have differed between the two species [5]. This study tests the hypothesis that maxillary sinus ontogeny is independent of that of the rest of the face and so aims to explore the extent to which ontogenetic integration differs between the sinus and other cranial components. To these ends we examine the growth and development of the maxillary sinus in modern humans, assessing patterns of association between the developing maxillary sinus and related facial structures. We then compare these findings with those from our limited sample of Neanderthals, to assess the extent and nature of any differences from modern humans. Using an ontogenetic sample, we apply geometric morphometrics to investigate the growth and development of maxillary sinuses and their interactions within the facial complex. Two sets of landmarks were acquired on 3D surfaces of skulls and sinuses belonging to modern humans and Neanderthals (Sapiens N=60, Neanderthals=6), and growth trajectories, covariation, modularity and integration between these anatomical features were investigated. Our results show that in modern humans, allometry is the main factor that drives the development of maxillary sinuses. When considering the entire ontogenetic sample, the development and growth of maxillary sinuses shows varying degrees of integration with adjacent craniofacial structures. Integration is greatest in the subadult sample and is particularly marked between the maxillary sinus and the maxilla and nasal cavities. In adults the association between maxillary sinus form and that of the maxilla is reduced. This may be linked to differences in growth rates, and differences in timing of cessation of growth of the maxilla and its sinus, with the former occurring at 10 and the latter at 14 years respectively, in humans. When compared to *H. sapiens*, Neanderthal adults and infants possess larger maxillary sinuses than equivalently aged modern humans but maxillary sinus shape in Neanderthals fully overlaps that of modern humans. In both species, the pattern of association between maxillary sinus form and that of related facial structures appears similar. Thus, despite the difference in facial morphology, the development of the maxillary sinus in Neanderthals does not appear to differ from that of *H. sapiens*. However, the Neanderthal maxillary sinus achieves larger sizes through extended growth. This conservation of developmental interactions suggests that the mechanisms that impact the development and growth of sinuses are common to both species and have been maintained despite significant shifts in craniofacial form. It will be of interest to examine other fossil hominin groups to investigate the extent and phylogenetic depth of such conservation.

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Poster Presentation Number 12, Th 19:00-19:45

Late Pleistocene landscapes and human mobility in the southern Levant: Results of geoarchaeological research in the Wadi Sabra, Jordan, and the Dead Sea

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Landscapes east of the Jordan rift valley are characterized by semi-arid to arid biomes that make human occurrences seem comparatively remote today. Since 2008 we have conducted geo-archaeological research in the Wadi Sabra, southern Jordan, investigating Pleistocene terrestrial stratigraphies and archaeological sites related to the presence of Homo sapiens during various prehistoric periods under different climatic conditions [1, 2]. The main interval of sedimentation in Wadi Sabra stretches from mid MIS 3 to the end of MIS 2 and is associated with Upper Palaeolithic and Epipalaeolithic contexts, i.e. Initial Upper Palaeolithic, Ahmarian, Levantine Aurignacian, Masraqan and various Epipalaeolithic entities. Since early Holocene, continuous erosion and possibly flash-floods lead to the modern appearance of the deeply incised Wadi Sabra. The chronological framework has been established by combined C14, TL and OSL-dating [1, 3]. The first half of the sedimentary record is characterized by fluvio-aeolian sedimentation during MIS 3. During MIS 2 fluvial layers are intercalated by stable surfaces that relate to phases of soil formation. This indicates alternating dry and humid conditions in the Wadi Sabra, particularly during the LGM [1]. Shifting climate conditions at the MIS 3/2 boundary are corroborated by a long pollen record from the Dead Sea that shows a decreasing trend in tree and shrub taxa throughout MIS 3 and MIS 2 as well as considerably colder conditions during MIS 2 evidencing mixed Mediterranean and semi-arid biomes in its catchment area [5]. Pleistocene hunter-gatherers adapted to these challenging conditions during late MIS 3 and MIS 2 by adopting technological innovations and by increasing residential mobility. In the Wadi Sabra, this is indicated by higher raw material diversity employing more distant sources in comparison to mid-MIS 3 sites, by adaptive/ fragmented *chaîne opératoires* for the production of bladelet tools and by technological innovations such as carination and microlithisation [2, 4]. These behavioural changes are further corroborated by higher tool curation indices and shorter site occupation intervals after mid-MIS 3. Tool kit mobility thus played a major role at the MIS 3/2 boundary and thereafter. This stands in stark contrast to behavioural patterns observed at mid-MIS 3 sites which are located in prime geographic positions near fresh water springs and primary flint sources, when core reduction strategies were highly standardised and blanks and tools had been exported for transport. Research in the Wadi Sabra thus shows that changing mobility patterns and technological innovations at the MIS 3/2 boundary coincide with alternating dry-humid climatic conditions and a mosaic-like biome distribution in the southern Levant.

First of all, we would like to thank the ESHE committee for the kind invitation to this year's ESHE meeting. We are indebted to the PIs of the CRC 806, Jürgen Richter, Frank Lehmkuhl and Thomas Litt who made this research possible in the first place. Finally, we would like to thank the many researchers who actively contributed to this research with their dissertations and projects and without whom it would have been impossible to write this paper.

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Poster Presentation Number 51, Fr 18:15-19:00

Early Hominin Environments in Southern Africa: A Micromammalian Perspective

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Environmental change, especially the expansion of open C4 savanna grasslands at the expense of more heavily wooded C3 habitats, is frequently cited as a driver of hominin evolution. The disappearance of the genus *Australopithecus*, the rise of the cranio-dentally robust *Paranthropus*, and the emergence of *Homo* have all been linked to environmental change during the period from 3 and 2 Ma. The large mammal communities which co-existed with hominins are often used to reconstruct paleoenvironments in southern Africa during this period, but small mammals have been relatively underutilized despite their potential to provide information about hominin ecosystems. Analyses of bovids suggest that older deposits, associated with *Australopithecus africanus*, were relatively more closed and mesic while younger deposits containing *Paranthropus robustus* and early *Homo* were more open and grassy. However, one previous study by found little evidence of change in micromammal community composition between deposits of different ages and argued that conditions were more arid in the past than are characteristic today (Avery, 2001). These findings clearly contrast with reconstructions based upon larger fauna. It therefore remains unclear how to integrate these two lines of evidence. A primary goal of this study is to determine whether patterns of evolutionary change observed in the large mammal fossil record of southern Africa during the Plio-Pleistocene are also evident in the small mammal record. In this study, we use data from both previously published research and newly identified material to revisit the micromammalian fossil record in southern Africa. We employ taxonomic habitat indices, diversity indices, and stable isotope analyses to assess the environmental context of several hominin-bearing sites in the Cradle of Humankind. These methods allow for direct comparison of our data to both the large mammal fossil record and to similar studies of micromammals in eastern Africa. First, a taxonomic habitat index (THI) was developed using published data on the habitat associations of modern small mammal taxa in southern Africa. Taxonomic habitat indices (THI) are models which incorporate data on the habitat associations of all fauna within a given community in a systematic way to produce a composite representation of the environment from which the community derives. The accuracy of the developed THI in predicting habitat composition was evaluated using small mammal community data from modern barn owl (Tyto alba) roosting sites throughout southern Africa. These analyses indicate that taxon presence/absence data can be used to generate habitat reconstructions, but that this type of data is more to likely to predict the presence of habitat categories which do not actually exist. Instead, reconstructions based upon relative abundance data more accurately reflect habitat composition. In all cases, the dominant habitat categories in each biozone and at each roost site were predicted. Next, we applied our small mammal THI to the micromammalian fossil record at eight Plio-Pleistocene aged hominin-bearing sites in the Sterkfontein Valley, South Africa to generate paleoenvironmental reconstructions. These reconstructions indicate no clear shift from more mesic, closed habitats to more open-grassy habitats between 3 and 1 Ma in southern Africa, but instead suggest that the environment in this region was predominantly open with patches of mesic C3 woodland habitat. *Australopithecus africanus* and *Paranthropus robustus* appear to have been associated with both habitat types, perhaps taking advantage of resource-rich C3 habitat patches whenever they were available.

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Pecha Kucha Presentation Session 6, Fr 12:20-12:45

New data on the Altai Middle Palaeolithic variability: the Levallois perspective

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The Altai range, in the South of the Russian Federation, has yielded an important series of prehistoric assemblages in various contexts (caves, shelters and open-air sites). Recent anthropological and archaeological studies have established the significance of this area, with complex peopling events involving at least three different human species, Neanderthals, Modern Humans and Denisovans, the latter being exclusively associated with Altai assemblages. However, if the cultural background of these hominins' occupation is well defined for the beginning of the Upper Palaeolithic, a better characterisation of the previous period's productions is yet to be undertaken. Identified as one of the important cultural features of the Altai Middle Palaeolithic [1], Levallois technology is present in almost every site related to this period, with the exception of Chagyrskaya – the lithic material of which displaying very singular technological characteristics [2]. However, if previous studies allowed the identification of the presence of Levallois in those sites, they only did so in terms of presence/absence through a typological approach. These kinds of studies focus on the aspect of the cores and final products, and do not allow us to deal with the complexity and variability of the Levallois reduction techniques, and thus to extract behavioural conclusions. To address this issue, we have undertaken a review of material coming from some of the key Altai sequences, while trying to reconstruct the different *chaînes opératoires* implemented for the production of the desired products that had been previously recognized as Levallois. The analysed artefacts cover a large time span, from Early Middle Palaeolithic (Denisova, stratum 22 of the Central Chamber, RTL dated to 220-280 ky BP) to layers associated with Upper Palaeolithic (Ust'-Kanskaya, strata 3 to 1), and come from both caves and open-air sites. This allowed us to establish a chronological comparison, as well as regional. Results have shown that Levallois technology may not have been present in Altai as early as it has been previously claimed, with a difference of 100.000 years; besides, our attribution of layers previously described as Upper Palaeolithic to the Middle Palaeolithic allows us to question the validity of the theory of a late Levallois persistence in this region. We will also discuss the validity of the established variants of Altai Middle Palaeolithic.

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Poster Presentation Number 50, Fr 19:00-19:45

An online open-access database for southern African radiocarbon dates

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In this paper, we present the Southern African 14C Database (SA14C), a new online open-access database of absolute dates from archaeological contexts across southern Africa, comprising more than 2500 conventional and AMS radiocarbon ages culled from published sources which span several decades of research. The database is hosted on the website of the Oxford Radiocarbon Accelerator Unit, and is integrated with the radiocarbon calibration, Bayesian modelling and mapping functionality of the widely-used, open-access OxCal software. Individual ages are minimally categorised by site, geographic coordinates, and publications, while further details such as stratigraphic context, ecological biome, site type, technological designation and dated material can also be included. The database will be continuously maintained, with an interface for accepting newly published radiocarbon dates. Data can be easily searched and filtered using the associated information, then downloaded or analysed further within OxCal.

As with other regions where radiocarbon databases exist, including Australia, Canada and Europe, this database should greatly help to document and analyse chronological trends across the subcontinent, although caution is warranted when using decades-old legacy dates, where chemical pretreatment and analytical methods have been superseded. We present several case studies that demonstrate the utility of both this database and the integration with OxCal for investigating southern African archaeological research questions, including geographical and ecological patterning in archaeological visibility across the Last Glacial Maximum, terminal Pleistocene and Holocene; the timing of Later Stone Age technological turnovers such as from the late Pleistocene microlithic (Robberg) to the early Holocene macrolithic (Oakhurst) across different regions; and the occurrence of Iron Age archaeological settlements.

Poster Presentation Number 69, Th 18:15-19:00

Dietary versatility of early Pleistocene hominins

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Dietary adaptations reflect significant behavioral and ecological differences among humans and other primates. Early hominin diets in Africa prior to 4 Ma were dominated by C_3 resources and diversified over time. Increasing contributions of C_4 plants were triggered by biomes gradually shifting to more open C_4 grasslands since the Late Pliocene. In Eastern Africa, dietary versatility was very likely an integral part of early hominin adaptations to open landscapes, yet, does this hold generally true for African early Pleistocene hominin evolution?

A multi-proxy approach on samples of paleosol, hominins and fauna elucidates an unexpected diversity in Pleistocene hominin diets in different habitats of the East African Rift System (EARS). We present new isotopic data from the hominin bearing Chiwondo Beds in Northern Malawi, today situated in the Zambesi Ecozone just south of the boundary to the Somali-Masai Ecozone along the southernmost distribution of the Intertropical Convergence Zone (ITCZ). This region as a sensitive transition zone is crucial for understanding habitat and dietary flexibility of early hominins.

The interpretation of a) climate patterns based on clumped isotope ($\Delta 47$) paleosol temperature reconstructions, b) hominin and other mammalian dietary preferences - and with it the availability of plants and drinking water - based on carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotope data of tooth enamel of *Homo rudolfensis*, *Paranthropus boisei* and co-existing bovids and equids, and c) ecosystem reconstructions based on high-resolution profiles of $\delta^{13}C$ and $\delta^{18}O$ data of pedogenic carbonate provides insight into both, paleohabitat and hominin evolution around 2.4 Ma.

We show, that early *H. rudolfensis* and *P. boisei*, inhabiting relatively cool and wet wooded savanna ecosystems along the western shores of paleolake Malawi in the southernmost part of the EARS, consumed a large fraction of C_3 nutrition. Our reconstructions of water-consumption suggest, that hominins were likely living near freshwater sources along the lake margins. In contrast, later hominin taxa (<2 Ma) further north in the EARS inhabited open savannas with a hot and arid climate, where especially Paranthropus dominantly fed on C_4 resources.

Thus, Pleistocene *Homo* sp. and *Paranthropus* sp. were both dietary opportunists and able to cope with a wide range of paleohabitats, which clearly demonstrates their high behavioral flexibility.

Podium Presentation Session 9, Sa 10:50

Mothers from the past: Gravettian vs. Epigravettian human mobility strategies at Grotta Paglicci inferred by Sr isotopes of deciduous tooth enamel

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The reasons behind human mobility strategies include a mix of different biological and social factors that span from the spatial dispersion of local resources to population dynamics. Because moving is bioenergetically expensive, human group movements should be reduced to a minimum threshold by natural selection, both in terms of single-travel distance and annual movements [1]. In this sense, the reconstruction of hunter-gatherer mobility patterns is a key point to understand how human relationships have been influenced by climatic changes and, in general, to get further insights into human mental templates. Strontium isotopes (87Sr/86Sr) can help unravel human mobility because of the strong link between the Sr isotopic fingerprint stored in human bones/teeth and the living location of the individual [2]. In particular, while permanent teeth reveal the place where an individual spent his/her childhood, deciduous teeth form during pregnancy and the first months of breastfeeding, thus reflecting the food ingested by the mother. As a consequence, it is possible to decrypt the mobility pattern of a pregnant woman within a period of ca. 1-2 years and, generalizing, of the entire human group. A crucial period in terms of both human mobility and climatic changes is the transition from the Gravettian to the Epigravettian culture. It has been recently suggested that the Epigravettian culture (Southern Europe) might be genetically correlated with Near East populations, reflecting movements of peoples at the end of the last Ice Age. In this work, we thus analyzed the Sr isotope composition of deciduous teeth (n = 15) from the Gravettian and the Epigravettian layers of Grotta Paglicci (Gargano Promontory, Southern Italy), by laser ablation MC-ICP-MS. This is one of the most important Upper Paleolithic sites in the Mediterranean Area, where a continuous sequence from the Aurignacian to the Epigravettian has released more than 140 *Homo sapiens* remains [3]. Radiocarbon dates of the site span from 40.939-36.570 to 13.712-12.970 yrs cal. BP (2σ), well across the Last Glacial Maximum, making this site an extremely important case to better understand *Homo sapiens* mobility strategies in relation to glacial/interglacial periods [4]. The deciduous teeth Sr isotopic signature is significantly different between Gravettian and Epigravettian individuals. While the former on average present local values with a high degree of intra-tooth variability, the latter show a clear non-local signature and a low degree of intra-tooth variability. We suggest that: 1) the Gravettian groups exploited mostly local resources, but also non-local foods with a high degree of annual travels over long distances; in this context, pregnant women/mothers were likely stable at the base camp while men moved in search of food. 2) The Epigravettian groups exploited a different mobility strategy, with a lower number of movements per year, where the whole group likely participated to the travel. Where the non-local individuals come from is still debatable. Based on our geochemical data, we can speculate they could have exploited resources from Southern Italy (e.g. Calabria), from the Central Italy volcanic areas or even from the Near East.

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Poster Presentation Number 57, Th 18:15-19:00

Did the environment drive hominin life history evolution?

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Modern humans exhibit a unique set of life history traits: relatively short gestation times, early weaning, extended juvenile periods and long lifespans. Undeniably, there is a strong link between hominin large brains and their extended juvenile period and lifespan. However, the ultimate cause(s) that led to a situation where some life history stages are in fact accelerated (i.e., relatively shortened) and only some have been extended, have thus far remained elusive. Here I draw on comparative primatology to argue that climate and resource availability probably underlies the evolution of hominin life histories.

Life history traits (brain size, gestation length, interbirth interval, longevity) were compiled from the published literature, as were climate data (temperature, precipitation, evapotranspiration etc.); for 53 species the entire set of variables was available for uni-and multivariate analyses (OLS, PGLS, SEM) [1]. After controlling for the effects of phylogeny and female brain size, two trends became apparent: First, gestation length, which is traditionally considered conservative and phylogenetically constrained, showed the greatest response to climatic variables. Second, rather than any single measure, it is the combination of abiotic conditions which seems to influence life history traits. Specifically, results consistently highlight the contrasting relationship between annual precipitation and actual evapotranspiration as a determining factor for growth and development; all results are statistically significant at the 1% probability level. The effects of temperature and aridity, calculated as a proportion between actual and potential evapotranspiration, are negligible however. This is confirmed in multivariate PGLS analyses as well as structural equation models, which, in addition to climate data, take into account the correlations between life history variables too.

The negligible influence of any one climate variable, including aridity, on life history variables is surprising. The combined effects of the abiotic factors analysed here suggest that the effects of climate on primate life history may be more indirect, i.e. through habitat productivity and seasonality. The latter affect primate energetics and determine the predictability of resources. The relatively short gestation periods and high reproductive rates of hominins may conceivably have evolved in response to resource limitations [2]. An extended growth period, on the other hand, would provide a suitable mechanism to protect the growing brain from starvation. Observations that the highest glucose uptake, either absolutely or in relation to the metabolic demands of the body as a whole, only peaks during childhood and well after the offspring has gained independence [3], clearly supports such a propositions. The results of the present study thus highlight that the "unique" modern human life history is in fact predicted by the ecological setting in which hominins evolved; extant primates living under comparable conditions exhibit similar trends. Taken further, hominin larger brains are likely a consequence, rather than a driver, of life history changes in early hominins.

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Poster Presentation Number 15, Th 18:15-19:00

Quantification of raw material properties and their influence on the morphology of lithic tools

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Raw material influence on artefact shape is a much-debated topic [1]–[3] in the field of lithic studies, with studies querying its importance as one of the defining factors for the morphology of a tool. Studies concluded that raw material might not influence shape (e. g. [2]) while others conclude that it plays a role in symmetry (e. g. [4]), at least in regard to its availability. The undeniable importance of these studies lies in the throngs of implications that knowledge of raw material properties bring to the discussion about human behavioural evolution and the cognitive abilities and technological skills of our early ancestors. Studies that focus on or take into consideration raw material have traditionally focused on the quality of the raw material or their source, often on a subjective scale for the former. Attributes such as "micro-defects" are often mentioned but sometimes poorly defined or explained, leaving the final verdict on raw material "knappability" as a judgement of the scientist reporting on his findings. Beyond the common realms of "micro-defects" present in the internal structure of a raw material nodule (a characteristic that is mostly unknown before the rock is shaped) and other qualitative properties of rock, we aim to analyse and correlate elastic and plastic characteristics of the artefact's raw material via non-destructive hardness testing as a vector to understand their morphological characteristics. Different from purely qualitative methods, analysis of the raw material tests the hardness of the material and correlates the obtained values with other properties such as density. The results, compared to "pilot materials", are used as a "scale" for comparison of physical properties – acting as guides on the most desirable hardness/density ratio for a lithic tool. We believe that our approach for artefact raw material analysis, a novel approach that can be combined with morphology analysis such as geometric morphometrics or qualitative data regarding the *chaîne opératoire*, will contribute to a better understanding of raw material selection. This in turn will shed light on how material constrains tool morphology and effects the decision making process involved in all steps of lithic production, from raw material selection to the knapping process.

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Poster Presentation Number 28, Fr 19:00-19:45

Dental development, stress, and dietary transitions in the Ngogo chimpanzees

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Understanding the dental development of our closest living relative, the chimpanzee, is essential for developing a clearer picture of the relationships between the dental development, ecology, and life histories of fossil hominins. The microstructure and chemistry of dental tissues have been successfully used together to demonstrate the ages at which dietary transitions occur during development in a number of primates. Such studies inform our understanding of the ways in which the weaning process and other life history variables manifest in dental tissues, but there are, as yet, no such combined data available for wild chimpanzee populations.

This study presents novel and detailed dental development data from a long-studied population of wild chimpanzees (*Pan troglodytes schweinfurthii*) from Ngogo in Kibale National Park, Uganda. In addition to the microstructural data documenting the timing of crown and root development in these individuals, this research also presents preliminary trace elemental mapping data showing the distribution of calcium-normalized barium and strontium levels in key areas of the chimpanzee M1 crown, offering insight into indicators of dietary transitions early in chimpanzee development.

The M1-M3 of all chimpanzees in the study were histologically sectioned and imaged. A number of dental developmental variables were compared between members of this population as well as with other chimpanzee populations from the literature. Individuals from Ngogo showed an increase in average enamel daily secretion rates, and a lower average Retzius line periodicity compared with other populations. Cusp-specific total formation times were observed, and assessing the formation ages of major accentuated lines permitted developmental chronology and overlap to be documented, while also tracking periods of developmental stress, and their frequency, duration, and severity.

Laser ablation inductively-coupled plasma mass spectrometry (LA ICP-MS) was then used to obtain calcium-normalized barium and strontium ratios (Ba/Ca and Sr/Ca) from first molar thin sections in order to detect and track the timing of dietary changes early in chimpanzee development. Results are considered in the context of the local ecological conditions of this unusually large group of chimpanzees. Laser ablation was conducted at Michigan State University's ICP-MS laboratory. Qtegra software was used to analyze Ba/Ca and Sr/Ca levels from ablated tracks of enamel close to the enamel-dentine junction (EDJ).

Overall, these data add to our understanding of variation dental development and the timing of early dietary transitions in wild chimpanzee, greatly augmenting the great ape data pool with which the dental development and life history data of fossil hominins can be compared.

Podium Presentation Session 12, Sa 16:30

Rethinking demography's role in shaping the Palaeolithic archaeological record

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Recently it has become commonplace to interpret instances of change and periods of stability in the Palaeolithic archaeological record in terms of demography. Changes in population size, for instance, have been hypothesized to account for the so-called symbolic revolution [1] and the abandonment of the bow-and-arrow in Northern Europe during the Late Glacial [2]. Similarly, changes in population density has been used to explain the Middle Palaeolithic to Upper Palaeolithic transition [3] and the technological innovations that accompanied the so-called broad spectrum revolution [4]. Such is the strength of belief in the explanatory power of demography among archaeologists that it has recently been argued to be key to understanding socio-cultural change in prehistory [5]. In the first part of this paper, I offer a critique of this "demographic turn." I show that it is problematic from an epistemological perspective and also not supported by the evidence pertaining to recent hunter-gatherers. In the second part of the paper, I outline an alternative hypothesis and discuss the evidence that supports it. This hypothesis contends that cultural complexity in small-scale societies is affected by both population size and environmental risk, and that which of them dominates depends on the amount of niche construction the members of a society engage in. When niche construction is limited, environmental risk dominates, whereas when niche construction is extensive, population size dominates. Recent modelling work shows that this hypothesis is plausible, and the hypothesis makes sense of the results of the analyses of inter-population variation in technological complexity that have been carried out to date. In the final part of the paper, I discuss the implications of the niche construction hypothesis for the interpretation of the archaeological record. I argue that changes in cultural complexity before the origins of agriculture ca. 12,000 are most likely to have been a response to changes in environmental conditions whereas changes in cultural complexity after the development of agriculture were probably more influenced by changes in population size.

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Poster Presentation Number 54, Th 19:00-19:45

Evidence for climatic adaptation in human nasal turbinate morphology

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Anthropologists have long recognized an association between nasal morphology and climate as evidence of natural selection on modern human craniofacial form. Numerous studies have demonstrated that variation in nasal passage morphology influences inspiratory air conditioning (heat and moisture exchange) via the amount of contact between respired air and mucosa within the internal nasal cavity. The nasal turbinates, scroll-shaped bones that project from the nasal wall, directly influence the overall size, shape, and surface area of the mucosa-lined nasal passages. Thus, variation in nasal turbinate morphology may substantially impact heat and moisture exchange within the nasal cavity. However, unlike the encapsulating walls of the nasal cavity, ecogeographic variation in nasal turbinate morphology has not been established. Accordingly, this study investigated population variation in inferior nasal turbinate morphology, employing linear measurements of inferior turbinate length, height, and breadth, as well as common meatus, inferior meatus, and overall nasal passage dimensions. These measurements were collected from CT-scans of crania from two climatically distinct, mixed-sex, extant human samples from equatorial Africa (n=33) and the Arctic Circle (n=30). Permutation t-tests revealed the existence of significant ecogeographic differences in inferior turbinate morphology, with individuals from the Arctic Circle characterized by significantly longer ($p<0.0001$), taller ($p=0.0005$), and wider ($p=0.011$) inferior turbinates compared to equatorial Africans. Further, although the Arctic sample was found to possess slightly narrower nasal passages ($p=0.015$), greater breadth of the inferior turbinate resulted in substantially narrower common meatus dimensions ($p<0.0001$). Similarly, while the Arctic sample actually exhibited significantly taller nasal passages ($p=0.004$), greater inferior turbinate heights also resulted in narrower inferior meatus dimensions ($p=0.0007$). Analysis of covariance results confirm that, compared to equatorial Africans, individuals from the Arctic Circle possess significantly narrower common meatuses ($p=0.0004$) for a given nasal passage breadth, and significantly narrower inferior meatuses ($p=0.0002$) for a given nasal passage height. To our knowledge, this study is the first to document such ecogeographic variation in nasal turbinate morphology among humans, and suggests that turbinate morphology likely substantially augments other aspects of nasal cavity anatomy which modulate respiratory heat and moisture exchange. Indeed, variation in turbinate morphology likely influences not only the total amount of mucosa available for contact with respired air, but also the direction and rate of airflow through the nasal passages. Thus, although the taphonomically fragile turbinate bones in Neandertals and other pre-modern hominins are rarely preserved, the morphometric relationships revealed in our study suggest future attempts to model heat and moisture exchange in fossil hominins should likely account for potential variation in turbinate morphology.

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Poster Presentation Number 7, Fr 18:15-19:00

The postnatal ontogeny of the hominoid pharynx and its relationship with cerebellar expansion

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Dean [1] proposed that fossil hominin cranial base width variations might link variation in cerebellum expansion which could have a knock-on effect on other cranial base structures. Findings of different brain growth patterns in modern humans and Neanderthals further supports this [2]. Here, we explore the idea of the effect of cerebellar expansion on the postnatal ontogeny of the modern hominoid pharynx and how it varies (a) intra-and interspecifically and (b) in relation to unstable (foramen magnum FM) and stable (foramen rotundum FR; internal acoustic meatus IAM) neurovascular cranial base structures [3].

We used a complete growth series of 57 humans and 32 chimpanzees and a partial growth series of 8 gibbons, 2 gorillas and 2 organ-utans to study the pharynx and cranial base configuration based on 19 pharyngeal musculoskeletal and 30 cranial base and mandibular neurovascular and musculoskeletal 3D Landmarks (LMs). Statistical analyses (General Procrustes Analysis, Canonical Variant Analysis, 2-block partial least square regressions PLS) were used to describe pharynx size and shape variation and to assess relationships between pharynx and cranial base LMs.

(a) Humans achieve more pharynx growth during their first postnatal year than chimpanzees during the comparative developmental period (< 6 months). Human pharynx variation is statistically significantly different from great apes (chimpanzees) from birth (CV1=83.354 %, p-value>0.001). Shape variation is small for cranial base muscle attachments (superior pharynx constrictor). The nasopharynx varies vertically via increased Hormion-posterior nasal spine (PNS) distance. Oropharynx variation is due to hyoid drop relative to FR and IAM and vertical and posterior mandibular ramus expansions. The chimpanzee nasopharynx varies via anterior displacement of pharynx muscle attachments, PNS position and Hormion-PNS vertical distance increase. Oropharynx variation is due to a mix of hyoid drop and anterior mandibular ramus growth. Gorillas and orang-utans fall within the shape distribution of the equivalent chimpanzee age groups. Gibbon pharynx shape differs from great apes in relative hyoid width and a more posterior position of longus capitis attachment (CV3=4%, p<0.001) (b) PLS indicates a strong correlation (RV coefficient=0.6207, p < 0.001) between postnatal human pharynx and cranial base variation: FM drop relative to the stable FR and IAM has a tight relationship with variations in hyoid position and small variations in PNS position. In chimpanzees, the FM displaces supero-posterior relative to FR and IAM. This too correlates strongly with pharynx LMs (RV coefficient=0.6071, p<0.001), particularly with hyoid position (drop, anterior positioning). Nasopharynx variation (PNS, Hormion, longus capitis attachments) and mandibular attachments of the superior pharynx constrictor also correlate strongly with FM variation.

A defining characteristic of the modern human cranium is its pre-and postnatally establishing globular morphology, linked with variation in brain development [4] and subsequently expressed in the early FM drop. Modern hominoid pharynx shape variation is present in neonates, indicating a prenatal development as well. Humans undergo substantial pharynx growth during the first year of life which coincides with the FM drop. Simultaneously, the pharynx maintains its breathing function and accommodates transitions in feeding behavior (liquid to solid food). The superior rotation of the FM in great and lesser apes is probably related to nuchal muscle expansions and the absence of an endocranial expansion of the cerebellum links to less rapid pharynx growth in anterior direction during the equivalent postnatal period, whilst the same demands for functionality of the pharynx apply. Modern hominoid pharynx shape variation is thus best explained by pre-and postnatal changes to brain form whilst maintaining functionality in feeding and breathing.

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Poster Presentation Number 68, Fr 19:00-19:45

What does the trigonid crest pattern tell us on the Arago dental sample?

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Nowadays, one of the most important issues in human evolution is to try to understand the complex evolutionary scenario in Europe during the Middle Pleistocene (MP). The remarkable morphological variability that characterizes the MP species suggests that the settlement of Europe could be the result of several migration waves, at different times, coming from the same mother population probably placed in Southwest Asia. The human fossils found in the Caune de l'Arago (Tautavel, France) are, together with the Sima de los Huesos hominins, one of the largest and best documented samples of European MP (1). To date, this site has yielded more than 140 human remains that, according to the latest dates obtained for the Arago hominin-bearing layers (2), are nearly contemporaneous with the Sima de los Huesos population. For that purpose, these fossils are of special interest to investigate human evolution in Europe during this period. Since dental morphology is an important source of taxonomic and phylogenetic information (3), the pattern of the trigonid crest has proved to be useful to characterize the Neanderthal species (4). Therefore, we have analyzed the trigonid crest pattern exhibited at the outer enamel surface (OES) and enamel dentine junction (EDJ) of the Arago lower molars using a microtomographic technique. Furthermore, to understand the polarity of this morphological feature in the evolution of European populations, we also compared this morphological trait among *Homo antecessor*, the Sima de los Huesos population, *Homo neanderthalensis* and *Homo sapiens*. Our results reveal that the Arago specimens present high frequencies of continuous mid-trigonid crests, typical of the Neanderthal lineage. However, the height of their crest and their variability at the dentine are lower, although this may be due to the small sample size. Despite the similar chronology and the geographical proximity of Arago and Sima de los Huesos sites, our data support the idea that the Arago dental sample exhibits Neanderthal patterns together with other plesiomorphic features, while the Sima de los Huesos teeth are more like *Homo neanderthalensis*. These results are consistent with those recently published by Bermúdez de Castro and coworkers (5) that proposed a less linear settlement of Europe where two or more hominin groups could have coexisted during the MP.

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Poster Presentation Number 33, Fr 18:15-19:00

Tooth crown tissue proportions and enamel thickness in Early Pleistocene *Homo antecessor* molars (Atapuerca, Spain).

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Tooth crown tissue proportions and enamel thickness distribution are considered reliable characters for inferring taxonomic identity, phylogenetic relationships, dietary and behavioural adaptations in fossil and extant hominids. While most Pleistocene hominins display variations from thick to hyper-thick enamel, Neanderthals exhibit relatively thinner [1-3]. Moreover, studies of the external and internal dental structures documented the existence of a temporal trend in the structural organization of the European Neanderthal lineage [1-4]. However, the chronological and geographical origin for the appearance of this typical Neanderthal condition is still unknown. Comparative studies on the Early Pleistocene species of *Homo antecessor* (Gran Dolina-TD6 site, Sierra de Atapuerca) identified anatomical traits shared with the Neanderthal clade [4]. In this context, the European population from TD6 represents an excellent opportunity to investigate the appearance of the derived (thin) enamel condition. In this study, we aim to test the hypothesis if *H. antecessor* molars approximates the Neanderthal condition for tissue proportions and enamel thickness. To do so, for the first time we characterised the molar inner structural organization in this Early Pleistocene hominin population (n=17) and compared it to extinct and extant populations of African, Asian and European origin. We used high-resolution images to investigate the structural configuration of TD6 molars (tissue proportions, enamel thickness and distribution). TD6 molars included in the study exhibit wear degree between 1 (no occlusal wear) and 3 (small dentine patches). Following established protocols [1-3] we measured and calculated three sets of variables. For the 2D estimates, the complete sample was included although we performed cusp reconstruction. For the 3D estimates, complete crown, 13 molars were included (excluding the four molars exhibiting wear degree 3). In order to extract the largest amount of information of the TD6 specimens, including the occlusal worn molars, we assessed lateral (non-occlusal) enamel thickness. Adjusted Z-score of the three variables accounting for tissue proportions (percentage of dentine, average and relative enamel thickness) were computed to compare 2D and 3D dental tissue proportions and enamel thickness values of the TD6 specimens to the means and standard deviations of the Neanderthal and modern human groups. This statistical method allows the comparison of unbalanced samples by using Student's inverse t distribution [1,3]. To visualize enamel thickness topographic distribution in TD6, 3D chromatic maps were generated[3]. For comparative purposes, we generated the chromatic maps of a selected sample of specimens of European and African origin. The results showed that TD6 permanent molars exhibit thick average and relative enamel in 2D and 3D estimates. This condition, regarded as primitive trait, is shared with the majority of extinct and extant hominin sample, except for Neanderthals and some isolated specimens, such as African Early Pleistocene specimen from Eritrea. However, while the total crown percent of dentine in TD6 globally resembles the low modern values, the lateral crown percentage of dentine tend to be much higher, closer to the Neanderthal signal. Similarly, the *H. antecessor* molar enamel distribution maps reveal a relative distribution pattern that is more similar to the Neanderthal condition (with the thickest enamel more spread at the periphery of the occlusal basin) rather than that of fossil specimens and modern humans (with thicker cuspal enamel). Future studies on European Middle Pleistocene populations will provide more insights into the evolutionary trajectory of the typical Neanderthal dental structural organization.

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Poster Presentation Number 21, Fr 18:15-19:00

A 3D geometric morphometrics study of the influence of non-neutral factors on the different parts of the skull -insights on the settlement of America hypothesis.

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The first humans to have settled America went through Beringia probably from East Asia. However, the migration events are controversial from genetic continuity [5], morphological variations between Paleoamericans (>8,000 BP) and Native Americans [2] or, alternatively, a continuous variation linked to early diversification through recurrent flows [4]. It has been demonstrated that the cranium inherited ancestral morphological characters related to population history. Neutral evolutionary theory considers population genetic processes induce phenotypic diversity. However, a growing body of evidence suggests that specific regions of the human cranium (maxillofacial and basicranium) are influenced by external factors that constitute microevolutionary adaptations [1,4], especially regarding populations living in extreme cold climate [1,3]. This study aims to examine issues on population history and the possible greater influence of environment on maxillofacial/mandibular morphological variability. Using 3D geometric morphometrics method, different parts of the skull (face, neurocranium and mandible) have thus been analyzed, both separately and with the whole skull, in order to determine whether there is a strong covariation between them. Our sample consists of 224 individuals from the America, East-Asia and Australasia territories, with an emphasis on North American populations (artic and subarctic areas) as well as those that are supposed to show effects of genetic isolation (Fuegian, Pericues and Nicoleño). Our results show a covariation between the cranium and the individual parts of the skull. Yet, the effects of external factors and settlement hypothesis vary depending on the structures involved. For the whole cranium and neurocranium variation, the geographic factor has a greater impact and can support the hypothesis of two major migration waves. Mandibular and maxillofacial variation reflects cultural and dietary influences -but corroborate observations based on the skull highlighting the particular morphology of Pericues (Baja California), Fuegians (Terra del Fuego) and Inuit [4]. This study shed light on the necessity to test the influence of external factors to refine phylogenetic accuracy especially regarding population covering a spectrum of environments and cultures. It highlights the morphological variability found among Native Americans populations as well as on the complexity of the first American settlement and subsequent population history.

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Pecha Kucha Presentation Session 2, Th 12:20-12:45

A non-destructive ZooMS methodology applied to Neandertal bone tools shows raw material selection

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In 2013 we reported [1] the discovery that Neandertals produced a specialized bone tool previously thought to be restricted to *Homo sapiens*. We interpreted four nearly identical fragments of shaped and worn animal ribs as *lissoirs*, a French term meaning "smoothers". The bones come from two Middle Paleolithic sites in southwest France, Pech-de-l'Azé I and Abri Peyrony, and together span three separate archaeological deposits with varying faunal species distributions. Using standard morphological assessments, we determined that the *lissoirs* were produced on ribs of medium-sized ungulates. Because the bones are highly fragmented and modified, species determinations were challenging; however, red deer (*Cervus elaphus*) and reindeer (*Rangifer tarandus*) are relatively common medium-sized ungulates in the faunas of these two sites. In an effort to better understand raw material selection for these four *lissoirs* plus a fifth example recently found at Abri Peyrony, we reassess their taxonomy using a modified method for evaluating proteomic data that employs Zooarchaeology by Mass Spectrometry (ZooMS) [2,3]. Given that these artifacts are extremely rare and fragile and are quite small, an entirely non-destructive method was adapted for this study. Through this approach, four of the five *lissoirs* produced identifiable MALDI-TOF MS collagen fingerprints. Significantly, these four were made on ribs from the same taxonomic clade (*Bos* sp./*Bison* sp.). These results provide a promising new avenue for non-destructive analysis of precious artifacts. In addition, these results have implications for Neandertal selection and curation of raw materials for producing bone tools. The four Abri Peyrony *lissoirs* were found in two separate layers (L-3A and L-3B) with distinct species diversity. For example, three of the *lissoirs* are attributed to Layer L-3B, which is dominated by reindeer (90% NISP). Even though Neandertals were largely hunting reindeer during this time period, they still chose to manufacture and possibly curate *lissoirs* from the more robust ribs of large bovids. The demonstrable Neandertal preference for a particular skeletal element from a specific taxon bolsters the evidence that Neandertals deliberately exploited the raw material properties of bone for specific purposes.

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Podium Presentation Session 5, Fr 9:30

The sedimentology of the Jacovec Cavern, Sterkfontein, South Africa: contextualising fossil deposits with high resolution sedimentological analyses

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The Sterkfontein Cave Network is a Plio-Pleistocene site that has produced some of the most significant finds in palaeoanthropological research. Although this karst system contains a large amount of faunal material, placing them into a stratigraphic framework is met with much difficulty. This is largely due to the governing mechanisms of cave deposition as well as post-depositional imprinting. Therefore, intricate multidisciplinary geological methods must be applied to provide the best context for these fossils. This project undertook a geological investigation of siliciclastic deposits (containing partial cranium of Australopithecus sp.) in one of Sterkfontein's deepest cavern, the Jacovec Cavern. Contrary to previous work by Partridge et al. (2003), sedimentological work (facies analysis, log descriptions, petrography, micromorphology and microtomography) revealed the presence of two independent chambers in which one of them (Thulasizwe Chamber) has four distinct stratigraphic units. These units begin with a newly-discovered basal slackwater unit overlain by a debris flow diamicton which conformably grades into a fossiliferous Brown Breccia unit into an Orange Breccia channel deposit. In addition, this sequence has been subject to both biotic and abiotic diagenetic alteration. The distinct lithology (i.e. tuff seam clasts, ferrigenous crust) from the caverns has also assisted in constraining the provenance of the sediments, likely derived from the south-southeast of the cave system surface. In addition, the presence of ghost rock remnants (mostly in the form of microsparite) has provided nuance in the karstification mechanism, suggesting a long-lived chemical dissolution stage before total removal and supports earlier works of Wilkinson (1985) of a deep phreatic network. This has implications for stratigraphic interpretations and priority of cave filling for the entire cave network. The study highlights the importance of high resolution sedimentological work in palaeoanthropological sites.

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Poster Presentation Number 3, Fr 18:15-19:00

Sporadic sampling not climatic forcing drives early hominin taxic diversity

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The role of climate change in the origin and diversification of early hominins is hotly debated. Most accounts of early hominin evolution link observed fluctuations in species diversity to directional shifts in climate or periods of intense climatic instability. None of these hypotheses, however, have tested whether observed diversity patterns are distorted by variation in the quality of the hominin fossil record. Here, we present a detailed examination of early hominin diversity dynamics, including both taxic and phylogenetically corrected diversity estimates. Unlike past studies, we compare these estimates to sampling metrics for rock availability (hominin-, primate-, and mammal-bearing formations), collection effort (number of years of field study at each formation), and estimates of sampled area, in order to assess the geological and anthropogenic controls on the sampling of the early hominin fossil record. Taxic diversity, primate-bearing formations, and collection effort show strong positive correlations, demonstrating that observed patterns of early hominin taxic diversity can be explained by temporal heterogeneity in fossil sampling rather than genuine evolutionary processes. A similar, but slightly weaker, trend is observed with sampled area: the larger the area of the African continent sampled, the greater the taxonomic richness at any one time. The hominin fossil record contains multiple peaks in taxic diversity, and history has demonstrated that the taxa comprising these peaks are robust and meaningful evolutionary units. However, troughs in taxic diversity all correspond with poor sampling. In combination, these sudden peaks and troughs in taxic diversity produce the appearance of pulsed diversification, which are more simply explained as a result of non-uniform sampling. Peak taxic diversity at 1.9 million years ago (Ma) is a sampling artefact, reflecting merely maximal rock availability and collection effort. In contrast, phylogenetic diversity estimates imply peak diversity at 2.4 Ma and show little relation to sampling metrics. Our results suggest that significant improvements in the quality of the fossil record are required before the role of climate in hominin evolution can be reliably determined.

Poster Presentation Number 11, Fr 18:15-19:00

Heat or Cold Adaptation in Pleistocene Humans: Evidence of Vascular System Development in Tubular Bones

Maria Mednikova[1]

1 - B.

Wide spread of humans during Pleistocene created appearance of different adaptive trends and radiation of cold or warm adapted forms. The key point of biological adaptation to contrasting environments of the glacial age should be heat exchange. During our preliminary studies we assumed, that significant difference in development of the vascular system of bone is caused by the adaptation process and in general reflects degree of termoregulation [1, 2]. Progress of radiological technique offers deeper insight into the microstructural patterns of human bones. The volumetric radiological microscopy we used is a nondestructive method of evaluation of vascular net density in compact bone, which became an important tool in the study of fossil remains. Studying the volume the Haversian and Volkman' channels, which have been calculated inside of the determined volume of cortical bone, we proposed a new index of vascular volume part (VVP, %). VVP was estimated as the percent of channels to the total bone volume. The bones of the 2nd and 4th digits of the hand composed the bulk of the sample for current comparative analysis. The sample included specimens belonging to various taxa of genus Homo: the Neanderthals of Europe and Asia, and the Early and Late Paleolithic H. sapiens. The European Neanderthals are represented by the specimens from the Musée de l'Homme in Paris (La Ferrassie 1) and the Museum of Anthropology and Ethnography (Kunstkamera) RAS in St. Petersburg (Kiik-Koba 1). The Altai Neanderthals are represented by the skeletal remains from Okladnikov, Denisova and Chagyrskaya caves. The Upper Paleolithic H. sapiens are represented in this study by remains from sites of Kostenki 14 and 8, Sunghir; by the phalanx from Abri Pataud (Musée de l'Homme, No. 26227). Additionally, the VVP was estimated in the dorsal compact of femoral bones of anatomically modern humans from various locations from Europe (individuals Sunghir 1 and 4) and Siberia (Ust-Ishim). Study of microstructural patterns of the skeletal system of Neanderthals and anatomically modern humans gives evidence that the both Pleistocene mankinds were polymorphic in their adaptive reactions, both included cold - and warm adapted forms.

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Poster Presentation Number 51, Th 18:15-19:00

Reconstructing the Shoulder Girdle from Skeletal Remains

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Purported shifts in shoulder girdle structure underlie a number of large-scale hypotheses in hominin evolution. Shoulder elevation and protraction are of particular interest in debates over adaptation to arboreal locomotion [1], long-distance running [2], throwing [3] and manipulatory abilities [4] in various hominin species. Shoulder breadth and thorax dimensions are referenced in studies of ecogeographic adaptation. Researchers have inferred these properties using clavicle and scapula morphology, although the predictive value of such relationships has never been demonstrated.

Landmarks and scalar measurements were collected from the articulated clavicle, scapula and ribs 1-3 in 3D CT scans of living humans (n = 58). The CT scans permit morphological observations while bones remain articulated. The data were virtually disarticulated to examine covariation patterns using regression and partial least squares analyses.

We show that resting protraction can be predicted using a combination of linear dimensions from associated but disarticulated clavicles, ribs and scapulae. A simple ratio predicts protraction with an accuracy comparable to the triangle model described by Chan [5]. Elevation is more difficult to predict. The superoinferior position of the scapula on the thorax (a property distinct from shoulder height) is determined through an interaction between clavicle elevation and rib declination—extrinsic properties that are not apparent from disarticulated remains. Clavicle length is positively correlated with shoulder breadth. Variation in clavicle orientation reduces the precision of breadth predictions, but does not alter the slope of the relationship. Clavicle length is more closely related to rib dimensions than it is to cross-sectional thorax dimensions.

Our findings contribute to improving methods of skeletal reconstruction by identifying features that can predict shoulder girdle configuration in humans. Associated elements are particularly informative, further emphasizing the value of partial skeletons. Our results also highlight the importance that extrinsic factors (bone orientation and position) have in determining skeletal configuration and overall upper body dimensions. In some cases the effect of extrinsic factors are as large as, or larger than, those of bone morphology. There appear to be sex-based differences in human shoulder girdle structure that require further investigation. With regard to the fossil record, a human reference sample is pertinent to understanding skeletal structure when aspects of bone morphology fall within the human range of variation. Future work investigating patterns of covariation among hominoids will be valuable in identifying predictive relationships that are applicable to a wider hominin sample.

We thank Pr. Michel Panuel and Pr. Olivier Dutour for their assistance in arranging access to CT scans from the Hôpital Nord de Marseille.This research is funded by the Max Planck Institute for Evolutionary Anthropology, Department of Human Evolution.

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Poster Presentation Number 21, Th 18:15-19:00

Environmental reconstruction in the context of the first *Homo sapiens* in Indochina (Tam Pà Ling site, NE Laos)

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Recently modern human remains dating 70 ± 8 kya have been excavated from the Tam Pà Ling cave in northeast Laos. To date, these important findings represent the oldest evidence of *Homo sapiens* in the Indochinese peninsula, supporting the hypothesis of migrations across Southeast Asia during MIS 4. Generally, climatic and environmental conditions are important factors framing early human movements. For this reason, reconstructions have a critical role in the interpretation of any archaeological finding. However, very limited information is available in the region of mainland Southeast Asia and the local environmental conditions prevailing since Late Pleistocene are still largely unknown. The aim of this study is to assess the type of environment encountered by the first modern humans in Indochina. Temporal changes in vegetation and rainfall patterns are reconstructed using terrestrial gastropod carbonates excavated from Tam Pà Ling cave as climate archives. Shell carbon stable isotope composition ($\delta^{13}C$) is used to infer snail diet composition in terms of proportion of C3 (arboreal vegetation) and C4 (grasses and shrubs) plants. The availability of these specific vegetation types is used to interpret the occurrence of open vs close habitats. Furthermore, shell oxygen stable isotope composition ($\delta^{18}O$) is adopted as humidity proxy. The results indicate that during MIS 4 and MIS 3 (from 70 ± 8 to 34 ± 2 kya) the landscape was characterized by the dominance of arboreal vegetation, similar to modern times. In terms of precipitation, this period was influenced by intense summer monsoons bringing large amount of rainfall able to sustain the forested habitats. These conditions underwent a drastic change during the Last Glacial Maximum. Shell stable isotopes show that from 23 ± 2 to 14 ± 3 kya northeastern Laos experienced a decrease in rainfall, potentially related to the weakening of the monsoon system. Simultaneously, there was reduction in arboreal vegetation coverage and a shift toward more open landscapes. Ultimately, wetter conditions returned to characterize the area after the onset of Holocene. The results of this study provide insights into the climatic and environmental settings experienced by the first *H. sapiens* populations in Indochina and they set the basis for further interpretation of human-environmental interactions at local scale.

Podium Presentation Session 12, Sa 17:10

Assessing hand-delivered wooden spears as effective hunting weapons using experimental, archaeological, and ethnographic evidence

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Untipped wooden spears are the earliest weapons in the archaeological record, with examples dating from the late Middle Pleistocene onwards. Although the most famous examples are those from Clacton-on-Sea (UK), Schöningen and Lehringen (Germany), there are further examples from Late Pleistocene and Holocene sites. Wooden spears were both thrust and hand-thrown by recent foragers making them the longest-serving weapon. The performance of the earliest spears frequently features in human evolutionary and weaponry models particularly in relation to subsistence behaviours. The focus has typically been on limitations of these earliest weapons for earlier species of *Homo* in comparison with *Homo sapiens*. Specifically these are proposed to relate to low velocity, kinetic energy and effective distance; danger to the user; restrictions on suitable hunting strategies; and constraints on the prey and environments [1 - 5]. However, these characterisations primarily rest on estimates, limited datasets, and/or use by unskilled participants. Furthermore they are somewhat paradoxical when considering the archaeological and ethnographic records. Archaeological examples of wooden spears are known from multiple continents in a range of environments, and are associated with at least two species including *Homo neanderthalensis* and *Homo sapiens*. Ethnographic records show a global distribution and use of wooden spears for capturing a wide range of terrestrial and aquatic prey, as well as in interpersonal and collective violence.

This paper compares the archaeological and ethnographic evidence with the outcomes of an experimental programme undertaken by the authors as collaborative work involving archaeologists, engineers, athletes and trained weapon users from UCL, Cranfield Defence and Security, and Loughborough University. The first phase of the experimental programme assessed the mechanics of wooden spears as thrust and thrown weapons when used by skilled users. Quantitative and qualitative data collection used regular digital and high-speed video cameras, force transducers and observation. Spear throwing provided data on release and impact velocities, impact angles, kinetic energies, and distances while thrusting captured forces and velocities.

Phase two of the experiments used replicas as thrusting and hand-thrown spears on adult horse carcasses, resulting in lethal depths of penetration of up to 33 cm in the rib area. The spears penetrated in all of throws, though the spears failed to penetrate in 18% of thrusts. In all impacts the spears struggled to penetrate scapulae. Together the different lines of evidence indicate that wooden spears should be viewed as lethal weapons on a wide range of prey when used by skilled weapon users. Severe limitations in terms of velocity, kinetic energy, and distance are not supported by the experimental results and ethnographic review. Conversely, material properties look to be a possible shortcoming, affecting the ability to perforate through dense bone. Skill and fitness emerge as a significant determinant of effectiveness, and must be taken into consideration in future replication studies. These findings have implications for models about the emergence of early human hunting and innovations of weaponry in human evolution and explain their continued use from at least the late Middle Pleistocene through the Holocene alongside subsequent innovations such as composite and complex weaponry.

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Podium Presentation Session 3, Th 14:40

Recent palaeoanthropological investigations in West Turkana, Kenya: implications for the evolution of *Homo sapiens*

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Recent discoveries in Africa have added time and complexity to the evidence for the evolution of modern humans. On the one hand, new fossil discoveries suggest that hominin populations at or near to the threshold of *Homo sapiens* were found across the continent in the late Middle Pleistocene(1); on the other, there is evidence for significantly different hominins at the same time (2). Equally important is the fact that the Middle Stone Age of Africa has greater antiquity than previously thought, and displays greater complexity in its early stages (3). These discoveries highlight the importance of knowing more about the diversity of later Middle Pleistocene hominins in Africa and their behavioural and environmental contexts. This paper reports on new discoveries that contribute to this record of hominin diversity in Eastern Africa.

Since 2008, we have carried out palaeoanthropological investigations in West Turkana, Kenya, especially in the region between the Turkwel and Kerio Rivers. Laterally extensive deposits, ranging in age from the African Humid Period to around 500 Ka, have been surveyed, and archaeological, palaeontological and geological excavations carried out. These deposits are for the most part derived from the multiple short periods at the onset of interglacial phases when Lake Turkana was elevated by as much as 100 m above current lake-levels.

Hominin and animal fossils, as well as lithic artefacts are abundant across these deposits. The later Pleistocene and Holocene remains represent one of the largest assemblages of human skeletal material from prehistoric Africa, including the evidence for the earliest inter-group lethal conflict (4); earlier hominin remains are not as common, but nonetheless are beginning to reveal evidence for complex diversity in the Turkana Basin during the last 300,000 years.

Although widespread, Middle Pleistocene deposits are, compared to earlier and later sediments in Turkana, relatively shallow. It is probable that they constitute a continuous landscape, draped with deposits from subsequent high lake-level stands and cut by recent fluvial activity. Several localities have yielded significant hominin and faunal remains and stone tools. Here we report on the overall distribution and nature of the Upper and Middle Pleistocene deposits in West Turkana, and on some of the key localities that have yielded partial hominin remains – Kalakoel 3, Ngingolea 1, and Lon'garankak 1.

At certain sites, the hominins are associated with a mammalian and reptilian fauna that includes extinct elements (such as *Elephas recki*, *Hippopotamous gorgops*), some of which have evidence of humanly-derived breakage. The associated lithics are typologically and technologically MSA, with a strong Levallois component, and elements such as lanceolate points and pyramidical cores that show affinities with the Lupemban.

We discuss the implications of the new Turkana material and its context for understanding early modern human evolution and the development of African diversity during the Upper Pleistocene.

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Poster Presentation Number 27, Fr 18:15-19:00

Successfully reconstruction of hominin crown heights from Gran Dolina-TD6 and Sima de los Huesos (Atapuerca, Spain)

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Calculating crown formation times and enamel extension rates require the presence of unworn teeth. Unfortunately, most of the dental remains from archaeological sites are worn, so a reconstruction of the missing part is necessary. Here, we present a new application on fossil teeth of a recent methodology used to reconstruct minimally worn teeth based on tooth-specific regression equations [1].

Regression equations are based on the morphology of the cuspal area of unworn modern human molars, premolars, canines and incisors, both upper and lower. By defining three landmarks and fifty-one semilandmarks in specific microCT slices, we obtained XY coordinates which were used to calculate the regression models of every tooth type. To validate the application of these modern human regressions to fossil hominins, we selected six unworn teeth from Gran Dolina-TD6 and thirty-five teeth from Sima de los Huesos, both sites located in the Atapuerca hill (Spain). Then, using virtual imaging techniques, all these forty-one teeth were artificially worn until the dentine horns were exposed. They were subsequently reconstructed employing their tooth-specific regression equations and the reconstructed crown heights were measured. Lastly, we measured the real crown heights, which were then compared with the real ones.

Our results show that the percentage error between the estimated and the real crown heights in Gran Dolina-TD6 and Sima de los Huesos teeth are less than 5%, ranging most of the errors between -2.5 and 2.5%. We consider values below 5% as acceptable, since it involves only a half decile of the cuspal region when we divide this distance into ten equal segments. Our results suggest that we can confidently employ these regression equations to reconstruct slightly worn hominin teeth. These regressions allow us to estimate percentage of lost enamel and to compensate number of perikymata in such area, making crown formation times and enamel extension rates usable for comparison purposes.

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Poster Presentation Number 18, Fr 19:00-19:45

Allometric variation in modern humans and the relationship between body proportions and elite athletic success

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Height and arm span vary across humans and have been the focus of research in a wide array of fields, including genetics and development, public health, and sport sciences. In many sports, large height and arm span are highly desirable traits that have been proposed to be linked to athletic success. The evolution of human height and arm span, and of body proportions more generally, has been investigated using archaeological and fossil skeletons, as well as modern humans. However, very little research has investigated body proportions in humans of tall stature outside of clinical cases. Likewise, a large body of research has been dedicated to understanding the anthropometric characteristics of juvenile and elite athletes, but very few, if any, of these studies have considered those characteristics through the lens of evolution or skeletal constraint. This is one of the first studies to investigate body size proportions and allometric variation in a large sample of elite athletes. We investigated body size proportions, employing data on players scouted for the National Basketball Association (NBA, n=2,990), mixed martial arts (MMA) fighters (mixed-sex, n=1,284), as well as a control sample of healthy young adults who are not professional athletes, represented here by male (n=4,082) and female (n=1,986) recruits for the United States Army, to test two hypotheses: 1) There is a significant difference in body proportions (represented here as arm span to height ratio, ASHR) between elite professional athletes and the control population, and 2) There is a significant relationship between ASHR and athletic success within the NBA and MMA. We find that basketball players are significantly taller, with absolutely and relatively wider arm spans than MMA fighters and the control population ($p<0.001$). Arm span and height are significantly correlated ($r=0.95$, $p<0.001$), and there is a positive allometric relationship between the traits, where ASHR increases with height ($R^2=0.95$). Additionally, we find that a larger ASHR is significantly correlated with athletic success using the metrics of this study: Basketball players are significantly more likely to be drafted earlier in the NBA, and MMA fighters are significantly more likely to have a better loss to win ratio, if they have a larger ASHR. However, we note that arm span and height, as well as athletic success, are impacted by a myriad of factors, and some of the most successful professional athletes do not have particularly long arms relative to their height. Humans are highly variable in body size and shape, and the relationship between stature and arm span has been found to vary between human populations due to both environmental and genetic factors. As a global average, arm span generally exceeds stature, although in some populations arm span is very close and sometimes even less than stature. Our data reveal that arm span and height are tightly correlated, and we discuss the relationship between these traits within the framework of human evolution. Overall, successful athletes do tend to have a significantly wider arm span relative to their height, but these proportions are not outside the expected range of normal human variation.

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Poster Presentation Number 20, Fr 19:00-19:45

The European heritage of American Populations

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The genetic diversity of American populations has been shaped by several recent events of admixture and gene flow which involved sources from both the European and the African continents. These events started during the Colonial Era and involved the Atlantic slave trade, and were followed by several waves of immigration and subsequent admixture in the XIX century. In the last decades, several studies investigated the European and African legacy of modern day American populations, revealing the existence of multiple layers that contributed to the genomic jigsaw that can be observed nowadays. These multiple layers of different ancestries have contributed to the continent-wide genomic differentiation seen, and the exact characterisation of these admixture events is crucial for several disciplines, from history to medical genetics. The recent expansion in genomic data, coupled with the development of methods harnessing the variability created by recombination, have made possible to reconstruct the ancestry profile of human populations, including very recent contributions. Here we compiled a genome-wide dataset of 13, 000 individuals from twelve American countries and 7,000 individuals of European descent to finely dissect the European contribution to the genetic landscape of the Continent. We applied haplotype-based methods to dissect the genetic structure and the admixture history of the American populations, and evaluated its impact and dynamics through time. Focusing on the European contributions in the continent, we highlighted the high complexity underlying the genetic contribution of European populations in America, both under a geographic and temporal perspective. In addition, the analysis of the X chromosome revealed a high degree of variation among american populations and provided evidence for a complex pattern of sex biased admixture dynamics affecting several regions. These results will help to clarify the details of population movement in the whole American continent, and provide information relevant for anthropological, medical and epidemiological studies.

Poster Presentation Number 56, Th 19:00-19:45

The importance of the environment in the modification of craniofacial architectural relationships in *Homo sapiens*

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Neurocranial globularity as well as a reduction in facial projection are key features in anatomically modern humans. Two- and three-dimensional morphometric studies have shown that the shape of cranial base has a significant relationship with the face, and that this relationship is not limited to basicranial flexion. More shallow lateral cranial bases relate to elongated, less prognathic faces [1] in modern *H. sapiens*, while more downward-oriented cranial bases relate to more prognathic and larger faces in modern and Middle and Late Pleistocene hominins [2], suggesting a conserved basal architectural organization of the cranium. Artificial cranial deformation [4,5] offers an interesting model to study the effect of the environment on stable structural relationships that characterize closely related taxonomic groups. The lateral cephalograms of 119 individuals from current Chilean territories were used in this study. Ninety-nine individuals showed different forms of artificial deformation of the neurocranium, while 20 non-deformed individuals were used as controls. The coordinates of 19 landmarks representing the facial skeleton, the median and lateral cranial base were digitized. Using geometric morphometric tools and partial least squares analysis, we tested the null hypothesis that artificially deformed crania have the same covariation pattern between the cranial base (median or lateral) and the face. Our results show that the deformed crania have weaker relationships between all cranial base parts and the face than non-deformed individuals. Their patterns are different though: the lateral cranial base covariates more (RV=0.11) and statistically significantly (p=0.004) than the median part (RV=0.08) with the face in deformed individuals, while in non-deformed individuals this pattern is inverted (RV=0.25 and RV=0.30 respectively). The anteroposterior extension of the anterior part of the median cranial base determines facial projection and prognathism in non- deformed; in deformed crania, a more anteriorly projected median cranial base relates to a prognathic maxilla but a more retruded nasal area. The depth of the lateral cranial base in non-deformed also relates to facial projection and prognathism, and in deformed crania depth changes are less pronounced. Anteroposterior extension of the orbit roofs is a more relevant feature, and it relates to a more prognathic maxilla. The null hypothesis was subsequently rejected. Our results show a different pattern between deformed and non-deformed, and also interestingly that the parts of the cranial base of the reference population covary in a more homogeneous way with the face that in previous studies [1,3]. This could relate to the different origin of our sample (in comparison to the European, Japanese, West African and Greek origin in the aforementioned work). These findings highlight the importance of the environment in modifying what are assumed-to-be stable relationships among craniofacial features. Environmental factors such as mechanical deformations leading to positional plagiocephaly, or the presence of non-syndromic cranial synostosis, whose prevalence in ancient remains is unknown, should be taken into consideration during the assessment of craniofacial remains in evolutionary studies.

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Podium Presentation Session 7, Fr 15:20

Site Formation at Denisova Cave, Siberia: preliminary micromorphology results

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Denisova Cave occupies a prominent place in world prehistory because of the hominin fossils and ancient DNA recovered from the site, revealing the presence of both Denisovans and Neanderthals [1,2]. The site and its contents have been studied intensively over the past two decades [3], with research published on its various aspects (e.g., stone tools, fauna, pollen) [4,5]. In addition, the geology of the cave has been analysed revealing a complex geological history characterised by steeply dipping and deformed fine-grained sediments interstratified with layers of limestone roof and wall spall and punctuated with organic-rich lenses.

To further our understanding of the formation of these sediments, we have employed a microstratigraphic approach to the study of the site stratigraphy, using micromorphology and supplemented by spatially resolved elemental mapping to reconstruct the past depositional and post-depositional environments and clarify the use of the cave by hominins and other animals during the Middle and Late Pleistocene. We examined 24 micromorphological thin sections from several of the stratigraphic units exposed in both the East and Main Chambers in 2014 and 2016, including both occupation horizons and sterile karstic deposits.

We observe that the Denisova sediments are predominantly geogenic in composition, with the main mineralic components comprising 1) sand-sized particles of quartz/quartzite, schist, and limestone; 2) silt-sized grains of quartz, mica and calcite, 3) clay, 4) mm- to cm-sized limestone clasts, and grains of metamorphic rocks, and 5) clasts of bedded silt and clay (rip-up clasts). However, we also note that there are significant quantities of biological material included within this sedimentary matrix, such as bone fragments and splinters, occasional charcoal, biogenic silica, and frequently occurring sand- to granule-sized coprolite fragments. The coprolites are present as suites of recurring morpho-types, presumably associated with different animals, in varying states of preservation. They are common in many of the units forming the fill of the East Chamber. Aside from Holocene fumier deposits, darker layers observed in the field that have affinities with combustion bi-products do not appear to relate to burning, but are more likely natural accumulations of organic matter formed within channelled depressions. Although isolated pieces of charcoal occur locally, ashes are present only in very low quantities, demonstrating the paucity of anthropogenic signals in the Denisova microstratigraphic record.

We also record physical and chemical modification of the sediments and their inclusions. Post- and syn-depositional chemical modification (diagenesis) is represented by the presence of apatite (dahllite) rims on limestone clasts, localised dissolution of calcite sand, and sesquioxide mobilisation, as well as occasional degradation of bone inclusions. Physical transformations of the sediments include aligned clay particles and micro-faulting that mirror the deformation/slumping features recorded in the field. Infilled animal burrows (krotovinas) are evident in the field, and in thin section smaller scale bioturbation by small soil fauna (e.g., isopods, worms) is concentrated in the upper layers. Finally, we identify platy microstructures in the upper layers of both chambers, reflecting periods of cooler temperatures and the concomitant disturbance of sediments through ice lensing and frost heave.

These micromorphological results provide additional insights into the depositional history and use of the cave during the period of occupation by Denisovans and Neanderthals.

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Pecha Kucha Presentation Session 10, Sa 11:30-11:55

Deciphering African Late Middle Pleistocene hominin diversity and the origin of our species

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The origin of *Homo sapiens* remains unresolved. Particularly, the extent and geographic patterning of morphological diversity among Late Middle Pleistocene (LMP) African hominins is largely unknown, thus precluding the definition of boundaries of variability in early *H. sapiens* and the interpretation of individual fossils. Here we use a phylogenetic modelling method to predict possible morphologies of a virtual last common ancestor (vLCA) of all modern humans, which we compare to LMP African fossils (KNM-ES 11693, Florisbad, Irhoud 1, Omo II, and LH18). The phylogenetic modelling method uses maximum likelihood and 3D geometric morphometrics within a Brownian model of evolution to compute vLCAs of modern humans from hypothesised phylogenies representing the most up to date and consensual hypothesis regarding the evolution of the genus *Homo* and especially of *H. sapiens*. Those hypotheses are based on palaeoanthropological and genomic studies and exclude all LMP fossils. The terminal taxa of the phylogenies are the mean shape of 29 populations based on the sampling of 249 crania. We used three African early Homo species (N=7), four Neandertal populations (N=7), an early H. sapiens group (N=3), and 21 extant modern human populations (N=232) from Africa, Eurasia, Oceania and North America. Each individual specimen is described by 780 landmarks and semi-landmarks. The vLCAs are computed as sets of shape coordinates used to warp a modern skull to obtain fully rendered 3-dimensional shapes of the predicted ancestral morphologies. The vLCAs are compared to the LMP African fossils through three different approaches. 1) A surface comparison method (color-coded deviation spectrum), expressing the shape differences between a reference and a test specimen by color-coding the vertices of the reference, is applied to the aligned and scaled (GPA) LMP fossils and vLCA models. This method offers an original mapping of the morphological differences expressed within our sample. 2) The LMP specimens are projected within the phylo-morphospace (i.e. morphological space of the tested phylogenetic hypothesis) based on both a fully reconstructed morphology and their actual preserved morphology in order to characterize the morphological variation of the LMP specimens when compared to the variation represented by the hypothesised phylogenies. 3) The Procrustes distances between each LMP specimen and the vLCA models, the Neandertals and modern humans are computed and assessed. Our results support a complex process for the evolution of H. sapiens, with the recognition of different, geographically localised, populations and lineages in Africa – not all of them contributing to our species' origin. Based on the available fossils, H. sapiens appears to have originated from the coalescence of South, demonstrated by the morphological proximity between the vLCA and Florisbad and, possibly, East African source populations, which could alternatively be interpreted as both South and East African source populations originating from a common ancestor. Consistent with their intermediate geographical position, North-African fossils fall into a phylo-morphospace between African and Eurasian populations, suggesting that populations from this region may have been both contributors and receptors of gene flow from both Sub-Saharan Africa and Eurasia through time.

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Poster Presentation Number 46, Fr 19:00-19:45

MSA occupation at the east coast and interior of South Africa: plant use, vegetation and climate at Sibudu and Bushman Rock Shelters

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South Africa today represents the epitome of human origins research on the continent with several ground-breaking discoveries of Plio-Pleistocene hominin remains and well preserved Late Pleistocene early human material culture. Several MSA sites have been studied in South Africa and most past environmental studies are concentrated in the Western Cape Province along the west coast and the Eastern Cape Province along the south coast with few studies available from the eastern part of the country that experiences a different climate. This poster presents data that makes a contribution to understanding MSA early human-plant interactions and their prevailing environment at the east coast (Sibudu Cave) and in the eastern interior (Bushman rock shelter) , which also fall in different biomes. Sibudu cave, a rock shelter in itself is located in KwaZulu-Natal Province on the east coast, 15 km from the Indian Ocean and is among South Africa's most important MSA sites. Many studies have been conducted at Sibudu over the years while little has been done at Bushman Rock Shelter, located in Limpopo Province, c. 350 km from the Indian Ocean. This presents us with an opportunity to compare two environments from the east during the MSA. New excavations at BRS that started in 2014 are seeking to place it within the South African archaeological context.

We studied fossil phytoliths (plant microscopic silica) that were chemically extracted from sediments in MSA layers and studied under the microscope. Phytolith results from Sibudu confirm the extensive use of wood for fire and grass phytoliths are not as abundant given that grasses are prolific phytolith producers compared to the woody plants. It was thought that grass was most likely used to start fires at Sibudu. Phytolith analysis further provided evidence for the use of sedge plants at Sibudu which corroborates seed studies that have suggested that sedges were used as bedding. Overall, C4 grasses that thrive in warm and moist environments appear to have been the most commonly utilised grasses and were likely dominant throughout the MSA sequence studied at Sibudu (>77-58,000) as they are today. There is no evidence for major vegetation shifts specifically for the grasslands in the area. However, because the deposits at most archaeological sites are largely anthropogenic, environmental interpretations are problematic and caution needs to be exercised. New phytolith analyses are on-going for Bushman, firstly to determine phytolith taphonomy and representativeness and results will be compared to those of Sibudu to make a contribution towards understanding past environments during the MSA in the eastern part of South Africa.

The Palaeontological Scientific Trust (PAST), The Leakey Foundation, The National Research Foundation of South Africa (NRF), The Centre of Excellence in Palaeosciences (CoE) and The French Institute in Southern Africa (IFAS)

Poster Presentation Number 6, Th 19:00-19:45

Systematic or opportunistic use of small prey in the Middle Palaeolithic? A view from Gruta da Figueira Brava, Portugal

Mariana Nabais[1]

1 - University College London

Optimal foraging theory models often place large mammals in a high-ranking position due to their high-energy return that is dependant on the animals' caloric value and handling costs. However, such practice has been heavily challenged archaeologically. Moreover, mass collection of small prey can result in return rates comparable to large game (Madsen & Schmitt 1998); and Hockett & Haws (2003) validate such assumptions showing that dietary diversity is nutritionally beneficial on its own right. Additionally, ethnographic studies confirm that hunter-gatherers are willing to travel long distances in order to acquire foods with little net return but with high nutritional variety, as the ones provided by plants and small animals, like molluscs. Formulations of broad-spectrum diets were originally developed within the framework of food production and domestication, but Stiner and colleagues (eg. Stiner et al 2000) were pioneers in pushing back the chronology to late Neanderthal times. A growing body of evidence has also been recovered from Iberian sites, confirming Neanderthal use of small prey, like tortoises, rabbits, birds and molluscs. Systematic use of the latter was claimed for coastal Iberian sites through comparisons with the dense amount of remains recovered from several Middle Stone Age (MSA) sites in South Africa. However, Klein & Steele (2008) argued that there was not sufficient data for such conclusions. Marean (2014) further considers that Iberian sites present small amounts of shellfish that it is sparsely distributed in large sedimentary deposits therefore compromising assumptions of systematic use. Recent works in Gruta da Figueira Brava, Portugal, recovered a significant amount of small animals from levels dated from the MIS-5, in stratigraphic association with Mousterian tools and large mammal remains. Through detailed taphonomic analysis (where type of breakage, percussion marks, cuts, tooth marks, burning and post-depositional processes, such as manganese stains and calcite coating, were considered), it was possible to confirm that most MIS-5 bones and shells were accumulated by hominins despite the presence of few carnivore remains that sporadically used the cave. When considering fast moving prey, leporids are predominant and skeletal part representation suggests hominin accumulation. The bird assemblage is less significant, but bone surface modification, age and several skeletal ratios indicate a mixed accumulation. Corvids used the cave for their nests, but the presence of marine birds is due to anthropogenic activity. Amongst the slow moving prey, tortoises were processed in the cave, where they were roasted in their shells and cracked open with stone tools, following the techniques already described for other Middle Palaeolithic sites. All these resources seemed to have been used opportunistically. Conversely, molluscs and crustaceans played a significant role in the diet. Shellfish densities compare well with those from costal MSA sites. Despite the wide variety of species, there is a strong bias towards limpets, mussels, and brown crabs. These animals were easily collected from the cave's surroundings with preferential targeting on large size individuals. They were understood as staple foods within an ecotonal environment that was profiting from fairly permanent terrestrial and marine resources. A variety of techniques for food acquisition were used reflecting the participation of all individuals within the hominin group. Resource diversity, in which plants like pine nuts also had an important role, confirms the Neanderthal ability to adapt to different environments advocating towards a more permanent use of the habitat.

MN is indebted to João Zilhão for facilitating access to Gruta da Figueira Brava faunal collection. The Laboratório de Arqueociências from the Direcção-Geral do Património Cultural (DGPC), in Lisbon, allowed daily access to the reference osteological collection and laboratory space. The current research is part of the PhD project "Neanderthal Subsistence in Portugal: small and large prey consumption" that has been carried out in University College London and has been funded by the London Arts and Humanities Partnership (LAHP).

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Poster Presentation Number 47, Fr 18:15-19:00

Early Stone Age Archaeology in Sudan, from the new sites discoveries at Hudi depression east of Atbara River

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African Stone Ages research started early, when the early Paleolithic sites were discovered in Kenya and Ethiopia. Large differentiation have been recognized from the sites setting and stone artifact technology and typology. The following researches have been concentrated on the variation of stone tools and "Out of Africa" debate from multiple approaches. The few of the studies focused on the stone tools revealed many taxonomic items from Early Stone Age to Middle Stone Age. The location of Sudan in north east Africa itself is one of the most important geographical corridor out of Africa, the natural aspects and location make it unique area for interdisciplinary research. Stone Age archaeology in Sudan started early and there are many Late Stone Age sites excavated. The general picture of Sudan Late prehistoric archaeology have been largely discussed. The discoveries of Early Stone Age remain lack, some sites documented in northern Sudan dated back to MSA archaeology (Levallois strategy technology). Acheulean archaeology remain uninteresting topic for a long time, surface assemblage described from single sites in central and northern Sudan (Arkell 1949, Wendorf 1968). The new discoveries of Early Stone Age archaeology in east and north Africa encouraged researchers to targeted Sudan as a geographical link of two homeland of early human. EDAR Project is Stone Age archaeological research was established in 2016 by the University of Neelain to map Stone Age sites in the eastern desert of Lower Atbara river. In early 2017, another joint project established between University of Neelain, University of Wroclaw (Poland), and NCAM (National Cooperation of Antiquities & Museum) in the eastern part of the area focusing on Early Stone Age sites (Masojć et al 2017). In late 2017 systematic archaeological survey conducted by the Author and funded by Ministry of Higher Education and Scientific Research Sudan (MHESR) to locate new Stone Age sites that could give further insight into sites chronologically. The areas were basically chosen from the results of the first season in 2016, where there were 134 archaeological sites discovered and some of them were tested by excavation (Nassr 2017). Archaeological exploration, GIS and systematic survey carried out east of Atbara River a long Hudi depression and Hanfar desert. Two diagnostics Early Stone Age sites documented about 15 km east of Atbara River on the right bank of Hudi depression. Artifact recorded from systematic survey and sampled from many courtyard of the sites. Site EDAR138 show large extension of Acheulean lithic (Mode 2). Our systematic survey of area 300 x 300 m revealed 227 Acheulean stone tool and accumulated of flakes and cores, Handaxes are the dominant with large flake chopping tools and scraper and some Levallois point and flake. Site EDAR143 also provided more concentration of Acheulean and Levallois, chopping tools, Handaxes and Levallois core and bifacial points are the common stone tools features.. This paper discuss the sites landscape and stone artifact classification from the systematic survey collections and comparing with EDAR discoveries in the east (Masojć et al 2017) and with other sites discovered in Sudan such as Khor Abu Ang (Arkell 1949), Arkin-8 (Chmielewski 1968) Sai Island (Van Peer et al 2003) and Hayna (Beyin et al 2017) . The sites setting and assemblage characteristics show new region of Early Stone Age archaeology in Sudan similar to the ESA and MSA sites in east Africa, which will shed a light of Out of Africa I debate from the eastern part of Sudan. In the same time the diversities of stone artifact will help in understanding Paleolithic transition and development in Sudan.

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Podium Presentation Session 9, Sa 9:30

A 1.1 million-year palaeoclimate record of Arabia and Human Evolution

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The vast Saharo-Arabian desert belt is a key area for human migration. Successful dispersals out-of-Africa or back into Africa were only possible at times when the desert became a green corridor with abundant freshwater resources. Currently terrestrial records, predominantly derived from lacustrine sequences, from these regions can only provide limited environmental data, and - due to the erosive nature of deserts - are temporally restricted to 500 Ka [1]. Speleothems (e.g. stalagmites and flowstones), however, are protected from erosion and can be dated back with superior precision using the U-Th and U-Pb dating methods. Speleothem calcite $\delta^{18}O$ and $\delta^{13}C$ values provide records of precipitation amount and vegetation above the cave, respectively. In addition, fluid inclusion δD and $\delta^{18}O$ analysis allows to identify moisture source. Here, new speleothem environmental data from the southern Arabian Peninsula is presented, synthesised with existing records, and used to discuss human evolution during the last 1.1 Ma.

The lowest section of stalagmite Y99 (Yemen) was dated to 1.039 ± 0.051 Ma (MIS 29). Thereafter, Y99 grew only during peak interglacials, when much of Arabia received considerably higher rainfall, due an intensification of the summer monsoons. Within peak interglacials, savannah environments flourished in the now arid interior of Arabia. Fluid inclusion water $\delta^{18}O$ and $\delta^{13}C$ values of stalagmites Y99 and H13 (Oman) clearly indicate that moisture was delivered by the African and Indian monsoons. This assumption is supported by high-resolution of annual growth layers, which indicate a seasonal climate dominated by summer rains occurred during peak interglacials.

Here, it is argued that formations of savannah environments during peak interglacials created "windows of opportunity" for Lower-Middle Pleistocene hominin dispersals Out of Africa. The Middle Pleistocene Transition (900-700 Ka) shift from 40 Ka to 100 Ka paced interglacial cycles reduced genetic connections between Eurasian and sub-Saharan populations - leading to development of European and African lineages by 765-550 Ka [2]. Finally, the savannah conditions of the Saharo-Arabian belt facilitated the earliest movements of *H. sapiens*. Out of Africa during Middle Pleistocene peak interglacials.

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Poster Presentation Number 67, Th 18:15-19:00

Analysis of changes in body mass through ontogeny in a captive *Pan troglodytes* sample

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The evolution and ontogeny of body mass dimorphism in hominoid primates is a topic of considerable interest to researchers (e.g. [1,2,3,4]). The addition of more data on the developmental timing of sexual dimorphism in extant hominoids is of great utility, as it can have a bearing on the comparative samples used for estimation of body mass in modern individuals of unknown mass and also fossil remains, for example the juvenile *Australopithecus afarensis* Dik 1/1. This study draws on observations from longitudinal studies of captive chimpanzees (*Pan troglodytes*) recorded at the Arizona Primate foundation between the years 1984-2009. This facility was incorporated in 1970, dedicated mainly to rescuing chimpanzees from previous owners (e.g. circuses, medical facilities and private owners) and improving care of captive chimpanzees. Over time, the foundation also engaged in a breeding program, and 55 individuals in this sample of 79 chimpanzees have known dams, of which, 51 of the individuals have body mass data from their first year of life. The foundation closed in 2012, and surviving individuals were rehomed at the Michale E. Keeling Center for Comparative Medicine and Research of The University of Texas MD Anderson Cancer Center in Bastrop, Texas (CARTA 2018). In all, 4079 datapoints were extracted from a dataset on body mass and blood pressure provided by the Centre for Academic Research and Training in Anthropogeny (CARTA) with many individuals measured at regular intervals from birth. The data is separated into 3 month time periods, and each time slot has an average of 21.9 observations (12.7 female/11.8 male). This dataset therefore is an important contribution to our understanding of expected variation in captive chimpanzee body size and dimorphism, as well as an additional large resource for comparative studies of primate size ontogeny and dimorphism. For each age slice, the median and standard deviations were calculated. All analyses were carried out using R. The early part of ontogeny (that of 0-5 years of age), was also compared with modern human growth standards (WHO 2005). The patterns observed in this dataset are very similar to those found by Pusey in her analysis of the data from Gombe[5] . Key findings are that juvenile female chimpanzees are on average heavier than males until 7 years old, which is later than observed in wild populations (Pusey et al. 2005). There is acceleration in body mass accumulation in males until 12 years. Growth of chimpanzees under the age of 5 is also much more linear than in modern humans. In mature individuals, body mass stays generally stable until their mid-thirties, at which point mas becomes a lot more variable. This is almost certainly related to loss of condition due to senility and/or illness. The implications of this study are that sex pooled body mass datasets are potentially problematic even for very juvenile individuals and where sex of the individual is uncertain, if *Pan* is used as a reference, separate estimates based upon male and female datasets should be undertaken.

I am very grateful to the Centre for Academic Research and Training in Anthropogeny (CARTA) for kindly granting access to the underlying data for this paper.

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Poster Presentation Number 23, Fr 18:15-19:00

A multidisciplinary approach to reconstruct Upper Palaeolithic and Mesolithic dietary habits: human adaptation to Pleistocene-Holocene environmental change in northeastern Italy.

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Key information can be gleaned from the study of human dietary habits, first and foremost the human capacity to develop specific cultural and dietary behaviors in response to environmental changes. To date, the integrated use of different analytical methods have rarely been adopted to understand paleonutrition. As a result, there are aspects and implications of ancient human diets, which still remain poorly known. In this work, we have investigated aspects of cultural and dietary adaptations in three individuals who lived the time range included between the Late Pleistocene and the Early Holocene in North-eastern Italy, at the burial sites of Riparo Tagliente (Verona), Riparo Villabruna (Belluno) and Modeval de Sora (Belluno). In the present work, we combined three different sources of evidence emerging from to the bio-archaeological study of human teeth: dental calculus, macrowear pattern and stable isotopes. The consumption of different plant foods is suggested as different types of starches in archaeological dental calculus, which have been attributed to the Poaceae grass family. The presence of non-dietary micro-residues (e.g. plant fibres, wood particles, fragments of feathers, etc.) in the dental calculus of the analyzed individuals also implies the use of mouth and teeth in extra-masticatory activities. Dental wear patterns of mandibular M2s were analyzed and compared with a reference dataset including Neanderthal, Early *H. sapiens*, Natufians as well as Inuit. The three archaeological individuals are characterized by high values of lingual Phase I, which, according to Fiorenza et al. [1], would suggest increased transverse mandibular movements produced by the reliance on hard, abrasive foodstuffs including roots, seeds and other plant materials. Isotopic signatures characterizing individuals from Riparo Villabruna [2], Riparo Tagliente and Mondeval de Sora are consistent with a subsistence based on the high intake of animal proteins with a very marginal role played by plant foods. However, the high δ15N values recorded for Riparo Tagliente [3] and Mondeva de Sora individuals, which are well above a trophic step shift to local fauna (herbivores and omnivores), suggest that high trophic level animals (e.g. foxes) and/or aquatic resources might also have had an important role in their diet. Overall, our results indicate that animal proteins and freshwater resources were consumed by Upper Palaeolithic and Mesolithic individuals of North-Eastern Italy together with a variety of plant foods. Such evidence conveys an alternative view of Late Pleistocene and Early Holocene dietary habits while contributing to the reconstruction of non-dietary related cultural practices which involved the use of the mouth in para-masticatory activities. In conclusion, we highlight the importance of using different analytical methods to better characterize the complexity of dietary and non-dietary related habits in human fossils.

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Poster Presentation Number 29, Th 18:15-19:00

Those that were missing. A Neandertal foot phalanx from Galería de las Estatuas (Sierra de Atapuerca, Spain)

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Recently, Galería de las Estatuas site (GE), a new Mousterian site inside the karstic system of Cueva Mayor-Cueva del Silo in the archaeopalentological complex of sierra de Atapuerca (Burgos, Spain) has been presented [1]. In this site, two test pits (GE-I and GE-II) have revealed a Late Pleistocene detrital sequence with at least five lithostratigraphic units, interpreted as a human occupation site with sporadic carnivore activity. A stalagmitic crust, sealing the detrital sequence, was dated in 13.7 ka cal BP by the U/Th isotopic method [2].All the five lithostratigraphic units have yielded lithic tools of clear Middle Paleolithic (Mousterian) affinity and an ungulate and carnivore faunal assemblage dominated by equids and cervids [1]. Several 14C radiocarbon dates provide minimum ages older than 45 ka cal BP for the Mousterian layers [1]. More recently, the Mousterian levels of this sequence have provided older datings (80-112 ka BP) by single-grain optically stimulated luminescence (OSL), which locates the sequence at the end of the MIS 5 and beginning of MIS 4 [3]. Here, we present a metric and morphological study of a human foot phalanx (GE-1573) recovered during the 2017 field season in the interface between the lithostratigraphic units 3 and 4 in the GE-I test pit. It corresponds to a distal foot phalanx, probably from the fifth toe, and from the right side due to the lateral deviation of the distal trochlea or tuberosity. It is complete and belonged to an adult individual. The foot of Neandertals is similar to that of recent humans in overall size and proportions, and comparable in the implied locomotor capabilities [4]. However, Neandertals display foot phalanges broader and more robust than those of recent humans [4,5]. This robustness in Neandertals traditionally has been associated with a high degree of biomechanical stress and with greater general robustness of the postcranial skeleton [4]. The phalanx GE-1573 is broad, long and robust relative to recent modern humans and Upper Paleolithic humans when compared to the scarcity of well-identified comparative samples for this element in the *Homo* fossil record. These traits align the foot phalanx GE-1573 with the Neandertal morphology, are consistent with the stratigraphic context and it probably corresponds to one of the oldest Neandertals inland of Iberian Peninsula. Additionally, it provides the first evidence of a Neandertal remain in stratigraphic context in the Sierra de Atapuerca, being the fifth site in this archaeopaleontological complex to provide Pleistocene human remains.

We are deeply grateful to the Atapuerca research and excavation team, especially those people involved in the Galería de las Estatuas site excavation. Without their work, help, effort and advice studies like this would not be possible. The availability of the huge comparative collection, both modern and fossil, would have not be possible without the help and collaboration of multiple institutions and people that allowed access to important collections under their care and kindly provided assistance. Fieldwork at Atapuerca was funded by the Junta de Castilla y León and Fundación Atapuerca. This research was supported by the Spanish MINECO/FEDER project CGL2015-65387-C3-2-P. We would like to thank also the BBP/R3 and "Grupo de Bioacústica Evolutiva y Paleoantropología (BEP)" research groups.

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Podium Presentation Session 9, Sa 10:10

The effects of season and habitat on the nutritional properties of potential hominin plant foods in an eastern and southern African savanna

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Our understanding of early hominin diets has been challenged in a number of ways over the past decade. For instance, the dental microwear exhibited by *Paranthropus boisei* presents no evidence of hard-object consumption despite the species' initial portrayal as "Nutcracker Man." Also, stable carbon isotope analysis suggests that C4 plants and/or fauna eating C4 plants became increasingly import hominin dietary resources beginning more than 3 Ma. The notion that early hominins were potentially consuming significant quantities of C4 grasses and/or sedges was particularly unexpected because these plants are generally regarded as being nutritionally unsuitable for primate consumers. Given this, there is renewed interest in understanding the nutritional properties of potential hominin plant foods (C4 or otherwise) and how these properties are affected by their spatiotemporal distribution across African savanna landscapes. Here, we present nutritional data (crude protein, acid detergent fiber) from plant samples collected over four field seasons in the Cradle of Humankind, South Africa, and Amboseli National Park, Kenya. In each field site, transects were established in varying types of wetland, woodland, and grassland habitats, as these environments have been associated with early hominins. Within each transect the dominant grass, sedge, tree, and forb species were collected, and their relevant parts (e.g., fruits, seeds, leaves, stems, underground storage organs) were isolated for analyses. We find that there are strong differences between various plants and plant parts and that habitat and seasonal effects likely influence their potential consumption by hominins, though not in a uniform manner and, at times, in unexpected ways. Also, there are clear differences between the nutritional properties of plants growing in our southern and eastern African field sites, particularly among C4 species, which may have implications for the apparently contrasting dietary behavior of southern and eastern African *Paranthropus*. These data are a first step towards enriching our understanding of early hominin diet and habitat use as means to begin constructing new hypotheses about early hominin dietary ecology.

Poster Presentation Number 13, Th 18:15-19:00

Ground breaking technologies in the Middle Paleolithic of the Levant: High resolution functional analyses of Ground Stones Tools

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The topic of Ground Stone Tools (GST) is of great interest to understand the evolution of human behavior throughout time and space. These artifacts are a testimony of the most persistent and durable technological adaptation in human evolution, their appearance stretches from the earliest evidence of human activity to the present day across wide geographic distribution. By definition, this group includes any stone item that is primarily manufactured through mechanisms of abrasion, polish, or impaction, or itself used to abrade, polish or impact [1]. The GST diachronic and spatial distributions during the Middle Paleolithic of the Levant (ca. 250- 47 Ka) are limited to mainly open air sites while in caves and rock-shelters they are very rare. The reasons for these distribution patterns are unknown. It can either be due to a research bias related to the difficulties in the identification of these artifacts, or can be related to the specific function of this material. In order to contribute to this discourse, two main problems need to be resolved: a) develop analytical units via experiment-based actualistic studies to improve the identification of these materials, and b) understand the specific function/s of these materials. In the literature a wide range of possible uses has been suggested for GST, including the processing of organic materials (e.g. plants; faunal) and also mineral products (e.g. ochres and bipolar lithic production). The project will test these possibilities on the MP of the Levant, analyzing Ground Stones from different sites (caves and open air sites). In order to address these questions, this project follows a dedicated workflow characterized by 3 main topics: 1) lithic raw material characterization, 2) controlled experiments, and 3) use-wear analysis. The experimental program will include different types of GST activities using various raw materials in a *controlled* way. With the help of robotics, as many variables as possible will be controlled, resulting in numerical data to facilitate both, the comparison of results and the replicability of the experiments. Functional analysis of the use-wear will combine; low and high magnification analysis, generating 3D data in order to qualitatively assess and quantify different types of use-wear traces. In sum, the goal of this project is to bring ground breaking research, contributing to the knowledge about the behaviors of Middle Paleolithic populations, addressing questions related to subsistence (e.g. food processing), technology and, possibly, symbolic behavior. The project also aims to contribute to the methodological improvement of experimental and functional studies, creating a unifying methodology that would enable a comparison of GST across time and space. The goal of this poster is to present the general research direction of this project (all comments are very welcome!)

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Poster Presentation Number 27, Th 18:15-19:00

Reconstruction of the atlas (C1) of the La Chapelle-aux-Saints Neanderthal through geometric morphometric techniques.

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The almost complete Neanderthal skeleton of La Chapelle-aux-Saints (LC) was discovered in 1908 by Amédée and Jean Bouyssonie and Louis Bardon in the homonymous French town [1]. Marcellin Boule provided the first anatomical description of the fossil, where he considered that LC had a less curved cervical spine than the modern human, based on the orientation of the articular facets and the spinous processes [2]. The atlas of LC was recovered in four fragments: right and left lateral masses, right transverse process, and a fragment of the anterior tubercle [3]. The aim of the present project is to reconstruct the atlas of LC using virtual morphological and geometric morphometric (GM) techniques to include this fossil in the study of the comparative anatomy of the cervical spine and head posture of Neanderthals. The comparative sample consists of 27 3D atlas models of different individuals of the genus *Homo*; (*H. neanderthalensis* N=5, *H. antecessor* N=1, and *H. sapiens* N=21). Atlas shape is quantified through 119 3D (semi)landmarks [4,5]. Previous analyses [4] showed that a Form Space PCA ordered atlas variation along an allometric component, which was common to both Neanderthals and modern humans (PC1), and an interspecific component, which separated modern humans and Neanderthals (PC2). This study is based on these variables to provide a quantitative reconstruction of the LC atlas. Thus, the GM reconstruction of LC is carried out following a sequence of different steps. First, the target shape coordinates are calculated. Procrustes form space PCA is used to identify shape variables associated with size (allometry) and with inter-specific differences. In parallel, two linear regression models are applied: Regression 1 for predicting the size (centroid size, CS) of the complete vertebra of LC based on the CS of its preserved left lateral mass, and Regression 2 for predicting the allometric form (*target PC1 score*) that corresponds to a generalized atlas morphology with the given size of LC as obtained by regression 1. Using an interspecific deformation vector (*target PC2 score*, Neanderthal mean), the generalized allometric form is transformed into a mean Neanderthal allometric form (an allometric form with characteristics of a mean Neanderthal atlas). This target configuration is warped by Procrustes-registrated and TPS-estimated missing semilandmarks towards a new shape that contains the geometry of the original LC lateral masses. Finally, the original lateral masses are virtually registered at their corresponding positions defined by the homologous landmarks of the reconstructed vertebra. PC1 (47.4% of total variance) ordered the sample along a common allometric gradient and PC2 (11.4% of total variance) separated Neanderthals and *H. sapiens*. Regression 1 (r2=0,73; p= 0.001) yielded a total CS of 234.92 that corresponds to the CS of the lateral mass of LC (56.37). Regression 2 (r2=0,98; p=0.001) predicted a target PC1 score of 0.026. The Neanderthal mean PC2 score was 0.724, leading thus to the target coordinates of PC1 and PC2. Next, this allometric and Neanderthal-like 3D model, is warped into the configuration of the original lateral masses, and the original fragments are added by Procrustes registration. This reconstruction of the atlas of La Chapelle-aux-Saints shows the potential of the virtual morphology combined with 3D-GM technics and represents a hybrid between statistical methods and geometric morphometric techniques. This atlas model has Neanderthal features in anterior and posterior arch and the specific morphology of LC in lateral masses. It shows the characteristic dorsoventrally elongated neural canal of Neanderthals, although the validity of this method should be tested by checking its anatomical relationship with other fossils recovered from La Chapelle-aux-Saints considering also possible differences in orientation of the articular facets [2].

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Poster Presentation Number 48, Fr 19:00-19:45

Renewed paleoanthropological investigations in the Albertine Rift, western Uganda

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We report on renewed paleoanthropological investigations in the Albertine Rift, western Uganda. Sedimentary successions in eastern Africa provide key evidence of early human evolution, with the East African Rift preserving and exposing abundant fossil and archaeological occurrences. The eastern branch of the Rift is particularly well-known for its exceptional and well-dated records of hominin behaviour, anatomy, and environments. The western branch (Albertine Rift) of the Rift, extending south from Lake Albert in western Uganda and eastern Democratic Republic of Congo, has contributed comparatively little to human evolutionary debates. The Albertine Rift Paleoanthropology Project, which we introduce here, seeks to integrate archaeology, paleontology, paleoecology, geochronology, ecology and taphonomy in western Uganda. First, we synthesize existing chronostratigraphic information on these sequences, which have previously been divided into formations and members using lithology as well as mollusc and mammal biostratigraphy. Next, we report on results from initial field surveys, and summarize ongoing modern comparative work on fauna in the Albertine Rift, including neotaphonomy and the isotope ecology of large mammals.

Previous work in the region demonstrated that sedimentary sequences on both sides of the rift were found to preserve fossil mammals, and a small number of hominin fossils, including an isolated upper molar (australopith or early *Homo*) from sediments west of Lake Albert as well as cranial fragments and an upper molar (*Homo* cf. *erectus*) from sediments south of the lake. Abundant Oldowan stone tools confirm that hominins inhabited this region. However, questions remain regarding the age and context of these collections. There are currently only three numerical dates for strata in the Albertine Basin, including only one date from the Pleistocene, derived from proposed geochemical correlations of volcanic tuffs with deposits in the eastern Rift.

In 2016 and 2017, we conducted field surveys to locate archaeological and fossil sites situated in the Albert basin, aimed at identifying targets for renewed geological, archaeological, and paleoecological research. Potential outcrops were identified using maps generated by the Uganda Palaeontology Expedition (1985-1993) as well as satellite images. Although soil and vegetation cover much of the landscape, ground surveys documented exposed continental sediments. In the Nyabusosi area, south of Lake Albert, we located multiple surface concentrations of Oldowan artifacts, including abundant quartz and quartzite flaked pieces. Fossils were more abundant in the Kaiso-Nkondo area, east of the lake, including mammal teeth. Vertebrate fossils included bovids, equids, hippopotamids, crocodiles, and fish. Stone tools included Oldowan flakes and cores as well as possible Middle Stone Age artifacts in overlying beds.

Our project is also investigating the modern ecology of the Albertine Rift, a global biodiversity hotspot. Ongoing neotaphonomy research in Queen Elizabeth National Park provides a key for interpreting carnivore access to prey in the fossil record, critical for understanding hominin-carnivore interactions. The Albertine Rift today includes savanna- and forest-dwelling chimpanzees and baboons, providing a useful study system for developing models of early hominin environments, particularly using stable isotopes. These data will provide important context for interpreting evidence for hominin behavior and ecology in an important but poorly understood region in eastern Africa.

This research is being carried out with the permission of the Uganda National Council for Science and Technology and the Uganda Wildlife Authority. We thank Amon Mugume of the Uganda Museum, and volunteers George Timothy Gross and James Cheney for their assistance.

Poster Presentation Number 25, Th 18:15-19:00

Micromorphological Analysis of the Deposits at the Early Pottery Xianrendong Cave Site, China.

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We present here the results of analyses of the geoarchaeological components of the cave site of Xianrendong in Jiangxi province, South China. This and other caves in South China, such as Yuchanyan in Hunan, show hunter-gatherers producing pottery from 20,000 cal BP onward, some 10,000 years before the first sedentary settlements of agriculturalists, making this the earliest known appearance of pottery in the world. The discovery of such early pottery in a hunter-gatherer context from the Late Palaeolithic confirms that in Eastern Asia, pottery production started before and independently of plant cultivation. At Xianrendong, along with the pottery, archaeologists recovered a typical South China Upper Paleolithic chopper-chopping tool assemblage, bone, antler, and shell tools. This study reconstructs site formation processes and infers human activities at the site. The deposits from two previously exposed profiles, a western and an eastern one, were studied using archaeological soil micromorphology. The analysis shows sediments to consist of sand, mica, and clay with anthropogenic input of bone, charcoal, and ash. Components are generally uniform within each individual profile, although their microstructure, organization, and percentage vary both along the profiles and across the cave. The micromorphological analysis of the samples from the East and West profiles demonstrates that the West is composed of sandy clay sediments with mica, schist, and very few fragments of bone. Instead in the Eastern profile the sandy clay sediments contain abundant inclusions of clay aggregates burned bone, ash, and charcoal. The sediments in the Western Profile are massive with overall low porosity. The Eastern Profile has a more complex microstructure from massive and compact to crumbly. Bioturbation was minimal in both profiles with insect passages never exceeding 9 mm in diameter. These differences in both profiles reflect differences in sources and agents of deposition. It is clear from the components and their arrangement that the deposits in the Western part of the cave are of alluvial origin, while those of the Eastern Profile contain alluvial sediments in the lower portion of the sequence and anthropogenic deposits in the mid and upper parts of the section. In the Western Profile, repeated low-energy flooding episodes were associated with a watercourse that we hypothesize flowed in front of the cave in ancient times, and at some point invaded the cave, resulting in slackwater deposits rich in micaceous clay. In the Eastern Profile the same alluvial processes deposited the lower layers, while the mid and upper layers were deposited by humans. The burned components suggest that most anthropogenic sediments were related to fire episodes; however, their arrangement suggests that the sediments are accumulated refuse composed of cleaned hearth features and other archaeological material. The dumped nature of the sediment and absence of in situ fire features suggests that the cave was not used as a living space and that living spaces were elsewhere. This study lends further support to the security of the dating of Xianrendong early pottery at 20.000 cal BP because bioturbation at any given time at Xianrendong is very low. Our results produce a high-resolution context for the material culture recovered at the site, inferring human activities and behavior of Upper Palaeolithic of pottery making hunter gatherers. Further analyses of the site in new test trenches are needed to locate the living quarters, and FTIR analysis as well as residue analysis of the pottery to determine if it was fired and how it was used.

Funding for this project was provided through grants from the National Science Foundation (USA) (#0917739 and #0551927) and the American School for Prehistoric Research (Peabody Museum, Harvard University). Logistical support was provided by the Jiangxi Provincial Government, Wannian County Government, and Jiangxi Provincial Museum, and we extend our gratitude for their gracious and enthusiastic help.

Poster Presentation Number 5, Th 18:15-19:00

The earlier Mousterian in westernmost Iberia: geoarchaeology of the Cobrinhos site, in the Tejo River terrace staircase of Vila Velha de Ródão (Portugal)

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Cobrinhos is a Middle Paleolithic site found during the construction of a paper factory, in the winter of 2014, in Vila Velha do Ródão, central inland Portugal. In this region, a staircase of six terraces was identified (T1 to T6), but Paleolithic is only found in the T4, T5 and T6. The T4 was dated of ca. 340 ka to 155 ka, with Acheulean at the basal and middle levels and early Mousterian at the upper levels.

Cobrinhos is in a colluvium that, by geomorphological correlation, links to the top of the T4 terrace, has a paleowethering with the same geochemical characteristics (reddish clay-sand sediments) that characterizes the T1 to T4 terraces, which is considerably different from that of the T5 and T6. Despite disturbed by recent plowing, the site shows an evenly distribution of sizes and shapes of the lithic assemblage, thousands of implements <30 mm, a coherence the Mousterian assemblage and absence of Acheulean or Upper Paleolithic-on tools.

The lithic assemblage comprises extensive, intensive and pre-determinate reductions. Extensive reduction was opportunistic and aimed the production of large flakes that were used as without retouch and as cores. Intensive reduction was mostly centripetal and unipoloar unidireccional for the production of medium and small flakes. Pre-determinate reduction includes Levallois preferential, Levallois recurrent and Discoidal for the production of medium and small Levallois flakes and points, Pseudo-levalois points and blades.

The combination of data suggests that the colluvium unit is coeval of the deposition of the T4 topmost deposits and that Cobrinhos is in its original geomorphological context. Based on these, we believe to be possible to establish a probable age of ca. 165 to 155 ka for the site, but, this age needs to be supported by more finite absolute ages to be gathered in the near future. These results are of relevance in the scope of the investigation about the demise of archaic Pleistocene human populations and the proliferation of Neanderthal groups.

Poster Presentation Number 35, Th 18:15-19:00

Comparison of parietal lobe morphology in modern humans and Neandertals

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Neandertals and modern humans have similar cranial capacities, but different endocranial shape [1]. When compared to their less encephalized common ancestor *Homo erectus*, Neandertals have wider parietal lobes, whereas modern humans have more bulging parietals and an overall endocranial shape that is more globular [1, 2, 3]. These endocranial studies rely on geometric morphometric analyses of two different kinds of metric data: first, endocranial landmarks defined on impressions of brain convolutions and the main dimensions of endocasts, and second, endocranial bony landmarks and semilandmarks on curves and surfaces. Both approaches have their advantages and limitations: anatomical landmarks on endocasts provide direct information about changes of brain organization but cannot capture the overall endocranial shape as well as a dense mesh of semilandmarks on the endocranial surface. In this study, we combined both landmark sets to further investigate the known differences in the parietal areas of modern humans and Neandertals. To this end, we generated digital endocast based on CT scans, including 52 modern *Homo sapiens* and 6 Neandertals. We measured landmarks and hundreds of sliding semilandmarks on endocranial bony features as well as landmarks defined by brain features including the points where the central sulcus and the parieto-occipital fissure, respectively, meet the midplane, the center of the supramarginal boss, the center of the angular boss, and the posterior end of the lateral sulcus. Visualization of group mean differences reveals that the typical globularity of modern human brains is associated with a different organization of parietal brain morphology that leads to parietal bulging. Lateral parietal regions, especially between the two inferior parietal gyri and the intraparietal sulcus, are rotated backwards and bulge more in modern humans as compared to Neandertals. Additionally, this region has a larger surface area in the former than the latter group, while the parietal as a whole has not. In the midsagittal plane, the variation of parietal arc and chord lengths (in absolute and relative terms) between the central sulcus and the parieto-occipital boundary overlaps between modern humans and Neandertals, but Neandertals cluster on the lower half of the modern human range of variation. We demonstrate that combining a dense surface semilandmark set and a set of anatomical brain landmarks provides new insights into the differences between brain anatomy in modern humans and Neandertals. It remains to be investigated how subcortical structures (like, e.g., the precuneus [4]) and areas on the brain surface (like the angular and supramarginal gyri) together contribute to these morphological differences.

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Poster Presentation Number 41, Th 18:15-19:00

Paranasal sinuses still have much to say: introducing the surface-volume index of frontal sinuses.

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Paranasal sinuses are epithelium-lined cavities found surrounding the upper airways. In humans there are four types described: frontal, maxilar, ethmoidal and sphenoidal sinuses. From these, the first two are the ones that have produced more literature, however, their function, if there is any, and their role in craniofacial evolution are still up for debate, as contradictory interpretations of results keep appearing. These cavities have been studied mostly from the perspective of their volume and shape because they vary widely across human populations, but its research has got stuck using the same variables to compare populations and individuals. This situation has motivated our search for a different light under which these cavities could be studied, taking the frontal sinuses as our pilot. To achieve this, 3D imaging techniques have been used. First of all, the frontal sinuses of a sample of modern *Homo sapiens* were segmented using medical image processing software to create a 3D object from which measures of both surface and volume were taken. Then, both magnitudes were combined to get the surface-volume index, which indicates the relation between the surface and the volume of each sinus, and is a really interesting concept in physiological terms, because under certain circumstances, organisms tend to relatively increase the surface of organs in relation to their volume, so they can maximise their functionality. We also segmented the frontal sinuses of four Upper and Middle Pleistocene individuals (Broken Hill 1, Petralona 1, Forbes' Quarry 1 and Spy 1) to get the same three variables and compare their surface-volume index with the previous sample. The comparison has shown that the range of values of the surface-volume index found among *Homo sapiens* is wider than those of the Pleistocene individuals. *Homo sapiens*' frontal sinuses also show higher values of the index, with a very narrow overlap with the other sample, which means that these structures have experienced a greater decrease of their volume in favour of their surface in modern humans in comparison with those of the Pleistocene fossils. Knowing that the paranasal sinuses have been marked as places of nitric oxide production, and the physiological implications that this could have on blood vessel dilatation [1, 2], the introduction of the surface-volume index in the study of paranasal sinuses could lead to new results and insight into their possible role in craniofacial evolution.

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Poster Presentation Number 48, Th 19:00-19:45

Adaptations for bipedalism in human vertebrae: A 3D geometric morphometric analysis

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Identifying skeletal features associated with bipedalism in the fossil record is crucial to furthering our understanding of the evolution of bipedalism. However, there remains some uncertainty about which specific traits are associated with bipedalism in the fossil record. Comparative analyses of human and extant nonhuman primate anatomy can help address this issue by identifying features unique to humans that may be functionally related to bipedalism. With this in mind, we performed a study comparing the 3D shape of four thoracic vertebrae (i.e. first, second, penultimate, and final) and two lumbar vertebrae (i.e. first and second) of *Homo sapiens*, *Pan troglodytes*, *Gorilla gorilla*, and *Pongo pygmaeus* to identify distinctive features of *H. sapiens* vertebrae that may be functionally related to bipedalism. Across all vertebrae analysed, *H. sapiens* have shorter and more pinched spinous processes, longer laminae, more cranially projecting transverse processes, neural foramina that are wider in the coronal plane, and vertebral bodies that are taller in the craniocaudal direction. We also found that the specific traits of *H. sapiens* were not consistent across all vertebrae. Rather, the vertebrae could be divided into three groups according to the way in which the shape of the *H. sapiens* vertebral elements differed from those of the great apes—the two upper thoracic vertebrae, the two lower thoracic vertebrae, and the two upper lumbar vertebrae. We discuss our findings in light of previous studies that have identified several vertebral traits unique to *H. sapiens* and provided compelling arguments for how they relate to bipedalism based on a review of the biomechanical and clinical literature dealing with the spine and back muscles. Specifically, we identified traits of the spinous processes, transverse processes, and apophyseal facets of *H. sapiens* vertebrae that can be argued to restrict posterior extension while allowing for some ability for anterior and lateral flexion, as well as allow or restrict rotation. Furthermore, the shape of the neural foramina, vertebral bodies, and neural arches of *H. sapiens* can be argued to hold the spinal nerves needed for lower limb motor control and withstand the large amount of loading placed on the spine during bipedalism. Thus, our findings provide new insight into the functional anatomy of *H. sapiens* vertebrae, as well as add to the accumulating knowledge of how the adaptation of bipedalism influenced the *H. sapiens* spine.

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Podium Presentation Session 12, Sa 16:50

A New Interpretation of Short Term Group Behaviour at the GTP17 Horse Butchery Site, Boxgrove.

Matt Pope[1], Silvia Bello[2], Rob Davis[3], Adrian Evans[4], Annemieke Milks[1], Simon Parfitt[1], Mark Roberts[1]

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The Horse Butchery Site from Boxgrove, in southern England, was excavated some 30 years ago and has yet to be fully published [1]. Despite this the locale is often referred to as an example of short-term butchery activity by hominins and as an example of an 'in-situ' signature of Lower Palaeolithic tool production [2][3]. This paper presents a revaluation of the site based on new analysis undertaken by the UCL team in combination with further detailed refitting work directed by the Bradford and British Museum-led Fragmented Heritage Project, funded by the AHRC [4]. The study is framed by a multi-proxy assessment of site formation processes aimed at establishing the integrity and temporal resolution of the stone artefact assemblages. A combination of assemblage composition studies, consideration of both artefact and refit orientation as well as soil micromorphology of the artefact-bearing horizon, have established the high likelihood that the assemblage relates to a very short-term episode of hominin activity associated with the butchery of a single horse carcass over a few hours. A combined programme of technological analysis of the stone artefact assemblage, extensive refitting of debitage and microscopic use wear-analysis were used bring the hominin behavioural repertoire into sharp focus over short, minute by minute time-scales. The results indicate the manufacture or reduction of at least nine handaxes at the site, each constrained within a discreet knapping cluster and all nine tools were removed from the excavation area by the hominins after the butchery event. But exhaustive refitting has been able to track the removal of flakes from these knapping scatters and their movement to the centre of the site, which we interpret as hitherto unseen individuals using the knapping scatters as a source of material to participate in the butchery process. Tracking these previously unseen behaviours creates scope for the presence of more hominin agents and has transformed our understanding of the site and of its significance, revealing complexity in the ecological and social role of butchery sites in the Middle Pleistocene. Rather than the site referring to the activity of nine or ten, handaxe-using hunter/butchers, there is now scope to model the involvement of a much wider and more complete hominin population in the butchery event, and allows for consumption as well as processing to have been the focus of activity at the site. The analysis has brought into focus previously invisible group dynamics which suggest greater social complexity at the site, indicating how we might begin to look at such locales in terms of the emergence of subsistence strategies based on group predation and niche construction.

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Poster Presentation Number 14, Fr 19:00-19:45

Evaluating the load-carriage economy in males and females. Insights into the foraging strategies of palaeolithic hunter-gatherers.

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Load transport activities are of vital importance for daily subsistence tasks among current hunter-gatherers and agriculturalist populations [1]. Thus, it has been proposed that burdened locomotion has helped to form our physical and behavioral characteristics through human evolution [2]. Together with the targets and strategies of procurement, the transportation of resources acquired while foraging may be strongly influenced by the gender of the foragers [3]. As a result, women despite their smaller body size, usually carry heavier burdens than males [4]. This fact has been attributed to an improved load transport capacity in females due to body composition parameters, biomechanical changes or training capabilities [5]. Nonetheless, the results of previous studies on this topic are contradictory.

Consequently, this work focuses on the load carrying activity from an energetic point of view. We will test whether males and females differ in the economy of load-carriage in terms of their energy expenditure. To reach this purpose, a sample of 48 volunteers (21 females, 27 males) performed locomotion and burden transport trials while Energy Expenditure was monitored with the Indirect Calorimetry technique. All trials were carried out on a level treadmill at 4km/h, during 10 minutes each one and resting 5 minutes between them to avoid accumulated fatigue. First, an unloaded locomotion trial was performed, and then all the subjects walked carrying 5, 10 and 15 kg backpacks. These experimental tests were carried out at the Bioenergy Laboratory of the National Research Center on Human Evolution (CENIEH, Burgos, Spain) with the approval of the Hospital Universitario de Burgos Ethical Committee (Ref. CEIC 1480).

The Carrying Cost Index (CCI), based on the gross energetic cost, was used to evaluate the cost of burden trials relative to unloaded walking test. In addition, the absolute burdens transported were transformed to Relative Carried Loads (RCL), by expressing the weight of the load as a percentage of the subject body mass. This procedure allows us to compare the energetic expenditure of individuals differing in body size but transporting similar loads with respect to their body masses. Afterwards, simple linear Reduced Major Axis regressions of CCI on RCL were computed for each sex, and the regression lines were compared. All the statistic analyses were performed with the PAST3® software.

Our results prove that males and females carrying the same relative loads, experience the same increment over their cost of unloaded locomotion. So, apart from obvious differences in body mass, there is no evidence of a dissimilar economy favoring one gender over the other that would explain the differences in load-carriage activities observed among current foraging populations. These outcomes provide new conclusions about the constraints of the behavioral ecology of burden transport activities, as well as the necessity to re-evaluate, in an evolutionary perspective, the statements proposed about the sexual division of different subsistence labors of hunter-gatherers and agriculturalist populations.

We are sincerely grateful to all the volunteers who participated in this experimental study. Our research was performed at the CENIEH facility Bioenergy Laboratory. Data were obtained from the EVOBREATHDataBase, managed by A. Mateos and J. Rodríguez. The work of the CENIEH Palaeophysiology and Human Ecology Group and Mammalian Paleoecology Group is gratefully acknowledged. This study was funded by National Research Center on Human Evolution (CENIEH) and supported by the Spanish Ministry of Economy and Competitiveness (MINECO) projects CGL2012-38434-C03-02 and CGL2015-65387-C3-3-P. Prado-Nóvoa, Vidal-Cordasco and Zorrilla-Revilla benefited from a predoctoral research grant from Junta de Castilla y León funded with the Social European Fund, Operative Program of Junta de Castilla y León, through the Consejería de Educación.

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Pecha Kucha Presentation Session 2, Th 12:20-12:45

Incised aurochs bone shaft dated to 130 kys at the Middle Paleolithic open-air site of Nesher Ramla (Unit III), Israel

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We present a new example of bone engraving dated to ca 130 kys ago. It was retrieved from the Unit III at the Middle Paleolithic open-air site of Nesher Ramla (Israel). The incised bone was found within a small round feature (around 50 cm in diameter) composed of few flint artifacts, stones (manuports) and dense in faunal remains. The zooarchaeological analysis shows that this feature is mostly composed of large ungulates, some medium sized ungulate and testudines specimens. Several remains show evidence of butchering activities and human consumption. The bone is a mid-shaft fragment of radius that probably belonged to an aurochs (*Bos primigenius*), the most abundant ungulate species at the site. It measures 8.1 cm x 5.3 cm and has less than 50% of its remaining circumference. The surface exhibits 6 parallel incisions oriented perpendicularly to the bone axis. The incisions covered the surface almost completely and follow the convexity of the bone. The general aspects of the incisions; dimensions, orientation, organization and localization exclude them from being butchering/cutting marks, carnivore tooth scores or trampling/biochemical etching. The parallelity and the similar shape and size of the incisions indicate a deliberate and intentional production.

The analysis included macroscopic and microscopic observations, SEM scanning, experimentations and 3D imaging in an attempt to understand the method used to create the incisions. The incisions are U-shaped in section and are wide and shallow rather than V-shaped, probably due to the use of a stone artifact with a thick edge. All the incisions are deeper at one extremity suggesting the starting point of the cutting motion. The six incisions appear to start from the same side of the bone. Two of them exhibit a pattern of converging grooves at the starting of the incisions indicating that they were produced by a succession of unidirectional cutting motions. Furthermore, longitudinal striations at the bottom of two incisions were observed, indicating a repeated motion.

We cannot link the incised bone to any technical function, and therefore we interpret it as a non-utilitarian object related to an early graphic expression. Such graphic behavior was already described in a few Middle Paleolithic and MSA sites. The other examples of non-utilitarian incisions have been observed on stones (sometimes on the cortical part), on ochre, on shell (and eggshell) and on bones, exhibiting different types of graphic patterns; zigzag lines, parallel/fan shape lines and crossed pattern. The Nesher Ramla incised bone shaft exhibits a geometric pattern similar to other younger non-utilitarian items, but it emerges to be the oldest example thus far within the Levantine Middle Paleolithic and African Middle Stone Age.

Poster Presentation Number 66, Th 19:00-19:45

Primate evolution by random genetic drift: Comparing linear and geometric morphometrics of the cranium in testing cercopithecine divergence

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Linear measurements and landmark-based geometric morphometrics are both widely used to quantitatively describe primate cranial form and its variation. Each type of data is often subsequently used to study evolutionary aspects of primate cranial form, including the action of microevolutionary processes, such as random genetic drift and natural selection. Previously [1,2], we have applied "Cheverud's conjecture" to a sample of cranial linear measurements to test what the relative contribution of genetic drift is that have acted on the anthropoid cranium to produce its current diversity of forms. Results had shown that the null hypothesis of diversification by random genetic drift alone is rejected in many (but by no means all) phylogenetic branches; a large contribution of non-random processes like natural selection seems to have occurred particularly in the Papionini branch. Now we apply the same protocol to landmark-based geometric morphometric data, and compare them to linear measurements taken on the same sample of cercopithecine crania, to assess whether results are concurrent between the two types of data. The within- (**W**) and among-group (**B**) variance-covariance matrices were compared, substituting the genetic (**G**) variance-covariance matrix by the **W** matrix, following the claim [3] that, in contemporary populations, the **W** matrix is often proportional the **G** matrix. Comparing **B** and **W** (as a surrogate of the average **G**) was accomplished by using the method of Ackermann and Cheverud [4]. The null hypothesis of random genetic drift is rejected if the slope of the regression (β) deviates significantly from 1. When using a significance level of α = 0.05, it is expected that a true null hypothesis has a 5% chance of being rejected (a type I error). This test was proved to be robust in falsifying the underlying assumptions [5]. A phylogenetic tree is used here as a basis for the analyses and for the interpretation of results. All the analyses were run in the R environment. Preliminary results indicate differences can be substantial when using one type of data or the other, but not in every cercopithecine group: in the Papionini, divergence by random genetic drift alone was rejected when either type of data was used. The outcome of these comparative analyses should help clarify the interpretation of this protocol when applied to different data types in studies of primate cranial form evolution, especially if and when fossils are to be included in the study.

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Podium Presentation Session 1, 10:50

Revisiting Panda 100: Reanalysis of the first archaeological chimpanzee nut cracking lithic assemblage and its relevance to understanding the emergence of hominin technology

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The recent discoveries of the earliest intentionally produced stone tools at the Lomekwi 3 site in Kenya have shown that the first lithic technology was not as advanced as the earliest Oldowan. This technology was employed, however, with an understanding of conchoidal fracture mechanics, to detach superimposed flakes form a core [1]. This discovery has re-focused attention on the stone tool using behaviours of non-human primates, and their applicability to understanding the emergence of hominin lithic technology.

Primate archaeology applies modern archaeological techniques to the study of primate stone tools, allowing insights into primate tool use as well as potentially informing our discussions of early hominin technological development and behaviour [2].

Archaeological recovery of chimpanzee *Panda oleosa* nut cracking tools at the Panda 100 (P100) and Noulo sites in the Taï Forest, Côte d'Ivoire, showed that this behaviour leaves an identifiable archaeological footprint [3, 4]. Chimpanzee Panda pounding in the Taï Forest has been traced back over 4,000 years, making it the oldest known evidence of non-human tool use. In 2002, the first report on the lithic material from P100 directly compared it to early hominin stone tools, highlighting their similarities and proposing the name 'Pandan' for the chimpanzee material. The P100 assemblage was initially compared to early Oldowan assemblages, including Omo. However, re-analysis of the Omo tools has highlighted their technical complexity, casting doubt on the comparability of chimpanzee and early hominin lithic material [5].

Here we present an expanded and comprehensive technological, microscopic, and refit analysis of the original chimpanzee lithic assemblage from P100. We identify and describe several new refit sets, including the longest hammerstone transport seen in the chimpanzee archaeological record. We provide detailed evidence of the fragmentation sequences of Panda nut hammerstones, and characterise the percussive damage on fragmented material from P100. Our re-analysis provides new data and perspectives on the applicability of chimpanzee nut cracking tools to our understanding of the percussive behaviours of early hominins. This study emphasises that the chimpanzee lithic archaeological record is dynamic, with the preservation of actual hammerstones being rare, and small broken pieces being more common. P100 - the first archaeological chimpanzee nut cracking lithic assemblage - provides a valuable comparative sample by which to identify past chimpanzee behaviour elsewhere, as well as similar hominin percussive behaviour in the Early Stone Age.

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Poster Presentation Number 46, Th 19:00-19:45

Arothron: an R package for virtual anthropology to build endocast and to perform digital reconstruction

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Arothron is an R package [1] containing brand new tools for geometric morphometric analysis. The package comes with examples pertaining to the field of virtual anthropology, yet it is addressed to the entire audience of geometric morphometricians. The functions embedded in the package allow aligning disarticulated parts belonging to a single specimen (i.e. broken skull fragments), to build internal cavities such as endocasts, and to reproduce and analyse the shapes of three-dimensional objects. Arothron functions import and export landmark coordinates and 3D paths into 'landmarkAscii' and 'am' format files. The Digital Tool for Alignment (DTA) is a landmark-based methodology which allows aligning two or more portions of a 3D mesh (i.e. a disarticulated model, DM) by using a reference sample or model (RM) for comparison. To run DTA, a set of anatomical landmarks is defined on two separated portions of the DM. Each point of the landmark sets is moved to the nearest vertex of the triangles. This way, each landmark is identified by a number corresponding to a row of the vertex matrix of the mesh and its position is tracked on the 3D models moved in the Cartesian coordinate system. The second step is the alignment via Generalized Procrustes Analysis (GPA) of each part of the DM on each RM of the comparative sample, where the same landmark configuration as with the DM has been previously defined. The items of the reference sample are previously scaled to the mean of the single scale factors calculated for each half of the DM, separately, and symmetrized via reflection and relabelling, thereby producing a perfectly symmetrical, bilateral, and scaled landmark configurations (to avoid alignment error as introduced by asymmetry). The last step consists in the quantification of the morphological (Euclidean) distances between each part of the DM and the corresponding landmark configurations on each item in the RM set. Computer-Aided Laser Scanner Emulator (CA-LSE) and Automatic Segmentation Tool for 3D objects (AST-3D) are two new tools designed for the reconstruction of virtual cavities and external shapes [2]. CA-LSE provides the reconstruction of the external portions of a 3D mesh by simulating the action of a laser scanner. AST-3D performs the digital reconstruction of anatomical cavities as endocasts. Both tools use the definition of points of views that can be placed externally to the object (CA-LSE) or inside the object (AST-3D). By applying these tools is possible in few minutes to build virtual cavities as endocast, maxillary sinuses and trabecular bone. In the Arothron R package, we supplied three examples of reconstructing: the dental pulp cavity within a deciduous Neanderthal tooth, the network of blood vessels within a human malleus bone, and an endocast of a human skull. The tools could be used in virtual anthropology application. The digital alignment tool is efficient in find ideal alignments of broken pieces. It could be applied as the first step in virtual reconstruction on human fossil specimens that often consist of a disarticulated fragments such as BOU-VP12/130 (*Australopithecus garhi*), AL-442 (*Australopithecus afarensis*), OH5 (*Paranthropus boisei*), ATD6-15 and ATD6-69 (*Homo antecessor*), Amud 1 (*Homo neanderthalensis*), Le Moustier 1 (*Homo neanderthalensis*). The easily and quickly use of the Arothron R package to build virtual cavities may provide a new means largely applicable in virtual Anthropology.

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Poster Presentation Number 63, Th 18:15-19:00

Inferring locomotor behaviours in Miocene New World monkeys using talar morphology as proxy

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The occupation of diverse niches by the New World Monkeys in the Americas has been accompanied by distinct locomotor, behavioural, morphological and ecological adaptations. The talus is the most commonly preserved post-cranial element in the platyrrhine fossil record, with several Miocene platyrrhine taxa having at least one conserved talus. Talus morphology can provide information about postural adaptations because it is the anatomical structure responsible for transmitting body mass forces from the leg to the foot, as well as providing stability and mobility throughout most postural and locomotor behaviours. The aim of this study was to see whether the locomotor behaviour of fossil plattyrhines could be inferred from their talus morphology. To test this possibility we first classified our extant sample into three different locomotor categories (clamber/suspensory, leaper/clawed and arboreal quadrupedalism) and then compared the talar strength in the different locomotion categories by simulating a static loading scenario using finite element analysis (FEA). Then we collected talar morphometric data and performed geometric morphometric analyses (GM) to distinguish between the main locomotor modes. The same morphometric data was used to evaluate if there was an association between talar shape and its strength by using partial least squares analysis (PLS). Finally, several machine-learning algorithms were trained using both the biomechanical and morphometric data from the extant sample in order to infer the possible locomotor behaviour of the Miocene fossil sample. The obtained results show that the different locomotor categories are distinguishable using either biomechanical or morphometric data. Clamber/suspensory specimens exhibit the weakest tali, while leaping species showed the strongest morphologies. The machine-learning classification algorithm applied to both biomechanical and morphometric data categorised most of the fossil sample as arboreal quadrupeds. This study has shown that a combined approach using FEA, GM and machine-learning algorithms can contribute in the understanding of platyrrhine talar morphology and its relationship with locomotion. In future this approach is likely to be beneficial for determining the locomotor habits in other primate taxa.

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Poster Presentation Number 45, Fr 18:15-19:00

The Geoarchaeology of the Late Stone Age sites of Machampane River, Massingir, Mozambique

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The present paper focus on the link between archaeology and geology, and its importance for understanding the formation of the archaeological record through sediments studies (Hassan, 1978). The present case study is the archaeological site of Txina-Txina, located in Massingir District, southeastern Mozambique. This area was chosen because Mozambique is a central place for the research of modern human origins and evolution due to its proximity to regions of great palaeoanthropological significance and where hundreds of new archaeological sites have been discovered in recent years (Bicho et al., 2016; Gonçalves et al., 2016). The Txina-Txina site is located between the junction of Machampane and Chifati rivers and is marked by a 5 meter long stratigraphy. Field work carried out in 2016 and 2017 including three 1sq. meter tests provided an important archaeological sample that includes lithic, terrestrial and aquatic shells, ostrich egg shell (OES), bones, OES beads and engraved gastropod shells. The lithic materials are composed of a wide range of lithic raw materials, all likely coming from local sources. The lithic assemblage is based on the production of flakes and bladelets mostly from centripetal, bipolar and prismatic cores. Formal tools are rare, but nevertheless there are a few microlithic crescents, backed bladelets, scaled pieces and denticulates and notches (Bicho, et al. 2016). The main aim of this study was to reconstruct the local paleoenvironment and site formation processes of the Txina-Txina location. We collected sediment samples (in 10 cm intervals encompassing all the changes of the sediment mass properties) in the 3 test pits and 2 sections on the northeast section of Txina-Txina. In the laboratory, subsamples of about 100-200 g and 10 g were taken for, respectively, textural and geochemical analysis. Textural analysis was carried out by sieve analysis. Facies descriptions were based on the textural analysis, as well as on field observations and morphometric analysis. Geochemical analysis (lithogeochemical analysis by fusion inductively coupled plasma emission) for major and several trace elements were carried out. Additionally, the number and weight of lithics was measured for all the the three test pits. Based on these methods, the resulting data show that Txina-Txina site is formed by both colluvial and alluvial sediments. On the northeast wall, next to the hill slope, there are colluvial sediments with angular boulders. These sediments were overlaid by a conglomerate, cemented with calcium carbonate and without internal structures, covered by fine sediments episodically interrupted by gravel layers. The presence of a conglomerate and round gravel layers indicates that there were high energy events that transported these sediments along both rivers for some distance. According to our radiocarbon dates, it is possible to infer that the gravel layers were deposited in wet periods that occurred before 29000, (i.e. before the Last Glacial Maximum - LGM) and after 14000 years ago, during the African Humid Period (AHP - Liu et al., 2017). Our preliminary conclusion lead us to infer that the fine sediments may have had two origins: i) deposited by the rivers in a lower energetic environment or/and ii) colluvial. During drier periods in southern Africa, due to decreased monsoonal activity, both vegetation cover and river energy decreased, favoring the transport and deposition of fine sediments (Singh et al., 2017). All the analyzed sediments have a geochemical composition similar to that of the Jozini–Mbuluzi rhyolites present in the adjacent hill slopes. Furthermore, the lithic concentrations showed that the site occupation was likely to have been more intense during drier periods. Although our interpretation is that the fine sediments have a colluvial origin during the Later Stone Age occupation, more analysis will be carried out in the next few months to confirm this hypothesis.

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Poster Presentation Number 59, Th 18:15-19:00

Ontogenetic changes of diploic channels in modern humans, and a comparison to fossil hominins

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Cranial bones are composed of external and internal compact layers, which are separated by the diploe. Inside the diploe, the diploic channels are bony passages of veins, running within frontal, parietal, and occipital bones, and interconnected through a network of microscopic vessels. In this study, we use Computed Tomography (CT) scans of 40 dried crania to reconstruct and analyze ontogenetic changes of diploic channels in a sample of non-adult and adult modern humans, and compare modern patterns with 10 fossil hominins including one early African *Homo erectus*, four Neanderthals, one European and one African Middle Pleistocene specimen, one Middle-Late Pleistocene African fossil, one early anatomically modern human, and one Upper Paleolithic European. A specific protocol was used for the segmentation and reconstruction of the vascular network. Three-dimensional models of diploic channels have been reconstructed with MIMICS 18.0 (Materialise). We provide quantitative comparisons and correlations between compact and cancellous bone thickness, vessel branch length and lumen size, vascular asymmetries and volumetric distribution in frontal, parietal and occipital bones. Lumen size of the diploic channels was measured using the *Centerline Functions* tool, sampling the values of the best fit diameter throughout the branches with control points set every 1 mm. These resulting values were averaged per side and bone and used in the statistical analysis. Main branch length refers to the dimension of the longest vascular branch. Volume refers to the total value of each diploic channel reconstructed. Compact and cancellous bone thickness were computed with 3-Matic 9.0, *Thickness Analysis* function (Materialise). We find that in non-adult modern humans, the vascular system displays a progressive but not linear development. During growth, only lumen size is correlated with age. The complexity of the vascular network increases with adulthood. The degree of development of the diploic channels in fossil specimens resembles that of modern sub-adult individuals. Diploe thickness is only correlated with lumen size and vascular volume. Compact bone thickness displays nonlinear relationship with branch length and volume. There is a nonlinear association between vascular variables and cranial size in modern humans. Considering potential metabolic differences and constraints associated with modern human brain size and shape, these vascular differences might be related to endocranial thermoregulation.

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Pecha Kucha Presentation Session 6, Fr 11:55-12:20

Using time-averaged cave deposits and geospatial statistics to demonstrate spatial structure in Neandertal behavior

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The spatial organization of stone artifacts, fauna, and other archaeological features (e.g fire-places) provides a unique window into how Paleolithic people conceptualized and organized their behaviors in space. Drawing behavioral inferences from the spatial structure of archaeological assemblages have relied on ethnoarchaeological research that characterizes the material traces of modern hunter-gatherers. Temporally, ethnographic datasets represent a brief moment in time, whereas, the bulk of the archaeological record is comprised of palimpsests that have formed over hundreds if not thousands of years. To mitigate this issue, Archaeologists have developed methodologies that attempt to dissect palimpsests in order to isolate individual episodes of occupation. However, this line of research has identified more issues regarding than solutions. It remains unclear what constitutes a brief instance of activity or an episode of occupation, and even when archaeological assemblages or features can be isolated in time, determining their synchrony with the rest of the assemblage remains problematic. Thin assemblages from open-air sites where the structure of the archaeological assemblage appears to reflect an isochronic surface, can still represent several episodes of occupation spread across considerable time. Even when rare conditions allow for the preservation of brief occupations, some researchers have questioned their relevance for understanding broad-scale evolutionary processes.

Given this, it may be more fruitful to develop methods that analyze palimpsests for what they are rather than continue to try to tease them apart. Here we take the view that palimpsests are not a hindrance but instead are necessary for viewing meaningful behavior at an evolutionary scale. To test whether such patterning exists, we use a moving window analysis to characterize the stone artifact distributions within the time-averaged layers of Roc de Marsal in terms of stone tool production, use, and discard. Local Moran's I was then used to determine the significance of spatial patterning of each metric within each level. Results of this analysis show that non-random patterns exist in time-averaged assemblages at Roc de Marsal. The consistency of some of the spatial patterning of burned lithics, scrapers, cores and large flakes throughout each layer suggest that the size and shape of the cave structured some stone artifact discard patterns throughout this time. Based on our findings, we suggest that palimpsests have the potential to contribute to our understanding how hominin use of spaced varied through time. However, the spatial relationships revealed to reflect the complex interaction of hominin behavior, artifact discard, external factors, and thus are not intuitively interpreted as behavior. Linking spatial patterning to long-time behavioral processes will likely require modeling to create expectations in time-averaged and emergent contexts such as these.

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Poster Presentation Number 38, Fr 19:00-19:45

A reappraisal of the human remains from the Upper Palaeolithic – Mesolithic levels of Riparo Fredian (Tuscany, Italy)

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Pleistocene and early Holocene human fossils in Tuscany are very few and poorly described, with remains from only three sites: Buca del Tasso, Vado all'Arancio and Riparo Fredian [1]. Any new information is thus an important contribution to our knowledge of the peopling of this region. Here we present a revision of the human fossil remains from Riparo Fredian, a site located in Garfagnana, a mountanious region of northern Tuscany. In 1995, a dedicated paper described in detail the geology, the stratigraphy and the materials of the site [2]. In this work, the authors also described the human remains pointing out the presence of 39 isolated human teeth (19 maxillary and 20 mandibular) and a few fragments of long bones identified as a humerus, a femur of a child and an ulna of a young; they considered the remains as belonging to six individuals at least. A recent reanalysis of the human remains indicated that several specimens were incorrectly identified. It was thus deemed important to systematically revise the identification of each fossil and their interpretation. Our revision of human remains from Riparo Fredian has led to several changes in their anatomical identification with respect to the original publications. Of the 39 teeth previously described, the analysis revealed that two of them belonged to non-human animals, and 18 were mistakenly identified. A new, correct identification is provided for each of them. Also, two human teeth not described in the original papers have been identified. The anatomical identification of the post-cranial remains has been confirmed for two out of the three specimens, as the bone supposed to be a fragment of a child's femur most probably belongs to a small ruminant. The minimum number of individuals, based on the dental remains, is confirmed to be at least 5, but most probably 6, although with a different allocation of teeth to individual specimens. The age at death of the six individuals has also been reassessed, indicating the presence of two infants, two young adults and two mature adults.

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Poster Presentation Number 31, Th 18:15-19:00

Extreme asymmetry of sacral alae in the Neandertal Regourdou 1 (Montignac-sur-Vézère, Dordogne, France)

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The Neandertal skeleton Regourdou 1 was excavated in the 1950–60s, but many skeletal remains belonging to this individual were identified recently in the site's faunal collections [1]. These new findings allowed detailed analyses of certain anatomical regions which provided new data on Neandertal variation but also on the paleobiology of this individual [2]. The Regourdou 1 sacrum belongs to those remains known since 1957. Together with the fragmentary coxal bones partially described recently [3] they represent the best MIS 5–3 preserved European Neandertal pelvis with almost intact sacroiliac joints. However, the sacrum shows a considerable asymmetry which may limit a virtual reconstruction of the pelvis as reconstruction techniques often rely on symmetry. The observed asymmetry was analyzed with computer imaging techniques and quantified in order to know the degree of the asymmetry relative to an extant modern human sample and other Neandertal individuals. The analysis was performed on 3D models segmented from CT scans and with data published in the literature. Anatomical landmarks were placed on the sacrum from the superior view. Linear measurements of the first sacral body (S1) and sacral alae and a facet angle (relative to the median plane) were computed from projected configuration of landmarks onto the plane of S1. The modern human reference sample was digitized twice to consider the measurement error but no measurement revealed significant directional asymmetry except the orientation of articular facets. Two important issues result from the morphometric comparison for the Regourdou 1 sacrum. 1) Regourdou 1 shows a considerably shorter right ala below the 3rd to 97th interval and it is also small relative to the total sacral breadth. 2) The orientation of articular facets shows a difference of 22° with the right ala oriented in 80° angle relative to the medial plane which exceeds substantially the range of the modern sample. Although we can find some similar metric patterns in other Neandertal sacra, none shows such marked asymmetry as Regourdou 1. When the 3D model of the Regourdou 1 sacrum is superimposed with its mirror-image, it is apparent that the right ala is placed higher than the left one relative to the S1 body, suggesting an important influence on the global architecture of the pelvis. To further reconstruct the Regourdou 1 skeleton, it is important to understand the origin of the sacral asymmetry and possible effects on other skeletal structures. Ontogenetically, a sacral ala develops from paired anterior and posterior ossification centers at the level of each of the first three sacral vertebrae. The lateral parts fuse with sacral bodies before the age of 6. Asymmetry in sacral alae thus seems to reflect developmental abnormality rather than a biomechanical adaptation. However, unusual maturation of sacral alae in the Neandertal sacrum of Kebara 2 and of different Regourdou 1 anatomical regions [4] suggests questions their skeletal maturation's similarity to modern humans. Due to a small number of sufficiently preserved Neandertal sacra (almost all of them are considered males), it is difficult to assess their morphometric similarity to modern ones and exclude the possibility of having relatively shorter alae. Facet tropism (asymmetry of articular facets orientation) is quite common in the lumbosacral articulation but it is undoubtedly associated with mechanical instability and degenerative issues [5]. The Regourdou 1 skeleton presents more skeletal anomalies which may relate to the sacral asymmetry but their origin requires further study.

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Poster Presentation Number 62, Th 19:00-19:45

The evolution of fertility signals in primates: An agent-based modeling approach

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Although the theory of sexual selection is primarily focused on dyadic interactions related to mating, the consequences of these interactions on group- or species-level properties, such as demographic composition and sex-biased dispersal patterns, can be profound. Some traits thought to be under sexual selection, such as body and canine size, are often detectable in the fossil record, but sexually selected behavioral strategies and soft-tissue morphological features can be directly investigated only using data from extant taxa. Despite this limitation, researchers investigating the processes of sexual selection have made significant progress toward understanding the evolution of many traits involved in mating competition (e.g., exaggerated sexual swellings, mate guarding), often by employing the comparative method to investigate variation in living taxa. In addition, equation-based mathematical models have provided support for several key hypotheses in sexual selection theory, such as Fisherian runaway selection and the handicap (or costly signal) hypothesis, but these models have often been limited in their ability to explain observed variation in real primate groups. Spatially explicit agent-based modeling has the potential to provide insights that are more externally valid than equation-based alternatives, while maintaining a high level of "experimental" control. Agent-based models simulate agent-level (i.e. individual-level) decisions about how to interact with other agents and with the environment and are powerful tools for investigating the group-level phenomena that emerge from these individual decisions and interactions. We have developed agent-based models that simulate the mating interactions of opposite-sex individuals, and the competitive interactions of same-sex individuals, to test hypotheses regarding sexually selected trait evolution. Specifically, we are interested in the factors that underlie the dramatic variation across primates in the expression of fertility signals. While some female primates display conspicuous signals of fertility around the time of ovulation, such as exaggerated sexual swellings and dark red facial coloration, other species, including humans, seem to have lost all or most perceptible signs of peak fertility. The implications of this inter-specific variation are wide-ranging, as fertility signals are associated with variation in the degree of breeding seasonality, reproductive skew, infanticide risk, paternity certainty, and type of mating system across species. In the case of humans, for example, concealed ovulation (i.e., the loss of fertility signals) is thought to be causally linked to increased male parental care and sexual monogamy. Using agent-based modeling, we are testing these and other hypotheses by simulating contest competition, mate choice, reproduction, and trait evolution to better understand why species vary in the degree to which females signal fertility. Model parameters are informed by empirical data on primate behavior, such as age at first birth, reproductive skew, and sex-biased dispersal, and genetic inheritance and trait evolution are guided by the principles of quantitative and population genetics. Finally, we are conducting rigorous comparative analyses of empirical findings to test hypotheses related to fertility signal evolution and will compare these results to the results of our agent-based model simulations.

Poster Presentation Number 16, Th 19:00-19:45

TIP-N-POINT: a regional and assemblage scale perspective on Neanderthal point technologies across Western Europe

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Stone-tipped hunting weapons are an important marker of the technical and cognitive capacities of Palaeolithic hominins and represent a crucial tipping point in human behavioural evolution. Neanderthals were skilled hunters, as indicated by zooarchaeological and isotope analyses, but preserved remains of organic spears are sparse and potential lithic weapon tips are not ubiquitously present during the Middle Palaeolithic (MP, ca. 300,000 - 40,000BP). Unravelling this enigma and reconstructing the technology underlying MP hunting events is one of the key challenges in studies of Neanderthal behaviour. Securely identifying hafted weapon tips is complex and past analyses of MP points have mainly focused on individual artefacts, their morphometric characteristics, use-wear and residue traces. Conversely, studies that contextualise MP points at an assemblage level, cross comparing various blank and tool types, are sparse, especially for the European record, even though they are key to a more comprehensive understanding of the role of point shapes in the Neanderthal tool kit. This poster presents two sets of initial results of this Marie Curie-Sklodawska funded project. Firstly, at the regional scale, it outlines the occurrence and typo-technological characteristics of point shapes across MP assemblages in western Europe. Results indicate the low presence of triangular forms in many Middle Palaeolithic assemblages but also their more common occurrence in certain specific spatio-temporal entities (e.g. MIS-5 northern France or MIS-3 south-eastern France). Secondly, initial results from an assemblage level study of the lithic material from layer 1 of the Abri du Maras rockshelter (MIS-3, Southeastern France) are presented. Focus was on the material from the 1946-1950 excavation by R. Gilles which resulted in a lithic collection of around 3,000 artefacts. Past studies have pointed out the presence of several pointed flakes with convergent ventral retouch, assigning the assemblage to the so-called Neronian, a late Middle Paleolithic entity only known from the Rhone valley. A detailed attribute analysis focused on the recording across all blanks of a series of features which have been linked to projectile use or hafting (e.g. diagnostic impact fracture, lateral crushing, basal modifications). Results indicate a large variability in the convergent tools, both in terms of blank type (Levallois, discoidal and laminar flaking) as well as retouch extent and location. This poster will further present and cross compare these points within the context of the rest of the assemblage.

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Poster Presentation Number 42, Fr 19:00-19:45

Demographic processes in the territory of Estonia from the earliest inhabitants to modern times

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This project deals with the studies of temporal population dynamics in the territory of present-day Estonia in the eastern coast of the Baltic Sea. We characterize the genetic structure of the population in a time series starting from the earliest layers of lithic cultures to the contemporary population. We extracted and sequenced aDNA from skeletal remains from Estonian archaeological collections. The sample consisted of 72 individuals – 24 from the Bronze Age (stone-cist graves), 13 from the Iron Age (tarand-graves) and 35 from the Middle Ages (rural and town cemeteries). We used teeth for aDNA extraction and produced low-coverage (average 0.19x, maximum 0.92x) Illumina whole-genome sequencing data. The resulting data was analyzed in a context of modern Estonian and European genetic variation. Primary bioinformatical analyses showed that 53 out of the 72 ancient samples contained sufficient amounts of endogenous DNA (more than 3%) for Y chromosome and autosomal analyses. We determined the mtDNA and Y chromosome haplogroups (hg) of the individuals and compared the autosomal data of all time layers to that of both ancient and modern populations including Mesolithic and Neolithic samples from Estonia. Hgs N3 and R1a are the two most common Y chromosome hgs among modern Estonians [1, 2]. While we have previously found that hg R1a appears in Estonia together with farming with Corded Ware culture people [3], the arrival of hg N, which has been proposed to be connected with the arrival of Uralic languages to Europe, is yet to be studied. We found that the Iron Age individuals do in fact carry Y chromosomal hg N3 (3 out of 5) while all 18 Bronze Age males belong to R1a. Furthermore, based on their autosomal data, all of the studied individuals appear closer to Estonian hunter-gatherers and modern Estonians than Estonian Neolithic Corded Ware individuals do. The Medieval period started in the eastern Baltic region much later than in Central Europe and in Scandinavia. The crusades and conquest in 13th century AD brought along vast social, economical and cultural changes, which presumably changed the structure of the local population. While the Medieval individuals buried in rural cemeteries are considered as the representatives of the local Estonian population, those of big towns can often be associated with the new wave of people who arrived, mostly from Western Europe, together with Christianity via the economical, cultural and political networks. We find that there is a clear difference between the genome-wide data of individuals belonging to Medieval urban and rural communities. The urban elite clusters genetically with modern Germans but the rural local class with modern Estonians. We did find a few individuals of mixed genetic ancestry, but the overall admixture between the two classes was limited. Our results reveal several population shifts during the prehistory of the region and show a clear continuity of the population starting at least from the Iron Age.

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Podium Presentation Session 11, Sa 14:20

The Sima de los Huesos origin of hominin accumulation. The state of the art.

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The Sima de los Huesos (SH) site represents one of the most intriguing human fossil accumulations for the abundance of hominin remains recovered to date (7000 fossils), their chronology (430 ka) and their extraordinary location deep inside a karstic environment. Since systematic excavations began in 1984, numerous hypotheses to explain how the skeletal remains arrived at the site have been proposed, including the hypothesis of an anthropic origin, favored by the excavation team[1]. A long-term research project is currently in progress addressing the biostratinomic and the fossil-diagenetic phases. The present study provides an overview of our current state of knowledge regarding the origin of the hominin accumulation. We are now in a position to rule out conclusively several scenarios proposed as possible agents for the hominin accumulation at the site. 1) The sedimentological features of the hominin-fossil-bearing level (LU6), indicate low-energy depositional processes and no traction transport from outside the karst system[2]. The human fossils were not transported to the site from a remote place. Furthermore, the only possible access to the SH chamber was a 14m vertical conduit (shaft). This circumstance excludes any hypothesis that implies an accessible exit from the site. 2) Carnivore tooth marks have been documented on the SH hominins[3]. These tooth marks, only present in a very low proportion of the assemblage, do not involve bone fracturing typical of carnivore dens. The results of the taphonomic analyses indicate that carnivore modification of the SH assemblage is compatible with bear activity, although limited intervention of lions, while less probable, remains possible. Neither lions nor bears accumulate bones in their dens (and no carnivore accumulates exclusively humans). Carnivore access and modifications, then, occurred exclusively in the context of scavenging of hominins previously accumulated at SH by other causes. 3) Forensic and taphonomic analyses of cranial fractures has shown that at least some of the hominin individuals likely were already dead before they were deposited at the site, ruling out accidental causes[4,5]. Given these circumstances, the intentional accumulation of bodies by other hominins remains as the only possible explanation for this extraordinary deposit of human fossils. The analysis of the spatial distribution of hominin fossils within the site has revealed that the bones are not found in their original position, but are generally mixed together in the sedimentary matrix of the main chamber. For this reason, many of the usual criteria for identifying mortuary behavior are not applicable here. Different agents have modified the original position of the skeletal remains. 1) Within the SH site itself, the presence of a sloped ramp of sediments at the base of the shaft, has facilitated the secondary deposition of fossil remains at the lowest point of the cavity. Hominin fossils are found throughout the site, from the bottom of the shaft to the distal wall of the chamber some 13m away, with a maximum accumulation after the sloped ramp in the horizontal, lower part of the site. 2) The erosive event associated with the deposit of LU7 and the subsidence in the central zone of the site[2] probably modified the structure of the hominin-bearing level LU6. 3) The carnivore scavenging activities must have affected the original position of some of the remains. 4) Finally, repeated entry to the site during historic times by inexperienced diggers in search of bear fossils resulted in moving tons of sediments. At present, the SH site has been only partially excavated, and it is estimated that more than the half of the extension of the deposit remains unexcavated. Under these circumstances, as a cautionary note, we maintain that any attempt to solve the site by dealing exclusively with one factor, such as the relative abundance of skeletal elements, is likely to lead to unreliable interpretations.

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Poster Presentation Number 19, Fr 18:15-19:00

Ancient human parallel lineages within North America contributed to a coastal expansion

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Little is known regarding the first people to enter the Americas and their genetic legacy. Genomic analysis of the oldest human remains from the Americas showed a direct relationship between a Clovis-related ancestral population and all modern Central and South Americans as well as a deep split separating them from North Americans in Canada. Here we investigate the ancestral relationship between the northern (NAM) and southern (Mexico, CAM and SAM) branch populations. To do so, we sequenced 91 ancient whole genomes from North America, mainly from two geographic areas: the California Channel Islands in the west and Southwestern Ontario in the east, near modern Algonquian-speaking populations. Both of these areas show evidence of occupation from at least 13 kya (1) and are geographically located south of the known distribution of the ancient Neo- and Paleo-Eskimo dispersals (2). We radiocarbon dated 27 individuals to between 4.8– 0.2 kya and sequenced all genomes to an average depth of 0.0007 - 13.6x Mitochondrial DNA (mtDNA) haplotypes were recovered from all samples and Y chromosome haplotypes from 34 of the male individuals. In addition, a set of modern whole mitochondrial genomes (n = 45) were re-sequenced from a previous study to explore sex-specific migration patterns on the west coast of Southern California. While we do not find evidence of any ancient individuals sharing excess derived alleles with Austronesian populations (3), we are able to demonstrate the existence of two distinct ancestries in North America, which possibly split south of the ice sheets, and show that both branches contributed to modern Central and South American populations. The proportions of these two ancestries in ancient and modern populations are consistent with a coastal dispersal and multiple admixture events. Further analysis of this new data reveals novel mtDNA and Y chromosome lineages, helps elucidate the timing and direction of significant population structure shifts in southern California, and sheds light on the population structure of the "First American" wave.

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Poster Presentation Number 50, Th 19:00-19:45

Ontogeny of the human maxilla: a study of intra specific variation using surface histology and geometric morphometrics

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Ontogenetic changes in craniofacial morphology are the result of a process called bone modelling (BMod) [1]. It is the combined activity of two types of cells located on the surface: the osteoblasts that add new bone via bone formation (BF), and the osteoclasts that remove bone via bone resorption (BR). In the face, bone modelling starts at an early prenatal stage (around the 8th week *in utero*), continues after birth into childhood and progressively decreases with time. Each group of cells leaves specific marks on the surface of dry bones that are identifiable via surface histology [2]. Thus, it is particularly relevant to focus on the expression of the BMod patterns in order to better understand ontogenetic processes that result in morphological shape changes. It is generally assumed that BMod patterns are species' specific; however, intra specific variation has so far never been investigated, nor quantified, in a large sample across regional groups within one species. Here we analysed midfacial BMod patterns in an ontogenetic series ranging from birth to late childhood in three geographically diverse populations of *Homo sapiens*, each with distinct adult facial morphologies [3]: Western Europe (France; n = 48), Inuit (Greenland; n = 20) and Khoisan (South Africa; n = 15). The specimens were classified into four age groups according to dental development. We hypothesised that the distinct facial morphologies are the result of different BMod patterns. High-resolution replicas of maxilla bone surfaces were created using epoxy resin and investigated with a digital stereo microscope. The activities of BF and BR were quantified using surface histology methods and represented as colour maps. Patterns of form (size and shape) changes were analysed with semilandmark geometric morphometric (GM) techniques, and patterns of growth intake (i.e., where growth is more/less predominant) were visualised using heat maps, computed as the distance between the mean forms of two subsequent age groups ("distance maps"). Results of both methods (surface histology and GM) were compared using a partial least square (PLS) analysis. In accordance with previous studies [3, 4, 5], our GM analysis suggested that facial differences between populations were already present at early ontogenetic stages. According to the distance maps, this is partially explained by different postnatal growth trajectories. However, the BMod maps show similar patterns of bone formation and resorption in the three populations, especially in age group 1, with only slight differences expressed in later age groups. Moreover, no significant differences between the three populations ($p = 0.59$) or between age groups ($p = 0.14$) were found in the BMod patterns, suggesting that they are genetically determined in human populations of different ancestries and living in different environments. We conclude that facial shape differences between populations are likely due to different rates in the expression of the cellular activities. These results are encouraging for interpreting facial bone modelling patterns in extinct species for which studies of intra specific variability are rare due to small sample sizes, as we found that the ontogenetic variability in BMod patterns within *H. sapiens* is low.

We thank Pr. Lynnerup from the department of Forensic medicine (University of Copenhagen), Mrs. Wilhelmina Seconna from the Iziko Museum (Cape Town, South Africa) as well as Dr. Gibbon from the University of Cape Town for letting us access the collections.

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Poster Presentation Number 68, Th 19:00-19:45

Understanding edge angle variability and morpho-functional design of Late Middle Palaeolithic Keilmesser assemblages

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The Late Middle Palaeolithic *'Keilmessergruppen'* (KMG) assemblages of Central and Eastern Europe are characterised by asymmetrically backed tools. Most of these items are bifacially worked, produced in a highly standardised mode and display characteristic wedge-('Keil')-shaped sections. Due to their single working edge these tools have been interpreted as knives. In Keilmesser, long reduction sequences have repeatedly been documented [1], allowing for detailed morpho-technological reconstructions of their use-life histories, including repetitive phases of production, usage, re-sharpening and re-use.

Due to the aforementioned characteristics, Keilmesser provide a unique archive for tracing certain features of late Neanderthal behaviour. These may range from understanding tool dedication, function and its underlying design and production concept, learning strategies, technical innovations, the transmission of ideas and knowledge to the formation of late Neanderthal regional traditions.

At some KMG sites, Keilmesser frequently display the application of tranchet blows that sharpens the working edge at the tip of the tool through removing the lateral edge. The use of this method (within KMG contexts called *'Prądnik method'*) reflects intentional design and puts special emphasize on the edge angle near the tool-tip. This observation implies a certain hierarchization of different parts of the working edge within the same tools that might be related to its use-life. Various interpretations consider the application of this method as e.g. tool-finishing or as maintenance, sharpening or optimization of an existing working edge. Nevertheless, which effect it has remains so far speculative.

In order to address these aspects, here we apply a particular methodology, which includes - among others - 3D scanning to acquire the measurements and for morphometric analyses [2]. To obtain a more distinct picture of the working edge a sample of Keilmesser made of silicified schist is used as a case study. Our study aims at an improved understanding of how the working edge of a Keilmesser was actually designed and which effects specific edge angles might have had. Targeted objective and quantitative use-wear analyses[3] on the material will supplement this study.

By including controlled experiments, 3D morphometric data analysis as well as macro and micro use-wear analysis, this approach will provide new data that aim to test the given interpretations of these asymmetrically backed tools from the Late Middle Palaeolithic. Hence, this research will contribute to a more holistic understanding of the concepts underlying tool design, function and its realisation.

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Pecha Kucha Presentation Session 10, Sa 12:20-12:45

Analysing Primate Grip Shapes Using Geometric Morphometrics

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The primate hand is a key innovation of the order and its adaptability in the context of locomotion, foraging and tool use is a key component of the human evolutionary narrative. The shape of the bones that make up the hand has been extensively studied across many primate taxa, but the dynamic shapes that the hand adopts during specific tasks have not, and this lack of data hampers functional interpretation of hand morphology. The lack of such data is primarily because of the difficulty in obtaining this information from living primates whilst performing grasping tasks. In this paper we demonstrate a novel technique based on markerless motion capture using video photogrammetry [1] that allows us to capture three-dimensional finger kinematics during hand use. This process allows us to define and measure a mid-task pose for a specific action and we can then use standard Procrustes superimposition to compare the finger tip and finger joint locations both between taxa and between tasks in a standardised fashion. Using this method we measure the hand shape during foragings tasks for 3 primate species: Macaca fuscata, Ateles beelzebub, Cebus apella. Each monkey performs 3 different reach and pick up actions with food items of different sizes. We also compare foraging actions with the grasp patterns associated with locomotor tasks (horizontal pole walking and vertical pole climbing). We can demonstrate that there are task specific poses that are chosen across multiple taxa and we suggest that these reflect optimal hand use strategies for these tasks. We further suggest that this approach will find wider utility in hand use studies since it condenses the complex dataset of dynamic 3D kinematics into a form that allows straightforward categorisation and analysis. Similarly, the approach provides a direct link between morphology and function and so further work in this area should help us interpret the hand use capabilities of fossil primates.

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Pecha Kucha Presentation Session 6, Fr 11:30-11:55

Back to Skhul Cave, Israel

Ron Shimelmitz[1,2], Israel Hershkovitz[3], Reuven Yeshurun[1], Orbach Meir[1], Norbert Mercier[4], Mathieu Duval[5], Lior Weissbrod[1], Maayan Lev[1], Julia Lee-Thorp[6], Francesco Berna[7], Dan Cabanes[8], Valentina Caracuta[9], Chiara Belli[1], Ariel de Lazari[1], Mina Weinstein-Evron[1]

1 - Zinman Institute of Archaeology, University of Haifa · 2 - David Yellin Academic College of Education · 3 - Department of Anatomy and Anthropology, Tel Aviv University · 4 - Institut de Recherche sur les Archéomatériaux, Université Bordeaux Montaigne · 5 - Australian Research Centre for Human Evolution (ARCHE), Environmental Futures Research. Institute (EFRI), Griffith University · 6 - School of Archaeology, University of Oxford · 7 - Department of Archaeology, Simon Fraser University · 8 - Department of Anthropology, Rutgers University · 9 - Laboratory of Archaeobotany and Palaeoecology, Università del Salento

It was long believed that Skhul was excavated down to bedrock. A test excavation in 2016 showed that this was a misinterpretation of the original site report, uncovering the northern section of the 1930's excavation and adjacent *in situ* archaeological layers buried below the 1930's dump. In this area we identified a series of four superimposed layers with a total depth of ca. 1 meter. The two upper layers are rich in faunal remains and lithic artifacts, bearing heavy white patination that is typical of the upper Middle Paleolithic layer (B1 of McCown's original excavation). The identification of several layers enables us for the first time to systematically trace processes of change within this unique site and discuss diachronic patterns.

Homo sapiens-bearing deposits from the critical early wave of expansion into Eurasia in MIS 5 are exceedingly rare outside of Africa [1–3]. Skhul has previously yielded *Homo sapiens* diagnostic anatomical remains together with significant evidence for early symbolic behavior [4,5]. However, in spite of extensive excavation of the site in 1931-1932 our ability to reconstruct early *Homo sapiens* behavior and its paleoenvironmental context has been limited by lack of systematic collection of finds and the coarse-grained excavation techniques typical of the early 20th century.

The identification of stratified, *in situ* assemblages allows correlating between components of the material culture, environmental data and chronology in a much more precise and contextualized manner. Preliminary results of the new excavation campaign of *in situ* layers of Skhul, address the lithic industry and faunal remains, including macro- and microfauna, demonstrating a more variable use of Levallois technology and more diverse taxonomic lists of taxa than previously reported. We also consider a sample of the material found within the 1930's excavation dump, allowing a more nuanced understanding of McCown's original report and further insights into biases of interpretation of this key site, which were due to the absence or underrepresentation of certain lithic and faunal elements in the 1930's published assemblages. Worth noting are also the occasional shells, ocher pieces, and ostrich eggshell, whose significance was entirely overlooked in the old excavation report.

Eexcavations at Skhul are supported by the Gerda Henkel Foundation, the Leakey Foundation and the Irene Levi Sala CARE Archaeological Foundation.

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Poster Presentation Number 53, Fr 18:15-19:00

The Gorodtsovian as a particular cultural phenomenon of the Eastern European Upper Palaeolithic

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Like almost all cultural entities of the Eastern European Upper Palaeolithic, the Gorodtsovian was distinguished on materials from the Kostenki group of sites (Middle Don basin, Voronezh region). It was identified by P.P. Efimenko [1] shortly following 1952 excavation of Kostenki 15 (Gorodtsov' site), from which the Gorodtsovian takes its name. He combined under the taxon material from Kostenki 15, Kostenki 4 (cultural layer II) and Kostenki 14 (Markina Gora, layers I and II). The Gorodtsovian was recognized a containing a high content of typically "Mousterian" tool types, notably side-scrapers and points, as well as a dominance of steep-faced and often triangular (fan-shaped, eventail) end-scrapers tapering to the base, as well as splintered pieces. A.N. Rogachev, who excavated all Gorodtsovian sites, considered as Gorodtsovian: Kostenki 15, Kostenki 12 (layer I, locality B), Kostenki 2, Kostenki 3, Kostenki 4 (cultural layer II) [2]. Later, G.P. Grigorev [3] proposed a reduced number of Gorodtsovian assemblages restricted to sites geo-chronologically positioned in Upper Humic Bed deposits (= chronological group II of the Kostenki model): Kostenki 14 (layer II), Kostenki 15, Kostenki 16 and Kostenki 12 (layer I, locality B), ordered according to the decreasing number of Mousterian tool-types. A.A. Sinitsyn [4] then broadened the category by including as Gorodtsovian all assemblages of chronological group II of non-Aurignacian and non-Gravettian attribution.

On the basis of series of radiocarbon dates made in the 1980s, the chronological position of Kostenki's chronological group II was determined as 32-27 ka, within which Gorodtsovian sites occupied the uppermost position, together with the Early Gravettian (Kostenki 8, layer II).

In any understanding of its contents, it seems that approaches to tool manufacture and more generally the material culture of Gorodtsovian populations were less fixed and were freer than manufacture technologies and tool-kits of other cultural entities. There is only one "index fossil" for identification of assemblages as Gorodtsovian: a specific type of mammoth bone knife/shovel with capitate handle (according to P.P. Efimenko) or knife-spatula with a handle with nail-like head (according to A.N. Rogachev).

Beyond Kostenki, A.N. Rogachev saw the closest analogy for the Gorodtsovian at Talitsky' site (Ostrovskaya) in the Chusovaya basin (Mid Urals) and Karacharovo on the Oka River. Modern chronological data and comparative studies of archeological assemblages argue against these analogies. Of more importance is the apparent similarity between Gorodtsovian assemblages (and particularly Kostenki 15) with Mira on the Lower Dnieper.

The most recent radiocarbon dates position the Gorodtsovian within a relatively short period between 29-27 ka. It appears to be a specific cultural phenomenon of the Eastern European Upper Paleolithic that has no direct analogies in Central and Western Europe, unlike the preceding Aurignacian and the contemporary Early Gravettian (Kostenki 8-II). The Gorodtsovian's key sites are Kostenki 14-II and Kostenki 15, alongside additional debatable but probable assemblages from Kostenki 12 (layer I), Kostenki 16 and Mira. Its principle distinguishing features are: (1) a marked techno-typological variability; (2) a high degree of flake (rather than blade) technology for tool production, up to total dominance of the Kostenki 14 Layer II assemblage; (3) a high content (up to 50% in Kostenki 14 layer II) of typically "Mousterian" tool types, mostly side-scrapers; (4) a scarcity of burins, up to their complete lack at Kostenki 14 Layer II; and (5) high indices and marked variability of end-scrapers and splintered pieces.

Finally, the Gorodtsovian is a good example of the common system of cultural values, including technological, aesthetic, behavioral and possibly ritual subsystems [5].

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Podium Presentation Session 3, Th 15:00

Genomic models of early modern human populations in Africa

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Genomic sequencing of archaeological material has revolutionized our understanding of the human past in Eurasia, but ancient DNA sequencing has yet to be comprehensively brought to benefit the study of Africa's past. I will discuss our current state of understanding of the genomic record of past African populations, and how this record can be interpreted together with the archaeological, fossil and climatic records. I will present inference of population genetic models of prehistoric African population history based on both ancient genome sequences and present-day genetic diversity. Analysis of ancient genomes from Africa [1-4] now emphasize long-distance interconnectivity between early Holocene southern African and eastern African populations, and new evidence of deep human population structure in Africa around the time of emergence of anatomically modern humans. Specifically, new results provide evidence for deep structure in west Africa that may reflect some of the earliest diversifications of population lineages contributing to present-day populations [2]. Additional analyses that I will present now highlight the possibility of an ancient expansion from the east into western Africa, in possible concordance with the archaeological record and oral histories or the region. We also consider a new class of models for continuous genetic structure that may provide alternative explanations. These continuous models can be fitted as one-dimensional stepping stone "chains" of up multiple populations, and allow predictions of the model to be explicitly tested and deviations identified. Regardless of the promises and limitations of models of the deep human past, the ancient genomic record obtained so far reveals substantial impacts of expansions of food-production on early Holocene hunter-gatherer metapopulations in Africa. Together, the preliminary ancient genomic record of Africa cautions against extrapolating genetic models of the deep past from more recent data, and highlight the need for further ancient DNA studies in Africa.

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Podium Presentation Session 1, Th 9:30

Direct evidence for admixture among Pleistocene hominins: The genome of a Neandertal/Denisovan offspring

Viviane Slon[1], Fabrizio Mafessoni[1], Benjamin Vernot[1], Cesare de Filippo[1], Steffi Grote[1], Bence Viola[2,3], Mateja Hajdinjak[1], Stéphane Peyrégne[1], Sarah Nagel[1], Samantha Brown[4], Katerina Douka[4,5], Tom Higham[5], Maxim Kozlikin[3], Michael Shunkov[3,6], Anatoly Derevianko[3], Janet Kelso[1], Matthias Meyer[1], Kay Prüfer[1], Svante Pääbo[1]

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Denisovans and Neandertals are two archaic hominin groups that separated from each other at least 390,000 years ago [1]. Remains of individuals from both groups have been discovered in Denisova Cave (Russia), including one Denisovan ("*Denisova 3*") and one Neandertal ("*Altai Neandertal*", also known as "*Denisova 5*") whose genomes have been sequenced to high coverage [2,3]. We present the genome of "*Denisova 11*", a morphologically undiagnostic bone fragment excavated in Layer 12 of the Eastern Gallery of Denisova Cave. Collagen peptide mass fingerprinting enabled its identification as a hominin bone, and direct radiocarbon dating showed that the individual lived >50,000 years ago [4]. By comparing the thickness of the bone fragment to long bones of recent modern humans and Neandertals, we estimate that *Denisova 11* was at least 13 years old. We extracted DNA from 175 mg of bone powder collected by taking multiple small samples from the specimen and sequenced the genome of *Denisova 11* to an average coverage of 2.6-fold. The occurrence of damage-induced nucleotide substitutions at the ends of the sequenced DNA fragments attest to the preservation of ancient DNA in the specimen. A comparison of the sequence coverage of the X chromosome and the autosomes indicates that *Denisova 11* was a female. To attribute *Denisova 11* to a hominin group, we determined the proportions of DNA fragments that match derived genetic variants seen in the genomes of the *Altai Neandertal*, *Denisova 3*, or a present-day African individual. While the DNA fragments from *Denisova 11* matched the present-day human state in 1.2% of cases, they matched the Neandertal state in 38.6% of cases and the Denisovan state in 42.3% of cases. This surprising result suggests that *Denisova 11* had ancestry from both Neandertal and Denisovans, in approximately equal amounts. A signal of mixed ancestry in the genome of *Denisova 11* could arise if her parents belonged to a population with mixed Neandertal and Denisovan ancestry; or if one of her parents was a Neandertal and the other a Denisovan. To investigate which of these scenarios is more likely, we sampled two DNA fragments from *Denisova 11* at sites where the *Altai Neandertal* genome differs from the *Denisova 3* genome. In 43.5% of cases, one DNA fragment from *Denisova 11* matched the Neandertal state while the other matched the Denisovan state. This proportion fits the numbers expected from an offspring of a Neandertal and a Denisovan best. Since *Denisova 11* carries a mitochondrial genome of the Neandertal type [4], we conclude that she was the daughter of a Neandertal mother and a Denisovan father. The genome of *Denisova 11* thus provides direct evidence for admixture between Neandertals and Denisovans approximately 300,000 years after the separation of the two hominin groups, adding to mounting evidence suggesting that admixture between hominin groups in the Pleistocene was frequent when they encountered each other.

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Podium Presentation Session 12, Sa 17:30

Subsistence strategies throughout the African Middle Pleistocene: zooarchaeological evidence for behavioural change and continuity across the Earlier to Middle Stone Age transition

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Current genetic and fossil data consistently point towards the emergence of the modern human evolutionary lineage in Africa during the late Middle Pleistocene [1, 2]. The Middle Pleistocene (ca. 780-128 ka BP) in Africa also encompasses a technological change from the Earlier Stone Age (ESA) Acheulean technocomplex, characterised by handaxes and large cutting tools, to assemblages dominated by flakes, points and the use of prepared core technologies labelled as the Middle Stone Age (MSA). This lithic turnover appears to be associated with an increase in the use of exotic raw materials, pigments and a broader resource strategy including large and small prey [3].Such data have been used to argue for a significant re-organization of hominin landscape use, reflecting a more mobile lifestyle driven, in part, by climate and environmental instability [4].

Faunal data provides insights into the subsistence behaviour of Middle Pleistocene hominins, including prey selection, transport distances and carcass processing. To complement current research on site or regional lithic studies, we undertook a meta-study of published faunal data from the African Middle Pleistocene. This characterized the faunal record for this period and facilitated comparisons of hominin subsistence behaviour between the late Acheulean and earlier MSA techncomplexes.

40 archaeological localities with preserved fauna, comprising 63 faunal assemblages, were identified and synthesized in an extensive database. Next, a four-fold categorization scheme highlighted available data and its interpretive value. This identified 27 well-contextualised faunal assemblages with either quantitative palaeontological and/or zooarchaeological data. Palaeontological data was sorted by species and body size class (BSC); generalised linear mixed modelling (GLMM) characterized the relationship between BSC and technology, while considering context and differential abundances across assemblages. Finally, zooarchaeological data on carnivore and human bone surface modifications (BSM) allowed the further study of variation in carcass access and butchering intensity across the Middle Pleistocene.

Sites were identified from all regions except western Africa. 52 faunal assemblages were dated securely to the Middle Pleistocene, equally spread between Early (781 to 345ka BP, n=23) and late Middle Pleistocene (345 to 128ka BP, n=29). The structure of the sample illustrates that most Acheulean sites are open-air while earlier MSA are cave locales.

At each site type a range of herbivore species were recorded, dominated by BSC 3 and 4 animals such as zebras, kudu, wildebeest, and buffalo. The best supported GLMM suggests the MSA is associated with smaller sample sizes across all BSCs but the distribution across the classes remains consistent throughout the Middle Pleistocene and between late Acheulean and earlier MSA. However, BSC distribution is structured by context (open-air vs. cave) with larger BSC rarer in cave settings.

Similarly, zooarchaeological data illustrates higher proportions of carnivore modifications across late Acheulean assemblages relative to hominin bone surface modifications, with a reverse pattern during the early MSA. Increased hominin BSM during the earlier MSA could illustrate increased primary access, linked to greater transport (to cave locations) and more intensive carcass processing.

Continuity in the structure of late Acheulean and early MSA faunal assemblages is offset by increased cave use, reduction in animals of the largest BSC and increased hominin carcass processing intensity. This study provides a comprehensive discussion of hominin subsistence change across the Middle Pleistocene. Further work may correlate these trends with broader patterns of behavioural change (lithic technology, transport, pigments) during the late Middle Pleistocene and whether this relates, more specifically, with the emergence of the modern human lineage.

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Poster Presentation Number 49, Fr 18:15-19:00

The Sanzako: an almost unknown techno-complex in the Mumba Rockshelter (Lake Eyasi, Tanzania)

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Located in the Northwest of Lake Eyasi, Mumba Rockshelter is a key archaeological site in order to discover the Stone Age of Eastern Africa. Its stratigraphy, covering the last 130 000 years, includes levels from the Middle Stone Age, the Later Stone Age and the Pastoral Neolithic. The site has been dug out on several occasions, being the first one between 1934 and 1938 by Margit Köhl-Larsen, and subsequently by Michael Mehlman in 1977 and between 1979-1980,[1] as well as by Domínguez-Rodrigo in 2005,[2], [3] defining one the oldest LSA in the continent. Currently, the stratigraphic sequence is made of the following periods: VI-B level - MSA (Sanzako); VI-A level - MSA (Kisele); V level - LSA (Mumba); Lower III level- LSA (Nasera); Middle III level -LSA and Upper III level - LSA/Kansyore pottery (Oldeani).

Regarding the MSA, Mumba has helped to systematize two industries in Northern Tanzania: Sanzako (+/-130 Ka BP) and Kisele (90-50 Ka BP). However, this serialization was carried out by using the collections obtained by Kohl-Larsen, as the ones from Mehlman were unprecedented and nothing is known about them.

Four decades after the last excavation in the VI-B level, split in three sub-levels (lower, middle and upper), the hypothesis on the MSA origin and the methodology to examine the lithic industry required the study of this level so as to understand the technological dynamics of the first Modern Human beings in the region on the basis of one key site in the area. Thus, in this paper we introduce the first research on the VI-B level in the excavations conducted by Mehlman which, as we have already mentioned, were unprecedented up to now.

Among the three levels, 3282 pieces have been analyzed: 2 of them in the lower VI-B level, where there were no retouched pieces; 451 pieces in the middle VI-B level, where there were 33 retouched pieces; and 2829 pieces in the upper VI-B level, with 119 retouched pieces.

Technologically, it is characterized by the flake production from different operational schemes. Most of they are Discoid type. Levallois methods have a low representation, while Bipolar methods have an almost nonexistent representation. The bulk of retouched pieces are mainly denticulate tools prevail, followed by the scrapers and notches, tools associated with domestic activities.

This ensemble was proposed as an independent industry, the Sanzako, but it can only be found at Mumba Rockshelter. Hence, this paper evaluates the lithic collection of VI-B Mumba as well by contrasting it with other sites and industries in Northern Tanzania (Njarasan, Ngaloban, Kisele and Loiyangalanian). It takes into account that the regional sample was highly selected, that there are few sequences and sites being representative enough and that our collection might have been mutilated, as a small part of the materials was taken to the USA by Mehlman. Thereby, we aim to check the representation of the VI-B level of Mumba as a MSA industry in Northern Tanzania.

This study has been carried out thanks to funding provided by the HAR2015-64407-P MINECO/FEDER UE project. We would like to express our gratitude to COSTECH (Tanzania Commission for Science and Technology) for its permission to research; to the Olduvai Gorge Museum for making the research easier, and to the Olduvai Paleonthropology and Paleoecology Project (TOPPP), particularly to M. Domínguez-Rodrigo and E. Baquedano for their support.

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Pecha Kucha Presentation Session 6, Fr 11:55-12:20

Simulating fire-affected archaeological lithic assemblages using the computer-based model 'fiReproxies'

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The presence of evidence for fire use on an archaeological site, when available, is an important source of knowledge regarding the site's occupants. Careful examination of the nature and frequency of combustion features and fire residues can potentially provide insights into, for example, how often fire was used at a site [e.g.1], the function of individual fireplaces, what fuels were collected to feed the fires and how a site was structured (i.e. the position of the hearth in relation to other activities carried out at a site) [e.g. 2]. However, primary fire residues (i.e. intact combustion features, charcoal, ash) are not always preserved within some depositional settings. In such instances, fire proxy data (i.e. heated lithic artefacts, combusted/charred bone) are used to infer the relative amount of fire used and, when found in discrete concentrations, the probable locations of hearths. While previous experimental studies have demonstrated the physical effects of heat on stony artefacts [e.g. 3] and the underlying substrate [e.g. 4], the mechanisms influencing the proportion of fire proxies produced within archaeological layers remain understudied. In an attempt to remedy this, our fundamental study is the first to use a computer-based model (fiReproxies) to simulate the complex interplay of factors that could influence when and in what proportions lithic artefacts are heated by (anthropogenic) fires, thereby quantifying their relative effects [5]. The number of variables that factor into the production and preservation of fire residues and proxies is extensive, and it would be virtually impossible model them all. We have, however, incorporated into our model those variables we felt were the most important, including (among others) site occupation frequency, fire size and intensity, lithic production rate, sedimentation rate and site surface area. The model allows users to tabulate the expected percentages of heated lithics produced over the course of multiple occupation episodes within an archaeological level by adjusting the values set for the various parameters listed above per occupation of a site based on known or hypothetical environmental or cultural conditions. These tabulated percentages can then be compared to known heated lithic percentages from an archaeological site in an effort to understand which parameter settings could have resulted in these values. Determining which combination of parameter settings might be the most parsimonious explanation for the observed archaeological percentages can be assessed through comparison with known palaeoenvironmental (e.g. fauna or pollen assemblages), geological (e.g. estimated sedimentation rates) and/or archaeological evidences (e.g. other fire proxy data, or evidence pertaining to group mobility or site function). As an illustrative example, we apply our model to two hypothetical archaeological layers that reflect glacial and interglacial conditions during the late Middle Palaeolithic within a generic simulated cave site. Ultimately, the take-away message from this small proof-of-concept study is that under certain conditions, namely those that could be expected during colder climatic periods, estimated heated lithics percentages can be expected to be very low even if fire is used during every occupation of site within an archaeological layer. This has major implications for how archaeologists interpret fire use signals in layers where small amounts of heated lithics are present, but where primary evidence for fire use is not preserved.

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Podium Presentation Session 8, Fr 17:50

Evolutionary timing and relationships of the talar facets: implication for hominin talus

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With the rise of terrestrial bipedalism operating as a selective force, hominins evolved a suite of specialized skeletal adaptations (e.g., anteriorly placed foramen magnum, S-shape vertebral column, broad and flattened ribcage, wide and short pelvis, long lower limb, stable knee, relatively long and robust ankle region, arched foot) which together facilitate efficient bipedal gait as well as upright standing [1]. Among locomotor adaptations, the human foot is unique compared to other primates because it is highly specialized for bipedal walking. Specifically, the talus occupies a pivotal position between the leg and foot, as 1) it sustains the weight of the body while distributing load anteriorly (i.e., to the navicular) and inferiorly (i.e., to the calcaneus), 2) it contributes importantly to plantar and dorsi flexion of the foot, and 3) it is part of the medial longitudinal arch. Importantly, the talus is relatively frequently found element in the fossil records and therefore can be used to reconstruct locomotor patterns among fossil hominoids [2]. For all these reasons, there is a vast literature addressing the evolution of bipedalism based on talar morphology [3]. Until now, however, no work has addressed the evolutionary timing and functional significance of relationships of variation in talar facets among hominins. Here, we analyze hominoid talar morphology as a whole, as well as individual and combined talar facets 1) to determine the evolutionary timing for the appearance of the human-like talar facets, and 2) to evaluate the discriminatory power in recognizing bipedal features in single and combined talar facets. A template of 251 (semi) landmarks was used to analyze 81 Homo sapiens, 31 Gorilla, 29 Pan, and 20 fossil hominin specimens (Australopithecus afarensis, A. africanus, A. sediba, Paranthropus robustus, H. habilis, early Homo, H. erectus sensu lato, H. floresiensis, H. neanderthalensis). The advantage in using semi-landmarks is that they allow more robust estimation of missing data in incomplete specimens [4] that are frequently omitted from analyses due to their fragmentary conditions. We used digital reconstructions to estimate missing (semi)landmarks on damaged fossils with cracks and/or gaps in order to include as many as possible. Generalized Procrustes analysis was used to convert the (semi)landmark configurations to shape coordinates, and talar shape variation was explored by Principal Component Analysis [5]. The results of the whole talus analysis show wide separation between H. sapiens and African apes. No fossil hominins fall inside the range of ape morphospaces suggesting that all extinct hominins had acquired bipedal locomotion even if there may variation between species. The analysis of individual facets reveals different levels in distinguishing bipeds versus knuckle-walkers. The navicular facet appears human-like in A. afarensis, while more recent fossils, such as A. africanus and A. sediba retain more ape-like navicular facet morphology. The lateral malleolar facet seems to most effectively discriminate bipedal species from more arboreal species, suggesting that this facet evolved toward a bipedal form already in australopiths. When combining articular surfaces, the combined head, trochlea and posterior calcaneal facets perform the best, with a net separation between australopiths and Homo. Therefore, we suggest that the relative position of the major articular facets of the talus might inform about the presence of the medial longitudinal arch. Overall, this study points out that individual and combined talar facets vary in discriminatory power in recognizing bipedal forms, and that analysis of articular facets can contribute to the taxonomic and functional assessment of fragmentary fossil tali.

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Poster Presentation Number 64, Fr 19:00-19:45

Healthcare provisioning in evolutionary context

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We are increasingly recognising many complex ways in which the ecological, social, cognitive and anatomical elements of our human evolutionary past interact and influence each other. One relatively new area of this type of interaction is the potential significance of healthcare provisioning on other realms of human evolution and behaviour. Evidence from skeletal remains for care has traditionally been considered to be subject to some debate. However, whilst precise interpretations remain open to discussion, widespread evidence for healthcare in Palaeolithic contexts is now widely accepted [1] [2] [3]. Healthcare practices are significant in several ways, such as by changing the profile of how injuries impact both group subsistence and individual survival, as well as having a profound impact of social relationships. Here we explore this issue through the interpretation of a large scale survey of evidence for care practices in early, archaic and modern humans. We consider the ecological basis for care for the ill and injured, how such care changes through time and in different contexts, the role of care practices in group survival, and the potential influence of increasingly sophisticated medical knowledge on care. Although healthcare provisioning has typically been seen in purely cultural terms, we argue that it is not only a significant and often overlooked element of social relationships throughout the Palaeolithic but is also of evolutionary significance. While other animals provision the ill and injured, none go to such lengths or with such competency as seen in archaic humans, as recent research has started to highlight [4] [5]. Healthcare practices in such groups are likely to have included not only provision of food and water and protection from predators, but also a knowledgeable approach to promoting wound healing and recovery from severe injury. We argue this adaptation was an important part of hominin sociality and may have become especially important to humans that were trying to survive in hostile environments.

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Pecha Kucha Presentation Session 10, Sa 11:55-12:20

First experimental analysis of the bonobo and common chimpanzee middle ear function

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While hearing in humans is studied well, audition in great apes remains poorly understood. Comparisons of hearing capacities of humans and the common chimpanzee, the only great ape species tested so far, suggest distinct differences between the two species. While common chimpanzees show an overall hearing pattern most similar to old world monkeys, a number of auditory specialization have been found in humans. Even though the functional basis for these auditory differences is not yet understood recent research has shown a number of striking differences in the morphology of the middle ear of humans and chimpanzees including distinctly larger tympanic membranes, smaller stapes footplates and differently shaped ear ossicles in the latter. In reference to these anatomical differences our aim thus was to experimentally study the functional morphology of the middle ear of great apes for the first time ever. Therefore, we measured the middle ear transfer function (METF) of the two chimpanzee species and made comparisons to the human METF. Experiments were performed on cadavers of two common chimpanzees (*Pan troglodytes*), three bonobos (*Pan paniscus*) and 15 human (*Homo sapiens*) temporal bone preparations. In order to characterize the METF we recorded stapes footplate vibrations using laser-Doppler vibrometry after access to the tympanic cavity was gained via an extended posterior tympanotomy of the left and right temporal bones. In all specimens, the middle ear was excited acoustically through the external ear canal and the investigated frequency bandwidth ranged between 100 Hz and 10 kHz. While the general progression of the METF of *Pan* and *Homo* shows a similar pattern we also found a number of distinct differences between the two genera. In the low-frequency range (<1 kHz) of both chimpanzee species, the METF is shifted upward compared to that of humans. Both genera show a decrease in the magnitude of the METF after it reaches 1 kHz. However, while the METF in humans continuously decreases until the end of the measuring range is reached, it characteristically slopes upwards around 4-5 kHz in *Pan* and progresses above the human curve. Overall, the METF of bonobos is similar to the one of common chimpanzees. However, when comparing the two chimpanzee species to each other, we found a generally more heightened METF in the bonobo. An elevated METF as seen in the low-frequency range of chimpanzees likely relates to a lower stiffness of the absolutely larger tympanic membrane and the larger area ratio of the tympanic membrane to the stapes footplate of these great apes. The adaptive explanation for this pattern could relate to the acoustic properties and/or the need for efficient long distance communication within the forested habitats most chimpanzee populations occupy. We further expect the characteristic shift in direction seen in the METF of chimpanzees but not humans to result from differences in timing of the motional behavior of the middle ear components due to differences in anatomy. Our experiments indicate that differences in auditory capacities between humans and chimpanzees are also related to differences in middle ear morphology. This opens up promising new avenues for studying the evolution of hearing in hominins based on the morphology of fossil middle ears and may shed light on the evolution of hearing sensitivity relevant for language perception.

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Poster Presentation Number 35, Fr 18:15-19:00

Prediction of third molar impaction based on 2D geometric morphometric analysis

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Third molar (M3) impaction mostly concerns modern industrialized societies. The etiology of M3 impaction is controversial, yet has become the basis for risk-related prophylactic M3 removal. Current models for predicting M3 eruption, mainly the lower M3, are inaccurate [1-3]. We performed a 2D geometric morphometric analysis to predict M3 impaction, taking into account covariation between M3 position and the form of the dental arches. 108 landmarks and semilandmarks were digitized on lateral cephalograms generated from Computed Tomogrpahy (CT) scans of 64 patients of both sexes (age 15.6 to 43.4 years) with complete dental arches not altered by previous orthodontic or prosthodontic treatments. Their M3s ranged from fully impacted to fully erupted. Mesiodistal and buccolingual M3 crown diameters were measured on the CT images. Separately by jaw and sex, the correlation between the M3 measurements and the form of the posterior alveolar arches was estimated via shape regression analysis, and prediction of eruption group (favorable/unfavorable) by logistic regression on the predicted shape regression score, M3 crown size, M3 inclination and the alveolar space available for the eruption. We report using the Nagelkerke R^2, a quantity representing the R^2 that would be reported for an equivalently powerful model that used ordinary instead of logistic regression [4].

Using two-block Partial Least Square analysis [5], we found a weak correlation between the posterior mandibular landmarks configuration and mesiodistal M3 size in females (r=0.45) and buccolingual M3 size in males (r=0.61). No correlation was observed between upper M3 diameters and the posterior maxillary landmark configuration in males but in females weak correlation (r=0.55) between buccolingual M3 size and the form of the posterior maxilla.

In females and males, respectively, Nagelkerke R^2's of 73% and 91% for impaction are generated from the form of the posterior part of the mandible, the inclination of M3 and the shortage of eruption space. In females, this R^2 is 62%, as predicted from the maxillary form, the inclination of M3 and the lack of eruption space. In males, the upper M3 impaction is independent of the posterior maxillary form, and the Nagelkerke R^2 is only 36%.

The pattern of the covariance between dental arcades and teeth indicates that the M3 impaction is strongly linked with size and size-related shape changes. The relative position of the jaw in sagittal direction and the posterior facial height correlate with M3 impaction, but M3 impaction is independent of the craniofacial type. The impaction of the wisdom teeth could be predicted by the M3 tilting and deficiency of space for eruption. The effect of the form of the posterior alveolar bone is negligible on M3 eruption. The jaws relationships mainly in the sagittal direction, the posterior facial height and the position of neighboring teeth have a substantial effect on M3 impaction.

The Medicina Co., Moscow, provided CT data; Dr. Cinzia Fornai helped at many points during this work.

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Pecha Kucha Presentation Session 2, Th 11:55-12:20

Season's Eatings! Establishing reference data for revealing seasonality from tooth wear in chimpanzee molars

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We previously showed that the well-studied Western chimpanzee population (*Pan troglodytes verus*) of the Taï National Park (Côte d'Ivoire) has distinct occlusal molar wear facet signatures in the dry and wet season [1]. These wear signatures were linked to seasonal variations in the diet and the variable presence of external abrasives, such as dust, on the food. Here, we use the Taï chimpanzee results as a reference dataset to predict dietary preferences and seasonal changes in dust loads on food of a historical population of *P. t. verus* from neighboring Liberia. Although, there is no detailed dietary information for this historical population, these chimpanzees will have occupied an evergreen lowland rain forest similar to the Taï forest. Added to this both populations are assumed to have undergone similar seasonal changes such as a bi-annual rainfall pattern, monthly precipitation rate and dust deposition through the Harmattan trade wind during the more pronounced dry season [2]. We therefore expect that the wear signatures of the Liberia population are comparable to those of the Taï chimpanzees. We investigated two central wear facets (f3, f9) on the upper first and second molars of 30 chimpanzees of the extant population from the Taï forest (of which 11 died during the Harmattan dry season and 19 during the wet season), and 32 chimpanzees originating from the northern part of the former Central Province of Liberia. Eleven 3D surface texture (ST) parameters from ISO 25178, motif and furrow analyses [3] were chosen to describe volume, density, height, depth and area of the wear facets. We found that STs of f3 differentiated better than those of f9 between dry and wet season in the Taï chimpanzee dataset. Of those Taï chimpanzees which died during the wet season f3 STs were heterogeneous with larger texture heights and increased variance compared to individuals which died during the dry season. STs found on the Liberia chimpanzee molars were in general similar to those of Taï chimpanzees from the dry season, showing homogeneous and flat surfaces with reduced variance. Moreover, the Liberia chimpanzee STs were found at the lower bound of the range of most ST parameters and showed the least variance of our sample. Our findings allow for two possible ecological scenarios for the Liberia population: 1) these chimpanzees engaged a highly abrasive diet, which led to the homogeneous and flat STs, and/or 2) the foods consumed carried a high amount of dust, which masked the dietary ST signals. Since the individuals of this Liberian chimpanzee population were known to be hunted for meat consumption [4], which is an activity reported to occur intensely during the dry season [5], this suggests that the second scenario may be more likely and that most of these chimpanzees died during the dry season. In general, our findings confirm that seasonal habitat changes are reflected in the tooth wear of chimpanzee molars, even those occupying closed canopy forests. Our approach therefore bears the great potential for reconstructing paleo-habitats and highlights what impact seasonal differences may have had on the dietary ecologies of fossil hominins.

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Poster Presentation Number 12, Fr 19:00-19:45

Walking on all fours : modifications of the locomotor system in quadrupedal humans

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The acquisition of habitual bipedal locomotion which resulted in numerous modifications of our skeleton was a crucial step in hominid evolution. However, our understanding of the inherited skeletal modifications versus those acquired while learning to walk remains limited. We here present unique data on an exceptional model of a quadrupedal adult human and compare his morphology to that of his bipedal brother. In a South Turkish village five adults of a family of 19 children suffer from a mutation at a gene of chromosome 17, inducing a loss of a fundamental protein implied in the development of the cerebellum [1]. The cerebellar hypoplasia results in a drastic imbalance which renders the acquisition of bipedal locomotion difficult. Our aim is to understand the impact of growth on a skeleton which presents the inherited characters of bipedalism but did not acquire the epigenetic features linked with bipedal gait acquisition [2,3,4] and was remodelled by a quadrupedal practice of walking. Two quadrupedal subjects and one bipedal brother 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 Aviso software. Our results demonstrate differences in the femur, pelvis, and lumbar vertebrae in the quadrupedal subject compared to his bipedal brother. Differences in the femur are marked and involve angular measurements including the lack of obliquity of the femur of the quadrupedal brother. The differences in the pelvis are more subtle and complex, yet of functional importance. The modification of the ischial spine to an ischial ridge and the perfectly rounded shape of the sacral curvature are two unique features that can be directly attributed to a quadrupedal locomotion. The angle of pelvic incidence, which increases with bipedal gait acquisition, is larger in the quadrupedal brother. In bipeds this angle is positively correlated with the degree of lumbar curvature while in the quadrupedal subject this curvature is nearly absent; a crucial functional association in bipeds is consequently disrupted. The marked differences in the femur, pelvis, and lumbar vertebrae in the quadrupedal subject compared to his bipedal brother are illustrated visually in our supplementary videos.

We thank Sevket Sen, director CNRS and paleontologist in the National Museum of Natural History of Paris who gave us advice and helped us prepare the project and the two trips to Turkey. We thank the radiologists and orthopedic assistants who performed the scans and x-rays of the patients in the Hospital of Adana. We thank P. Campignion, physiotherapist and teacher of physiotherapy, who used his anatomical knowledge to reconstruct the skeleton of the brother in a quadrupedal stance.

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Poster Presentation Number 61, Th 18:15-19:00

Quantifying curvature in bones without landmarks: a study of primate clavicles

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The clavicle remains a relatively understudied bone in the field of human evolution, despite the plethora of information it holds. This bone is of great importance in understanding the functional morphology of the upper limbs and shoulder girdle [1, 2]. Though infrequently preserved in the fossil record, fossil clavicles that have been discovered may hold the key to a deeper understanding of arm and shoulder morphology in our hominid relatives. The present study aims to provide new insight into hominid shoulder functional morphology by using qualitative and quantitative measurements of clavicular curvature and morphology. With the naked eye, identification of a clavicle to genus or species is quick and easy, with distinct differences in morphology between *Gorilla, Pan, Pongo, Papio* and hominids. Previous attempts to quantify these morphological differences have employed the use of linear measurements, 3D geometric morphometrics, and 2D geometric morphometrics. While linear measurements may quantify the magnitude of curvature, the distinct taxonomic shape profiles are almost entirely lost [1]. Due to the high levels of variation both within and between species, 3D geometric morphometrics can be very difficult to apply reliably because there are virtually no landmarks that are consistent across genera. While the use of semilandmarks may be utilized, the reproducibility and accuracy of landmark placement is low and therefore less than ideal [3]. 2D geometric morphometrics has most accurately captured clavicular shape and curvature thus far, but still fails to quantify the morphological differences that are visible to the eye [2]. The present study attempts to move towards a more encompassing quantitative measurement of clavicular morphology and curvature that captures the differences in shape between taxa. Analyses focus on clavicles from *Gorilla, Pan, Pongo, Papio, Homo, Australopithecus,* and OH 89, a recently discovered hominid clavicle not yet identified to taxon.

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Pecha Kucha Presentation Session 2, Th 12:20-12:45

The double pointed wooden stick of the palaeolithic site of Schöningen and its context

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Excavation of the site Schöningen 13/II-4, which is located in a lignite mine in the district of Helmstedt in lower Saxony, during the 1990s by H. Thieme provided the most important record of Palaeolithic wooden weapons (1). The site is about 300.000 years old and can probably be assigned to MIS 9. The find concentration was located along the shore of a former lake, where horse hunting took place. Among the worked objects were identified eight spears, a lance and a double pointed stick (1, 2). Successful use of the spears was tested by experiments (3). The status of preservation of the wooden pieces is good to excellent, but some compression of the soft wood material can be observed. There is some indication for a deposition of the wooden material during a longer period of time. This is indicated by the distribution of the objects and differences in the status of preservation. Since the excavation objects are stored in water and only the most important finds were treated for permanent conservation. Evaluation of the wooden material is going on and among otheres the record is checked for possible further worked objects. Some recent results will be presented in the lecture. There is increasing evidence that only spruce and pine were used for the manufacture of wooden tools (2). Systematic investigation of all pieces enables us to provide an updated list of worked wooden objects. One of the best preserved objects is a double pointed stick c. 78 cm long. Closer inspection of this find does allow a detailed reconstruction of the manufacturing process. What part of tree was used? How and to what extant was the surface of the piece processed. What kind of working traces are visible and can we identify specific tool / cut marks. On the basis of these results the function of the tool will be discussed. Are there any clear use wear traces visible on the tips? Finally the former identification of the object as a killing stick will be critically evaluated. Another aspect of the talk will be the find context of the object.

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Pecha Kucha Presentation Session 10, Sa 12:20-12:45

Trabecular structure in the distal tibia of *Australopithecus africanus* from Sterkfontein Member 4

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Trabecular fabric in the distal tibia has proven to be sensitive to subtle variation in ankle sagittal plane kinematics during experimental locomotor-related loading in both mammals and birds. Differences or similarities within primate trabecular structure can be insightful for interpreting gait kinematic experimentation in the hominin lineage leading to the evolution of obligate bipedalism. This study tested the hypothesis that trabecular structure in the distal tibiae is reflective of locomotor related loading and that the trabecular structure of *Australopithecus* from Sterkfontein Member 4 is more human-like in structure, reflecting bipedalism. High resolution computed tomography (micro-CT) images (25 – 48μm voxels) were acquired to quantify trabecular bone structure deep to the tibial plafond in extant comparative species with divergent locomotor behaviours, namely modern human hunter-gatherers *(Homo sapiens)*, *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus* and *Papio hamadryas*, as well as four fossil hominin individuals from Sterkfontein, Member 4 attributed to *A.africanus*. Nine trabecular sub-regions were isolated beneath the articular surface of the tibial plafond and further segmented into spherical volumes for quantification of localized structure. Descriptive statistics were used to visualize variation followed by an analysis of variance (ANOVA) ($p < 0.05$). A further stepwise discriminant function analysis (DFA) was conducted to assess the capability of trabecular structure to discriminate between species with divergent locomotor behaviours based on trabecular structural properties. The results of the multivariate DFA highlighted the ability of trabecular structure to distinguish species based on locomotor type and that the ability to differentiate species fluctuates between regions based on loading. Trabecular structure of *A. africanus* distal tibiae was highly variable, with some properties exhibiting greater variation than observed in any single extant species. The extent of this intraspecific variability in trabecular structure suggests the presence of two potentially different morphs in Sterkfontein Member 4. One morph resembled a baboon-like structure, composed of numerous thin trabecular struts that were highly oriented (i.e., anisotropically distributed), whilst the other morph resembled overlapping human-like and ape-like traits observed in previous studies of trabecular architecture in *A. africanus*. Based on the findings of this study, it can be concluded that trabecular structure in the distal tibia is effective at distinguishing species based on postural and locomotor behaviour, provided that homologous regions are sampled, and that trabecular bone structure and organization mirrors kinematic indicators of ankle loading regimes. When these criteria are met, trabecular fabrics may be a useful tool for reconstructing behaviour in fossil hominin specimens in order to corroborate external morphological studies.

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Poster Presentation Number 44, Fr 19:00-19:45

Baboon genetics and potential introgressive hybridization at Gorongosa National Park, Mozambique

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Baboons (Papio sp) are usually classified into six morphologically distinct species or subspecies. Baboons are parapatrically distributed throughout the African continent and a small part of the Arabian Peninsula. Hybridization between baboon morphs occurs naturally in contact zones. Recent studies have shown a complex evolutionary history of introgression between species, with yellow baboons exhibiting mitochondrial DNA (mtDNA) paraphyly. In order to explain this mtDNA paraphyly in Papio cynocephalus, it has been proposed that, in the past, males of P. ursinus dispersed north into P. cynocephalus range. In this scenario, gene flow would be mediated by introgressive hybridization producing a "nuclear swamping" effect in the descendant populations. This implies that descendants retained the mtDNA from yellow baboon but incrementally replaced their nuclear genome. Here we present a genetic assessment of natural hybridization in a population of baboons inhabiting Gorongosa National Park (GNP), Mozambique. GNP is located 100 km from a Papio cynocephalus and Papio ursinus predicted contact zone near the Zambezi River. Previous observations at GNP identified these troops as Papio ursinus or chacma baboons. However, many phenotypic features of the GNP baboons are similar to yellow baboons (Papio cynocephalus). Is hybridization between Papio cynocephalus and Papio ursinus taking place in Gorongosa National Park? Are the baboons from Gorongosa National Park the result of partial or complete introgressive hybridization between chacma and yellow baboons? In order to answer these questions, 186 baboon fecal samples were collected from different areas of the Park. DNA was extracted using Fast DNA Stool Mini Kit (QIAGEN ®) following a modified protocol to maximize the quantity and quality of extracted DNA in a room specially dedicated to non-invasive samples. The cytochrome b of the mtDNA was amplified and sequenced. Preliminary results show that mtDNA sequences from Gorongosa baboons are grouped within the same clade than northern chacma. Samples will be analysed using a set of 15 microsatellite loci to understand population structure within the park and identify genetically distinct individuals that could be hybrids between P. cynocephalus and P. ursinus. Our results will contribute for a better understanding of the evolutionary history of baboons in southern Africa and the biogeographical significance of the Zambezi River.

Poster Presentation Number 6, Fr 19:00-19:45

Trabecular bone ontogeny in the forelimb and hindlimb of chimpanzees

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Internal bone structure remodels during life and, as such, has the potential to reflect the behaviour of an individual during its lifetime. Extant apes, including humans, undergo locomotor transitions during ontogeny, although the mode and timing of these transitions differs across taxa. In chimpanzees, locomotor transitions are characterised by increasing frequencies of hindlimb loaded locomotor modes (e.g. knuckle-walking) and reduced frequencies of forelimb loading (e.g. suspension) with increasing age [1-3]. As trabecular bone is likely to respond to changing loads during ontogeny [4, 5], its structure across an ontogenetic series may reflect the mechanical loading that characterises these locomotor stages.

We investigated changes in trabecular bone structure during ontogeny in the proximal humerus, proximal femur and distal tibia across a single population of chimpanzees (*Pan troglodytes verus*) from the Taï National Park, Côte d'Ivoire. Using high-resolution microtomographic scans, trabecular structure was quantified in volumes of interest (VOIs) and across the entire metaphysis in a sample of 21 subadult individuals. Spherical VOIs were placed in similar locations across age categories, and bone volume fraction (BV/TV), trabecular thickness (Tb.Th), trabecular spacing (Tb.Sp), trabecular number (Tb.N), and degree of anisotropy (DA) were quantified. Ratios of each trabecular variable between the elements were used to interpret the differing patterns in each skeletal region. Morphometric maps were generated to visualise the distribution of BV/TV and the orientation of trabecular bone throughout the metaphysis.

Results from VOIs indicate that trabecular structure beneath the growth plate differs across ontogenetic stages in chimpanzees. There is an increase in both BV/TV and Tb.Th with increasing age that is more pronounced in the hindlimb elements than that of the humerus. There is little change in Tb.N and Tb.Sp across ontogeny. The pattern of DA differs between elements. In the proximal humerus and distal tibia, DA is initially high but reduces until around five years of age, and then increases again. In contrast, in the proximal femur, DA is relatively similar across younger age groups and increases at adolescence. Morphometric maps of BV/TV distribution show that bone is homogeneously distributed at birth, but with increasing age, trabecular bone becomes more heterogeneous. In all elements, trabeculae are initially proximodistally oriented throughout the metaphysis, with the primary orientations becoming more variable after one or two years of age.

The pattern of trabecular ontogeny in the chimpanzee proximal humerus, proximal femur and distal tibia is characterised by an increased amount of bone and thicker trabecular struts with age, but limited changes in the spacing between trabeculae. Changes in DA within the humerus and tibia may reflect a locomotor transition from more variable, arboreal loading before five years of age, to more stereotypical loading as knuckle-walking becomes more frequent. Relative to the humerus and tibia, the proximal femur has a greater increase in robusticity during ontogeny. This first study of trabecular ontogeny in chimpanzee long bones reveals striking differences with published analyses of humans, including the presence of a high BV/TV at birth and rapid changes in trabecular structure around two years of age in humans [5], neither of which are documented in chimpanzees. Overall, these findings demonstrate that analysis of trabecular ontogeny in extant apes has the potential to reveal developmental changes in the locomotor repertoire and that the trabecular pattern varies between chimpanzees and humans, both of which have important implications for robust reconstruction of behaviour in fossil hominins.

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Poster Presentation Number 13, Fr 18:15-19:00

Phylogenetic perspectives on Catarrhine talo-crural joint morphology and phenotypic plasticity: a phylomorphospace approach

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The current study examines shape in the talo-crural joint (TCJ) of the common ancestor of African apes and Old World monkeys. Phylomorphospace, the projection of phylogeny into multivariate morphospace, can map diversity of shape, its magnitude and direction across a phylogeny. It can estimate the possible ancestral shape of a highly integrated and modular structure, such as, the TCJ, among related extant species if a strong phylogenetic signal is present. Prior trajectory analysis of TCJ ontogeny suggested a morphological change in response to habitual substrate use (epigenetic signal) among adults, but not among subadults (genetic signal). Adults and subadults were studied to identify the influence of phylogeny and substrate use on shape in the two subgroups. Two hundred forty one adult and subadult talo-crural osteological specimens, divided by developmental age based on molars erupted into occlusion (M2, M3) formed the study group. It included four species of African ape: *Gorilla gorilla* (13, 39), *Homo sapiens* (8, 56), *Pan troglodytes* (12, 21), and *Pan paniscus* (9, 10); plus four species of Old World monkey: *Papio hamadryas* (5, 12), *Nasalis larvatus* (3, 11), *Macaca mullata* (10, 12), and *Macaca fascicularis* (8, 12). Substrate use for all species was scored from 0 (most arboreal) to 10 (most terrestrial) based on the literature. For each specimen the matched talus and tibia from one side were laser scanned and digitally reconstructed. Twenty seven landmarks were placed, 15 on the proximal talar facets and 12 on the distal tibial facets, using *Landmark Editor*. *Geomorph in R* and *Phytools in R* were used to perform all subsequent analyses. Following generalized Procrustes analysis, Catarrhine phylogeny from the 10K trees website was projected into multivariate space, with squared change parsimony estimating TCJ for ancestral nodes. Phylomorphospace was explored separately for each developmental stage and each element with respect to phylogeny and substrate use. Phylomorphospace plots reveal a genetic signal in both the subadult talus and tibia with a strong phylogenetic signal ($p<0.001$, and $p<0.003$ respectively). In adults neither the talus nor tibia showed a phylogenetic signal ($p<0.322$, and $p<0.639$ respectively). The plots of subadult tali and tibiae were consistent with the phylogenetic plots of both hominoids and cercopithecoids and the common ancestral node was central to the plot. Plots including substrate preference revealed an association in adults, but not subadults, consistent with an epigenetic signal. A common ancestor for TCJ shape generated from the subadult talar and tibial plots, consistent with their strong phylogenetic signals, was produced. Our results suggest that subadult ankle morphology preserves a strong phylogenetic signal, but it is not preserved in adults. This seems to be due to the influence of habitual substrate use and the consequence of bone remodeling during the latter part of development. A common ancestral shape of the TCJ can reliably be produced from the subadults among a diverse sample of Catarrhine taxa. Consistent with prior ontogenetic trajectory analysis adults showed an epigenetic signal (phenotypic plasticity) that must be taken into account before estimating common ancestral morphology, while subadults provide a genetic signal with the potential to reconstruct common ancestral shape in other morphological features.

Poster Presentation Number 57, Fr 18:15-19:00

Middle to Upper Paleolithic Transition : New Data about Utililization of Bone Raw Materials based on the Finds from Ortvala Klde and Bondi Caves and Unexpected Discovery in Ortvala Klde (SOUTH CAUCA)

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New researches of Otvala Klde and Bondi Caves, located in about 6 km from each other on territory of Chiatura Municipality (Imereti region, Western Georgia) have led to the important conclusions distinguishing this Paleolithic region from the North and South Caucasus. The life support system, the strategy of hunting of Neanderthals, as well as cutting, transportation and (consumption) meat diets were quite similar to those which were practiced by the modern humans in Upper Paleolithic. The anthropogenic influences on Ortvale Klde and Bondi Cave faunal remains have been defined by using the experimental and traceological methods. During the studies of the primary knapping and splitting of the bones the results of studying of the tools structures, exact addresses of the finds and the comparative methodology have been taking into account The conclusion is drawn that some part of primary prepared workpieces were made on the elongated tubular bones of hoofed animals. Also, they could be the results of the additional deliberate blows to the cracks of the bone subject's longitudinal axes and blows to the end-faces of the epiphyses. The question about the additional food sources other than eating of the marrow, and their role in emergence of the technology of longitudinal splitting in the bone industries is raised.

According to the results of the new studies of Middle and Upper Paleolithic bone materials from Ortvala Klde is observed the continuity of uniform, similar strategy of utilization of the bone raw materials, which was connected directly with the features of the type of life and the ancient economy. Respectively, we have received one more confirmation of the similar life support system of Middle Paleolithic Neanderthals and the Early Upper Paleolithic Modern Humans during EUP and Final Middle Paleolithic of Western Georgia. We found the collar-bone belonged to Macaque during the re-study of the bone collections of Ortvala Klde. The bone was discovered in the Layer 4, corresponding to the Middle to Upper Paleolithic Transitional industry by me (mixed layer, according to Adler, Bar-Yosef etc.). Until to the present, on the territory of Georgia the Macaque remains have been discovered only in the Acheulean Layer of Kudaro I, which was dated by the radiothermoluminescent method (360-350 000 ka BP). This unexpected find is arising some new questions about the Paleoenvironmemt and the faunal species of Western Georgia during Late Pleistocene.

We are grateful to our colleagues at Harvard, Hebrew and Haifa Universities O. Bar-Yosef , A. Belfer-Cohen and Guy Bar-Oz for their collaboration during our many years of research of Ortvala Klde. We thank the Georgian State Museum and D. Lordkipanidze, A. Vekua, for their collaboration and assistance during our works on the bone collections from Ortvala Klde preserved at the museum. We thank N. Jakeli and the Ilia State University students and volunteers who took part in fieldwork and laboratory analyses. We are grateful to the Institute of Human Paleontologie (Paris, France) and our colleagues Marie-Helen Moncel and David Pleurdeau for the collaboration and the joint project on study of Ortvala Klde in 2006-2007. We thank N. Mercier (Laboratoire des Sciences du Climat et de l'Environnement], E. Boaretto (Weizman Institute of Science), and J. Rink (McMaster University) for their assistance in the dating of Ortvale Klde.

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Pecha Kucha Presentation Session 10, Sa 11:55-12:20

Analysis of the primate vestibular apparatus: a comparison of landmark-based and deformation-based 3D geometric morphometric approaches

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Inferring the positional behavior of extinct taxa is crucial for understanding the evolution of the ape and human clade (Hominoidea), with implications for reconstructing the locomotion of the last common ancestor between humans and chimps preceding human bipedalism. Besides a morphofunctional approach applied to the postcranium, several authors have relied on the morphology of the vestibular apparatus to infer the locomotion of extinct primates [1-2]. The vestibular apparatus, housed in the bony labyrinth, is composed of three semicircular canals, the utricle, and the saccule. These structures detect angular accelerations and provide sensory input for stabilizing the vision during rotary movements of the head, thereby being functionally related with maintaining balance during locomotion [1-4]. Different approaches based on inner ear morphology have been applied to gain insight on the locomotor repertoire of fossil primates [1-2]. Nevertheless, there is no current consensus about the most efficient methodology for assessing the locomotor repertoire of extinct species. Here we compare the results of two three-dimensional geometric morphometrics (3DGM) methods applied to the vestibular apparatus of extant primates, with emphasis on their potential for predicting the positional behavior of the investigated taxa: landmark-based and deformation-based 3DGM. The former relies on generalized Procrustes superimposition, whereas the latter directly compare the shape of different surfaces via continuous and invertible deformation [5]. While the preparation of the landmark set is more time consuming, deformation analysis needs higher computational power. We used a set of 9 landmarks and 128 semilandmarks distributed along each canal and the common crus. The deformation was calculated on the surfaces of the vestibular apparatus, cut at the connection with the cochlea. The studied sample includes 14 different catarrhine (hominoid and cercopithecoid) genera, representing 21 species. Principal components analysis (PCA) was performed for each method to assess morphological variation among genera. Univariate and multivariate Blomberg's K and Pagel's λ were used to evaluate phylogenetic signal in landmark-based method within the main axes of shape variation. Both analyses yield similar results and discriminate well between humans, great apes and the remaining catarrhines. Monkeys cluster together in the center of the morphospace (hylobatids overlap with cercopithecoids in the deformation results), whereas great apes are distinguished (especially in PC1) for having more eccentric and compressed semicircular canals, and *Homo* occupies a very distinct position in both PC1 and PC2, due to lateral canal morphology. Focusing on hominoids alone, discrimination among genera increases, although there is still some overlap between gorillas, chimpanzees and orangutans. The analysis therefore discriminates well between the bipedal humans, the agile ricochetal brachiators (gibbons), and the larger-bodied great apes, although among the latter there is some overlap between the knuckle-walking African apes and the more arboreal orangutans. Univariate estimation of the phylogenetic signal presents significant results for PC1 ($K=2.7$; $\lambda=0.99$) and PC3 ($K=0.47$), indicating that PC1 reflects shape changes closely approaching phylogenetic divergence. However, multivariate analysis indicates higher variance than that expected under Brownian motion between close relatives ($K=0.4$; $\lambda=0.53$), possibly implying some degree of homoplasy in overall vestibular morphology. In conclusion, both 3DGM analyses of primate vestibular apparatus give comparable results and appear to be reliable for discriminating among the studied primates genera on the grounds of positional behavior. Although phylogeny has an effect on the major axis of shape variation, and will be analyzed in future studies, overall vestibular apparatus shape is driven by other factors of functional relevance.

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Poster Presentation Number 43, Th 18:15-19:00

Digital reconstruction of the LB1 *H. floresiensis* cranium

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It is well known that interpretation of the human fossil record is complicated by variation in fossil preservation, particularly when those fossils are fragmented and/or distorted. Although qualitative morphological information can sometimes be gathered from a distorted fossil, morphometric and/or biomechanical analyses [1, 2] can be compromised because the integrity of the fossil is often an essential prerequisite. The logical consequence is that fragmented and/or distorted fossils are excluded from advanced morphometric and/or biomechanical analyses, thus reducing the fossil sample size and, ultimately, our knowledge of human evolution. In this contribution we present a virtual reconstruction of the H. floresiensis holotype (LB1) cranium using state of-the-art three-dimensional (3D) digital modelling and GM methods [3]. The LB1 cranium, along with the post-cranium, was recovered in September 2003 during archaeological excavation at Liang Bua, a limestone cave on Flores in eastern Indonesia 14 km north of Ruteng (the provincial capital of Manggarai Province). The age of LB1 ranges between 60.000 years ago (kyr) and 100.000 kyr [4]. As far as the skull is concerned, while the mandible is almost complete (apart the left condyle), the bregmatic region, right frontal, supraorbital, nasal and sub-nasal regions were discovered damaged [5]. Moreover, LB1 shows cranial asymmetry, which has been considered by some authors to be similar to that observed in non-pathological African ape and fossil hominin crania, but by others as positional deformational plagiocephaly, a condition that results from plastic deformation of the skull during infancy. Overall, even though the LB1 skull is mostly preserved, the fragmented and missing regions of the cranium coupled with the alleged physiological cranial asymmetry (post-depositional deformation cannot be entirely dismissed), a digital reconstruction is required in order to use the specimen for morphometric and biomechanical analysis. 3D digital models of the external cranial surface, endocranium, mandible, and upper and lower teeth were obtained from the CT image data acquired by Brown and colleagues in April 2004. The first step entailed the reconstruction of the right zygomatic arch, left supraorbital bone and left mandibular condyle by mirror imaging the preserved side, that is using morphological information of the original specimen. Then, the remaining missing parts (i.e., bregmatic, nasal and sub-nasal regions) were virtually restored by warping a reference cranium, i.e. KNM-ER 1813 (H. habilis) using thin plate spline interpolation. Finally, a symmetric version of LB1 cranium was obtained using reflected relabelling. This new reconstruction provides the opportunity to adjust and/or integrate previous cranial measurements and is suitable for further quantitative studies, such as assessing cranial morphological variation using GM methods or testing hypothesis of feeding behaviour by means of finite element analysis.

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Podium Presentation Session 11, Sa 14:40

Of teeth and algorithms: machine learning reveals the taxonomy of Sima de los Huesos

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The taxonomic attribution of the skeletal material of Sima de los Huesos (SH, Spain) has puzzled researchers for decades. At the time of their discovery, the SH hominins were considered as pre-Neanderthal based on their morphology [1]. Later, tooth dimensions were found to link the SH sample to middle Pleistocene specimens such as Mauer, Montmaurin, and Arago II [2], which are commonly ascribed to *Homo heidelbergensis*. More recently, a close relationship between Neanderthals and the SH specimens was suggested based on the morphology of cranial vault and face, in particular regarding the masticatory apparatus [3]. Decades of unresolved debate produced three plausible scenarios for the status of SH in the human ancestry:

(I) SH has to be regarded as part of the variability of *H. heidelbergensis*, (II) SH should be considered *H. neanderthalensis*, (III) SH and *H. heidelbergensis* could represent two separate evolutionary lineages co-existing during middle Pleistocene in Eurasia, with SH being phylogenetically closer to Neanderthals.

In this work, we applied supervised machine learning to test for the affinity of SH (N: 126) to *H. heidelbergensis* (N: 13), *H. neanderthalensis* (N: 73), and *H. sapiens* (N: 403). The sample included Mesio-Distal and Bucco-Lingual diameters of mandibular postcanine dentition. Because of the fragmentary nature of the dental fossil and archaeological records, several missing data were included in the dataset and were estimated using Multiple Imputation via Predictive Mean Matching [4]. To avoid biases due to disproportions in sample size, missing data were estimated separately for each group considered. A recursive partitioning algorithm known as Conditional Inference Tree (CIT) [5] was used to build a hierarchical model for predicting the classification of dental metric data into each of the categorical groups considered (SH, *H. heidelbergensis*, *H. neanderthalensis*, and *H. sapiens*). The data was divided in one training set and one test set. The training set (N: 105) was used to allow the CIT algorithm to determine the best classification solution for the dental data. The test set (N: 497) was necessary to control the accuracy of classification.

Our results show that when SH is considered as part of *H. heidelbergensis* it is easily misclassified as Neanderthal (33.6% accuracy). On the other side, SH is recognised as an independent group when other *H. heidelbergensis* specimens are discarded from the analysis (95.6% accuracy). In both cases, the classification is based on a major contribution of the Bucco-Lingual diameter of the third premolar in association with the dimensions of the second and third molars. The accuracy associated with the *H. sapiens* and *H. neanderthalensis* samples indicates that the model is capable of classifying discrete taxonomic groups. Our results support the hypothesis that SH represents a distinct evolutionary lineage from *H. heidelbergensis* and suggest that SH could be closely related to "classic" Neanderthals. This work represents the first application of supervised machine learning to Palaeoanthropology and highlights the potential of this field to the study of human evolution.

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Poster Presentation Number 9, Fr 18:15-19:00

Energetics of Carrying Loads in Neandertals and Modern Humans

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It has been suggested that thickened cortical bone, pronounced areas of muscle attachment and bowed proximal limb segments of Neandertal postcranial skeleton reflects high activity levels, which entails high energy requirements [1] [2]. Accordingly, it has been suggested that foraging efficiency of *H. neanderthalensis* was significantly lower than that of *H. sapiens* [3] [4]. However, to properly address if neandertals were disadvantaged in energetic terms in comparison to modern humans, it should be analyzed if their body proportions could affect the energetic costs of specific and regular activities. In this line, carrying burdens and walking are basic and habitual activities in the foraging trips of hunter-gatherers. Consequently, the main purpose of this study is twofold: 1) evaluating what somatic proportions may affect the costs of carrying different burdens and 2) extract predictive models from these relationships to be applied on Neandertals and Palaeolithic modern humans. An experimental study was developed at BioEnergy Laboratory at National Research Centre on Human Evolution (CENIEH, Burgos, Spain) . A sample of 48 healthy volunteers of both sexes participated in a study approved by the Hospital Universitario de Burgos Ethical Committee (Spain). Oxygen consumption and carbon dioxide production were monitored in four trials: walking unloaded during 10 minutes and walking with a backpack load of 5, 10 and 15 kg during 10 minutes. Moreover, the Resting Metabolic Rate (RMR) was measured during 30 minutes. Functions to estimate energetic cost from somatic dimensions were computed and applied to *H. neanderthalensis* and Upper Palaeolithic modern humans. Body mass, femur length and bi-iliac breadth significantly influence the costs of walking unloaded. Moreover, body mass, femur length and the load transported influence the costs of carrying loads. The results highlight that the costs of locomotion and load carrying activities of *H. neanderthalensis* were not significantly different from the energetic costs of *H. sapiens*. These results do not support the contention that differences in somatic dimensions lead to a decreased load carrying efficiency of *H. neanderthalensis* in comparison with *H. sapiens*.

We are sincerely grateful to all the men and women who participated in this study. The experimental design (Ref. CEIC 1480) was developed at the CENIEH facility Bioenergy. Data were obtained from the EVOBREATH DataBase, managed by A. Mateos and J. Rodriguez. This research was funded by National Research Center on Human Evolution (CENIEH) and the MINECO project, CGL2015-65387-C3-3-P. Vidal-Cordasco, Prado-Nóvoa and Zorrilla-Revilla benefited from a predoctoral research grant from Junta de Castilla y León funded with Social European Fund, Operative Program of Junta de Castilla y León, through the Consejería de Educación.

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Poster Presentation Number 26, Th 19:00-19:45

Morphology of the purported human remains from Sel'ungur cave, Kyrgyzstan

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Sel'ungur in the Fergana Valley of Kyrgyzstan is a crucial site for our understanding of the Palaeolithic of Central Asia, as the only site where lithic, faunal and hominin remains were found stratified, in a likely pre-OIS 5e context. Excavations in the 1980s revealed an at least 8 m thick sequence of Late and probably Middle Pleistocene deposits with a rich faunal and archaeological record. The cultural layers were interpreted as Acheulean by the excavators [1]. The hominin remains described by Islamov and colleagues included six teeth and a child humerus. Our new excavations since 2014 showed that the site is likely significantly younger than assumed before, and that the industry represents an early Middle Palaeolithic. Here, we report our re-examination of the purported human remains from the site. In the original description [1] the six teeth were interpreted as lower premolars and upper incisors of a local variant of *Homo erectus*, but several morphological details contradict this interpretation. The "premolars" show a strong buccolingual curvature of the massive root, and the crown is bent laterally and lingually at the cervix. They also show large, lingually tilted wear facets and one of them shows pronounced interproximal grooving. Comparisons with fauna indicate that these teeth are more compatible with being worn lower I^3s of *Ursus* sp. than having originated from hominids. The interproximal grooves are not an argument for an hominid origin (contra [2]) as such marks are also frequent in ruminants [3], and also occur in cave bears [4]. The teeth interpreted as incisors deviate from the human morphology by having extremely long roots relative to crown height, as well as having very cylindrical roots, with a much smaller diameter than the crown. Two of these teeth also show interproximal grooves, which is unusual in hominids, as most interproximal grooving occurs among the postcanine teeth. Cervid incisors on the other hand frequently have grooves, and are characterized by very long, thin and cylindrical roots, and are thus a more likely interpretation for the Sel'ungur teeth. The last specimen, only fleetingly mentioned in the original publication is a child humerus. Its stratigraphic position is unclear, but based on its preservation and colour we assume that it derives from the breccias preserved along the S wall of the cave. It preserves most of the shaft from the distal epiphyseal line to the proximal part of the deltoid tuberosity. It seems long and gracile, with very thick cortical. It is similar in size to the humerus of Teshik-Tash 1 and the Okladnikov 7 child humerus, both deriving from 8-12 year old individuals.

Our fieldwork at Sel'ungur, and research on the Sel'ungur human remains has been supported by the Leakey Foundation, the Max-Planck-Institute for Evolutionary Anthropology, the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences, the Social Sciences and Humanities Research Council, the Faculty for Arts and Sciences of the University of Toronto and the Russian Foundation for Humanities.

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Poster Presentation Number 2, Th 19:00-19:45

The earliest European Acheulian: The significance of recent findings for human evolution in Europe

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Analysis published in 2018 [1] of micromammalian remains, including 400 teeth of extinct Arvicolids, confirms the late (final) Early Pleistocene age of the Cueva Negra sequence (likely 0.8-0.9 Ma), corroborating previous magnetostratigraphy and palaeontological research [2,3] on the virtually undisturbed sediments [4] which also contain evidence of combustion [5]. A fundamental matter for European human evolution is how to interpret discovery in them of an Acheulian handaxe and abundant small chipped stone artefacts.

Comparisons with the conjunction of handaxes and combustion at Wonderwerk Cave (S.Africa, 1 Ma) and Gesher Benoth Ya'akov (Israel, 0.78 Ma) beg questions about "origins" (if any) and commensurability. The Catalan Barranc de la Boella cleaver (0.9 Ma) highlights Acheulian antiquity in Mediterranean Spain, whilst the Cueva Negra small chipped stone artefacts are comparable to many from Vallparadís (0.9 Ma), Orce (FN3, BL5, 1.2 Ma) and Atapuerca (Sima del Elefante, 1.2 Ma; Trinchera Dolina TD6, 0.9 Ma). TD6 *Homo antecessor* is the earliest hominin in Spain characterized at species level; the Sima del Elefante and Orce *Homo* fossils do not admit specific assignation (questionable specimens from Cueva Negra and Cueva Victoria in Murcia require revision and are ignored). The predominance of small chipped stone artefacts at early Mediterranean European sites vis-à-vis Acheulian tools implies incommensurability with well-known Early Pleistocene Acheulian assemblages in Africa and Israel.

An Acheulian handaxe at Atapuerca Sima de los Huesos came from the 0.43 Ma deposit of pre-Neanderthal *H. heidelbergensis*. In France, Caune de l'Arago level P handaxes date from 0.5 Ma together with abundant small chipped stone artefacts; lower down, a human tooth from level Q likely belongs to *H. heidelbergensis* (which is well represented in higher levels). In the Loire basin a handaxe from Brinay at La Noira dates from 0.665 Ma. The Abbeville handaxes of the high Somme terrace likely date from 0.6 Ma. In Italy, revised dating at Notarchirico points to handaxes from 0.66 Ma, and at Isernia La Pineta chipped stone tools (comparable to those at Cueva Negra) come from sediments with a human tooth from 0.58 Ma (the Isernia collection has been called an Acheulian without bifaces).

No overwhelming substantive archaeological or palaeoanthropological evidence exists that negates the ascription to any hominin lineage *other than that which gave rise to Neanderthal humans* of the aforementioned late Early Pleistocene and early Middle Pleistocene Palaeolithic European assemblages containing bifacially-flaked Acheulian handaxes and cleavers together with abundant small chipped stone artefacts. An economical working hypothesis is that human evolution of technical skilfulness requiring manual dexterity and cognitive versatility was sufficient to permit archaic humans in southern Europe from the late Early Pleistocene onwards to make different kinds of stone artefacts and manipulate aspects of their environment in ways that were shared by the genus *Homo* in Africa and Eurasia. Nevertheless, it should be borne in mind that different Acheulian techniques may well have developed in different parts of the world at different times during the Early and Middle Pleistocene, with possible repercussions for the interpretation of later Middle Pleistocene assemblages in Europe.

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Poster Presentation Number 5, Fr 18:15-19:00

An Investigation into Metacarpal and Proximal Phalangeal Torsion in Homo sapiens and Non-Human Primates, and its Application for Manual Manipulation

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The recent discoveries of Lomekwian stone tools [1], and evidence of butchery at Dikika, Ethiopia [2], pre-date the palaeontological record of *Homo* by at least 500,000 years. These recent discoveries contradict the long-held notion that the deliberate manufacture and use of stone tools, facilitated by the human capacity for forceful power and precision grips, originated in our genus [2]. Whilst several contemporaneous hominin species have been hypothesised to be responsible for the authorship of Lomekwian technology, such chronostratigraphic associations remain tentative and unproven. As such, comparative anatomical assessments of the hominoid hand are necessary to identify which contemporaneous hominin species were capable of the manufacture and utilisation of stone tools at Lomekwi.

The capability of the human hand to perform a distinct repertoire of grips and hand postures that facilitate the effective and forceful manual manipulation of objects have resulted in a suite of unique anatomical features [3]. Diaphysial torsion in the metacarpals of *Homo sapiens*, for example, has been shown to exhibit a distinct pattern of strength and direction amongst extant primates. Analysis of fossil specimens have also shown that several *Australopithecus* species display a human-like arrangement of metacarpal torsion, indicating adaptation for enhanced manipulative capabilities in the *Australopithecus* palm [4]. Whilst torsion in the proximal phalanges of modern humans have been identified in the medical literature as playing a vital role in enhancing the opposability of the fingers to the thumb in humans [5], comparisons of phalangeal torsion in humans and non-human primates has not previously been assessed.

This project compared torsion in the metacarpals and proximal phalanges of modern humans and non-human primates to assess the significance this feature plays in the manipulative capabilities of modern humans. *Homo sapiens*, *Pan troglodytes*, *Gorilla gorilla*, and several species of *Papio* were analysed, with the strength and direction of torsion in the metacarpals and proximal phalanges calculated by measuring the deviation of the palmo-dorsal axis of the distal head relative to the proximal base. The data was analysed with one-way ANOVA and correlation analysis.

The results of this investigation identified a unique arrangement of torsional strength and direction in the first, third, and fourth metacarpals and proximal phalanges of *Homo sapiens* compared to other primates. In modern humans, torsion in both the metacarpal and the proximal phalanx of the thumb is directed towards the ulna, thus facilitating enhanced forceful opposition during precision and power grips. In the third ray, a radial direction of torsion in the metacarpal and proximal phalanx of humans rotates the digit towards the thumb during flexion and facilitates effective opposition to the first digit, exposing a greater portion of the finger to manipulated objects during precision grips. In the fourth metacarpal and proximal phalanx of *Homo sapiens*, torsion in an ulnar direction facilitates the obligations of this ray in buttressing objects during power grips.

This investigation identified a previously unreported pattern of phalangeal torsional strength and direction present only in modern human specimens amongst the extant primates analysed. Analysis of torsion in the proximal phalanges of fossil hominins may contribute to the identification of human-like abilities for forceful precision and power grips in extinct hominin species, and would aid in the identification of deliberate and systematic stone tool making behaviours in the hominin lineage.

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Podium Presentation Session 3, Th 15:20

Early modern humans in the Levant

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The first evidence of modern humans outside Africa was found in the Levant – and was thought to coincide with the interglacial complex MIS 5, probably following the warmer and wetter conditions of the Eemian (MIS 5e). The sites of Qafzeh and Skhul from this period in Israel have yielded human remains that are generally regarded as early modern humans, despite some variation among the assemblages. Fossil discoveries from East Asia (e.g. Daoxian) also suggest the arrival of modern humans at a similar time. Recent evidence from Misliya cave, Israel, documents a considerably earlier dispersal of modern humans out of Africa [1]. The cave is located on the western slopes of Mount Carmel, rather close to Skhul and not far from Qafzeh. An adult hominin left hemimaxilla with a nearly complete dentition was discovered in Square N9 (Unit 6, Upper Terrace) during the excavations in 2002. The fossil (Misliya-1) was associated with an Early Middle Paleolithic (EMP) archaeological layer featuring Early Levantine Mousterian (Tabun D type) stone tools [2]. Three independent dating methods (Thermoluminescence, Electron Spin Resonance and Uranium-series) applied to the human fossil and associated materials yielded concordant results providing an early MIS 6 chronology of around 185 ka. The fossil was scanned at the Vienna Micro-CT Lab and the virtual fossil was cleaned of adhering matrix. The maxilla, P3, P4 and M2 were studied using 3D geometric morphometrics. These results combined with 2D morphometrics of the M1 and a multitude of traditional measurements and observations clearly indicate that Misliya-1 represents a modern human and is distinct from Neanderthals and Middle Pleistocene specimens from Europe, Africa, and Asia. Misliya-1 is approximately contemporaneous with other early modern human fossils from East Africa and considerably pushes back the timing of the earliest migration of members of the *H. sapiens* clade out of Africa. The presence of modern humans in the Levant at such an early date is consistent with several other lines of evidence, including the recent dating of early modern humans in Morocco to MIS8 [3], paleoclimatic reconstructions [4] suggesting increasing humidity and the presence of corridors between Africa and the Levant facilitating human dispersal between MIS 5-7, and genetic evidence [5] claiming an introgression of *H. sapiens* mtDNA into Neanderthals before MIS 6. While this changes our understanding of human dispersal, Misliya-1 likely only marks another episode of modern humans gaining a foothold in Eurasia. Depending on changing climatic conditions, recurrent groups of modern humans from Africa might have encountered other –more archaic – local populations in the Levant, which constitutes the geographical crossroad between three continents. Whether the later Qafzeh and Skhul populations represent local descendants of the Misliya-1 people or another incoming migration movement currently remains an open question, but morphometric analyses show some particular differences between these populations.

Field work in Misliya Cave was supported by the Dan David Foundation, the Irene Levi-Sala CARE Archaeological Foundation, the Leakey Foundation, the Thyssen Foundation, and the Faculty of Humanities of the University of Haifa. Laboratory work and dating were supported by the Israel Science Foundation (grant no. 1104/12). The anthropological study was supported by the Dan David Foundation, Ministerio de Economía y Competitividad of Spain (CGL2015-65387-C3-2-3-P MINECO/FEDER), Fundación Atapuerca, and The Leakey Foundation. The ESR dating study received funding from the Marie Curie International Outgoing Fellowship (IOF) 626474 and the Australian Research Council Future Fellowship FT150100215. N.M. is grateful to LaScArBx ANR-10-LABX-52 for support. Work on the virtual specimens was supported by the Life Science Faculty University of Vienna; Oesterreichische Nationalbank, Anniversary Fund, project no. 16121; the Swiss National Science Foundation grant nos. 31003A 156299/1 and 31003A 176319; A.E.R.S. Dental Medicine Organizations GmbH, Vienna, Austria, project no. FA547014; and the Siegfried Ludwig–Rudolf Slavicek Foundation, Vienna, Austria, project no. FA547016.

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Podium Presentation Session 8, Fr 16:50

Palaeoproteomic analysis of Early Pleistocene *Gigantopithecus blacki*

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Gigantopithecus blacki is a giant hominid known from a few subtropical or tropical localities between 2.0 and 0.3 Ma in southern China and northern Vietnam. The first remains of the species were discovered and identified by von Koenigswald in a Hong Kong drugstore where they were sold as "dragon teeth" [1]. Knowledge on the species remains limited to relatively large amounts of teeth and four mandibles. Nevertheless, it is one of the few, if not the only, extinct non-hominin hominid for which Pleistocene fossil specimens are available. The species is currently considered a diverging side branch of Pongo, although initial phylogenetic assessments proposed Gigantopithecus to represent an ancestral hominin. Its relationships with Pongo and other extinct pongines (such as Sivapithecus) remains tentative due to the paucity of postcranial Gigantopithecus remains, and the primitive status of most shared dental characteristics between Gigantopithecus blacki, Indopithecus giganteus (a presumed late Miocene ancestor) and Sivapithecus [2].

To clarify the phylogenetic status of Gigantopithecus blacki, we sampled a Gigantopithecus molar from Chuifeng Cave, China, for palaeoproteomic analysis. The site is dated by ESR, U-series and paleomagnetic methods to approximately 1.38-1.92 Ma [3]. The Gigantopithecus molars are associated with a typical Early Pleistocene fauna that does not include any Pongo specimen [4]. We attempted proteomic analysis of both dentine and enamel samples and obtained a variety of protein identifications. Contaminants were removed from the datasets by analysing several protein degradation parameters, while protein contamination was monitored within the laboratory environment through the incorporation of extraction and injection blanks during all stages of analyses (following [5]). After this step, a restricted endogenous enamel proteome remains, including, for example, enamel-specific proteins such as amelogenin.

Phylogenetic analysis of the retrieved protein sequences was conducted through Bayesian, maximum-likelihood and neighbour-joining phylogenetic analysis, involving homologous protein sequences of all extant Hominidae, gibbons (Nomascus leucogenys), and macaques (Macaca mulatta). This allows us to test the evolutionary relationship of Gigantopithecus blacki with extant hominids such as pongids (Pongo abelii and Pongo pygmaeus), and speculate on its hypothesized morphological affinities with its presumed late Miocene ancestors (Sivapithecus / Indopithecus giganteus (=Gigantopithecus bilaspurensis) from a molecular point of view.

Together, our analysis provides the first molecular sequence data for an extinct hominid outside of the genus Homo. We thereby simultaneously demonstrate that ancient proteins deriving from skeletal tissues survive deep into the Pleistocene at subtropical sites.

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Podium Presentation Session 1, Th 10:30

The archaeological context of early rock art in Cueva Ardales (Spain)

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We report on the latest results of the ongoing archaeological investigations in Cueva Ardales and discuss the behavioural implications of the Neanderthal and anatomically modern human (AMH) occupations. Cueva Ardales, located 40 km north of Malaga, is a deep karstic cave system in Andalusia, Spain, containing evidence of Middle and Upper Palaeolithic human presence through remains of occupation and rock art. The cave was first discovered in 1821 and the rock art was first published by Breuil [1]. Today more than 1.000 pictorial artefacts of Palaeolithic provenience are known from the cave and more than 90 % of them are nonfigurative [2]. In 2011 systematic excavations in the cave was initiated – the first in nearly 200 years – by an international collaborative team within the frame of the CRC 806: Our way to Europe. Multiple excavation campaigns have taken place between 2011 and 2018 which have focused on three different zones within the cave: zone 2, 3 and 5 [3]. Most recently, the cave has become central to the discussion of Neanderthal use of ochre for non-utilitarian purposes as U-Th dates suggests that some of the ochre panels date to the period before AMH were present in southern Iberia – thus suggesting that Neanderthals were the makers of these particular expressions [4]. The results of the excavations in the three zones give important insight into the spatiotemporal use of the cave by Neanderthals as well as AMHs and provide a crucial context to the rock art. Access to the cave is only possible via a steep sediment cone in the entrance area covered and intersected by flowstone. Zone 2 is located in the steep part of the cone while zone 3 and 5 are located in flat areas beyond the cone, both covered and intersected by thick flowstone. In zone 2, the archaeological excavations revealed material from Late Neolithic, Late Palaeolithic and the Gravettian as well as a small diagnostic Solutrean assemblage. Ochre pieces were also found in zone 2, however, the material is not *in situ* and was probably redeposited from the upper part of the sediment cone. In zone 3, stratified and dated (COL4582.1.1 = >58,000 ka BP) lithics (including *levallois*) as well as several pieces of ochre attests the presence of late Neanderthals exploiting the cave on an ephemeral basis. The archaeological remains in zone 3 are found immediately below and in direct vicinity of non-figurative rock art (dots) and future excavations will focus on investigating the possible context between these two bodies of evidence. In zone 5, human evidence is sparse but include a small number of lithic artefacts, ochre pieces and a tooth pendant which on the basis of the radiocarbon chronology is attributed to a Gravettian and possibly a Late Aurignacian presence. The long-term spatiotemporal presence of humans in the cave suggest recurrent and predominantly non-domestic activities including tool maintenance and symbolic behaviour. Based on the results from the three zones excavated, human presence inside the cave seems to be limited to ephemeral visits by Neanderthals as well as AMHs. The presence of ochre is a recurrent phenomenon and may allude to the functional purpose of these visits. The composition and provenience of the ochre is currently under study and will help clarify this matter in the future.

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Podium Presentation Session 11, Sa 15:00

Quantifying Supraorbital Variation in the Middle Pleistocene Hominins

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Middle Pleistocene hominins, sometimes referred to as *Homo heidelbergensis*, have been suggested to represent the ancestral group of *Homo sapiens* and *Homo neanderthalensis*, with specimens being found across Africa, Europe, and Asia [1]. The taxonomic status of these Middle Pleistocene hominins (MPH) has long been a subject of debate, with two main hypotheses predominating in current literature [1, 2]: that the MPH represent a single, cross-continental species; or that they represent multiple, geographically-delineated species. This study aimed to investigate the levels of variation in the supraorbital region of the MPH in relation to accepted primate and hominin species.

A sample of 711 specimens was used, including 14 MPH from Africa, Europe, and Asia, along with members of 19 hominin and non-hominin primate species within *Papio*, *Macaca*, *Gorilla*, *Pan*, *Homo*, *Australopithecus*, and *Paranthropus*. 230 3D landmarks and sliding semilandmarks were placed around the orbits, supraorbital torus, and frontal bone of each specimen. Variation in shape was quantified and compared using assessment of Principal Components, following Principal Component Analysis, and Procrustes distances, following Generalised Procrustes Analysis. Two groups of MPH were created, based on the assessment of Procrustes distances: the first, MPH *sensu lato*, included all 14 MPH specimens; the second, MPH *sensu stricto*, excluded Sima de los Huesos 5 (SH5) and Ndutu, due to relatively large Procrustes distances between these specimens and the other MPH. Subsamples of 14 and 12 individuals were randomly selected from each species, 1000 times, with independent t-tests being used to assess significance of differences in intragroup Procrustes distances between the MPH and other taxa.

Assessment of a plot of the first two Principal Components (accounting for 72.9% of total sample variance) indicated that the MPH groups were comparable to Pleistocene *Homo sapiens* in variation in orbital and supraorbital shape. Comparison of specimens' values along the first 20 Principal Components (accounting for 95.3% of sample variance) showed that the ranges of the MPH groups were exceeded by those of other taxa in 18 cases. In the assessment of Procrustes distances, the MPH *sensu lato* were found to be significantly more variable than all other taxa, except for *Gorilla gorilla*, *Gorilla beringei*, and *Papio anubis*. The MPH *sensu stricto* were found to be significantly more variable than *Pan paniscus*, *Papio kindae*, and *Macaca mulatta*, but not significantly different from all other taxa.

The results of this study support the exclusion of SH5 and Ndutu from the wider group of MPH; this is based on relatively large differences in morphology between these specimens, argued here to be indicative of phylogenetic differences in the case of SH5, and due to reconstruction efforts for the Ndutu specimen [3]. Assessment of variation in the shape of the supraorbital region of the remaining 12 MPH supports the hypothesis that this group represents a single, cross-continental species. Future research should aim to investigate the patterning of variation within the MPH, and between Middle and Late Pleistocene hominins.

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Pecha Kucha Presentation Session 10, Sa 11:55-12:20

Assessing 3D kinematics across various substrates and speeds in modern humans and the implications for human evolution

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The defining feature of modern humans is habitual bipedalism with an erect posture, yet understanding the evolutionary implications of this subject is contentious. Footprints provide the most direct evidence of bipedal bouts of walking, yet the relationship between lower limb kinematics and the foot's interaction with the substrate remains poorly understood [1,2], inhibiting a comprehensive understanding of evolutionary locomotion. First, to determine the interaction between kinematics, substrate deformation and track morphology we employed 3D motion capture systems to characterise lower limb movement through various types of motion in modern humans across a range of substrates. Kinematics (joint angles, moment and velocity) of the trunk, hip, knee and ankle were quantified in 40 healthy adults (n=20 males; n=20 females). We predicted that variation in gait kinematics would vary according to speed and substrate, with these variables reflected in track morphology. Second, to test whether extinct hominins would have been capable of similar adjustments to their gait, and thus were bipedal in a similar way to modern humans, we examined 3D models of hominin lower limb (Australopithecines and *Homo* species) remains to assess functional ranges of motion. Participants were asked to walk, walk swiftly, jog and walk with a flexed limb on three trackways differing in substrate compaction, water content and compliancy. *Qualisys Track Manager*® [3]captured human movement in a 3D space across these trackways via a reflective marker set on the trunk/lower limb. Fifty trials were completed by each participant. Joint angles, moment and velocity were extracted using *Visual3D*®[4], with statistical assessments of kinematic variability between movements computed in *R*[5]. Tracks from each experimental trial were recorded using photogrammetry. Participants displayed significantly increased ranges of motion (sagittal, frontal and transverse) when moving across less compliant substrates, such as statistically significant increases in hip extension/rotation, knee flexion/abduction, and foot eversion/plantarflexion. Joint angles, moment and velocity significantly increased at greater speeds, with peak moment and velocity occurring earlier in the gait cycle associated with the need for greater limb power to move the body forward. This change is statistically greater when moving on a less compliant substrate versus a firmer substrate. Track morphology/depths were compared and regressed against speed, substrate and movement. Depth/morphology was found to be significantly altered correlative with these variables. Biometric information (e.g., sex and body mass) according to morphology was slightly variable when moving on different substrates, with biometrics being unreliably extracted in jogging trials. Our results have considerable implications for the hominin fossil record: according to our experiments, modern humans significantly alter their kinematics and produce tracks with different morphology dependant on substrate/speed. It is appropriate to assume that early hominins also had to adopt these changes. Modern humans are required to significantly increase hip/knee flexion and plantarflexion when moving across a less compliant substrate, particularly at increased speeds. Our analysis of the bony morphology of some Australopithecines suggest limited ranges of plantarflexion which may have prevented them from moving bipedally across a softer substrate at greater speeds, particularly if moving with a flexed limb. It would then be possible to argue that some of these early hominins were facultative bipeds, rather than habitual bipeds. If/when assigning taxa to a new fossilised trackway discovery it would be imperative to consider ranges of motion of the potential track-maker across a particular substrate as the primary classification, rather than using traditional methods of track morphology to assign ichno-taxa.

This research was funded by Liverpool John Moores University, UK. We would like to thank our participants for volunteering for this study, and finally thank you to the many researchers/institutions for making 3D hominin data freely available on MorphoSource. Ethical approval was granted by LJMU Ethics Committee.

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Poster Presentation Number 22, Fr 19:00-19:45

Environmental transition and human childbirth

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Compared to most other primates, human childbirth is difficult and risky; obstructed labor due to a disproportion of fetal and maternal dimensions is common in modern humans. In a mathematical model, Mitteroecker and colleagues recently showed how the current rate of fetopelvic disproportion has evolved by the asymmetric trade-off between obstetric selection and selection for a narrow pelvic canal [1]. Wells and others also proposed that environmental changes have disrupted a feto-maternal balance during pregnancy and thus increased obstructed labor [2,3]; this may have challenged childbirth during multiple phases of human evolution as well as in modern populations. Indeed, global C-section rates vary massively (from 1-2% in many Sub-Saharan African countries up to about 50% in Egypt, Turkey, or Brazil), even in Europe, but the medical literature primarily attributes this variation to socioeconomic and cultural heterogeneity, not ecological differences. Here we show that a considerable part of the international variation in C-section rate can be explained by the variation in the secular trend of adult body height. In many, but not all countries, socioeconomic conditions – and thus the mothers' immediate environment – have continually improved during the last century, which has led to a parallel increase in both fetal and adult average body size. As the fetus is one generation ahead of the mother, the fetus is likely to experienced better environmental conditions than the mother did, causing a disproportionately large fetus. To disentangle the various parallel effects on C-section rate, we collected national data on obesity and diabetes rates, female height, age at first birth, and Human Development Index (HDI; as a proxy of socioeconomic development) for 169 countries. A structural equation model shows that that even when controlling for socioeconomic and individual risk factors, the change of average body height from 1971 to 1996 is indeed a strong predictor of current C-section rate, accounting for one third of its variation. The direct effect of socioeconomic development on C-section rate is as strong as that mediated by actual biology: the historical trajectory of socioeconomic development (not merely its current state) affects – via its influence on pre- and postnatal growth – the proportion of maternal and fetal dimensions, and thus the difficulty of labor. While earlier studies claimed that intergenerational reduction of body size increases obstructed labor due to a lagged decrease of fetal dimensions [2,3], we find the opposite: childbirth is challenged by an increase in body size as a plastic (i.,e., non-genetic) response to improving life conditions. Both in Europe and North Africa, the change to an agricultural subsistence strategy in the transition from the Paleolithic to the Mesolithic and Neolithic was accompanied by a substantial decline in stature, followed by a slow recovery until the 19th century, and then a rapid secular increase in the last century. This continual increase of body height in the Holocene may have elevated risks for obstructed labor, especially in the last century.

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Podium Presentation Session 5, Fr 10:50

What is South African early *Homo*? New insights from the molar endostructural signature

Clément Zanolli[1], Lei Pan[2,3] Matthew M. Skinner[4,5], Jean Dumoncel[1], Amélie Beaudet[6,7], Frikkie de Beer[8], Jakobus Hoffman[8], Kudakwashe Jakata[9], Roberto Macchiarelli[10,11], Shani Reddy[6], Mirriam Tawane[12], Bernhard Zipfel[9]

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With recent fossil discoveries, South African Plio-Pleistocene hominin diversity is increasing, with the inferred (co)existence of a number of species representing the three genera *Australopithecus*, *Paranthropus* and *Homo* [1]. In particular, two to three *Australopithecus* species are recognized: *Au. africanus*, *Au. sediba* and possibly *Au. prometheus*. *Paranthropus* is predominantly represented by the endemic species *P. robustus*, with the GDA-2 molar from Gondolin also exhibiting morphology similar to eastern African *P. boisei* [2]. Regarding *Homo*, three Early Pleistocene species have been proposed, including *H. habilis*, *H. erectus/ergaster*, *H. gautengensis*, and one Middle Pleistocene taxon, *H. naledi*, was recently described [1,3]. It is also noteworthy that the South African fossil hominin record is mainly represented by dentognathic remains. In mammal paleobiology, tooth morphology is considered a highly reliable element for taxonomic assessment. However, the original shape of the outer crown is often altered by occlusal wear and/or taphonomic processes. For this reason, the taxonomic allocation of some hominin dentognathic remains is still controversial, even at the genus level. This is the case for a number of specimens from the cave deposits of Kromdraai (e.g., KB 5223), Swartkrans (e.g., SK 15, SK 27, SK 45, SKX 257-258) and Sterkfontein (e.g., StW 53, StW 80, StW 151), which are often attributed to different *Homo* species, or even sometimes regarded as representing *Australopithecus* or *Paranthropus* [1,4]. Such uncertainty affects the reconstruction of reliable taxon-specific evolutionary trajectories which, in turn, should rely upon solid taxonomic hypotheses. We used non-invasive X-ray microtomographic imaging to characterize the molar structural signature of this controversial fossil assemblage. We then compared these results with the endostructural features displayed by a number of extant and fossil hominins, including East African *H. erectus/ergaster* from Mulhuli-Amo, North African late Early Pleistocene *Homo* from Tighenif, and Indonesian *H. erectus* s.s. from Sangiran. In addition, these comparisons were made with samples representing *Au. africanus* and *P. robustus*, including their respective holotypes (i.e., Taung and TM 1517). Besides the virtual exploration and deformation-based geometric morphometric (GM) analysis of the enamel-dentine junction (EDJ) and root system, we also assessed the crown tissue proportions (through the 3D relative enamel thickness index) and the enamel thickness distribution pattern (rendered by chromatic scale cartographies). By combining quantitative information from the molar and root structural organization, our results unambiguously confirm the attribution of SK 27 to the genus *Homo*, more likely related to *H. ergaster/erectus*. The specimen StW 80 shows an intermediate signal between the australopiths and *Homo*. All the other specimens purportedly regarded as *Homo*, even if displaying some *Homo*-like features (more gracile morphology, thick but not hyper-thick enamel), align either with *Paranthropus* or *Australopithecus*. In particular, the GM analyses of the EDJ of KB 5223, SK 15, and SKX 257-258 clearly distinguishes them from *Homo* and place them close to or inside the variability of *Paranthropus*. In addition, these analyses discriminate StW 151 from *Homo* and place it inside the *Australopithecus* range. Until more precise information on their original chrono-stratigraphic context is available, similar analyses including other Early-Middle Pleistocene South African hominin taxa, like *Au. sediba* and *H. naledi*, could shed light on local hominin paleobiodiversity.

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Podium Presentation Session 7, Fr 14:20

Neandertal fire

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The ability to use fire is unanimously considered to represent the crossing of a fundamental threshold in the emergence of the human genus, but when did the technology to produce it at will first appear remains the object of much debate. In a recent paper, Dibble et al. (2018) conclude, based on the evidence from southwest France, that Neandertals used fire frequently during warm climatic periods and very infrequently during cold periods, implying that they could harvest natural fire but lacked the capability to make it. Those authors further suggest that the hypothesis could be tested and would be refuted if (a) climate was found to be unrelated to the occurrence of natural fires, (b) other sites showed abundant evidence for fire during cold periods, or (c) alternative explanations better explained the observed pattern.

When discussing alternative (b), Dibble et al. (2018) further shed doubt on the reliability of most reports on the evidence for fire in Lower and Middle Paleolithic contexts (namely, Combe Grenal, Zhoukoudian, La Cote de St.-Brelade, Schöningen, Theopetra, Roc-de-Marsal or Grotte XVI). We present data from several Middle Paleolithic sites that we have excavated and studied in Portugal and Spain over the last twenty years showing that the evidence relating to the use of fire — either in the form of finds (hearth features, presence of wood or bone charcoal, burnt flint, etc.) or of soil micromorphological analysis — shows no variation with climate and is as frequent as in the Upper Paleolithic.

At Gruta da Figueira Brava (Portugal), the MIS-5d occupation in units MC3-MC5 forms a dense midden of burnt bone, burnt mollusk shell and charcoal, implying the recurrent use of fire in the context of the human use of the site, eventually forming the archeologically observed palimpsest. In levels III-b/d and III-i/j of Cueva Antón (Murcia, Spain), short-lived episodes of use of riverside beach environments quickly buried by low-energy inundation events and forming single, non-palimpsested occupation surfaces document the use of fire each of the few times the site was visited during MIS-5a. At Gruta da Oliveira, charcoal and burnt bone are ubiquitous across a sequence spanning the 35-100 ka interval, although the preservation of actual hearth features varies in relation to changes in the dynamics of sedimentary accumulation and the position of the excavation trench relative to the morphology of the cave (fast-changing due to massive roof collapse events and the receding of the porch). At the rock-shelter of La Boja (Murcia, Spain), a geologically homogeneous accumulation of >6 m of sandy deposits features an archeo-stratigraphy defined by discrete, white-on-black-on-red lenses documenting the use of fire in every single one of the more than 30 human occupation horizons, whether Middle or Upper Paleolithic, documented at the site over the 10-60 ka interval; flat fires co-occur with hearth pits, earth ovens, and stone-lined or stone-capped hearth features from top to bottom of the sequence.

Based on this evidence, we infer that, in Iberia, Middle Paleolithic people possessed the technology to produce fire at will. If eventually validated, the pattern observed by Dibble et al. in southwest France can therefore be considered, at best, to illustrate cultural/technological variation within the Middle Paleolithic of western Europe — not a species-specific, ultimately biologically grounded feature of general "Neandertal-ness." More probably, it reflects changes in settlement pattern, as suggested by Sorensen (2017), or in the type of site occupancy.

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Poster Presentation Number 1, Th 18:15-19:00

Reappraising the Gran Dolina TD6.2 Cannibalism from an Energetic Perspective

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Acts of cannibalism have been numerous and repeated throughout human evolution. These behaviours have been registered in the fossil record for Early Pleistocene hominins, Neandertals, and anatomical modern humans. Past anthropophagic acts have been identified mostly by zooarchaeological and taphonomic criteria but also, to a lesser extent, by novel studies [1]. Recently Cole [2] analysed this topic comparing the energy contributed by the consumption of human bodies against the energy provided by other mammals in several archaeological assemblages. We present a reassessment of the earliest known case of cannibalism discovered in Gran Dolina TD6-2 (Sierra de Atapuerca, Burgos, Spain), from an energetic approach. The kilocalories contributed by the consumption of hominin corpses were estimated taking into account the age of the cannibalised individuals found in TD6.2 assemblage. The entire energy yields of the different edible parts of a human body was estimated taking into consideration the different tissue composition of the bodies of a child, an adolescent and a young adult. Likewise, the energetic return of the other mammals present in the TD6.2 assemblage was accurately estimated on the basis of the species body size, the edible proportion and the energy supplied by kilogram of edible mass. As a result, the total energy provided by all the *Homo antecessor* individuals and the other mammal species were compared, considering the minimum number of individuals provided by Bermúdez de Castro et al. [3] and Saladié et al. [4]. The total energy yield of the preys found in TD6.2 level provide enough energy to sustain a hunter-gatherer band of 25 individuals during 117 days or 50 individuals during 58 days. Our results refine the estimations provided by Cole (2017) on the energetic content of the human corpses in the TD6 assemblage, but support similar conclusions. Despite being the most abundant species in that fossil assemblage, *Homo antecessor* provides a relatively small energetic return in comparison to the large mammals recorded in the TD6.2 level.

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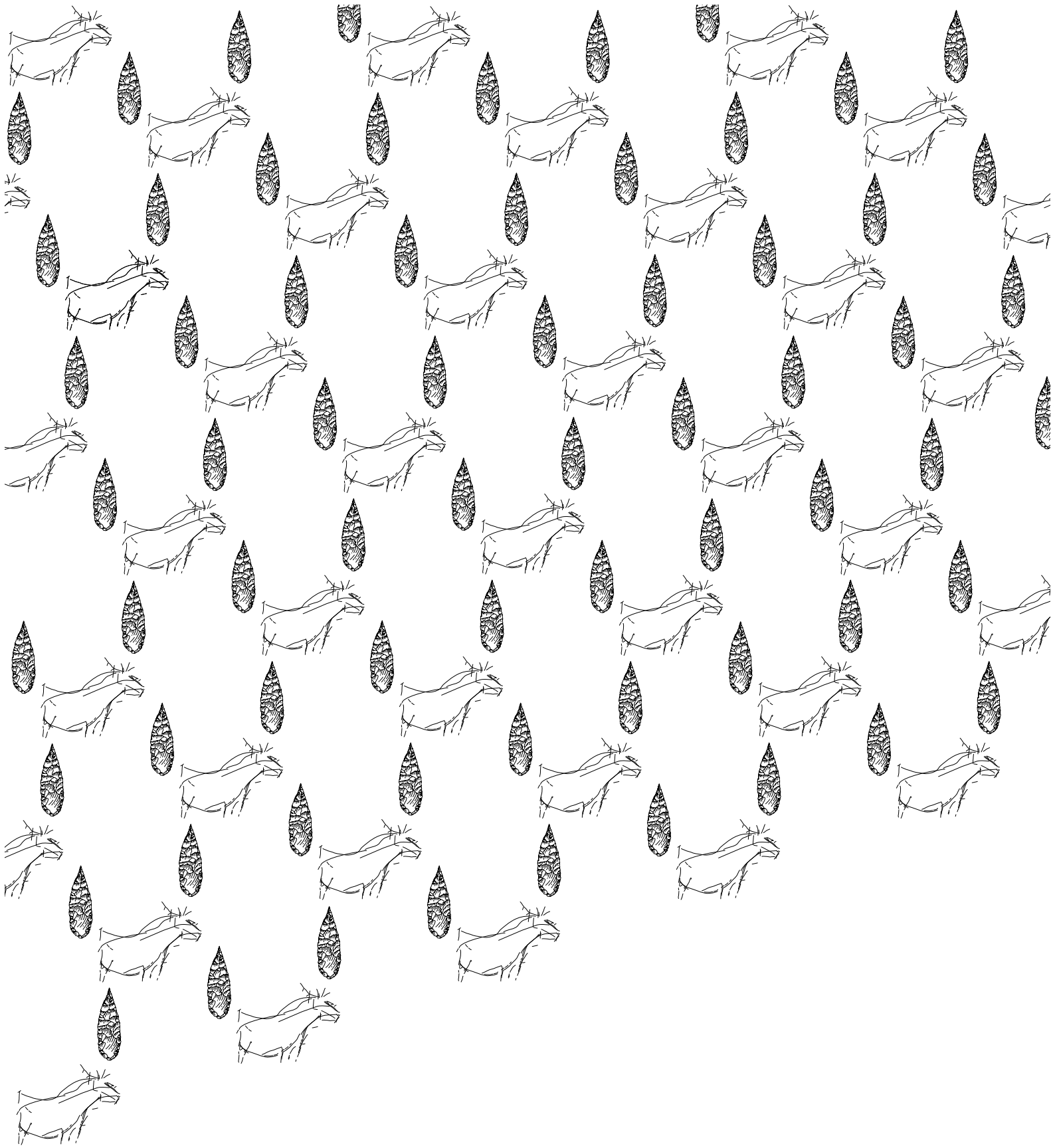

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