TOHOKU FORUM for CREATIVITY

Tohoku Forum for Creativity
Thematic Program 2022

Insights Into Human History in the Eurasian Stone Age:

Recent Developments in Archaeology, Palaeoanthropology, and Genetics

September 27 – October 4, 2022
Sendai, Japan

PROGRAM and ABSTRACTS

Edited by
Katsuhiro Sano & Waka Kuboyama

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PREFACE

We are delighted to welcome you to this historical city of Sendai, Japan, for the Tohoku Forum for Creativity (TFC) Thematic Program 2022 titled "Insights Into Human History in the Eurasian Stone Age: Recent Developments in Archaeology, Palaeoanthropology, and Genetics." The TFC at Tohoku University is the first international visitor research institute in Japan. The forum aims to identify issues across all fields of research, and develop innovative ideas and deeper theoretical foundations through intensive, focused discussions.

It is now well-known that Neanderthals and Denisovans lived in Eurasia, before the expansion of *Homo sapiens*. Although Neanderthals and Denisovans were genetically and culturally close to *Homo sapiens*, they became extinct after the arrival of *Homo sapiens*. In contrast, the population size of *Homo sapiens* steadily increased. However, there is limited information on how *Homo sapiens* increased their population size, while the other human species became extinct. An important goal of this thematic program is to share recent advances in archaeology, palaeoanthropology, and genetics.

Our TFC Thematic Program 2022 comprises an international symposium and two international workshops, and incorporates 50 oral presentations, including five keynote lectures and a special lecture. It is a great honor for us to host comprehensive presentations on the Eurasian Stone Age and welcome world-class researchers who have contributed to the field through cutting-edge studies. We sincerely appreciate all speakers for their presentations, which enable us to hold this thematic program. In particular, we would like to express our deepest gratitude to our colleagues who came from overseas despite difficult situations. We would also like to thank all participants who arrived in person as well as online.

The international symposium/workshops is supported by TFC and the Center for Northeast Asian Studies (CNEAS), Tohoku University. We thank the staff of TFC and CNEAS for their support. Lastly, we are particularly grateful to the secretariat Waka Kuboyama (CNEAS) and program coordinator Takao Koga (TFC), without whose support this event would not have been possible.

With best wishes,
Principal organizer
Katsuhiro Sano
CNEAS, Tohoku University

International Symposium

Insights Into Human History in the Eurasian Stone Age:
Recent Developments in Archaeology, Palaeoanthropology, and Genetics

Date: September 27 – 29, 2022
Venue: TOKYO ELECTRON House of Creativity, Tohoku University
Organizers: Katsuhiro Sano, Masami Izuho, Kohei Tamura, & Stefano Benazzi

Program

September 27 (Tuesday)

11:00 – 13:00 Registration

13:00 – 13:10 Opening address
Katsuhiro Sano (Deputy Director, Center of Northeast Asian Studies, Tohoku University)

13:10 – 13:20 Greetings
Akira Ono (Honorary President of Asian Palaeolithic Association/ Emeritus Professor, Tokyo Metropolitan University)

Session 1: Migration of archaic humans into Central and Northeast Asia

Chairperson: Stefano Benazzi

13:20 – 14:20 Keynote lecture: Neanderthal migration to the East [online]
Kseniya A. Kolobova

14:20 – 14:40 Coffee break

14:40 – 15:00 *Viviane Slon*
Genetic studies on Denisovans and Neanderthals

15:00 – 15:20 *Viviane Slon*
Inferences on the genetic history of Eurasia based on sedimentary ancient DNA

15:20 – 15:40 *Olaf Jöris & Marcel Weiss*
The spatio-temporal patterning of *Keilmessergruppen* assemblages: Implications for Neanderthal dispersal and migrations

15:40 – 16:00 *Yoshihiro Nishiaki*
Teshik-Tash Neanderthal lithic industry in the context of Neanderthal dispersals

16:00 – 16:20 Coffee break

16:20 – 16:40 *Xing Song*
Discussion on the evolutionary status of mainland East Asian late Middle Pleistocene archaic *Homo* [online]

16:40 – 17:00 *Dongju Zhang, Frido Welker, Chuan-Chou Shen, Bo Li, Jean-Jacques Hublin, Svante Pääbo, Qiaomei Fu, & Fahu Chen*
Denisovans from Baishiya Karst Cave on the Tibetan Plateau [online]

17:00 – 17:20 *Xing Gao*
The complexity of the Middle Paleolithic industries in China and implications for trajectories of human evolution in the region [online]

17:20 – 17:40 *Katerina Douka*
What we know about Denisovans: An overview of current fossils, archaeology, chronology and geographic spread [online]

17:40 – 18:00 *Frido Welker*
Palaeoproteomics for human evolution [online]

18:00 – 18:10 Coffee break

18:10 – 18:50 Discussion

SEPTEMBER 28 (WEDNESDAY)

08:50 – 9:00 Greetings
Motoko Kotani (Executive Vice President for Research, Director of Tohoku Forum for Creativity, Tohoku University)

Session 2: Origin and expansion of *Homo sapiens* in western Eurasia

Chairperson: Masami Izuho

09:00 – 10:00 Keynote lecture: Origin and expansion of *Homo sapiens* in western Eurasia
Jean-Jacques Hublin

10:00 – 10:20 Coffee break

10:20 – 10:40 *Israel Hershkovitz*
Pre-Neanderthals and modern humans in the Levant during the late Middle Pleistocene: A perspective from the Nesher Ramla *Homo* fossil [online]

10:40 – 11:00 *Seiji Kadowaki*
Multiple pathways to the Upper Paleolithic? Geographic variability in the Middle to Upper Paleolithic transition in the Levant

11:00 – 11:20 *Andrea Columbu*
MIS3 palaeoclimate and palaeoenvironment in western Eurasia

11:20 – 11:40 *Cosimo Posth*
The genomic profile of Upper Paleolithic European hunter-gatherers

11:40 – 12:00 *Tsenka Tsanova*
The Initial Upper Palaeolithic at Bacho Kiro Cave and in the Eastern Balkan area [online]

12:00 – 13:30 Lunch

13:30 – 13:50 *Andrea Picin*

Cultural perspectives on early dispersals of *Homo sapiens* in Central Europe and Eastern European Plains

13:50 – 14:10 *Stefano Benazzi*

ERC project SUCCESS: The earliest migration of *Homo sapiens* in southern Europe

14:10 – 14:30 *Katsuhiro Sano, Simona Arrighi, Lisa Vaccari, Stefano Benazzi, & Adriana Moroni*

Advanced projectile technology of the earliest *Homo sapiens* in Europe

14:30 – 14:50 *Sahra Talamo*

What a precise clock! ERC project RESOLUTION provides more refine chronology of the Initial and Early Upper Palaeolithic in Europe [online]

14:50 – 15:00 Coffee break

15:00 – 15:40 Discussion

Special Session: The Japanese Palaeolithic: Isolation and cultural exchanges

Chairperson: Kohei Tamura

16:00 – 16:40 Special lecture: Another Palaeolithic frontier: Modeling the earliest seafaring in East Asia

Yousuke Kaifu

16:40 – 17:00 *Katsuhiro Sano, Shunsuke Totsuka, Masami Izuho, & Kazuki Morisaki*

The spatio-temporal patterns of early Upper Palaeolithic assemblages in the Japanese islands

17:00 – 17:20 *Kazuki Morisaki*

Middle and late Upper Palaeolithic in the Japanese archipelago: Local development and continental influence

17:20 – 17:40 *Fumie Iizuka*

Ecosystem change and decisions for pottery using foraging: Late Pleistocene cases from the Japanese archipelago

17:40 – 18:00 *Hiroki Oota*

Ancient genome analysis of human remains in the Japanese archipelago

18:00 – 18:10 Coffee break

18:10 – 18:40 Discussion

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Session 3: The earliest migration of *Homo sapiens* into Central and Northeast Asia

Chairperson: Katsuhiro Sano

09:30 – 9:50 *Ted Goebel*
Problems and prospects in the study of modern-human dispersal in Northern Asia

9:50 – 10:10 *Masami Izuho*
Early adaptations into tundra landscape by modern humans: A case study of the Initial Upper Paleolithic in Mongolia and Transbaikal, Russia

10:10 – 10:30 *Nicolas Zwyns*
Exploring the variability of IUP assemblages using a techno-economic approach: The example of Tolbor-16, Mongolia

10:30 – 10:50 Coffee break

10:50 – 11:10 *Evgeny Rybin, Kseniya Kolobova, & Arina Khatsenovich*
Initial Upper Paleolithic of Southern Siberia and Central Asia: Continuity and variability

11:10 – 11:30 *Feng Li*
Understanding the Initial Upper Paleolithic of China in a regional context of Eastern Eurasia [online]

11:30 – 11:50 *Fei Peng, Huimin Wang & Xing Gao*
New progress on the excavation and research of Shuidonggou site complex [online]

11:50 – 12:10 *Xiaowei Mao*
Genetic insight into northern East Asia during the period of Ice Age and Paleolithic-Neolithic transition [online]

12:10 – 14:00 Lunch

14:00 – 14:20 *Steven Kuhn*
The Initial Upper Paleolithic in Asia: Is it still a useful concept?

14:20 – 15:20 Keynote lecture: Pitfalls and progress in dating the earliest appearance of *Homo sapiens* in Central and Northeast Asia [online]
Tom Higham

15:20 – 16:00 Discussion

Poster Session 16:30 – 18:00

WORKSHOP 1

Emergence of regional diversity of Northeast Asia

Date: September 30, 2022
Venue: TOKYO ELECTRON House of Creativity, Tohoku University
Organizers: Masami Izuho & Katsuhiro Sano

PROGRAM

09:00 – 9:40	1st keynote lecture: Regional differentiation from EUP to LUP in Northeast Asia: An overview *Kelly Graf*
09:40 – 10:00	*Arina Khatsenovich, Rybin E., Shelepaev R.A., & Olsen J.W.* Upper Paleolithic exchange networks in Siberia and Mongolia [online]
10:00 – 10:20	*Shejiang Wang* Paleolithic archaeology in the Qinling Mountains region, Central China [online]
10:20 – 10:40	Coffee break
10:40 – 11:20	2nd keynote lecture: The ebb and flow of human dispersals into Central Europe and further North from the Last Glacial Maximum to the beginning of Late Glacial warming, 25–14 cal kBP *Olaf Jöris*
11:20 – 11:40	*Maxim Kozlikin* Denisovans: Age, culture and habitat [online]
11:40 – 12:00	*Anton Anoikin, Kharevich Vladimir, Pavlenok Galina, & Taimagambetov Zhaken* 10,000 years without Levallois: IUP industries of Ushbulak site, Eastern Kazakhstan [online]
12:00 – 12:20	Coffee break
12:20 – 13:00	Discussion

Museum Tour of SENDAI CITY TOMIZAWA SITE MUSEUM 15:00 – 16:45

WORKSHOP 2

Recovering ancient remains and reconstructing past

Date: October 4, 2022
Venue: TOKYO ELECTRON House of Creativity, Tohoku University
Organizers: Stefano Benazzi, Adriana Moroni, & Katsuhiro Sano

PROGRAM

13:30 – 13:50	Opening address and introduction *Stefano Benazzi*
13:50 – 14:10	*Simona Arrighi* Function and behaviour: Recognizing use-wear on prehistoric tools
14:10 – 14:30	*Yoshitaka Kanomata* Methodology for the use-wear analysis developed by Tohoku University Microwear Research Team (TUMRT)
14:30 – 14:50	*Shunsuke Totsuka & Katsuhiro Sano* Methods for identifying hunting traces and its application for early Upper Palaeolithic sites in Japan
14:50 – 15:10	*Kohei Tamura* Quantifying morphological variation: Applications of geometric morphometrics to archaeological artifacts
15:10 – 15:30	Coffee break
15:30 – 15:50	*Matteo Rossini & Clarissa Dominici* Approaching Upper Palaeolithic hunting strategies through technology and residue analysis [online]
15:50 – 16:10	*Francesco Boschin & Jacopo Crezzini* Zooarchaeology and the Middle to Upper Palaeolithic transition: Some methodological insights [online]
16:10 – 16:30	*Vincenzo Spagnolo* Disentangling the spatial structure of a Palaeolithic camp: Methodological issues [online]
16:30 – 16:50	*Giulia Marciani* Lithic technology, the notion of *chaîne opératoire* and its application in two case studies: The Mousterian of Riparo l'Oscurusciuto and the Uluzzian of Grotta di Castelcivita [online]
16:50 – 17:10	*Federico Lugli* Elemental and isotopic analyses of tooth enamel disclose individuals' life histories [online]
17:10 – 17:30	Coffee break
17:30 – 18:30	Discussion

Session 1

Migration of archaic humans into Central and Northeast Asia

Keynote Lecture

Neanderthal migration to the East

Kseniya A. Kolobova

Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences

Neanderthals were once widespread across Europe and western Asia. They also penetrated into the Altai Mountains of southern Siberia, but the geographical origin of these populations and the timing of their dispersal have remained elusive. Here we present archaeological and anthropological assemblages from Chagyrskaya, Okladnikov and Strashnaya Caves at Altai represented late Neanderthals population between 59 and 44 thousand years ago. Environmental reconstructions suggest that the hominins were adapted to the dry steppe and hunted bison/horses. Their distinctive toolkit closely resembles Micoquian/Keilmessergruppen (KMG) assemblages from central and eastern Europe, including the northern Caucasus, more than 3,000 kilometers to the west of Altai. We identify eastern Europe as the most probable ancestral source region for the Altai toolmakers, supported by DNA results linking the Neanderthal remains with populations in northern Croatia and the northern Caucasus, and providing a rare example of a long-distance, intercontinental population movement associated with a distinctive Paleolithic toolkit. Comparative studies of Micoquian archaeological complexes from Central, Eastern Europe, the Crimea, the Volga region and the Altai have demonstrated a single pattern of bifacial manufacture. At the moment all Micoquian complexes show a certain variability, which does not depend on the geographical localization of the sites. Studies of adaptation behavior suggest that Neanderthals applied strategies known to them in newly occupied territories. The only recorded difference has to do with the adaptation of lithic technology to the shape of stone raw materials. The question of the possible migration of Neanderthals to more eastern territories remains unresolved. There have already been several hypotheses about the discovery of Neanderthal complexes in Tuva and Kazakhstan. We are also examining the question of a possible migration to China.

Acknowledgments

The study had been supported by Science Foundation, Project No. 21-18-00376.

Genetic studies on Denisovans and Neanderthals

Viviane Slon[1,2]

1) Department of Anatomy and Anthropology and Department of Human Molecular Genetics and Biochemistry

2) The Dan David Center for Human Evolution and Biohistory Research, Sackler Faculty of Medicine, Tel Aviv University

Genetic research conducted on ancient hominins can enrich our understanding of our own evolutionary history and that of our closest extinct relatives, the Neanderthals and the Denisovans, yielding insights on demography, population origins and admixture events. While Neandertals, who lived in western Eurasia, are well-characterized morphologically based on numerous remains in the fossil record, only a handful of remains have been identified as pertaining to the Denisovans, who are thought to have inhabited large parts of eastern Eurasia. Here I will summarize recent ancient DNA-based studies aimed at gaining further knowledge on both groups of archaic hominins, conducted while developing techniques to circumvent the scarcity of ancient skeletal remains available for genetic analyses.

Inferences on the genetic history of Eurasia based on sedimentary ancient DNA

Viviane Slon[1,2]

1) Department of Anatomy and Anthropology and Department of Human Molecular Genetics and Biochemistry

2) The Dan David Center for Human Evolution and Biohistory Research, Sackler Faculty of Medicine, Tel Aviv University

In the past years, DNA retrieved from ancient human remains have been instrumental in furthering our understanding of our own evolutionary past, as well as that of our closest relatives, the Neandertals and the Denisovans. Such studies, however, are inherently limited to sites and timeframes where such remains have been found and made available for sampling. A complementary approach can be to recover human DNA fragments from ancient sediments – a source material ubiquitously and abundantly found at any archaeological excavation. Here, I will outline a methodology to do so, including its highlights and pitfalls, and demonstrate the potential of this research to shed light on the genetic history of ancient populations using examples from prehistoric sites in Europe and Asia.

The spatio-temporal patterning of *Keilmessergruppen* Assemblages: Implications for Neanderthal dispersal and migrations

Olaf Jöris[1,2,3] and Marcel Weiss[4]

1) Römisch-Germanisches Zentralmuseum – MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution
2) Institute of Ancient Studies, Department of Prehistoric and Protohistoric Archaeology, Johannes Gutenberg University
3) MOE Key Laboratory of Western China's Environmental Systems Research School of Arid Environment and Climate Change
4) Institut für Ur-und Frühgeschichte, Friedrich-Alexander-Universität Erlangen-Nürnberg

The Late Middle Palaeolithic of Central Europe is characterized by an amalgam of different technological and typological features, hampering a straightforward interpretation of lithic assemblage variability (Weiss et al. 2017). However, certain techno-typological characteristics show Regionalised Cultural Signatures (RCS) and allow for the definition of spatio-temporally defined techno-complexes (Jöris et al. 2022). The *Keilmessergruppen* (KMG) techno-complex (Jöris 2004) features bifacial backed knives – asymmetric cutting tools with a plano-convex cross section that display a singular acute edge opposite a natural or roughly worked back. These *Keilmesser* represent one of the most studied Central European RCS. Detailed technological analyses have highlighted their inherent potential for (multiple) resharpening, showing they were designed for long use-life cycles (Jöris 2001; Weiss 2020), and that *Keilmesser* design and manufacture relied on the generational transmission of the tool concept through different stages of social learning (Jöris and Uomini 2019). These aspects make the *Keilmesser* an excellent *fossile directeur* for Late Middle Palaeolithic traditions.

Plotted against time, the geographical patterning of KMG assemblages hint at supra-regional changes in the dispersal areas of KMG populations. Earlier studies argued for North-to-South migrations in Central Europe resulting from adaptations to the flickering of interstadial and stadial conditions (Jöris 2004). New age estimates for KMG sites (Hein et al. 2020; Weiss et al. 2018, submitted) call for a revision of the KMG record. The present paper introduces a revised model of KMG dispersal and expansion throughout northern Eurasia relative to palaeoenvironmental changes. The results of this study formulate predictions on how the observed changes in KMG dispersal may be archived in Neanderthal aDNA.

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Teshik-Tash Neanderthal lithic industry in the context of Neanderthal dispersals

Yoshihiro Nishiaki
The University Museum, The University of Tokyo

The Teshik Tash cave in Uzbekistan, excavated in 1937 and 1938, is one of the best-known Middle Palaeolithic sites associated with Neanderthal fossil remains in western Central Asia. Its lithic industry, although radiometrically sufficiently dated thus far, provides an important insight into the processes of Neanderthal dispersion to this part of Asia, supposedly from the west. Furthermore, a recent analysis of the available lithic materials stored in Uzbekistan conducted by our team revealed a consistent set of techno-typological features, including the production of common blanks from little-prepared cores rather than Levallois ones, moderate production of elongated blanks, and very common production of side scrapers, which characterize the Teshik Tash lithic industry. When compared with the Middle Palaeolithic lithic industries to those in the regions neighboring to the west, they display similarities with those of the Zagros Mountains. This is not surprising, considering the geographical location of the Teshik Tash Cave. Rather, their dissimilarities with those located further west, such as in the Levant and the Caucasus regions, would provide a useful insight to understanding the cultural landscapes of the Neanderthal communities in western and central Asia in relation to their dispersal patterns from cultural perspectives.

Discussion on the evolutionary status of mainland East Asian late Middle Pleistocene archaic *Homo*

Xing Song
Key Laboratory of Vertebrate Evolution and Human Origins, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences

Late Middle Pleistocene is a crucial period for the origin of *H. sapiens*. At this time, mainland East Asia was occupied by a group of archaic *Homo*, e.g., Dali, Jinniushan, Maba, and Chaoxian. Regarding for its taxonomy, archaic *H. sapiens*, *H. heidelbergensis*, China archaic, archaic human, and late Middle Pleistocene non-erectus hominin or others have been proposed. However, none of this receive consistent approvals. Previous studies have revealed that these archaic *Homo* was characterized by a mosaic morphology of primitiveness and progressiveness. This state could be observed in cranial, mandibular, dental, and even postcranial materials without specificity of anatomical structures. In chronological age, more evidences support an approximately contemporaneity among archaic *Homo* from East Asia (~300-105 ka), Neanderthals from Europe (~250-40 ka), and Denisovans from Siberia and the edge of Tibet Plateau (~287-55 ka). Molecular evidences showed that Neanderthals and Denisovans belong to sister group, and they could hybridize to leave offspring as well as contribute to the ancestry of modern humans. Related to the Neanderthals and Denisovans, the taxonomic status of East Asian archaic *Homo* and its phylogenetic relationships with these two groups are unclear. According to the studies on the available materials, the classic features that are diagnostic of Neanderthals are rare in East Asian archaic *Homo* and there is no solid evidence to lump the East Asian archaic *Homo* into the branch of Neanderthals. Another possibility about the evolutionary status of East Asian archaic *Homo* is that it belongs to Denisovan. The findings of Xiahe mandible and its Denisovan classification increase this possibility. In addition, the reconstruction of Denisovan anatomy using DNA methylation maps match this special population with that of Xuchang, another archaic *Homo* from East Asia. However, the morphological comparisons between East Asian archaic *Homo* and Denisovans reveal variability between them, and it decreases the possibility that the available East Asian archaic *Homo* represent Denisovans. Nevertheless, morphological studies on the cranial, mandibular, and dental materials have revealed an increasing trend of diversity, the possibility that more Denisovans will be found in mainland East Asia in the future cannot be ruled out. Taking into considerations of available morphological and/or molecular evidences, East Asian archaic *Homo*, Neanderthals, and Denisovans living at approximately the same time but in separated geographic territories could represent three separated evolutionary branch rooted in mid-Middle Pleistocene hominins.

Denisovans from Baishiya Karst Cave on the Tibetan Plateau

Dongju Zhang[1], Frido Welker[2], Chuan-Chou Shen[3], Bo Li[4], Jean-Jacques Hublin[5], Svante Pääbo[6], Qiaomei Fu[7], and Fahu Chen[8]

1) College of Earth and Environmental Sciences, Lanzhou University
2) Department of Biology, University of Copenhagen
3) Department of Geosciences, National Taiwan University
4) Centre for Archaeological Science, School of Earth, Atmospheric and Life Sciences, University of Wollongong
5) Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology
6) Department of Evolutionary Genetics, Max Planck Institute for Evolutionary Anthropology
7) Institute of Vertebrate Paleontology and Paleoanthropology
8) Institute of Tibetan Plateau Research, Chinese Academy of Sciences

In East Asia, mysterious Denisovans so far are only found in Baishiya Karst Cave (BKC) on the Tibetan Plateau. A human mandible found in the 1980's in BKC is confirmed to be from a Denisovan at least 160-thousand-years-old based on paleoproteomic analysis and U-series dating of carbonate crust outside of the fossil, providing the first Denisovan fossil evidence outside of Denisova Cave and the earliest human occupation evidence on the Tibetan Plateau. Subsequent archaeological excavation in BKC reveals that prehistoric human occupied the cave for a long time from the late Middle Pleistocene to the Late Pleistocene (Chen et al., 2019). Comprehensive studies of stratigraphy, chronology, archaeology and mitochondrial DNA extracted from the sediments in BKC suggest that Denisovans occupied the cave ~100 ka and ~60 ka and possibly as recently as ~45 ka (Zhang et al., 2020). Analysis of the rich lithic and faunal remains collected during the excavation shows that simple core and flake technology was mainly used for lithic production and various wild animals, including rhinos (probably wooly rhinos) and hyena, were hunted. Paleoenvironment studies in the site and Ganjia Basin where BKC is located indicate that Denisovans had experienced large environment fluctuations in this high-altitude region. The long-term and intensive occupation of BKC by Denisovans suggests that they may have adapted to life at high altitudes and may have contributed such adaptations to modern humans on the Tibetan Plateau.

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The complexity of the Middle Paleolithic industries in China and implications for trajectories of human evolution in the region

Xing Gao
The Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences

The Middle Paleolithic is a controversial issue in Paleolithic research in China. While some researchers argue that there is no Middle Paleolithic industry in China comparable to that of the western Eurasia, others argue that there are some recognizable Middle Paleolithic cultural elements in the archaeological remains accumulated in China. Such arguments reflect the reality that technological development in China during the period coinciding with the "Middle Paleolithic" of western Eurasia is multifaceted and complicated, and deserves in-depth investigation in order to comprehend its factual nature and the dynamics behind it. Based on current discoveries, Paleolithic industries in that period of time in China exhibit at least three developmental trends, that is, the traditional core-flake industries (i.e. the small flake tool tradition in North China and the pebble tool tradition in South China), the Acheulean-like tradition, and the Mousterian-style techno-complexes. While the first trend prevailed all the way from the Lower Paleolithic to the Upper Paleolithic, the latter two seem to be only temporary and regional cultural phenomena. Why the core-flake tradition succeeded so long and so strong, and where were the source of the Acheulean-like and the Mousterian-style techno-complexes? These are hotly debated questions that need to be studied further. In addition, more attention should be paid to probe into a fundamental issue, that is, the creator of those complex cultural remains. We need to examine the origin and migration of certain hominid groups behind such cultural variables, as well as their social constrain and adaptation strategies.

What we know about Denisovans: An overview of current fossils, archaeology, chronology and geographic spread

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The first-ever identified Denisovan was discovered at the eponymous site, Denisova Cave, in the Siberian Altai over a decade ago. It derived from a relatively high part of the stratigraphic sequence, and while it was initially reported to be as young as 30 ka, it was indirectly dated to around 60 ka (Douka et al., 2019; Jacobs et al., 2019). More Denisovans were discovered from the site over the years, both through excavation as well as through biomolecular methodologies, in particular, screening of thousands of bones using palaeoproteomics and of sediment using aDNA techniques. Yet, until recently little was known of the first appearance of Denisovans at the cave and in the region more general, and similarly of their wider geographic distribution, their subsistence strategies, interactions with other hominin species, and eventual demise.

In this paper, I will summarise what we know about the Denisovans, mostly through the lens of the Denisova Cave findings. Recently, we discovered three hominin bones from the earliest archaeological layers of Denisova's East Chamber (layer 15 and 14). Genetic analyses shown that they carry mitochondrial DNA of the Denisovan type (Brown et al., 2022), placing therefore Denisovans as the first hominin occupants of the site. Indirectly dated to ~200 ka they fall at MIS 7, a very warm interstadial that would have favoured fauna and plant resources to thrive locally and would have render the Altai mountains a favourable spot for human occupation. The stratigraphic context of these early Denisovans contains a wealth of archaeological material in the form of lithics and faunal remains, allowing us to determine the material culture associated with these early hominins and explore their behavioural and environmental adaptations.

Finally, I will attempt to place Denisovans in their broader Eurasian context by discussing how the new hominin remains, their chronological position and associated archaeological evidence compare to those of other locations in Asia where Denisovans are assumed to have lived.

Acknowledgments

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Palaeoproteomics for human evolution

Frido Welker
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The elucidation of the complex evolutionary relationships between Neanderthals, Denisovans, and modern humans has recently revealed a new picture of our own ancestral past. How preceding hominin populations fit into this framework is partly unknown. It has now become clear that Pleistocene hominin populations were highly diverse, including several newly described hominin populations. These hominins were present across Africa and Eurasia, with large portions of the hominin fossil record outside the reach of ancient DNA research. Palaeoproteomic analysis of skeletal proteomes has recently emerged as a potential additional biomolecular approach across the Pleistocene that reaches much further back in time compared to ancient DNA. As a result, palaeoproteomics could provide molecular evidence on hominin evolutionary relationships on a global scale not reachable via other molecular methods. Achieving this aim requires overcoming existing limitations on sample size and, simultaneously, optimization of the information content recovered from ancient skeletal proteomes. Based on several case studies and ongoing research of the ERC Project PROSPER, I will discuss and present recent developments in the field of palaeoproteomics that might make it possible to retrieve sufficient quantities of proteomic sequence information from Middle Pleistocene hominins for evolutionary analysis.

Session 2

Origin and expansion of Homo sapiens *in western Eurasia*

Keynote Lecture

Origin and expansion of *Homo sapiens* in western Eurasia

Jean-Jacques Hublin[1,2]

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Genetic data from extant humans and the fossil record indicate that our species originated in Africa. The first *Homo sapiens* are documented in Northwest Africa 300,000 years ago, in association with the oldest Middle Stone Age assemblages. However, it is likely that different African populations contributed to the appearance of the later, so-called "modern" forms of *Homo sapiens*. During the late Middle and early Late Pleistocene, “Green Sahara” climatic episodes facilitated the spread of African populations towards southwest Asia. Their presence in the Near-East is documented in the paleontological record from 190,000 years BP. Contact with Eurasian Neandertals may have occurred even earlier, as suggested by the introgression of Y-chromosome and mitochondrial DNA haplotypes of African origin into the genome of western Eurasian Neandertals. In contrast, the subsequent expansion of our species into the mid-latitudes of Eurasia seems to have little to do with environmental conditions, and the earliest presence of modern *Homo sapiens* in Eastern Europe over 45,000 years ago occurred in a cold climate, as evidenced by Bacho-Kiro Cave (Bulgaria). Most likely, the spread of the initial Upper Paleolithic assemblages associated with these pioneer groups from Central Europe in the west to the Altai and Mongolia in the east was triggered by cultural and demographic factors. This first wave of modern settlement was not entirely successful in Europe. The first modern European populations did not leave detectable traces in the genome of present-day Europeans, and Neandertals persisted in far western Europe at least until 40,000 years ago. During this long period of coexistence on a continental scale, complex biological and cultural interactions took place. They still remain largely to be deciphered. Only with the later arrival of the makers of the Aurignacian complex did the complete replacement of the local archaic populations take place.

Pre-Neanderthals and modern humans in the Levant during the late Middle Pleistocene: A perspective from the Nesher Ramla *Homo* fossil

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The recently published late Middle Pleistocene *Homo* fossil found at Nesher Ramla, Israel, has reignited debate on the nature of the local fossils during this period, their cultural and biological relationships as well as their association with Middle Pleistocene Eurasian populations. In this talk I will describe the fossil, present the results of the comparative study, and discuss them within a wider late Middle and early Late Pleistocene anthropological record of Eurasia.

Multiple pathways to the Upper Paleolithic? Geographic variability in the Middle to Upper Paleolithic transition in the Levant

Seiji Kadowaki
Nagoya University Museum, Nagoya University

A traditional explanation for the Middle to Upper Paleolithic (MP-UP) transition in the Levant is the introduction of new cultural/behavioral patterns associated with incoming anatomically modern humans (AMHs) that replaced Neanderthals. Recently, some researchers have recognized both continuous and discontinuous cultural elements from the Late MP to the Initial Upper Paleolithic (IUP) and suggested autochthonous cultural development within indigenous populations with some influence of incoming groups. The latter view is congruent with an idea of coexistence of Neanderthals and AMHs in the Levant during the MP that led to the formation of polymorphic populations through interaction and interbreeding. The intensification of such social interactions, instead of a population turnover, has recently been proposed as a driver for the MP-UP cultural changes.

To discuss the above issue from a new perspective, this paper presents archaeological records that suggest geographic variability in the MP-UP cultural changes in the Levant. I review chronological and lithic technological data of several IUP and Early Upper Paleolithic (Ahmarian) assemblages, including my original data from the fieldwork in southern Jordan and northern Syria. I suggest that geographically variable technological trajectories from the IUP to the Ahmarian can serve as robust evidence that characterizes the MP-UP transition in the Levant. This is because the technological trajectories revealed by stratigraphic and geographic evidence are less vulnerable to chronological uncertainties arising from the difficulty in accurate dating for the period in question. Thus, even if the current chronology for the Late MP, IUP or the Ahmarian are to be changed or refined in future, the regionally different cultural trajectories from the IUP to the Ahmarian will remain stable evidence for the geographically variable pattern of cultural changes that provide important implications for human biogeographic phenomena in the Levant and our understanding in how the MP-UP cultural transition took place.

MIS3 palaeoclimate and palaeoenvironment in western Eurasia

Andrea Columbu
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Earth's climate is the end-product of a multitude of interactions and energy exchanges between several different subsystems, comprising atmosphere, hydrosphere, land surface, cryosphere and biosphere. All components are intimately linked or coupled with each other, such that changes in one subsystem may involve compensatory changes throughout the entire climate system. Thus, climate concurrently controls, and is controlled by, the Earth's surface environment where Humans live in.

The Arctic Region and the Atlantic Ocean are the "climate-regulators" of the Northern Hemisphere (and possibly the entire Planet), meaning that major changes occurring in these two broad regions may have effects on in-land climate and environments. However, how major climate changes propagate/propagated and impact/impacted throughout the vast Eurasian landmass is/was dependent upon: i) the magnitude and characteristics of climate changes; and ii) the geographical peculiarities of a certain area within the vast landmass. This means that specific hemispheric (palaeo)climate changes must be evaluated at specific locations. Palaeoclimate/environment geological archives such as speleothems, lacustrine and marine sediments, tree rings, etc, are highly useful to reconstruct ancient climates at specific locations within the framework of hemispherical-to-global climate variations.

From a general perspective, Marine Isotopic Stage 3 (MIS3, ~57 to ~29 kiloyears BP) is a transitional climate stage placed between the last interglacial (MIS 5e) and the last glacial maximum (MIS1). MIS3 is characterised by important intra-stage climate fluctuations in the Arctic Region and the Atlantic Ocean, which in turn affected continents. In this regard, the aim of this talk is to explore the effects of MIS3 hemispheric-to-global climate instability throughout the western Eurasian territory, by examining palaeoclimate/environmental archives from selected locations.

The genomic profile of Upper Paleolithic European hunter-gatherers

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After reaching Europe, modern humans relied on a foraging lifestyle for nearly 40,000 years and the reconstruction of their demographic history along this time span is of great interest. Paleogenetic analyses of Upper Paleolithic hunter-gatherers have contributed to the understanding of population structure and genetic turnovers in Ice Age Europe. Through temporal and geographic transects of genomic data it is in fact possible to infer past population movements and to identify their potential links with the climatic and archaeological records. However, our knowledge of the genetic history of European hunter-gatherers is still limited due to the relatively sparse and often poorly preserved human skeletal remains from that period. To date, genetically analyzed individuals older than 40,000 years ago are found to represent deeply divergent out-of-African lineages that did not leave traces in the gene-pool of present-day Europeans. On the contrary, individuals dating after 37,000 years ago belong to at least two main lineages that are primarily nested within the European branch after its split from Asians. Those ancestries survived in different European areas until the beginning of the Last Glacial Maximum (LGM, ~25-19,000 years ago), the coldest phase of the last Ice Age. The role of proposed climatic refugia for human populations during the LGM is discussed here, as well as the re-peopling of Europe after this event. Particularly important is the appearance of a new lineage in southern Europe, found to carry genetic ties with Near Eastern populations. This lineage further spread across Europe after 14,000 years ago, in conjunction with a major warming event, and largely replaced the preceding genetic landscape. However, not all European regions were equally influenced by this demographic shift. In the Iberian Peninsula the genetic turnover was minor and in eastern Europe a genetically distinct population emerged after the LGM. By expanding the distribution of hunter-gatherer genomic data through time and space it is thus becoming possible to delineate at a higher resolution the genomic transformations and interactions that took place in Europe during the Upper Paleolithic.

The Initial Upper Palaeolithic at Bacho Kiro Cave and in the Eastern Balkan area

Tsenka Tsanova

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The cave is located in the eastern part of the Balkans Peninsula, in northern Bulgaria, at the geographical lobby of the migration routes along the Danube corridor and has been reinvestigated since 2015. The previous excavations from the 1970s had revealed a sequence, spanning from the Middle to the Upper Palaeolithic with rich archaeological assemblages, known as Bachokirian from Layers 11 and 11a (Kozłowski 1982). The new excavation uncovered similar stratigraphy to those previously published. From techno-typological perspective, the presence of Levallois features combined with UP tool types allows to reattribute the Bachokirian to the Initial Upper Palaeolithic (IUP) (Kuhn and Zwyns 2014). The new human remains mostly detected by ZooMS are radiocarbon-dated to ca 45 ka cal BP (Hublin et al. 2020; Fewlass et al. 2020) and represent the largest number of recovered individuals in the context of their stone and bone tools, ornaments, and rich fauna remains, at this period of time.

The Layer I is in a good state of preservation, no evidence of mixing of separate entities, and the assemblage is characterised by: 1) artefacts made on allochthonous Aptian and Campanian flint; 2) off-site production and transportation of finished products (blades); 3) blade technology with morphology close to Levallois: large, straight blades with thick platforms, detached by direct percussion with hard hammer; 4) a high proportion of burnt artefacts and weathered surfaces; 5) a high rate of retouched tools on-site, morphological and typological variability among pointed blades and tools manufactured, with diagnostic impact fractures on some pointed blades; 6) high fragmentation rate, reworking and reshaping of tools; 7) intense reduction of the artefacts by bipolar knapping, sometimes related to their use as wedges for working hard organic material (Horta et al. 2020); 8) bladelets and small flakes obtained from core-on-flake and bipolar on-anvil percussion, presence of various splintered tools and blanks.

There are other assemblages in the same regional chrono-stratigraphic record, technologically and chronologically compatible with the IUP from Bacho Kiro Layers I and J, which are: Temnata (Layers VI and 4), Kozarnika (Layer 6/7 id. Level VIII), Samuilitsa II caves and possibly in Toplitsa cave (Layer 5) (Tsanova et al. 2021). Regional assemblages with Levallois and pointed blades from excavations before 1960 (Devetashkata, Tabashkata, Vasil Levski Caves) need to be re-assessed with possible links to IUP or Levallois-Mousterian traditions (Tsanova et al., in prep.). Finally, the IUP assemblages lasted after 39 ka cal BP in Temnata cave, Layer 4 (Tsanova, in press).

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Cultural perspectives on early dispersals of *Homo sapiens* in Central Europe and Eastern European Plains

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During the Initial and Early Upper Paleolithic, Levantine groups of *Homo sapiens* reached new geographic distributions moving northwards into unfamiliar European environments. In these dispersals along the Danube River and the Mediterranean coast, *Homo sapiens* was geared with new technologies and subsistence strategies that allowed the fully exploitation of colder ecological habitats. Thus far, researches in Central Europe support the hypothesis that these new settlements were restricted to certain latitudes and the territories above 49° north were ecological barriers for the new groups due to the harsh climates and the high seasonality of the biotic resources. Furthermore, even if the environmental conditions remained similar during the second half of MIS 3, it is thought that only after 35 ka BP, *Homo sapiens* was able to cross these ecological impediments and spread northwards (e.g. north of the Carpathians). This paper aims to review the current archaeological evidence from Central Europe and the Eastern European Plains, and present new data from Poland, the territory halfway between the two areas. While the Initial Upper Paleolithic signals continue to be weak in the region, the re-examination of several lithic assemblages support the view of cyclical visits since the Early Aurignacian.

ERC project SUCCESS: The earliest migration of *Homo sapiens* in southern Europe

Stefano Benazzi

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The time period between 50,000-40,000 years ago (ka) is a crucial event in human evolution, as *H. sapiens* expanded out of tropical areas into Eurasia replacing or partially absorbing local archaic humans, among which were the Neanderthals. To date, the time and mode of this major global replacement of populations remain unknown. Within this context, new evidence portrays Italy as a keystone region in answering questions surrounding this transition due to its geographic position, ecological variability, and key archaeological Middle-to-Upper Paleolithic sites, yet Italy has been largely absent in research. In this talk, I'm going to present the results of an ERC Consolidator Grant (n. 724046 - SUCCESS) that tackles this issue. The SUCCESS project is organized in 5 work packages (i.e., Fieldwork, Paleoecology, Analysis of faunal and human remains, Study of cultural objects, Analysis and modeling of cultural change), with a Research Team composed of seven postdoctoral fellowships and three PhD students. During the 5-year project, we deepened our understanding of the Italian paleoclimatic/paleoenvironmental variability in terrestrial ecosystems between 50-40 ka at sub-centennial scale, and we studied new human remains retrieved from Italian deposits dated to the Middle-to-Upper Paleolithic period. Moreover, we provided the most extensive study of the Uluzzian technocomplex, discarding its relationship with the Mousterian culture while supporting its inclusion within the early Upper Paleolithic. Among others, we determined that the backed pieces were used as hunting armatures on projectiles used with a spearthrower or a bow; moreover, we also found that the shell ornaments retrieved from the Uluzzian levels of Grotta del Cavallo represent the earliest known shell ornament-making context in Europe.

Advanced projectile technology of the earliest *Homo sapiens* in Europe

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Apparently, Neanderthals and *Homo sapiens* coexisted in Europe for over 5,000 years. However, little is known about why *Homo sapiens* could increase their population size after migrating to Europe and successfully occupy new territories, while autochthonous Neanderthals went extinct ~40,000 years ago. To better understand the replacement of Neanderthals by *Homo sapiens*, we studied modern human hunting weapons, directly relating to their subsistence strategies. We examined 146 crescent-shaped backed pieces retrieved from the Uluzzian culture of Grotta del Cavallo (Southern Italy) dated between 45 - 40 ka. The backed pieces were macroscopically and microscopically analyzed using a Hirox digital microscope and results were compared with use-wear patterns on experimental samples. Through this analysis, diagnostic impact fractures and microscopic impact linear traces were found on numerous backed pieces, demonstrating that they were used as hunting weapons. The diagnostic impact fractures showed the similar patterns of experimental samples delivered by a spearthrower and a bow, but significantly different from those observed on throwing and thrusting samples. Recent use-wear analysis of Initial Upper Palaeolithic points from the Boker Tacktit in the Levant also indicates that they were projected with high impact velocity, suggesting that Initial Upper Palaeolithic points may have performed the same function in Europe as well. In contrast, no Middle Palaeolithic points used by Neanderthals show similar impact patterns and they are overall much larger than Upper Palaeolithic points. These results signify that *Homo sapiens* migrating into Europe equipped themselves with mechanically delivered projectile weapons, such as a spearthrower-darts or a bow-and-arrows, which had higher impact energy. As the advanced hunting strategy is straightforwardly related to a competitive advantage, this study offered important insight to understand the reasons for the replacement of Neanderthals by *Homo sapiens*.

What a precise clock! ERC project RESOLUTION provides more refine chronology of the Initial and Early Upper Palaeolithic in Europe

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Radiocarbon dating is the most widely used dating method for archaeologists. However, the ^{14}C date does not correspond to the true calendar age, but to obtain it, the varying level of ^{14}C back through time needs to be reconstructed. Briefly, we need a calibration curve (Reimer et al., 2020).

Radiocarbon calibration for the past 14,000 years is highly precise and of high resolution (annual to a decade) due to tree-ring chronologies, but it is still rather coarse in the Initial and Early Upper Palaeolithic, where the carbon archives are connected only indirectly to the atmosphere (speleothems, coral reefs, marine and lake sediments). However, the resolution of the most used atomic 'clock' in the Glacial will be improved by new findings of Glacial trees in New Zealand (Kauri) and in the Mediterranean (Italy, Portugal), linked to the ice-core timescale via another cosmogenic isotope, Beryllium-10 (Adolphi et al., 2017).

Using these tree-ring-based data, we can begin to calibrate more accurately the ^{14}C ages associated with breakthrough discoveries of human evolution. The most recent discovery showed that Homo sapiens was already in Europe around 46,000 years ago at Bacho Kiro in Bulgaria (Hublin et al., 2020; Fewlass et al., 2020), propagating east-west along the Mediterranean rim within a fairly short time and reaching the westernmost part of Europe between 41,000 and 38,000 years ago (Haws et al., 2020). Moreover, the question about the beginning of the artistic development by *Homo sapiens* is still challenging because of the limited chronological information. The recent discovery of a pendant in Poland, dated 41,500 years ago, plays a unique role in demonstrating the importance of directly dating objects of Palaeolithic art to understand the origin of communication, celebration, and expression of Homo sapiens in Europe (Talamo et al., 2021).

These findings suggest that the history of our evolution in Europe has been particularly complex, leading us to emphasize the importance of having a precise and detailed 'clock' that can determine the accuracy of the time intervals that mark the course of our history.

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Special Session

The Japanese Palaeolithic: Isolation and cultural exchanges

Special Lecture

Another Palaeolithic frontier: Modeling the earliest seafaring in East Asia

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The rise of voyaging technology beyond nearshore boating was a key for early modern humans to exponentially expand their habitable territory on the globe. However, apart from intensive discussion on the earliest such evidence from Wallacea, the developmental process and regional variation of the Late Pleistocene seafaring remain unclear. To contribute this issue, I present a synthetic model for Palaeolithic seafaring in another region of the western Pacific, the Ryukyu Islands (Ryukyus), southwestern Japan. Here, some of the islands were more than 100 km away and invisible beyond the horizon, and one of the world's strongest ocean currents, Kuroshio, intervened the seaways. Despite these challenging situations, Palaeolithic sites appeared throughout much of the 1,200 km chain of the islands ~35,000–30,000 years ago. By integrating currently available information from archaeology, skeletal morphology, genetics, palaeogeography, oceanography, and our own experimental project called 'Holistic Reenactment Project of Voyages 30,000 Years Ago', (https://www.kahaku.go.jp/research/activities/special/koukai/en/), I discuss probable migration routes, possible watercrafts, preparation and strategy needed for successful maritime migrations in the region, and other issues relevant to deeper understanding of the origins and development of human maritime activities.

The spatio-temporal patterns of early Upper Palaeolithic assemblages in the Japanese islands

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In the Japanese islands, the number of Palaeolithic sites abruptly increases after c. 38 kcal BP, which coincides with the expansion of *Homo sapiens* into these islands. The lithic assemblages between 38 and 30 kcal BP, assigned to the early Upper Paleolithic (eUP), are characterized by trapezoids, pointed blades, and edge-ground axes. The Japanese eUP assemblages are quite different from the chronologically simultaneous Upper Palaeolithic assemblages in the neighboring regions, such as Korea, China, and the Russian Far East. Therefore, the distinctive features of the Japanese eUP may have been developed when modern human hunter-gatherers adapted into the environment in the Japanese islands. In this study, we examine spatio-temporal patterns of the eUP assemblages in the Japanese islands and discuss when and how the important components of these emerged. Based on the Bayesian models of reliable radiocarbon dates, we confirmed that trapezoids first appeared at ~37,500 cal BP, then blade production started at ~36,500 cal BP. Thereafter, both the trapezoid- and blade-based assemblages rapidly increased between 35 and 34 kcal BP, and the important eUP components, such as edge-ground axes and circular lithic concentrations, are also prevalent at numerous sites. However, from 34 kcal BP onward, the eUP sites drastically decreased, and the numbers of trapezoids, edge-ground axes, and circular lithic concentrations are reduced. The concept of blade production has also changed during this time. While triangular blades were unidirectionally removed from a narrow side of a core without preparing the striking platform in the earlier phase of the eUP, a new blade reduction concept represented by late Upper Palaeolithic (lUP) assemblages in Japan (blade detaching from a wide face of a prismatic or semi-cylindrical core with the preparation of the striking platform) gradually became predominant after 34 kcal BP. The spatio-temporal patterns of the eUP assemblages indicate that although the representative features of the eUP prevailed when the population density was high, the eUP components have declined thereafter according to the reduction of the site density and instead some lUP characteristics progressively emerged.

Middle and late Upper Palaeolithic in the Japanese archipelago: Local development and continental influence

Kazuki Morisaki
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Previous studies revealed that the radiocarbon dates of the Japanese Upper Palaeolithic ranged from 39,000 to 16,000 cal BP from the latter half of marine isotope stage (MIS) 3 to late MIS2. Reliable geochronology of several regions of the Palaeo-Honshu Island elucidated a millennial-scale development of local lithic industries after 30,000 cal BP, which is the global Last Glacial Maximum (LGM). In the northern area of Palaeo-Honshu, blade industries based on local cryptocrystalline shale were dominantly utilized, whereas various flake and/or small blade industries with varying levels of quality of local raw materials were prevalent in the southern area of Palaeo-Honshu. The diachronic change in these lithic industries well corresponded to rapid climatic cooling toward MIS2, which is evidenced by a global change in sea-level and palaeo-vegetation study. The inter-regional diversification of lithic industries occurred in parallel with the population decline of major species composing large mammal fauna at this time, suggesting that foragers began exploiting local low-mobility mammals.

As represented by the diffusion of diagnostic stemmed points on blade from the southern Korean Peninsula, several continental influences on the Palaeo-Honshu during MIS2 were recognized. Stemmed points on blade were mainly introduced into the present Kyushu, which is the southwestern edge of Palaeo-Honshu, during a very brief period, i.e., to be exact, between 29,300 and 27,500 cal BP, and rapidly changed their form into flake-based ones. This observation indicated short-term/small-scale human migration between the Korean Peninsula and Kyushu.

The end of the LGM circa 20,000–18,000 cal BP witnessed another continental influence: the introduction of microblade technology throughout the Palaeo-Honshu Island. Although early microblade technology, for example, prismatic types, may be explained by the technological evolution of a preceding small blade technological tradition and informational transmission from an adjacent continent, the emergence of wedge-shaped microblade technology circa 18,000–16,000 cal BP may have accompanied human migration from continental regions including the Palaeo-Sakhalin/Hokkaido/Kuril Peninsula.

Ecosystem change and decisions for pottery using foraging: Late Pleistocene cases from the Japanese archipelago

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In the Amur River basin and islands of Japan, where the earliest ceramic vessels are unambiguously associated with the terminal Pleistocene, the advent of pottery occurred in the context of broadening diet. A case from southern Kyushu of southern Japan furthermore suggests that the first indication of vessel adoption was by ca. 15,000 cal BP associated with a microblade using mobile foraging in the absence of megafauna. A substantial adoption of pottery began during the Bølling/Allerød in the Incipient Jomon, ca. 14,000/13,500-12,800 cal BP. In places such as Tanegashima Island to the south of mainland Kyushu, significantly broadened diet and increased sedentism, and adoption of a variety of new lithic tools and features are observed. It is inferred that change occurred in the context of resource abundance in a forested, ecotone environment (influenced by the warm Kuroshio current), and sea level rise disconnecting Tanegashima from the mainland Kyushu. Evidence of likely inter-island exchange of pottery and lithics is also found. The onset of the Incipient Jomon, therefore, may be associated with the transition from the Upper Paleolithic-like to Neolithic-like behavioral shift interpreted as the forager response to long-term risk related to sea level rise. In this presentation, I critically evaluate the associations of biome conditions and change, sea level rise, and the timing of the adoption of pottery and new technology from distinct regions of the Japanese archipelago. Those cases are compared with the context from southern Kyushu. This study contributes to understanding hunter-gatherer decision making processes involving pottery adoption, subsistence change, and new behavioral organization in response to ecosystem change in the terminal Pleistocene in the eastern islands of Eurasia. It may also provide comparative perspectives on pottery adopting, hunting and gathering and subsistence strategies of late Pleistocene foragers who migrated to the Americas.

Ancient genome analysis of human remains in the Japanese archipelago

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The ancient DNA analysis of human remains excavated from the Japanese archipelago started in the 1990s (Horai et al. 1991; Kurosaki et al. 1993; Oota et al. 1995; Shinoda and Kanai 1999). Firstly, mtDNA HVRs were sequenced in five Jomon individuals (Horai et al. 1991). Subsequently, nuclear polymorphic loci (variable number of tandem repeats) were examined (Kurosaki et al. 1993), and population studies of ancient mtDNA had also begun (Oota et al. 1995; Shinoda and Kanai 1999; Oota et al. 1999; Wang et al. 2000).

However, the first application of NGS to ancient genome sequencing in Japan (Kanzawa-Kiriyama et al. 2017) was 10 years later than the application to the Neanderthal genome. This delay was greatly influenced by the burial environment surrounding ancient Japanese human bones. The climate of the Japanese archipelago is warm and humid, and the soil is acidic because of the volcanic archipelago. For these reasons, especially on the Honshu (the largest island of the Japanese archipelago), it is difficult for human bones buried in the soil to remain. Therefore, very few human remains from the paleolithic period have been found in Honshu. However, we have been getting the Jomon genome data from the Japanese archipelago, recently. A draft whole-genome sequence of a 2,500-year-old Jomon woman from the Ikawazu shell-mound site in the Atsumi peninsula, Honshu, was subsequently reported (McColl et al. 2018), and a complete whole-genome sequencing of a Jomon individual from the Funadomari site in Rebun Island, Hokkaidō, was successfully achieved (Kanzawa-Kiriyama et al. 2019).

In this talk, I will review the ancient genome researches in Japan, and show our recent achievements.

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Session 3

The earliest migration of Homo sapiens *into Central and Northeast Asia*

Problems and prospects in the study of modern-human dispersal in Northern Asia

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In northern Asia, specifically southern Siberia from the Altai Mountains to the Lake Baikal region, information about the origins of the Upper Paleolithic and dispersal of modern humans has grown exponentially in the past 25 years. The region now boasts a chronology of > 100 radiocarbon ages from > 50 archaeological occupations that chronicle events from 50,000 to 35,000 calendar years ago, providing an opportunity to precisely measure the timing of the emergence of the Upper Paleolithic. High-resolution paleoenvironmental records from Lake Baikal and other sources now permit a consideration of the transition against the backdrop of climate change during Marine Isotope Stage (MIS) 3. Large-scale excavations have provided samples of artifacts adequate for measuring and interpreting variability among lithic and osseous artifact assemblages. Those same sites have yielded well-preserved remains of fauna, facilitating new studies of subsistence behavior. Nonetheless, problems with the record still plague us. First, three distinct hominin taxa (Neanderthals, Denisovans, and anatomically modern humans) are known to have inhabited the region during MIS 3, and we cannot yet determine which produced southern Siberia's initial Upper Paleolithic (IUP). Second, many of the sites are in colluvial settings and individual radiocarbon chronologies suggest they often represent palimpsests of numerous occupations spanning thousands of years, so that excavations need to carefully consider geological site-formation processes and spatial distributions of finds to measure the intactness of the IUP occupations. Third, theoretical assumptions for models explaining the IUP's emergence are under-developed and need to better consider how 'behavioral modernity' is expressed archaeologically, and how we might best detect behavioral versus cultural patterning in relation to the spread of modern-human populations. Fourth, outside of the Altai caves, the preceding Middle Paleolithic remains poorly documented, so that comparisons between it and the IUP are difficult, if not impossible, to undertake.

Early adaptations into tundra landscape by modern humans: A case study of the Initial Upper Paleolithic in Mongolia and Transbaikal, Russia

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The Initial Upper Paleolithic (IUP) is archaeological phenomena which archaeologists often refer to as one of the "evolved" Upper Paleolithic behaviors: the most widespread, the earliest (~45 ka), appearing as highly variable in its composition and duration, and discontinuous across Eurasia. In order to better understand whether the broad similarities of material culture reflect phylogenetic connections or broad convergence in its local scale, this paper investigates the correspondence between the chronological sequence from the Initial to Early Upper Paleolithic (EUP) and the ecosystem changes during MIS 3 in Mongolia and Transbaikal, Russia (MO-TB), as a test case. Having a rapid increase in the number of AMS dates in archaeological sites, archaeologists have made a consensus that chronological sequence of the IUP-EUP in MO-TB likely fall within the range of 45,000-30,000 Cal yr BP. Currently, environmental reconstructions are available and those provide higher-resolution than other datasets mainly due to lake sediment core analyses. Combining those archaeological and environmental data, some recent arguments propose that the modern human occupations were possibly placed at the onset of climatic ameliorations: IUP coincides with the interval between Heinrichs event (H) 5 and H4, and EUP between H4 and H3, respectively. We are still not sure if this expectation relates to the disappearance of occupations in cold-arid events implying that the IUP-EUP foragers were not yet adapted to Tundra landscape in MO-TB, simply due to the sampling bias, or because of archaeological visibility. Following this expectation, this paper will explore a single research question: did modern humans adapt into Tundra landscape during IUP in MO-TB?

Exploring the variability of IUP assemblages using a techno-economic approach: The example of Tolbor-16, Mongolia

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Lithic assemblages labelled as Initial Upper Paleolithic (IUP) are often described as a combination of Middle and Upper Paleolithic typo-technological features. This peculiar composition is usually interpreted as reflecting site function, raw material availability, contact between different populations/species or more broadly, as a technology in transformation. Aside from a common set of basic traits, there is little consensus on what is reminiscent of older stone technologies, what does represent site-specific behaviors and what is fully derived and UP in nature. It is perhaps why the IUP is described as highly variable unit while what the meaning of such variations remains unclear. Here we describe in detail an assemblage from the site of Tolbor-16, in Northern Mongolia, dated to ca. 45 ka cal BP. Aside from a derived pattern of blade production that defines the IUP in the region, we observe a high rate of fragmentation and a low blank frequency of actual blades relative to the evidence for active production at the site. Estimates of core/blade ratios obtained are relatively low, suggesting that material was imported in a late stage of reduction and/or that some of the blades were transported elsewhere. We observe that a substantial part of the retouched tools is produced on flake blanks, including types occurring in high frequencies among Middle Paleolithic assemblages. The morphology of the flakes and the absence of a systematic methods of production (e.g. Levallois, Discoid) point toward the recycling of product coming from the preparation of blade cores. Variations observed in core morphology is balanced by the redundant use of a peculiar reduction method. Comparing core volume between the different core types, we suggest that the variations observed in shape could illustrate a process of reduction (as opposed to distinct, independent pathways). Middle Paleolithic features are mostly typological or related to the percussion technique. Overall, our results suggest that the combination of traits observed can be explained in techno-economic terms, and do not necessarily require higher-level explanations such as strict link with older traditions, or contacts between species. In the present case, a techno-economic approach is helpful to isolate archaic features from behaviors that reflect equifinality. It warrants against the use of such traits to support evolutionary interpretations when the data available (e.g. fauna) is not sufficient to fully understand the nature of the occupation and the subsistence strategies involved.

Initial Upper Paleolithic of Southern Siberia and Central Asia: Continuity and variability

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Substantial progress has been made over the past decade in our understanding of the timing and variability of the earliest Upper Paleolithic in the South Siberia and eastern Central Asia. In these regions the emergence of Middle Paleolithic industries, in the technological set of which Levallois point-and-blade technology played an important role, can be traced from the late MIS-4 stage. Their chronostratigraphic position at the top of Middle Paleolithic record immediately precedes the local Upper Paleolithic. In chronological interval 49,000 - 45,000 BP in archaeological complex OH6-5/UP2 of Kara-Bom site (Russian Altai) is evidenced the existence of complete technological, typological and symbolic package related to trans-Eurasian techno-complex of Initial Upper Paleolithic (hereafter IUP). Assemblages of IUP are distributed over an exceptionally vast area of the mountain belt of Southern Siberia and Central Asia. The extreme points of their distribution, marked by stratified sites, are within N 54° - N 38° and E 84° - E 109°. The question of the variability of IUP assemblages from different regions of its distribution remains open along with the important discussion about diachronic patterns in lithic technology throughout Middle Paleolithic/Initial Upper Paleolithic boundaries. A set of statistical methods (NMDS scaling, PCA analysis, LDA analysis) will be used to achieve this goal. Samples will be grouped in order to determine the variability of the assemblages from the different regions of IUP geographic core according to cultural-chronological and territorial grouping. The relative typological and technological homogeneity of the Siberian and Central Asian IUP in comparison with the Early Upper Paleolithic, substantial difference between IUP and Middle Paleolithic and narrow chronological difference between the extreme points of IUP distribution makes possible to suppose the exogenous origin and very fast dispersal of that cultural event in the middle of Eurasia.

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Understanding the Initial Upper Paleolithic of China in a regional context of Eastern Eurasia

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Initial Upper Paleolithic (IUP) has attracted lots of attentions of scholars who are interested in the transitional period from Middle Paleolithic to Upper Paleolithic in Eurasia, especially in the eastern part of the landmass recently. As one of the regions, Northern China has played an important role in discussions on the chronology, diffusion, and adaptation of the IUP assemblages due to the abundant findings at Shuidonggou locality 1 and other sites. Attempts to understand the IUP of northern China in a regional context have been practiced, however, there are still much unclear information considering the definition of IUP, their dates, and technological characteristics. In this paper, the IUP assemblages are synthesized based upon currently published data illustrating their chronology and distribution in northern China. By means of technological comparisons with assemblages in Siberian Altai and Northern Mongolia, its regional significance of northern China IUP will be discussed as well.

New progress on the excavation and research of Shuidonggou site complex

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Shuidonggou site complex is one of most important Upper Paleolithic site in Northeast Asia. Since it was discovered in 1923, a series excavation had been carried out. Totally 9 localities including SDG1-5, 7-9, 12 had been systematically excavated before 2007. Abundant material has demonstrated the culture diversity and evolutionary trajectory in Northwestern China before 10,000 to 50,000 years ago. Meanwhile, a series issues about ancient human activities in this region still need more evidences from SDG. Since 2014, new excavation on SDG1 and SDG2 which are the most important localities among 12 localities have been carried out. Numerous artifacts including pendant, ostrich eggshell beads, blades, flakes etc and mammal fossils were yielded from several culture layers in these two localities. Dozens of hearths were unearthed as well. Preliminary research has clarified the chronology of SDG2 and provide some important new information to investigate the onset of Upper Paleolithic in this region.

Genetic insight into northern East Asia during the period of Ice Age and Paleolithic-Neolithic transition

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Northern East Asia was inhabited by modern humans, marked by the Tianyuan man who was found at the Tianyuan Cave near Beijing, as early as 40 ka. After 40ka, similar to Europe, northern East Asia has been largely impacted during two important periods: the Last Glacial Maximum (LGM) and the transition of Paleolithic to Neolithic (the beginning of agriculture). Using genome-wide data obtained from individuals dated to 33.6-3.4 ka from the Amur Region, Liao River region, and Yellow River region, we investigated what was the population history of northern East Asian and how did they adapt to drastic changes of climate or lifestyle. For the population history, our investigation demonstrated that Tianyuan and AR33K related ancestry was widespread in northern East Asia before the LGM. At the end of the LGM stadial, the earliest coastal northern East Asian, who are basal to ancient northern East Asians, appeared in the Amur Region. After 14 ka, ancient populations in the Amur Region represent the closest East Asian source known for the Ancient Paleo-Siberians. After the Paleolithic-Neolithic transition, we also observed more southern Asian related ancestry appeared in the ancient populations in Yellow River region. For the adaptation, we observed that *EDAR V370A* mutation (an East Asian specific adaptive variant which is associated with thicker hair shafts, more sweat glands, and shovel-shaped incisors), was likely to have been elevated to high frequency after the LGM, suggesting a possible timing for its selection. Our research provides the first look into the deep population history and adaptation of northern East Asia.

The Initial Upper Paleolithic in Asia: Is it still a useful concept?

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The term Initial Upper Paleolithic (IUP) was originally applied to a single lithic assemblage in order to describe its inferred position on a continuum from Middle to Upper Paleolithic. The term was later broadened to include a range of assemblages in the eastern Mediterranean, formerly called by other names, which shared certain elements of lithic technology. Subsequently the definition of the IUP has been expanded even further to encompass assemblages distributed from the Jordan Valley to the Siberian Altai, and from the Czech Republic to China. While researchers have been very successful in adding new archaeological assemblages to the corpus of the IUP, its sheer geographic dispersal does beg the question of what kind of cultural phenomenon it could represent. Some scholars consider the IUP to index the dispersal of anatomically modern *Homo sapiens*, whereas others see it as simply the result of convergence in lithic technology at the end of the Middle Paleolithic. This paper considers a number of alternative explanations in terms of current evidence. It also addresses the following question: if the IUP phenomenon is not unambiguously an expression of shared cultural roots, is it still a useful thing to think about?

Keynote Lecture

Pitfalls and progress in dating the earliest appearance of *Homo sapiens* in Central and Northeast Asia

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Chronology is crucial in understanding the movement and dispersal of H*omo sapiens*, and other hominins, across Eurasia, as well as understanding their interactions and disappearance. Dating material that is older than ~30,000 BP is challenging, but work undertaken over the last two decades has improved the situation. My group has developed and improved several of the crucial pre-treatment chemistry steps required to effectively decontaminate the most common archaeological materials for dating (bone, charcoal, shell), particularly the purification of bone collagen using ultrafiltration and in the dating of single amino acids from collagen, as well quantifying background limits and corrections. Within a large project funded by ERC, we have applied these methods to the analysis of over 1,000 samples of bone, shell and charcoal from more than 100 key Palaeolithic sites across Eurasia. The main focus has been on sites with a succession of contexts containing lithic industries attributed to the Mousterian (all mostly associated with Neanderthals) and the Initial and Early Upper Palaeolithic (thought to be related to *Homo sapiens*, but not always exclusively it would seem).

In this talk I will discuss the challenges in reliable radiocarbon dating, the importance of robust pretreatment chemistry and Bayesian analysis using other complementary dating methods, and give some initial results for the early dispersal of humans in this vast region of the world.

WORKSHOP 1

Emergence of regional diversity of Northeast Asia

Keynote Lecture

Regional differentiation from EUP to LUP in Northeast Asia: An overview

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Following the earliest appearance of *Homo sapiens* in Northeast Asia and after approximately 40 ka, regional variation emerges quite quickly in the archaeological record with differences through time and across space. From 40-25 ka we see decrease in the use of flat-face blade core technology with development of various flake-based and macro-blade-based technologies, rise and fall of mobile art production, change from opportunistic hunting by landscape novices to planned hunting and seasonally-based settlement by landscape experts, exploration of the extreme far north, and boating to procure obsidian from insular extraction sites in the east. After 25 ka and during the LGM, sites across the interior of this vast and varied region abate; however, along the eastern seaboard they continue and change as wedge-shaped microblade core technologies develop and eventually spread inland to the west and north. From 21-14 ka regional differentiation begins to take hold with continuation of only microblade-based technologies in some areas, emergence of various bifacial technologies in others, the combination of these two technologies in yet others, and development of a ceramic industry in the Far East.

What led to regional differentiation and changes in technologies and land-use strategies after 40 ka? Did this variability result from human responses to highly fluctuating climate and environmental changes that affected distributions and availability of resources? Did they result from population isolation and subsequent cultural identity development? These and similar questions will be explored during the lecture.

Upper Paleolithic exchange networks in Siberia and Mongolia

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People began transporting exotic and/or high-quality raw material over long distances in Central Asia beginning at least as early as the Final Middle Paleolithic. Rare cases of such transport have been recorded in the Russian and Gobi Altai Mountains, suggesting migrations and mobility rather than exchange networks. The Initial Upper Paleolithic in Siberia and Mongolia was characterized by the rapid spread of ideas, specific tool types, technologies, and non-utilitarian objects. Not all can be explained as the result of human mobility. The most prominent examples include ornaments and non-utilitarian objects. While IUP ostrich eggshell bead-making in Mongolia and, probably, Transbaikalia, was based on local raw material, the occupants of Denisova Cave in Siberia could acquire eggshell only through exchange between populations or extremely long-distance transportation. This conclusion is supported by the sophisticated bone ornament-making apparent in Denisova Cave due to the lack of softer and more easily worked ostrich eggshell. Highly variable stone raw material used to fabricate ornaments in northern Mongolia reveals connections with the Russian Transbaikal Region. The rapid spread of specific Initial Upper Paleolithic tool types throughout Central Asia and southern Siberia is also associated with exchange networks and cannot be explained simply by migration. Exotic raw material variability increased in EUP archaeological complexes. In some areas, such as Transbaikalia and the Altai Mountains, this can be explained by improved knowledge of geological resources in populations' home ranges, but also increased human mobility and the expansion of home ranges. Our research considers potential cases of long-distance contacts during the Initial and Early Upper Paleolithic and a spectrum of fabrication methods, identifying some as evidence of exchange networks rather than highly mobile human populations.

Paleolithic archaeology in the Qinling Mountains region, Central China

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Since 1995, we surveyed and excavated Paleolithic sites in the Qinling Mountains region, Central China. The areas include the Luonan-Lushi Basin, Shangdan Basin, Hanzhong-Ankang Basin and Lantian areas. The chronological data show that commencement of loess deposits in this region is at least since two million years ago. The open-sites in the Luonan Basin which located at the second terrace dated between 0.6-0.07 Ma. However, the sites which located on the second terraces in the Hanzhong Basin, Lantian areas, and the sites located on the higher terraces in the Luonan Basin shows that the loess deposits formed in the late Pleistocene. From the Early Pleistocene to the Middle Pleistocene, it appears that the regional lithic assemblage belongs to the Oldowan (Mode I) lithic industry, and it is dominated by choppers, cores, flakes, and simple retouched flake tools. However, from the Late Middle Pleistocene to the Late Pleistocene (between 250 ka to 50 ka), there were a large number of Model II (Acheulean) lithic artifacts, such as hand-axes, picks, cleavers, spheroids, and knives found in this region, shows that the lithic industry had experienced an important transformation process and the Acheulian LCTs lasted to the later Pleistocene in the region.

Keynote Lecture

The ebb and flow of human dispersals into Central Europe and further North from the Last Glacial Maximum to the beginning of Late Glacial warming, 25–14 cal kBP

Olaf Jöris [1,2,3]

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Until the late 1990ies it was widely accepted that Central Europe had been void of humans during the Last Glacial Maximum (LGM), and that re-occupation took place no earlier than ~16–15 cal kBP, i.e., during the Late Magdalenian. Over the last few decades, new radiocarbon dates and targeted dating programs have changed this picture significantly, showing that Central Europe experienced repeated phases of human presence and absense during the period ~25–14 cal kBP (Street & Terberger 2004; Jöris & Street 2014; Kozłowski et al. 2017; Reade et al. 2020; Maier et al. 2020; Jöris 2021). At least three discrete phases of human presence can be recognized in Central Europe over this time interval (Jöris & Street 2014): (1) sporadic occupation at ~23 cal kBP (Greenland Interstadial 2), during which the southern half of Central Europe was occupied by populations that most likely arrived from the East (Street & Terberger 2004; Reade et al. 2020); (2) a short episode of human incursion into Central Europe at ~18.5 cal kBP, when mid-Magdalenian groups from France expanded eastwards, eventually reaching southern Poland (Kozłowski et al. 2017); and (3) the major phase of Late Magdalenian population expansion that started ~16 cal kBP. Present evidence indicates that Western European populations expanded into Central Europe not simply by random dispersal, but steered by systems of rules and regulations implemented by Late Magdalenian societies. Archaeological data further indicate that this colonisation process spawned interactions between these Western European populations and groups of Eastern European origin (Maier et al. 2020; Jöris 2021). The potential social and technological exchanges between the two populations may have led to more sufficient adaptations to overcome the challenges these Late Upper Palaeolithic hunter-gatherers faced in Central Europe at a time of limited biomass production. This Late Magdalenian expansion represents the foundation of a more northward migration at the transition to the Late Glacial interstadial (Greenland Interstadial 1). It has been argued that the suceeding Central European *Federmessergruppen* (FMG), i.e., curve-backed point industries, evolved from this Late Magdalenian substrate. However, it must be discussed whether the FMG originated in the Late Epigravettian of Italy and south-eastern Europe.

A Late Epigravettian dispersal would represent a fourth phase (4) of northward population expansion that crossed the Alps at ~14.3 cal kBP and accounts for a major turnover of the archaeological record throughout the northern half of Europe. This interpretation is in line with a major population shift that has been recognised for the Late Glacial period using aDNA (Bortolini et al. 2020). The earlier dispersals and incursions into Central Europe may also be archived in past DNA signatures.

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Denisovans: Age, culture and habitat

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Denisova Cave is the oldest of the inhabited caves in Siberia and one of the most informative objects for studying the ancient human culture and the natural environment around it, not only in North and Central Asia, but also in the entire Eurasian continent.

Denisova Cave is located in the northwestern part of the Altai mountain system in the Anui river valley. As an archaeological site the cave was discovered in 1977. The objects discovered testified that the cave had been inhabited since the Middle Paleolithic. From 1982 to the present, archaeologists from the Institute of Archeology and Ethnography of the SB RAS have been conducting research in the Denisova Cave.

Denisova Cave became world famous in 2010, when the "Nature" journal published the results of a genetic analysis of human fossils found in the cave – a fragment of the terminal phalanx of the little finger of a girl aged 6–7 years. Deciphering first mitochondrial and then nuclear DNA from this bone sample showed that it belongs to a previously unknown hominin, which was named Denisovan from the place of discovery of anthropological remains.

As a result of interdisciplinary research, a unique stratigraphic sequence has been established, thanks to which the continuous development of the cultural traditions of ancient human has been traced over the past 300,000 years. Among the numerous Paleolithic materials from Denisova Cave, special attention is drawn to the finds reflecting the spiritual and social aspects of the life of primitive man - ornaments and objects of symbolic activity made of bone, mammoth tusk, animal teeth, ostrich egg shells and soft stone. The main collection of these items was obtained from deposits 35–50 ka BP. It includes a variety of pendants, beads, rings and bracelets. Currently, these are the most ancient ornaments known in Eurasia.

10,000 years without Levallois: IUP industries of Ushbulak site, Eastern Kazakhstan

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Ushbulak (ShiliktyValley, Eastern Kazakhstan) is a stratified site (8 layers): the Holocene assemblage (layer 1), the final UP assemblage (layers 2.1-3.3), the developed UP assemblage (layers 4-5.1), and the initial UP assemblage (layers 5.2-7.2). Detailed age model for Ushbulak site was created using Bayesian statistics on the basis of OSL -chronology and additional AMS ages. The assemblage from the lowermost layers 5.2-7.2 contains blade cores with the opposite platforms, numerous core trimming elements, core-burins, end-scrapers on blades, including those with ventral base thinning, truncated-faceted tools, truncated blades, a biface and an oblique point. Core trimming elements correspond well to the available cores. Experimental and attributive approaches established the absolute predominance of subprismatic bidirectional laminar method, based on well-prepared pre-cores knapping. Based on the composition of the lithic industry, layers 5.2-7.2 can be defined as a lithic workshop at the outcrops of raw material. The Ushbulak lithic industry is similar to the stratified assemblages attributed to the IUP in Southern Siberia (Kara-Bom site and others) and Northern Mongolia (Tolbor-4 site and others).
The most pronounced traits that make Ushbulak distinctive to IUP industries of neighboring regions, are total dominance of the only method for bidirectional blade production and total lack of Levallois component in the technocomplexes. Along with that, any changes in primary knapping methods and tool assemblages have not been revealed in IUP complexes of Ushbulak, nonetheless its long-term presence in the region (~10 ka). This industry first appeared in Eastern Kazakhstan about 49–47 ka in its complete form and existed changeless up to its disappearance about 37–35 ka.

Acknowledgements

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WORKSHOP 2

Recovering ancient remains and reconstructing past

Function and behaviour: Recognizing use-wear on prehistoric tools

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Stone tools are a primary source of information to reconstruct behavioural evolution of hominin species, including subsistence activities, social organization, and symbolic thinking. Therefore, understanding the function of prehistoric tools is a pivotal marker of ancient behaviours and activities. Use-wear analysis is a methodology used to identify the function of stone tools as well as the function of tools made on other materials such as bone, ivory, etc… This discipline, which has been introduced for the first time in a codified way by S.A. Semenov in the 1930s, is based on the observation of physical alterations produced by use on the working edges and/or surfaces of artefacts. Such alterations are usually interpreted by means of comparison with traces experimentally produced reproducing different activities with tool replicas.

Use-wear analysis is carried out using different types of microscopes and a range of magnifications in relation to different techniques of observation: low-power approach (LPA) and high-power approach (HPA), commonly used in combination.

LPA is conducted by way of a stereomicroscope with magnifications ranging from 10x to 50x. This method of observation allows us to record edge rounding and edge removals as wear traces that make it possible to identify the hardness of the processed material and type of action carried out (e.g., cutting, scraping…). HPA is carried out using a reflected light microscope (with 50x-500x magnifications) and it allows us to recognize microwear such as polished areas and striations along with micro-rounding of the edge. By means of HPA it is possible not only to distinguish the degree of hardness of the worked material, but also to identify different types of materials (e.g., hide, wood, bone, etc). In the last decades many studies focused on developing techniques that use quantitative methods to better characterize use-wear, such as, for example, laser scanning confocal microscope.

Methodology for the use-wear analysis developed by Tohoku University Microwear Research Team (TUMRT)

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Tohoku University Microwear Research Team was originally organized by Professor Chosuke Serizawa, one of the pioneers in the field of Japanese Palaeolithic studies. In 1976, he started to apply the high-power microwear analysis, and organized the research team including his students. The first series of experiments indicated that precise interpretation should be done by combining several categories of use-wear data such as polish, striation and microflaking. Therefore, in order to evaluate use-wear traces comprehensively, both “high-power” and “low-power” methods should be applied. By 1982, his team developed micro-polish classification, based on experimental program with abundant siliceous hard shale, chert, and obsidian. They classified features of the polished surface based on characteristics attributes such as brightness, smoothness, roundness, extension, elevation, connection, pit-features, and-so-on. This classification became an index for lithic functional analysis in Japanese archaeology. At the moment, 11 types of polish are used as criteria for the interpretation of use-wear.

As another pioneering study, Professor Kaoru Akoshima introduced the concept of the organization of technology and the middle-range theory (Binford 1979) to Japanese archaeology: these concepts were applied to the experimental microwear studies as a theoretical framework.

Practical studies of microwear analyses were carried out for the lithic artifacts in the Upper Palaeolithic, Jomon and Yayoi periods, in Japan. These studies led to understand the relationships between typology and functional aspects of lithic tools. The functional variability, re-sharpening, reuse, and degree of curation depend on the technological organization of prehistoric hunter-gatherers and farmers.

This presentation focuses on the methodological problems and research achievements TUMRT through the 45-year of research.

Methods for identifying hunting traces and its application for early Upper Palaeolithic sites in Japan

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A stone tip attached onto a wooden spear produces a variety of fractures when they hit an animal prey. While some impact fracture types can occur due to other factors, including blank flaking, retouching, and trampling, there are also specific fracture patterns that are yielded exclusively from hunting. One of the important clues for identifying impact fractures is bending initiation. Different from intentional flaking on lithics that produces a cone scar, impact fractures occur by bending force through longitudinal collision with an animal target and exhibit no negative bulb on the surface. However, spin-off fractures, which are secondary fractures caused by contact between the two primarily formed broken surfaces of a stone tip, often show a cone at the initiation (but they are sometimes bending fractures). Therefore, while primary impact fractures exclusively initiate with bending, spin-off fractures frequently show a negative bulb on the surface. In addition to these principal characteristics, our experiments and those of others have demonstrated that flute-like, burin-like, bifacial spin-off, and single spin-off fractures longer than 6 mm are reliable as diagnostic impact fractures (DIFs). These fracture types seldom occur due to the other factors. Transverse fractures with step, hinge, and feather terminations can be regarded as DIFs only if these fractures form after lateral retouching. Based on the reliable DIFs, we examined early Upper Palaeolithic (EUP) assemblages in the Kanto region of the Japanese islands to identify hunting armatures. The results of a systematic microfracture analysis of the EUP assemblages are presented and future issues to evaluate the ratio of DIF occurrences among different raw materials are discussed.

Quantifying morphological variation: Applications of geometric morphometrics to archaeological artifacts

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Analyzing morphological variation is an important step to extract information from archaeological remains. Computational methods have been increasingly used to quantify morphological variation in an archaeological data set, at least partly because of the increased access to large data sets of digitized three-dimensional data and the trends of reproducible research and open science. In addition, some scholars have emphasized, as an advantage of such methods, the importance to calculate relative ‘similarity’ values among individual artifacts rather than dividing the focal set of artifacts to some categories and assuming morphological homogeneity in each category.

Geometric morphometrics, originally developed in evolutionary biology and biological anthropology, is a suite of such quantitative methods and have been increasingly used to quantify morphological variation in archaeology. Examples range from stone tools to monuments. Advantages of geometric morphometrics approaches over ‘traditional’ ones include that geometric information is modelled as relative positions of coordinates, and thus there are a wide variety of ways to visualize morphological variation.

In this talk, I will first illustrate the concept of geometric morphometrics approach and demonstrate some simple examples in archaeology using R, including both outline- and landmark-based methods. In addition, I will briefly introduce some advanced applications in archaeological research including examples using digitized three-dimensional models. The limitations of geometric morphometrics in archaeological research will be also discussed.

Approaching Upper Palaeolithic hunting strategies through technology and residue analysis

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Backed tools are one of the most abundant categories of retouched blanks in Upper Palaeolithic assemblages and play a key role in the definition of specific cultural techno-complexes, possibly showing great variability in time and space. For this reason, their study is fundamental to understand behavioural dynamics of Palaeolithic hunter-gatherers. Based on archaeological and ethnographic cases, as well as on the numerous wear studies that have been produced in recent years on these artefacts, it can now be assumed that they were mainly used as part of composite weapon systems.

The study of backed tools through a modern integrated approach combining technological, morphometric and residue analysis enables us to greatly increase our understanding of the technological know-how related to hunting strategies. This kind of approach allows us to answer three main questions: 1) how armatures were manufactured, 2) how they were used and, eventually, 3) the role (cultural, environmental, chronological etc.) these specific artefacts have in defining the techno-economic behaviour of different groups.

For what concerns manufacturing modalities, an important role is played by the kind of backing technique used. It represents a fundamental aspect of the transformation of blanks in backed tools and has recently been investigated in experimental and methodological works, as well as archaeological case studies.

Use, on the other hand, can be inferred through residue analysis, which can provide important information on the types of adhesives selected to fix lithic implements to the shaft, as well as on their relative position when combined with functional analysis of diagnostic impact fractures. Residue analysis also deals with the identification of organic and inorganic substances with which lithic implements have come into contact during use, namely animal tissues, vegetal fibres etc., thus representing an essential discipline in the study of hunting strategies.

Zooarchaeology and the Middle to Upper Palaeolithic transition: Some methodological insights

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Animal remains from Palaeolithic contexts offer the possibility of exploring human-environment interactions and subsistence economy of hunter-gatherer groups. An intriguing topic is the so called “Middle to Upper Palaeolithic Transition” in Europe, a period in which not only a cultural turnover took place, but also the replacement of human populations (Neanderthals) due to the arrival of new groups with their own biological characteristics and needs (Modern Humans). Zooarchaeology can help us to disentangle changes in strategies for exploiting animal resources, not only considering prey selection in terms of species, but also in terms of age classes and anatomical parts. Despite the potentialities that this field of research offers, Palaeolithic zooarchaeology has to face peculiar problems, such as a high level of bone fragmentation, low taxonomic and anatomical identifiability of specimens and the presence of several actors who can alter (or create) the bone samples (e.g., hyaenas). Peninsular Italy offers the possibility to study in depth the demise of Neanderthals and the rise of Modern Humans from a zooarchaeological perspective. The talk will focus on case studies from cave sites, highlighting the methodological issues we must consider in order to obtain the best results is this particular field of research. Attention will be paid to the environmental influence on game availability, the identification of bone accumulators (distinguishing human camps from hyaena dens or mixed samples) and the influence of hunting strategies on prey selection. In addition, the different significance of peculiar animal resources for different human groups will be explored.

Disentangling the spatial structure of a Palaeolithic camp: Methodological issues

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The spatial structure of a Palaeolithic site is a wide window on multiple information about the settlement strategies of hunter-gatherer groups. Nevertheless, assuming the existence of a direct correspondence between social, behavioural and spatial structures at an archaeological site is clearly naive. For this purpose, both a high level of interdisciplinary and a complex and highly specialized perspective (the spatial archaeologist's one) are required. Nowadays the Spatial Archaeologists can benefit from very powerful investigative tools: the GIS. It acted a real technological and epistemological revolution, but the actual implications of this scientific debate are not yet expressed to their full potential. The GIS is not simply a software aimed at creating maps, it is the most developed expression of both philosophical and technical merging of spatial sciences. In particular, it has made the field of Spatial Archaeology the natural terrain expressing the best interdisciplinary convergence of contextual and behavioural approaches. A robust analytical protocol is required to best express this nature, correctly responding to the epistemological issues triggered by modern Spatial Archaeology.
Here, we present the work-flow developed for the intra-site study of palaeolithic sites, it includes 4 steps: 1) definition data and geodatabase design, 2) taphonomic analysis of the context, 3) spatial-functional analysis, 4) reconstruction of the activity areas and functional structure of the site. The first step, in particular, plays the decisive role, because the goodness of data definition and classification directly influences the "quality" the results.

Lithic technology, the notion of *chaîne opératoire* and its application in two case studies: The Mousterian of Riparo l'Oscurusciuto and the Uluzzian of Grotta di Castelcivita

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The notion of *chaîne opératoire* – first conceived by Leroi-Gourhan – is a method used to retrace the reduction sequence used in the production of stone artefacts. This entails arranging the actions required to envision and create the lithic tools in spatiotemporal order. Thus, the stone tool production process can be divided into several phases: the selection and acquisition of the appropriate raw material; the initialization and structuration of the raw block of material in order to produce stone tools with predetermined shape and technical features; the production of target flakes; the further maintenance of the convexities in order to produce other desired target objects; the eventual transformation by retouch of the products; and finally, the use of the tools. The tools could then be either abandoned or reused and recycled at the end of this process. Reconstructing the reduction sequence of an archaeological assemblage allows us to learn about the prehistoric craftsmen's intentions, the gestures and procedures involved in manufacturing the tools, and how they were used. We can thereby rebuild a series of complex behaviours from a single object.

The purpose of this talk is to illustrate the lithic reduction sequences of two Southern Italian sites: the Oscurusciuto rockshelter and Grotta di Castelcivita. Oscurusciuto is an important Mousterian site, and it contains a long succession of levels dating from the end of the middle Palaeolithic (42,724 ± 716 cal BP and 55 ± 2 ka $^{40}Ar/^{39}Ar$). The reduction sequence at the site is characterized by a dominating Levallois production aimed at producing elongated and convergent tools. The second case study is Castelcivita, which has an extended stratigraphy that covers the Mousterian, Uluzzian, and Protoaurignacian techno-complexes. The Uluzzian documents one of the earliest *Homo sapiens* dispersions in southern Europe. In terms of technology, it represents a notable shift from the preceding and broadly contemporaneous Mousterian techno-complexes. At Castelcivita, the Uluzzian assemblages were thoroughly investigated and understood from a technological and functional standpoint.

Elemental and isotopic analyses of tooth enamel disclose individuals' life histories

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Recent advancements in mass spectrometry techniques allowed to gather more and more data on animals' and humans' life history. This latter is broadly defined as the individual's pattern of allocation of time and energy to various fundamental tasks (e.g. growth, reproduction, and survival). Specifically, analyzing the elemental and isotopic composition of human and animal skeletal remains it is possible to infer about their mobility pattern, their eating habits, their health status and their metabolism. Being a growing tissue resistant to diagenetic alteration, tooth enamel is the foremost target for chemical analyses, preserving a wealth of biogenic information on past life events for millions of years. Overall this body of information may provide precious insights into evolutionary trajectories and adaptation of extinct and extant taxa. For more recent periods, individuals' life histories can inform on societal structures and cultural practices of people. With this lecture, I will give an overview of the current elemental and isotopic methodologies applied to skeletal remains, presenting e.g. the application of (non-)traditional isotope systematics to trophic niche reconstruction; the measure of time-resolved chemical data to infer about early dietary changes, mobility and exposure to toxic metals; the use of data modelling to formalize and maximize the collected information.

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