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The Role of Culture in Early Expansions of Humans (ROCEEH)

Figurine of a wooly mammoth carved from mammoth ivory from Vogelherd Cave, Swabian Jura (Photo: J. Lipták, © University of Tübingen)

HEIDELBERGER AKADEMIE DER WISSENSCHAFTEN
Akademie der Wissenschaften des Landes Baden-Württemberg

THE ROLE OF CULTURE IN EARLY EXPANSIONS OF HUMANS

Editorial

The 16th issue of the ROCEEH newsletter focuses on the climate of the Iberian Peninsula during the first wave of human expansion into Western Europe. We also take a closer look at Paleolithic mobile art in Central Europe and present a session report from INQUA 2019 in Dublin, Ireland.

Early Pleistocene climate of the Iberian Peninsula during the first hominin colonization

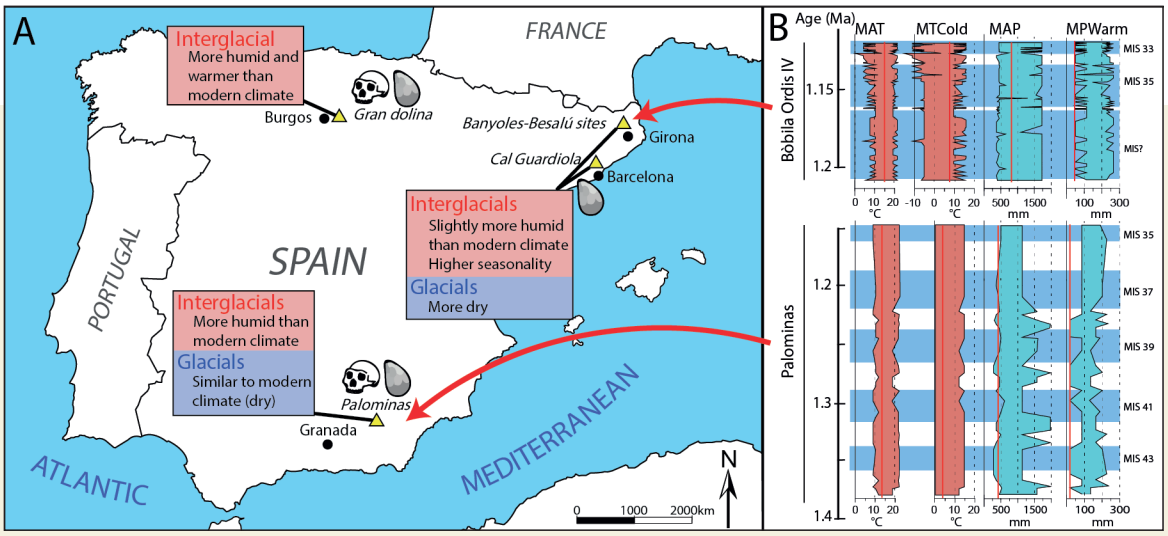
Some of the earliest evidence for a human presence in Western Europe comes to us in the form of fossils and lithic tools found on the Iberian Peninsula dating back to the Early Pleistocene. Three regions provide evidence of these early hominins: Orce, Atapuerca, and Vallparadís. Despite the abundance of sites, much remains unknown about the climate and environments which these hominins encountered when they first reached the Iberian Peninsula. Here, we take a closer look at the climatic calculations featured in our last publication (Altolaguirre et al. 2019).

With the aim of reconstructing the climatic conditions during the time of the first wave of hominin expansion into Western Europe, we applied the Coexistence Approach method to a selection of fossil plant and pollen records from the areas where early human evidence was found (Figure 2A).

The fossil sites of Orce in Granada (SE Iberia) contain fossils and Oldowan lithic artifacts dating back to about 1.4–1.2 million years ago. These findings are regarded as some of the oldest evidence for hominin occupation in Western Europe and the oldest on the Iberian Peninsula. In Northern Iberia, the Gran Dolina site (part of the greater Atapuerca complex) contains several strata rich in hominin fossils, especially the TD6 unit. The findings in this stratigraphical unit led to the discovery of *Homo antecessor*, dated to 1.0–0.9 million years. Finally, in Catalonia (NE Iberia) lithic tools dating to 800,000 years have been found at the site of Vallparadís. Although precise dating of most of these sites is not available, studies of the accompanying fauna place the formation of these hominin sites during interglacial periods, suggesting that early humans in Europe benefitted from improved conditions of the interglacial climate and avoided the colder glacial periods.

The Coexistence Approach method for climatic quantification was developed by Mosbrugger and Utescher in 1997. This method first links each identified fossil taxa with its Nearest Living Relatives and then compares the climatic tolerances of each of the Nearest Living Relatives. This way a coexistence interval is found where all Nearest Living Relatives can coexist. These intervals contain the climatic values related to temperature and precipitation which must

▲ Figure 1. Landscape of the Baza Basin featuring dry Mediterranean vegetation and, in the background, Jabalcón Mountain, an inselberg that looks over the plains of the basin, Spain.



▲ Figure 2. A) Map of the Iberian Peninsula featuring the location of pollen and leaf assemblages studied (yellow triangles). A skull indicates the presence of hominin fossil remains, while a handaxe shows sites where stone tools were found. B) Coexistence intervals for the pollen profiles of Bòbila Ordis IV and Palominas. Note the differences in MAP and how the MTCold intervals never reach 0°C (MAT=Mean Annual Temperature; MTCold= Mean Temperature of the Coldest month; MAP=Mean Annual Precipitations; MTWarm= Mean Temperature of the Warmest month).

have predominated during the development of the flora that later formed the fossil assemblage.

To study the past climate of the locality of Orce, the analysis was applied to fossil pollen assemblages from the upper part of the Palominas core (Figure 3) with an age between 1.4 and 1.1 million years encompassing several climatic cycles. Pollen records, such as the ones from the Palominas core, allow the identification of a large number of plant groups. The use of light microscopy to identify pollen grains usually only allows identification to the level of family or genus, but not to species. Since the climatic range of an entire plant family or genus is commonly very broad and diverse, the application of the Coexistence Approach in pollen records sometimes provides wide coexistence intervals. The resulting coexistence intervals for precipitation parameters, although broad, offer an insightful reconstruction of the Early Pleistocene climate in southeastern Iberia. There is a clear alternation of humid and dry phases, most likely linked with interglacial and glacial periods, respectively (Figure 2B). During glacial periods the precipitation would be similar to the current annual mean of about 350 mm, but during humid periods mean annual precipitation would have been at least 150 to 200 mm greater, with the average of the intervals being much higher. Although coexistence intervals for the temperature parameters are wide, it is clear that there were no abrupt temperature changes, with the average temperature of the coldest month always staying above 0°C, even during glacial periods. This is especially significant since the 0°C average for winter temperatures has been proposed as a climatic barrier for the presence of early *Homo* in Europe (Leroy et al. 2011). Regarding this proposed climatic limit for human expansion, the Coexistence Approach method reveals that early hominins could have survived the winters in the region of Orce, even during glacial periods.

For Atapuerca, the Coexistence Approach was applied to the pollen assemblages described from the TD6 level at the Gran Dolina site. This is the level where the *Homo antecessor* was first described and dated to 900,000 years ago. The coexistence intervals for the TD6 level reveal warmer and more humid conditions than the ones experienced at modern day Atapuerca. The Coexistence Approach was also applied to different pollen records and macroflora assemblages from Catalonia. The 800,000 years old lithic-bearing layers of the site of Vallparadís correlate to the nearby site of Cal Guardiola, where the same analysis was applied to the pollen record described there. Additionally, the Coexistence Approach was applied to the pollen records of the Banyoles-Besalú Basin (Tres Pins II, Bòbila Ordis IV (Figure 2B), and Crespià) also in Catalonia and dated to the Early Pleistocene. Crespià contains a diverse collection of fossil leaves which allowed the Coexistence Approach to provide more concise and narrower coexistence intervals. The results for these sites evoke a climate more or less similar to the modern one, with periods when precipitation was lower than today (as identified in Crespià) and periods when precipitation was slightly higher. Additionally, the pollen assemblages from Crespià produce winter temperatures lower than today while the results from Cal Guardiola indicate a stronger seasonality during the Early Pleistocene. These climatic reconstructions also prove that even during the Early Pleistocene the northern latitudes were more humid than in the south.

In conclusion, we applied the Coexistence Approach to fossil pollen and leaf assemblages from hominin sites and other sites dated to the same age as the early human expansion into Western Europe. Our findings reveal that the Iberian climate during the Early Pleistocene alternated between dry (glacial) and humid (interglacial) periods. During interglacial periods precipitation and temperature were higher than today, and during glacial

periods the climate was more similar to the modern one, with cooler temperatures and drier environments, especially in the southern latitudes. Although the warm and humid interglacial climate would have allowed the hominin communities to thrive, during the glacial periods the winter average temperatures were not so low that they impeded the survival of early hominins—at least not in the southern part of the Iberian Peninsula where the oldest evidence for human activity is found.

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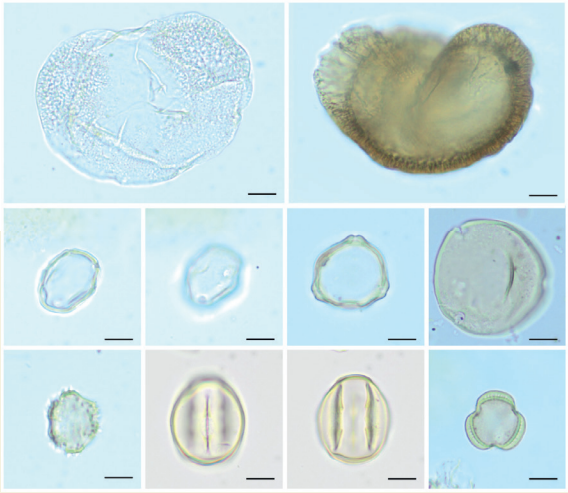
Yul Altolaguirre Zancajo



▲ Figure 3: Selection of Early Pleistocene pollen grains from the Palominas core, SE Spain. Featuring from left to right: (top) spruce and cedar; (middle) wingnut (two pictures with different focus), birch and hickory; (bottom) dwarf mistletoe, Eucommia (two pictures, different focus) and sagebrush.

What's it all about? Continuity, changes and surprises in the Paleolithic art of Central Europe

When it comes to Upper Paleolithic art, we immediately think about the spectacularly painted caves in France and northern Spain, such as Lascaux, Grotte Chauvet or Altamira. However, the phenomenon is neither limited to this region, nor to cave paintings alone. Upper Paleolithic art in Central Europe occurs mainly in the form of mobile objects and is associated with modern humans like oursleves, *Homo sapiens*. Mobile art describes all kinds of artistic expressions that are not fixed to a canvas, such as cave walls or rocks. Usually we are dealing with small to medium-sized objects that can be carried around easily. These objects are either artworks in and of themselves, or the artistic expressions appear on tools such as *bâtons percés* (perforated batons), spearthrowers, or personal ornaments.
In Central Europe, some regions can be described as centers of artistic creation. One famous region is the Swabian Jura which has yielded small figurines carved from mammoth ivory dating to the Aurignacian period (Figure 4), a cultural entity which existed roughly 42,000–35,000 years ago. These figurines are among the earliest evidence of figurative art in human history and show amazing artistic and aesthetic skills. They were found in four caves of the Swabian Jura close to the city of Ulm, namely Hohle Fels and Geißenklösterle in the Ach Valley, and Vogelherd and Hohlenstein-Stadel in the Lone Valley. Another artistic center includes the open-air sites of Moravia in the Czech Republic, for example Dolní Věstonice, Předmostí, and Pavlov. The latter site provides the name of a regional expression of the Gravettian culture—the Pavlovian—dated between 33,000 and 27,000 years ago. Like the Swabian sites, the Moravian sites are famous for figurines carved from mammoth ivory and also from clay. The small clay figurines were intentionally burnt and represent the first ceramics known in Europe. While in the Aurignacian and the Pavlovian we see distinct centers of art production, mobile art of the later Magdalenian culture represents a widespread phenomenon across Central Europe from about 16,000–13,000 years ago. Specific artistic centers dominate the landscape, including the sites of Gönnersdorf and Andernach in the Rhine Valley, and Petersfels, Kesslerloch, and Schweizersbild in southern Germany and Switzerland. The sites of the Rhine Valley particulary stand out with their extremely rich assemblages of mobile art. In contrast to the three-dimensional figurines of the Aurignacian and Pavolvian sites, Magdalenian sites contain many two-dimensional depictions of animals and humans engraved on plates of slate (Figure 5).
The aim of ROCEEH is "to reconstruct the spatial and temporal patterns of the expansions of hominins between three million and 20,000 years ago in Africa and Eurasia." Art and related expressions, including decoration, personal ornaments and the use of red ochre, are preserved as archaeological remains of cultural practices. These remains tell us much about how human groups conceived of themselves. If we can speak in a general way, humans tend to depict what moves them. They draw things with which they have built connections, and tell stories about myths that represent their value systems. With regard to European Paleolithic art in general, certain preconceptions have always prevailed: 1) animals are the dominant theme through time;

2) thematic changes are few during the course of the Upper Paleolithic; and 3) human depictions are present but always rare. In order to better understand the cultural dynamics within the European Paleolithic, I conducted a detailed investigation to answer these questions: 1) Which themes occur in the mobile art of Central Europe? 2) Are there differences between regions? 3) How do the themes evolve over time? and 4) Which differences existed before and after the Last Glacial Maximum, which occurred around 20,000 years ago?

To address these questions, I created a database of mobile art spanning the Upper Paleolithic from the beginning of the Aurignacian until the end of the Magdalenian. Since the Upper Paleolithic spans a considerable amount of time and Paleolithic art objects are abundant in Europe, I narrowed the study area to Central Europe. While this limitation is artificial with regard to geographical connections of the Upper Paleolithic, certain natural limitations have always existed, for example rivers and mountain ranges, which make a regional perspective tenable.

Information about each object, such as provenance, material, type of artifact, preservation, dimensions, and genre were collected. To detect which thematical spheres dominate the assemblages, every figurative representation was entered separately. The theme of representation might be anthropomorphic, zoomorphic, herbivore, carnivore, marine mammal, bird, fish, amphibian, reptile, or insect. The number of individuals appearing on one object was also recorded. A taxonomic identification was conducted and according to the "quality" of the depictions, they were classified as precisely as possible. Additionally, information about sex and age was collected, if available. Of course we must keep in mind that thematic and taxonomic definitions based on our selected criteria only vaguely approach the motivation of past people in selecting specific animals. In fact the chosen categories probably best correspond to our modern views about nature and its order, and may not necessarily reflect the considerations of Paleolithic people. For example our classification of herbivore vs. carnivore represents just one way to classify animals; others might sort them by size, similarity in appearance, color, solitary vs. social lifestyle, nutritional value or even their mythological significance.

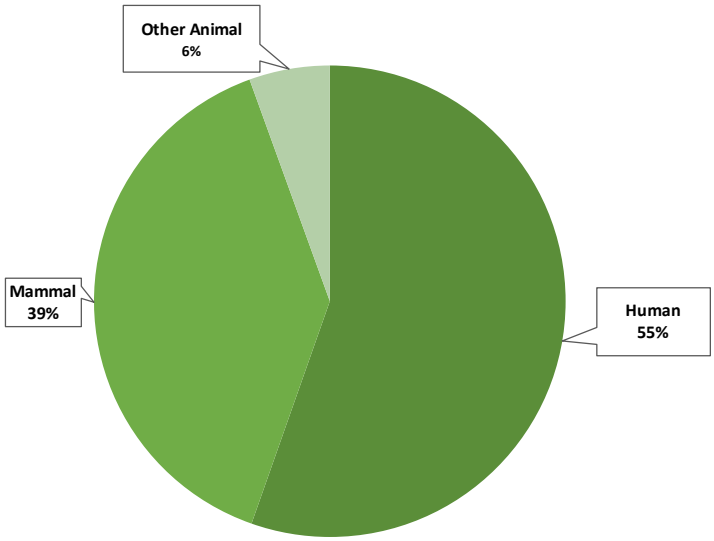
So far, more than 1,400 individual representations of animals, humans, or parts of them—if identifiable as such—were entered into the database. Objects from Austria, the Czech Republic, Poland, Germany, and Switzerland are present, partly due to the long and intensive research history of these countries. We divided the themes depicted in mobile art according to categories of humans, mammals (excluding humans), and other animals, such as fish, bird, or unidentifiable species. For the Aurignacian 19% of the representations are humans, with 55% mammals and 26% other animals. Aurignacian representations are mainly made from mammoth ivory and come in the form of sculptures. During the Gravettian/Pavlovian the portion of human depictions rises to 27%, while mammals are more or less stable with 57%, and other animals decline to 16%. Similar to the Aurignacian, figurines, made of ivory or burnt clay, are the main mode of representation in the Gravettian/Pavlovian. However, during the later Magdalenian, we see significant changes. Contrary to the preconceptions mentioned before, in which humans are rarely assumed to be shown as artistic expressions of the Paleolithic, we see that humans comprise 55% of all identifiable representations of the Central European Magdalenian (Figure 6). The representations appear mainly in the form of engravings on osseous materials like bone or antler, or on tabular plates of slate. Although many female figurines are present, their frequency is surprising. The marked increase in human figures as a topic of the Magdalenian is only one of the changes seen in artistic expression. The study also shows significant shifts in the use of raw material, medium of artistic expression and choice of animal species.

▲ Figure 4: Animal figurines from the Aurignacian site of Vogelherd in the Swabian Jura, southwestern Germany (Photo: J. Lipták © Universität Tübingen).

▶ Figure 5: Engraved mammoth on a tabular plate of slate from the Magdalenian site of Gönnersdorf (with courtesy of G. Bosinksi, after Bosinski and Fischer 1980, modified).

These changes are also reflected in other types of archaeological material such as personal ornaments and stone tool technologies. The shift in material culture mirrors population changes as suggested through genetic investigations. While genetic and material culture do not necessarily correlate, in this case it seems that these new Magdalenian populations spread across Central Europe after the end of the last glaciation, carrying with them new artistic ideas, needs, and expressions. This study demonstrates that prior perceptions of Paleolithic art need to be questioned. While animals are important, they are not necessarily the predominant theme during the Magdalenian. Human figures are least represented during the Aurignacian, but still occupy a part of people's artistic concept. Human representations show a surprisingly high frequency during the Magdalenian. Themes change remarkably during the Upper Paleolithic, indicating changes in the stories, myths, and values of these people. This detailed analysis of the representation of mobile art in Central Europe provides new data for interpreting Paleolithic art in a wider perspective and challenges our "traditional" views.

Ewa Dutkiewicz



▲ Figure 6: Themes of representation in the mobile art of the Magdalenian in Central Europe.

Session Report "Human and non-human responses to the Mid-Pleistocene transition" at the INQUA 2019 conference in Dublin, Ireland

The Mid-Pleistocene Transition (MPT) was a period of drastic climatic change occurring between 1.2 and 0.8 million years ago. These changes were caused by orbital forcing and resulted in a re-organization of the faunal communities. The climatic changes affected the presence of early hominins in Eurasia. We are however unaware to what extent these changes influenced their ecology and evolution. Archaeological and fossil evidence in this critical period is rare and full of gaps. In order to study these questions it is necessary to develop a set of scenarios and test the empirical output of every single one against the spatiotemporal pattern of individual finds. We accomplished this task by designing an agent-based model as a simulation environment.
To approach the question on hominin presence during and around the MPT, Ericson Hölzchen and Christine Hertler (both ROCEEH) co-organized an International Focus Group (IFG) on "Modelling Environmental Dynamics and Hominin Dispersals around the MPT (METHOD) " funded by the International Union of Quaternary Research (INQUA). In order to study the complex phenomena of hominin expansions, the group of international researchers pursues an interdisciplinary approach encompassing archaeologists, paleoanthropologists, paleobotanists, paleontologists, and computer scientists.
At the quadrennial INQUA conference held in Dublin from July 25 – 31 we organized a session on "human and non-human responses to the Mid-Pleistocene transition". The session was convened by Ericson Hölzchen, who was supported by Maria Rita Palombo (Sapienza University of Rome, Italy) and Lutz Maul (Senckenberg Research Institute, Weimar, Germany). It included 15 contributions.
The session was introduced by the talk of Christine Hertler (ROCEEH) on "Spatial Behaviour of Humans Across Scales: Mobility – Migration - Dispersal", where the terminology was introduced and examples about different migration behaviors of animals and humans were given. The determinants of human mobility and non-human migration were exposed. Mobility and migration need to be viewed as low resolution basis for large scale phenomena like dispersal.
Ericson Hölzchen and Jan-Ole Berndt (Trier University, Dept. of Business Informatics, Germany) focused on agent-based modelling as a simulation method. Whereas Hölzchen presented the array of ABMs developed in frame of the METHOD IFG, Berndt's presentation introduced the methodology of simulations in general and elaborated on the definition of simulation experiments in particular. In cooperation with ROCEEH the METHOD IFG designed and programmed one particular ABM on "Modelling Resource Dynamics of Hominins (MoReDoH)". Hölzchen introduced the model in its present state (Version 27), while Berndt showed how agent-based simulation experiments are designed and how the results may be analyzed.
Jesús Rodríguez and Ana Mateos (both CENIEH, Burgos, Spain) elaborated on the hominid agents, their features and their behavior, which have to be acknowledged in frame of simulations. Rodríguez discussed the role of cannibalism in early hominin behavior, such as *Homo antecessor*, and how it can be explained by optimal foraging theory and behavioral ecology. Ana Mateos introduced humans as potential agents. She showed how actual humans performing a task can generate data to examine the energetic demands of past activities, such as gathering plants or

knapping stone tools. The results of these studies are valuable for modelling approaches, because the preservation of behavior in the fossil or archaeological record is quite limited.
The remaining oral and poster contributions introduced further case studies which may be examined with the MoReDoH model. Yang Shi Xia (CAS, Beijing, China) presented results from archaeological excavations in East Asia. Furthermore, she discussed the MPT as an initiator of a cultural explosion in China, leading to a significant diversification of tool technology. Michaela Ecker (University of Toronto, Canada) presented South African paleoclimate reconstructions based on carbon-dioxide levels and discussed effects on vegetation and human culture around the MPT. Poster contributions included a concept for an agent-based model of hominin expansion in Southeast Asia (Mika Puspaningrum, ITB Bandung, Indonesia), the ecology of ground squirrels in eastern Europe (Lilia Popova, NASU Kiev, Ukraine), a methodology for agent-based models simulating early human behavior (Jan-Ole Berndt, Trier University), the reconstruction of the paleoenvironment near Orce in the Guadix-Baza Basin (Yul Altolaguirre, see report in this issue), a climatic reconstruction in Central Anatolia (Ozan Erdal, Istanbul Technical University, Turkey), a research program on human behavioral adaptations (Ana Mateos), a method for the reconstruction of environmental dynamics based on GIS (Christian Willmes, University of Cologne, Germany) and an introduction to METHOD (Jesús Rodríguez).
During the session we examined and discussed modeling of human and non-human spatial expansions from different perspectives and approaches. The work presented during the session provided roadmaps for future directions, and intensified the requirement for more complex behavioral models at different spatial and temporal scales to explain the complex patterns of Mid-Pleistocene expansions.

Ericson Hölzchen

Forthcoming

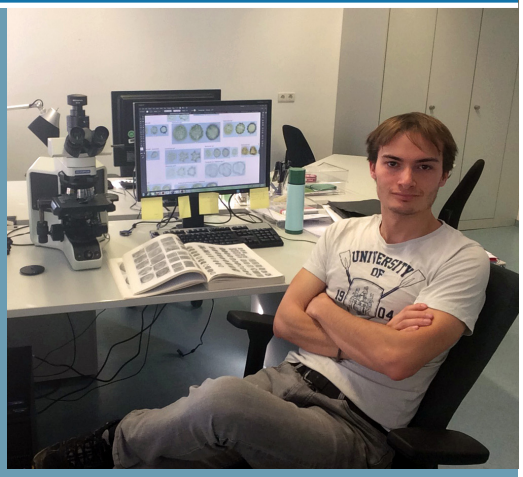
- ROCEEH Conference Human Origins–Digital Future **27–29 July 2020** in Frankfurt/Main, Germany.

The ROCEEH Conference "*Human Origins—Digital Future*" will present and discuss integrative aspects and approaches to the development, use, and future securing of large scientific databases, especially within the context of anthropological research. The primary research question asks how databases with their innovative information technology can be used to gain new knowledge by retrieving and extracting archaeological, paleoanthropological, paleobiological, and paleogeographic information.
With this conference, we will address core issues of digitialization, including possibilities and problems of large, multi-layered databases. Although digital tools are widely applied in scientific projects, questions of linkage, targeted expansion, evaluation, and sustainable safeguarding of databases remain unresolved. New approaches including innovative methods of data mining and machine learning as well as deep learning and artificial intelligence will be addressed.

Who's who?

This issue: Yul Altolaguirre Zancajo

Yul Altolaguirre Zancajo studied Geology at the Complutense University of Madrid. During this time he became interested in sedimentology and paleontology and joined the paleontological excavations of Somosaguas and Cerro de los Batallones in Madrid. After obtaining his Bachelor's degree in Geology in 2013, he completed a Master's degree in Geological Processes and Resources. In 2015 he finished a second Master's degree in Paleontology, with a focus on palynology and paleoecology. In 2016 he joined the "Ruta de los Dinosaurios," as an interpretative center guide, informing visitors about the dinosaurs of Spain.
In early 2017, Yul joined the ROCEEH team as a Ph.D. student working in the Senckenberg Institute and enrolled at the Goethe University in Frankfurt. Yul's doctoral project will create an environmental and climatic background for some of the earliest hominin sites of Western Europe by studying the fossil pollen recovered near the sites of Orce, Spain.



CONTACT The Role of Culture in Early Expansions of Humans
Heidelberg Academy of Sciences and Humanities

Senckenberg Research Institute Frankfurt/Main
Eberhard Karls University of Tübingen

COORDINATORS Miriam Haidle (scientific)
Julia Heß (administrative)

Senckenberg Research Institute
Senckenberganlage 25
D-60325 Frankfurt/Main
miriam.haidle@uni-tuebingen.de
julia.hess@senckenberg.de
www.roceeh.net

THE ROLE OF CULTURE IN EARLY EXPANSIONS OF HUMANS

The Heidelberg Academy of Sciences and Humanities is a member of the Union of German Academies of Sciences and Humanities, which coordinates the Academies' Program. The research project, „The Role of Culture in Early Expansions of Humans", was incorporated into the Academies' Program in 2008.

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