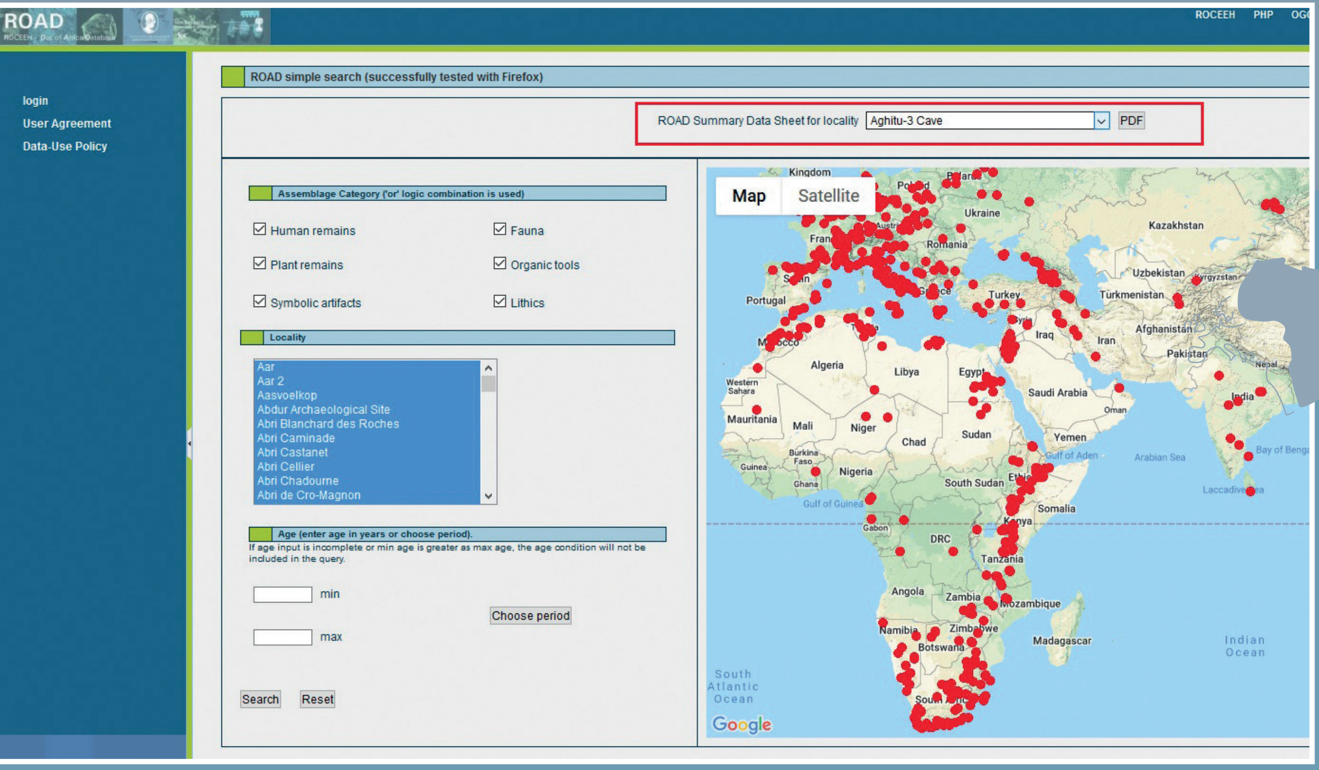
newsletter 17 | 2020

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



Picture of the ROAD homepage showing (in red) the new tool for generating ROAD Summary Data Sheets. The output is a downloadable PDF which summarizes the data entered in ROAD for a specified locality.
The map below is a tool to conduct simple searches based on assemblage category, locality and age. The data retrieved are plotted on the map.
To access this page, enter: https://www.roceeh.uni-tuebingen.de/roadweb.

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

THE ROLE OF CULTURE IN EARLY EXPANSIONS OF HUMANS

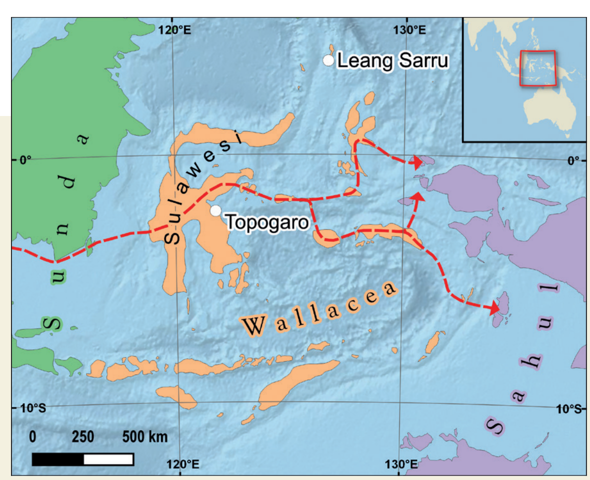
Editorial

This 17th issue of the ROCEEH newsletter focuses on early human migrations in Island Southeast Asia by examining microscopic traces of use-wear on stone artifacts. Next, we introduce the ROAD Summary Data Sheet, which provides an overview of locality data stored in the ROAD Database. Finally we discuss the latest developments in an agent-based model for Neanderthal movement called NeMo.

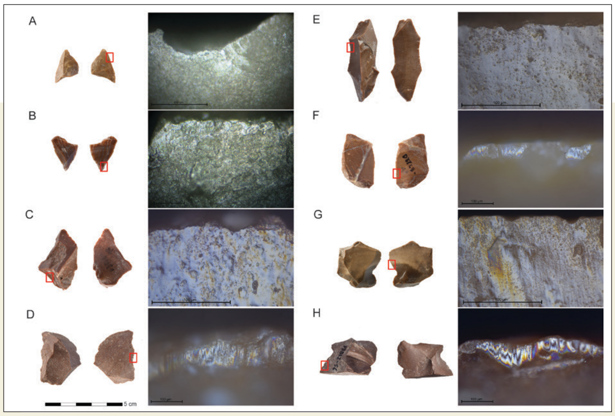
Use-wear analysis of stone tools from Late Pleistocene sites in Wallacea

The region known as Wallacea spans many of the islands situated between mainland Southeast Asia and Australia. The region has become a hotspot for archaeological and paleoanthropological research with recent discoveries of several new hominin species and a strikingly early record of modern human presence. Early modern human migrations passing through the Wallacean region and arriving in the Sahul[1] are now dated to as old as 50-60,000 years. However, in Wallacea itself, the current evidence for the presence of modern humans only reaches back to about 44,000 years (Ono et al. 2020). An ongoing project headed by Dr. Rintaro Ono from the National Museum of Ethnology in Osaka, Japan, and funded by the Japan Society for the Promotion of Science, revealed the earliest known human occupation along the eastern coast of Sulawesi. This was possibly the jumping off point towards the Maluku Islands and eventually onwards to the Sahul along the so-called 'Northern Route' which would have involved several sea crossings.

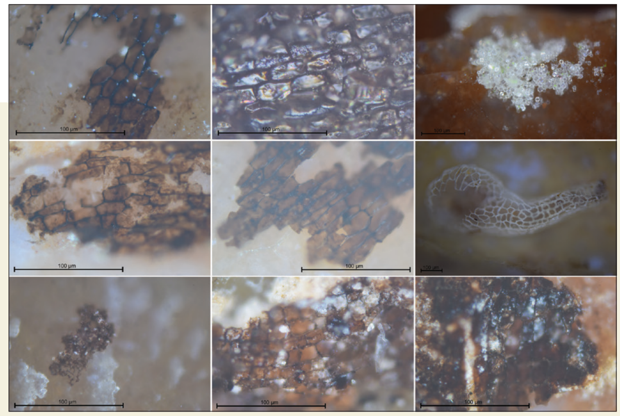
As a partner in this project, I studied lithic assemblages from North and Central Sulawesi for tool use through traceological[2] microscopic analysis (Figure 1). This became the core of my Ph.D. research entitled: *Island Adaptation and Maritime Interaction in Changing Environments from the Terminal Pleistocene to the Early Holocene: A Comparative Study of Prehistoric Technology in Northeastern Indonesia.* In collaboration with experts from several institutions in Germany, the Philippines, Indonesia and Japan, we were able to find direct evidence of complex and specialized technologies that were based on the seemingly simple, unretouched stone tools typical of Island Southeast Asia (ISEA) as early as 35-29,000 years ago. The stone tool assemblages from two Late Pleistocene cave sites in North and Central Sulawesi, Leang Sarru and Topogaro, were the focus of this study. To achieve this research, a mobile traceology laboratory was set up in the regional archaeology office located in Manado, North Sulawesi. Both low and high power microscopic use-wear analyses were conducted on all suitable stone tools. Selected artifacts were brought to the Philippines and Germany for further analysis. There, a combination of optical light microscopy and scanning electron microscopy was employed. At the same time, the application of laser confocal



▲ Figure 1. Location of the archaeological sites Leang Sarru and Topogaro. The red arrow shows potential paths of the so-called 'Northern Route.' Map: C. Sommer.



▲ Figure 2. Examples of stone tools and use-wear traces from Leang Sarru. Photos: R. Fuentes (Fuentes et al. 2019).



▲ Figure 3. Plant residues on stone tools from Leang Sarru. Photos: R. Fuentes (Fuentes et al. 2020).

microscopy for 3D analysis of stone tool surface was explored during the course of the project. A key component of this project was the identification and understanding of prehistoric technologies that were developed and adapted for the maritime ecologies of ISEA in the Late Pleistocene and Early to Mid-Holocene. More results are expected from this ongoing research project, which could reveal new information on how early modern humans adapted to environments that were drastically changing during the Late Pleistocene and the transition to the Holocene.

For Leang Sarru, a rockshelter located on a small island off the coast of North Sulawesi, our results indicate that use-wear analysis of unretouched flakes is a useful tool to infer more complex activities. This method can be applied to other inventories from sites beyond ISEA where similar difficulties exist. The problem here is that the unmodified flakes that appear throughout the Pleistocene and Holocene are rather indistinct. Through use-wear analysis, we were able to find direct evidence of different plant working processes in the form of distinctive micropolishes, striations and residues that appear on the surfaces of stone tools (Fuentes et al., 2019, Figure 2). Our experiments involved replicated stone tools with notched edges similar to artifacts from Sulawesi. We recreated the deposition of plant remains on scar negatives that served as catchments for such residues during use (Fuentes et al., 2020, Figure 3). Particularly well-developed micropolishes resulted from the intensive processing of phytolith-rich plant species. Bamboo is one of the main candidates for these phytolith-rich plants. In upcoming experimental research, we will work on producing more conclusive evidence for the use of bamboo in prehistoric technologies. It has already been proposed that bamboo working could be identified through experimental qualitative traceological research.

Excavations at Topogaro in Central Sulawesi started in 2016, conducted by Dr. Ono and his colleagues from the National Archaeology Research Centre (ARKENAS, Jakarta) and Balai Arkeologi (Manado, North Sulawesi). The site was occupied since at least about 29,000 years ago. Several stone tools that were retrieved show impact scars, probably caused by chopping hard materials such as animal bones. Intensive plant working was also practiced with unretouched flakes and resulted in clearly identifiable plant polish similar to Leang Sarru (Ono et al. 2020). During the Early Holocene, tool retouching appeared. Together with bone point production, the evidence indicates a shift towards the manufacture of reshaped tools. More analysis will be conducted at the site and on retrieved materials. In the upcoming excavations, deeper layers will be exposed. There is great potential for occupation layers older than 29,000 years.

As part of the project, we are establishing robust experimental and archaeological databases of both residues and use-wear traces for North and Central Sulawesi. We are collecting lithic raw materials from the periphery of the archaeological sites for flint knapping and experiments in modern tool use. Through this approach we intend to narrow down plant preferences during prehistoric times to the genus level through direct comparison with existing use-wear databases on archaeological materials. We expect that the results will address ongoing issues regarding the so-called 'bamboo hypothesis'[3], and its relation to the modern human colonization of ISEA during the Late Pleistocene. Another aspect being explored for future research is the application of quantitative techniques, especially laser scanning confocal microscopy. This method is suitable for studying smooth surfaces, such as 'sickle gloss'[4] micropolishes. Such traces were already documented on numerous artifacts at the Sulawesi sites. While quantification methods of polishes

1 The Sahul comprises mainland Australia, Tasmania, New Guinea, Seram (Maluku) and the neighboring islands during the Pleistocene.

2 Traceology is the study of how tools were used and is often called use-wear analysis.

3 The bamboo hypothesis suggests that people used bamboo to make tools because hard rocks suitable for toolmaking were scarce. Since bamboo is organic, it is invisible in the archaeological record after it degrades.

4 Sickle gloss occurs when stone tools are used repeatedly for intensive plant-cutting activities, resulting in a characteristic glossy micropolish.

are being tested for the region, they are still at an initial stage. In applying multi-level microscopic analysis coupled with a robust experimental database, this research will provide new insights into how people produced technologies from plants and even bones. Distinguishing different contact materials through the measurement of small-scale features on surfaces will not just benefit lithic studies. It will also contribute to our understanding of prehistoric technologies and tool use throughout the Late Pleistocene up through the Late Holocene. It will address questions on the function, versatility and role of the seemingly unchanging, unretouched stone tools that were used in the context of human behavior and adaptation to island and maritime environments until the historical period of Southeast Asia.

Overall, our research on sites with early modern human presence along the eastern coast of Sulawesi and following the 'Northern Route' has the potential to answer important questions. Above all, we can assess the level of technological innovation and adaptation of modern humans to vast seascapes of ISEA where sea crossings of hundreds of kilometers were possible, even during stages of low sea-level and enlarged land masses. Furthermore, research in Wallacea has a huge potential for finding direct evidence of the presence of early modern humans in cave and rockshelter sites. This will shed more light on the still enigmatic and fragmentary record of human evolution in the region, and also on the appearance of traits that indicate modernity such as rock art. The identification of stone tools is just the first step. Multi-level use-wear analysis can provide more clarity as to which materials were processed and how they were processed during the earliest occupation phases in North and Central Sulawesi around 35-29,000 years ago, if not earlier. In contrast to conventional lithic studies, use-wear analysis has demonstrated that it can obtain meaningful information about the amorphous and seemingly unchanging lithic assemblages typical of ISEA. These have eluded most attempts to classify them typologically and morphologically. In this regard, use-wear analysis is an important tool for the identification of early modern human traits and their behavioral and technological responses to fast-changing environments. With use-wear analysis, we may even be able to detect the first arrival of these early islanders along the eastern coast of Sulawesi.

References

Fuentes et al. (2019): Technological and behavioural complexity in expedient industries: The importance of use-wear analysis for understanding flake assemblages. J. Arch. Sci. 112, 105031. DOI: 10.1016/j.jas.2019.105031

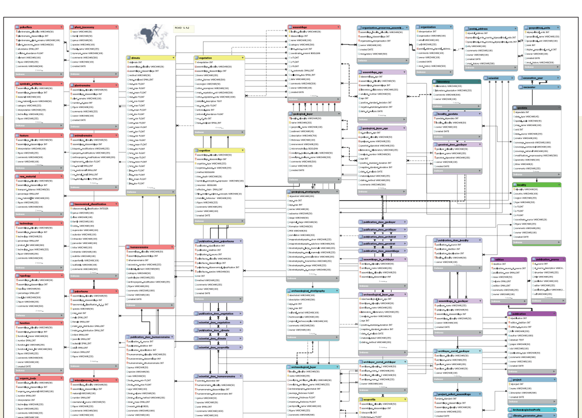
Fuentes et al. (2020): Stuck within notches: Direct evidence of plant processing during the last glacial maxiumum to Holocene in North Sulawesi. J. Arch. Sci. Rep. 30, 102207. DOI: 10.1016/j.jasrep.2020.102207

Ono et al. (2020): Island migration and foraging behaviour by anatomically modern humans during the late pleistocene to Holocene in Walacea: New evidence from Central Sulawesi, Indonesia. Quaternary International, available online 10 April 2020. DOI: 10.1016/j.quaint.2020.03.054

Riczar Fuentes

ROAD as a data publication tool

The ROCEEH Out of Africa Database, which we call ROAD, is a relational database. ROAD contains a vast amount of archaeological and paleobiological data stored in more than 50 separate tables. The information filling these tables comes from scientific publications written in English, German, French and many other languages. As of June, 2020, ROAD contains data more than 1800 localities, 11,000 assemblages and 3200 publications. ROAD's user interface, the ROAD application, incorporates several tools for visualization and querying data. For example, a user may be interested in performing a review of the database for the correctness of the data entered. To perform such a quality control, a user would need to understand the entire structure of ROAD, including its many tables and the relationships between them. In order to query all information stored in ROAD about a single selected locality, the user would need to query almost all of the tables (Fig. 4). Therefore, gathering information for one locality would not be an easy task, even for an experienced user. For a user unfamiliar with ROAD, it would be even more difficult.



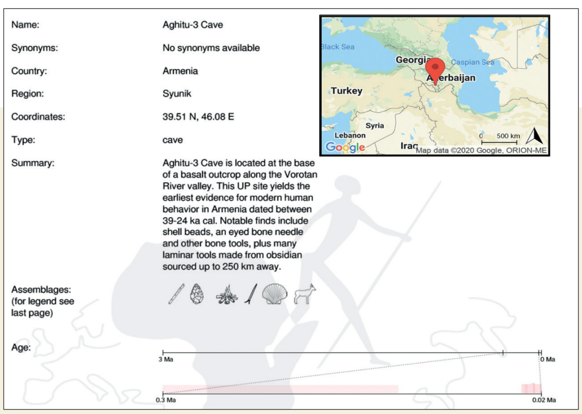
▲ Figure 4. The entity relationship diagram of ROAD. Graphics: Z. Kanaeva.

To make the information stored in ROAD more accessible to scientists and the general public, ROAD provides a tool for generating a datasheet summarizing each locality in the form of a PDF. Each ROAD Site Summary Datasheet is in itself a publication and can be used for scientific communication, education, data sharing and data control. The summary presents essential data for a selected locality including geographic coordinates, geological and archaeological layers, profiles, ages, assemblage descriptions and publication sources. The summary is published under a Creative Commons license (CC-BY-NC 4.0).

Datasheet structure

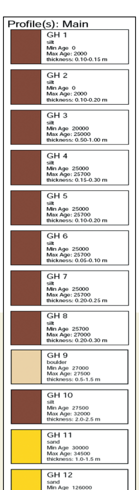
Each PDF document consists of five main sections: General Information, Geological Profiles, Archeological Profiles, Assemblages and References.

The first section is called "General Information" and includes the locality name and synonyms, geopolitical data such as country and region, spatial data, a small map, a summary of the locality, the type of locality, assemblage categories present and a graphical overview of the ages of the assemblages (Fig. 5).



▲ Figure 5. General information for the locality Aghitu-3 Cave in Armenia. Graphics: Z. Kanaeva.

The second section, "Geological Profiles," includes a graphical visualization of the geological profiles of the selected locality (Fig. 6). Similarly, the third section, "Archeological Profiles," provides a graphical visualization of the archeological profiles of the selected locality.



◀ Figure 6. Geological profile for the locality Aghitu-3 Cave. Graphics: Z. Kanaeva.

Assemblages

Archeological Stratigraphy	Min Age	Max Age	Archeological layer	Geological layer	Assemblage	Category
Upper Paleolithic - Eurasia	20000	25000	AH III	GH 3	AH III assemblage	feature, miscellaneous finds, organic tools, raw material, symbolic artifacts, technology, typology
-	20000	25000	-	GH 3	Aghitu-3 Cave Fauna Layer AH III	animal remains, paleofauna
Upper Paleolithic - Eurasia	25000	25700	AH IV	GH 4	AH IV assemblage	raw material, technology, typology
-	25000	25700	-	GH 4	Aghitu-3 Cave Fauna Layer AH IV	animal remains, paleofauna
Upper Paleolithic - Eurasia	25000	25700	AH IV	GH 5	AH IV assemblage	raw material, technology, typology
-	25000	25700	-	GH 5	Aghitu-3 Cave Fauna Layer AH IV	animal remains, paleofauna
Upper Paleolithic - Eurasia	25000	25700	AH IV	GH 6	AH IV assemblage	raw material, technology, typology
-	25000	25700	-	GH 6	Aghitu-3 Cave Fauna Layer AH IV	animal remains, paleofauna
Upper Paleolithic - Eurasia	25000	25700	AH IV	GH 7	AH IV assemblage	raw material, technology, typology
-	25000	25700	-	GH 7	Aghitu-3 Cave Fauna Layer AH IV	animal remains, paleofauna
Upper Paleolithic - Eurasia	25700	27000	AH V	GH 8	AH V assemblage	raw material, technology, typology
-	25700	27000	-	GH 8	Aghitu-3 Cave Fauna Layer AH V	animal remains, paleofauna
-	27000	27500	-	GH 9	Aghitu-3 Cave Fauna Layer AH V	animal remains, paleofauna
Upper Paleolithic - Eurasia	27500	32000	AH VI	GH 10	AH VI assemblage	feature, raw material, technology, typology
-	27500	32000	-	GH 10	Aghitu-3 Cave Fauna Layer AH VI	animal remains, paleofauna
Upper Paleolithic - Eurasia	30000	34500	AH VII	GH 11	AH VII assemblage	raw material, technology, typology
-	30000	34500	-	GH 11	Aghitu-3 Cave Fauna Layer AH VII	animal remains, paleofauna
-	126000	300000	-	GH 12	Aghitu-3 Cave Fauna Layer AH VII	animal remains, paleofauna

▲ Figure 7. Assemblage list for the locality Aghitu-3 Cave. Graphics: Z. Kanaeva.

Archeological Finds

Lithics

Assemblage	Function	Technology	Raw material	Lithic piece count	Typology list
AH III assemblage	No	Yes	Yes	4452	**chipped tool**: burin 45, notch 22, perforator 6, scaled piece 7, scraper end 30, scraper side 16, tool backed 174, tool diverse 431, tool truncated 14 **non-tool**: core 110, debitage 3597
AH IV assemblage	No	Yes	Yes	5	**chipped tool**: tool backed 1, tool diverse 2 **non-tool**: debitage 2
AH V assemblage	No	Yes	Yes	13	**chipped tool**: tool diverse 4 **non-tool**: debitage 9
AH VI assemblage	No	Yes	Yes	355	**chipped tool**: burin 1, notch 1, scaled piece 1, scraper end 1, tool backed 5, tool diverse 67 **non-tool**: core 3, debitage 276
AH VII assemblage	No	Yes	Yes	155	**chipped tool**: burin 5, perforator 1, tool diverse 8 **non-tool**: core 4, debitage 137

Non Lithics

Assemblage	Symbolic artifacts (material: category - interpretation)	Organic tools (material: number - interpretation)	Miscellaneous finds (material: number)	Feature (interpretation)
AH III assemblage	**shell**: ornament - ornament 8	**bone**: 3 - needle eyed 1, pointed artifact 1, unknown 1	**mineral pigment**:	combustion feature
AH VI assemblage	-	-	-	combustion feature

▲ Figure 8. List of the archaeologicla (lithic and non-lithic) finds and faunal remains for the locality Aghitu-3 Cave. Graphics: Z. Kanaeva.

References

Kandel, A.W., Gasparyan, B., Allué, E., Bigga, G., Bruch, A., Cullen, V.L., Frahm, E., Ghukasyan, R., Gruwier, B., Jabbour, F., Miller, C.E., Taller, A., Vardazaryan, V., Vasilyan, D., Weissbrod, L., 2017. The earliest evidence for Upper Paleolithic occupation in the Armenian Highlands at Aghitu-3 Cave. Journal of Human Evolution 110, 37-68.

Kandel, A.W., Gasparyan, B., Nahepetyan, S., Taller, A., Weissbrod, L., 2014. The Upper Paleolithic Settlement of the Armenian Highlands. In: Otte, M., Le Brun-Ricalens, F. (Eds.). Modes de contacts et de déplacements au Paléolithique eurasiatique, Actes du colloque international de la commission 8 (Paléolithique supérieur) de l'UISPP, Université de Liège, 28-31 mai 2012, Presses Universitaires de Liège, Liège, pp. 39-60.

▲ Figure 9. List of the publications used in data entry for the locality Aghitu-3 Cave. Graphics: Z. Kanaeva.

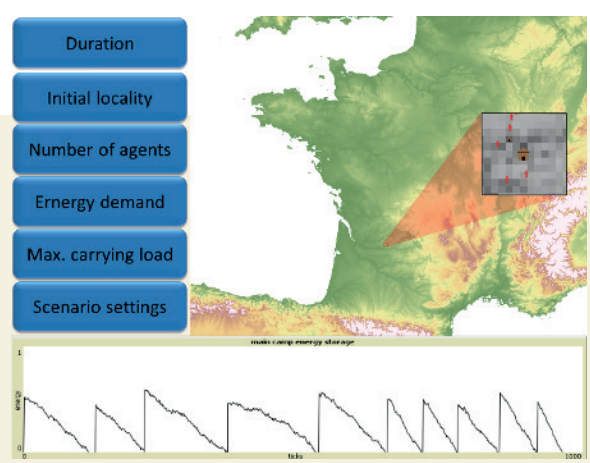
The fourth section, "Assemblages," consists of several subsections, one for each assemblage category. At the beginning of the section "Assemblages," all assemblages and their corresponding geological and archeological layers as well as the assemblage category are listed in stratigraphic order by age, with the youngest layer first, followed by the others below (Fig. 7). If an assemblage is included in more than one geological layer, it appears in the list more than once (and possibly with more than one dating).

The listed assemblages also appear with their relevant details in at least one of the subsections: Human Remains, Archeological Finds (Lithics and Non-Lithics), Faunal Remains and Plant Remains (Fig. 8). Finally, the "References" section includes all publications used for data entry of the selected locality (Fig. 9). In summary, the ROAD Summary Data Sheet includes relevant details for a given locality and can be accessed without registration at: https://www.roceeh.uni-tuebingen.de/roadweb/.

Zara Kanaeva

NeMo – An agent-based model for Neanderthal foraging

The Neanderthals were a Eurasian hominin species that disappeared about 40 thousand years ago following a short period of demise. What remains of the Neanderthals are fossil and archeological remains at sites across Eurasia as well as low-level genetic traces in modern human populations. The reasons for their demise are still debated. Various explanations relate their extinction to demographic factors, climatic changes and competition with modern humans. What makes this question even more interesting is that the Neanderthals managed to survive for more than 250 thousand years under a variety of environmental conditions, including cold and warm phases which each lasted for thousands of years. What we can surmise is that the large-scale patterning that we observe from the distribution of fossil and archeological sites resulted from the accumulated movement decisions by many successive generations of Neanderthal groups. If we want to reconstruct the dynamics of Neanderthals on a large scale, we need to explore their mobility behavior. By knowing how they moved across the landscape, we can analyze the environmental factors to which they were exposed. Because of the inherent complexity of movement behavior and related factors, a variety of methods needs to be applied. In particular, we need to combine the results of environmental and paleoclimate models on the one hand and behavioral and demographic models on the other. An advantage of computational simulations is that they provide a "virtual laboratory" in which hypotheses can be tested. For this purpose, we apply agent-based modeling (ABM) to explore Neanderthal mobility. An ABM consists of agents, an environment and rules of action and interaction. Furthermore, ABM allows us to conduct simulation experiments, with which we can test hypotheses and behavioral models and validate them with empirical data. Within ROCEEH, we developed the "Neanderthal Mobility" (NeMo) agent-based model which simulates the movement of virtual Neanderthals across a landscape in present-day France and adjacent regions. The model consists of three types of agents: Neanderthal agents, residential camp agents and logistical camp agents. The Neanderthal agents represent Neanderthal individuals who move across the landscape and forage. They build residential camps, which are places where resources and information are shared. Residential and logistical camps represent units in which joint activities occur. The camps display their own behavior, which is included in the model by treating them as specific agents of a different kind. The Neanderthal agents do not move arbitrarily across the landscape. Instead, individuals collect resources. The location of the resources—and the knowledge about where they are—directs the mobility of the Neanderthal agents. The environment constrains their speed of movement. We apply landscape features, summarized in a favorability map, as a quality measurement of the landscape upon which the Neanderthal agents decide where to go. The favorability value includes, for example, preferences for elevation, visibility and distance from water sources. An additional map layer determines the movement speed of the Neanderthal agents as calculated from slope. In NeMo, the subsistence behavior of the agents is presently kept at a basic level. We are in the process of developing models for more complex subsistence strategies, for instance hunting and gathering, as well as raw material procurement. These factors may be included in future versions of the model. At the beginning of a simulation, groups of Neanderthal agents are placed at individual spots. Any Neanderthal site within the extent of the map may act as a starting locality. A main driver of movement is the search for resources. In the model, the Neanderthal agents spend energy by moving, and therefore need to collect energy from the environmental cell to fill their energy storage. To do this, they search for a place to set up their residential camp, which is decided based upon favorability values of the environmental cells. When they find a suitable place, they build their residential camp and go on foraging trips. When foraging, they again search for suitable places with a high favorability value to set up a logistical camp. In the surroundings of the logistical camp, the Neanderthal agents collect resources, which are represented by a value of energy that is received from the cell. When they complete the acquisition of resources, they remove the logistical camp and carry the collected resources back to the residential camp. At the residential camp the resources are shared among the members of the group and consumed to replenish individual energy levels. If the surrounding region does not bear a sufficient amount of energy, and the energy storage in the residential camp is consumed faster than it is refilled, the Neanderthal agents will remove the residential camp and search for another place to set it up. In the current version of the model, the energy level is a basic representation of resources. We are presently developing more differentiated representations of resources in separate modeling projects, including plants and plant parts, aquatic resources such as fish and mollusks, and hunted resources like herbivores. In other words, we are in the process of designing a series of ABM modules which can be combined into tailor-made models, depending on the specific research question.



▲ Figure 10. Neanderthal Mobility (NeMo) agent-based model design. The model consists of a set of parameters (left), a visualization of the map (right), output variables (see example graph, bottom) and a close up of the foraging Neanderthal agents (inset). The model was implemented in NetLogo. Graphics: E. Hölzchen.

Returning to the NeMo ABM, the immediate result of ABM runs is data. We may generate a set of output variables, which not only permits us to test the model performance, but also to further evaluate and characterize behavioral patterns. At present, we analyze the simulation results by measuring their frequency, area covered and duration of the residential and logistical camp movements. Furthermore, we measure the performance in resource acquisition of the Neanderthal group by monitoring the energy storage of the residential camp. We want to find out whether mobility patterns differ among the various regions inhabited by Neanderthals. Moreover, we want to see if they represent regional clusters, and how they differ throughout the seasons or during the cold and warm phases of the last 150,000 years. Additionally, when examining temporal dynamics, we compare short and long-term strategies and behavioral flexibility of the Neanderthal agents. At this stage of development, the model is kept at a basic level of complexity and its performance is tested by verification and validation procedures, such as replication assessments and sensitivity studies. A reasonable approach is to first understand the basic mechanisms of the model prior to the addition of new features. When the basic mechanisms of NeMo are tested sufficiently, we want to further differentiate the mobility behavior by distinguishing among a set of subsistence strategies, for example, hunting, gathering or fishing. Aside from food and fresh water resources, the availability of rocks used as raw material has also influenced movement decisions. Certain subsistence strategies determine the way in which groups interact with the environment, which would then result in corresponding mobility patterns. Furthermore, NeMo not only allows us to explore the behavior of a single agent type, but also the integration of further agent types, for example, herbivores, carnivores and other hominin species, such as Denisovans or modern humans. We may then explore effects of seasonal migration, competition, conflict or admixture between hominin species. With NeMo, we can quantify these effects and explain them by the behavior of the Neanderthal agents. Furthermore, the results produced from NeMo can be used for further analyses in understanding the mobility of the Neanderthals and hominins in general.

Ericson Hölzchen

Forthcoming

- International ROCEEH Conference *Human Origins–Digital Future*

27–31 July 2020 online conference
The ROCEEH and Senckenberg Conference will address core issues of digitalization, including possibilities and problems in large, interdisciplinary databases as well as new approaches such as innovative methods of data mining, machine learning, deep learning and artificial intelligence in a series of five, two-hour, online sessions. More information and registration form available at: https://www.hadw-bw.de/en/research/research-center/roceeh/news#events/conferences/workshops.

- ESHE 2020 – 10th Anniversary Conference of the European Society for the Study of Human Evolution

24–25 September 2020 virtual meeting
For more details see:
https://www.eshe.eu/meetings.html

Who's who?

This issue: Riczar Fuentes

Riczar Fuentes studied at the University of the Philippines (Visayas) for his Bachelor of Arts degree in History. Later, he became interested in archaeology and enrolled at the Archaeological Studies Program of the University of the Philippines (Diliman) where he acquired the skills for lithic use-wear analysis and studied the lithic assemblage from Vito Cave in Northern Luzon, Philippines for his Master's Thesis. The research provided insights into lithic technologies of hunter-gatherer groups before and after the arrival of agriculture-based, pottery-wielding, Austronesian-speaking migrants about four thousand years ago. While studying at the University of the Philippines, he became one of the researchers of the multi-disciplinary Palaeoenvironmental and Biodiversity Study of Mindoro Island: An Archaeological Science Initiative project. Evidence of sea crossings between Sundaland and Wallacea during the Late Pleistocene were recovered in Bubog 1, the main excavation site, located on Ilin Island in southern Mindoro. In 2016, he became the first Gerda Henkel Foundation Lisa Maskell Ph.D. Fellowship recipient from the Philippines. For his doctoral research, he continued to explore and apply use-wear analysis within research collaborations with colleagues and institutions from Indonesia, Germany, Japan and the Philippines. Riczar completed his Ph.D. in 2020 with a thesis entitled *'Island Adaptation and Maritime Interaction in Changing Environments from the Terminal Pleistocene to the Early Holocene: A Comparative Study of Prehistoric Technology in Northeastern Indonesia'*. He is now pursuing post-doctoral studies to further explore 3D microscopy in the study of use-wear traces and its application to assemblages in Island Southeast Asia.

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THE ROLE
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