



Annual Report of the Research Center for 2022

The Role of Culture in Early Expansions of Humans (Frankfurt and Tübingen)

Human evolution is a story of expansions. During the last two million years the genus *Homo* spread from Africa into Asia and Europe in several waves of migration. New species developed and old groups became extinct (*range expansions*). As early as three million years ago, hominins had established new ways of dealing with their specific environment through culture. Stone tools produced with the help of another stone tool opened up access to new resources and activated changes in body, mind and behavior (*expansion of performances*). The ecospace of human species and their conspecifics changed the viability and development of potential resource spaces not only through natural processes, but also through changes in the distribution of a species and its behavior, which itself was increasingly shaped by culture (*expansions of resource space*).

ROCEEH's mission is to develop a systemic understanding of "becoming human", one which integrates these three types of expansion and how they interacted with each other. The project encompasses the time from three million to 20,000 years before present and spans from Africa to Eurasia. The project focuses particular attention on the development of the human capacity for cultural activities, as well as its background and characteristics.

At the core of the project is the multidisciplinary, web-based georelational database known as ROAD (ROCEEH Out-of-Africa Database) with its geographical information system (GIS) functionality. ROAD unifies geographical data about sites with additional information about the stratigraphical structure of layers and the archaeology those layers contain. In addition, ROAD assimilates information on human fossil history, fauna, flora and climate, information which can be used to model early human habitats. The results are integrated into a digital atlas detailing the development of humans and environment on the basis of GIS.

Started in 2008 and projected to run for 20 years, ROCEEH is a multidisciplinary research project situated at the interface between the cultural and natural sciences. This far-reaching, international effort is carried out by a team of cultural scientists, archaeologists, paleoanthropologists, paleobiologists, geographers and database specialists situated at the Senckenberg Research Institute in Frankfurt and the University of Tübingen.

Members of the Scientific Commission: regular members of the Academy, Thomas Holstein (chairman), Hermann H. Hahn, Lothar Ledderose, Irmgard Männlein-Robert, Claudia Maienborn, Joseph Maran, Ekkehard Ramm; Prof. Dr. Zvi Ben-Avraham (Tel Aviv), Prof. Dr. Manfred Ehlers (Osnabrück), Prof. Dr. Jürgen Richter (Köln), Prof. Dr. Wulf Schiefenhövel (Andechs), Prof. Dr. Marie Soressi (Leiden), Prof. Dr. Mark Stoneking (Leipzig).

Heads of the Research Center: Nicholas Conard (speaker, Tübingen), Prof. Dr. Volker Hochschild (Tübingen), Volker Mosbrugger (Frankfurt/M.), Prof. Dr. Friedemann Schrenk (Frankfurt/M.).

Research Staff: in Frankfurt, Priv.-Doz. Dr. Angela Bruch, Claudia Groth, Priv.-Doz. Dr. Miriam Haidle (scientific coordinator), Dr. Christine Hertler, Dipl.-Biol. Julia Hess (administrative coordinator); in Tübingen, apl. Prof. Dr. Michael Bolus, Dipl.-Inf. Zara Kanaeva, Xiangmei Kong (since August 2021), Dr. Andrew Kandel, Maria Malina, Dr. Christian Sommer.

Guests of the Research Center in 2022: In Tübingen, the scientific philosopher, Priv.-Doz. Dr. Oliver Schlaudt, worked at the research center from October 2018 until March 2022 as a Heisenberg Fellow of the DFG. Within the framework of a post-doctoral stipendium from the Fritz Thyssen Foundation, Dr. Rimtautas Dapschaskas worked at the research center from October 2021 until September 2022. Prof. Dr. Jamie Clark visited in July 2022, Mathilde Verstergaard Meyer (Aarhus, Denmark) in October 2022 and Tanner Kovach (Storrs, Connecticut, USA) from October to December 2022. Prof. Dr. Martin Porr (Perth, Australia) visited the research center from September until December 2022 with support from a stipend granted by the Alexander von Humboldt Foundation. In Frankfurt, Dr. Mika Rizki Puspanigrum (Bandung, Indonesia) worked in January, March and April 2022 as a Koenigswald Post-doctoral Fellow. Narine Hayrapetyan (Yerevan, Armenia) researched in November and December 2022 as part of her doctoral research.

Key Aspects

In the 15th year of the research center, after two years of travel restrictions due to the Covid pandemic, the ROCEEH team actively took advantage of the renewed opportunities to travel.

This included field research and direct exchange with colleagues, both at ROCEEH workplaces and in the research regions as well as at conferences and meetings. Two key areas of ROCEEH's research in 2022 will be singled out as examples. Both studies incorporate the investigation of ancient DNA in sediments (sedaDNA) in the context of archaeological excavations led by Dr. Andrew Kandel. Such work illustrates the importance of ROCEEH's own fieldwork coupled with the application of scientific methods that provide access to exciting and unexpected cultural-scientific results.

The analysis of aDNA from humans, animals and plants from sediment samples is a young branch of research that has gained increasing importance in archaeological studies in recent years. SedaDNA allows the presence of species to be detected at a site, even when no visible remains of bones, wood or seeds are preserved. Nonetheless, aDNA is subject to its own conditions of preservation: for example, increasing temperature causes DNA molecules to break down more quickly. Thus, relatively little aDNA data has been recovered from warmer regions like the Levant. This region represents an important land bridge between Africa and Eurasia and plays a key role in the dispersal of both anatomically modern humans and Neanderthals.

In the first study, an international research team led by Viviane Slon from the Department of Evolutionary Genetics at the Max Planck Institute for Evolutionary Anthropology in Leipzig (now Tel Aviv University) found traces of ancient mitochondrial DNA of cervids and hyenas in sediments from Sefunim Cave, Israel. The DNA comes from strata dated between 30,000 and 70,000 years old, overlapping the time of the last Neanderthals and the first modern humans. These observations exceed the theoretical expectations for the longevity of DNA deposited in such a warm environment. Both identified taxa are included in the archaeozoological records of the site, but are now extinct in the region.

The second study was led by Anneke ter Schure from the Center for Ecological and Evolutionary Synthesis at the Department of Biosciences at the University of Oslo with a diverse team of international collaborators. In contrast to Sefunim, the study conducted at Aghitu-3 Cave in the Armenian Highlands shows how sites in regions with good preservation can yield a wealth of knowledge from aDNA investigations. Here, sedaDNA of plant remains was preserved in 39,000 to 24,000 year old layers showing evidence of human settlement. These layers also yield finds of pollen, charcoal and even a piece of wood bast. These

sedaDNA analyses confirm and supplement our knowledge by detecting a large number of plants: about a quarter of the aDNA results overlap with finds from other sources. More evidence for plants was observed in the strata from times when humans used the cave than when people visited the cave less frequently. Therefore, the authors attribute the presence of most of the plants to human activities. Furthermore, of the 43 plant genera identified, all but five are known to be useful to humans.

Using the PlantBITES database of plant resources in early human environments built up over the years, Priv.-Doz. Dr. Angela Bruch showed various options for plant use at Aghitu-3 (Fig. 1). Some of the plants have medicinal properties, while others can be used as food, flavoring, or mosquito repellent. The discovery of aDNA from plants that provide dyes or fibers, suggests that people in this region may have used plants to make sewing thread or string, and to fasten shell beads onto clothing. These findings from the sedaDNA studies complement the finds from the cave. During the excavations, a 29,000 year old eyed bone needle and a pointed bone awl were found, both of which can be used for sewing complex garments. By analyzing the aDNA and comparing it to pollen types already identified, we get a more complete picture of the plants that were available to humans; by studying ancestral uses combined with archaeological evidence, we learn how people might have used them.



Fig. 1. Today's wild herbs of the Armenian Highlands can also be used in many ways. (Photo: ROCEEH/Alexander Gonschior)

Working with the ROCEEH Out of Africa Database (ROAD) marked a second scientific focus in 2022. A study on the emergence of habitual ochre use and its importance in the development of ritual behavior in the African Middle Stone Age, led by ROCEEH guest Dr. Rimtautas Dapschauskas, focuses on a temporally and spatially large-scale site analysis. With the help of ROAD, more than a hundred sites and the quantity of ochre finds in the respective layers were recorded from the early isolated evidence around 500,000 years ago until the end of the Middle Stone Age around 40,000 years ago. Based on statistical methods of time averaging and with the help of ROADWeb's time slice tool, age classification problems were solved with regard to: (i) summed time series; (ii) the dating of stratified sequences; and (iii) the probability that an inventory dated to a specific time. Three phases of ochre use were identified: an initial phase between 500,000 and 330,000 years ago, an emergent phase between 330,000 and 160,000 years ago and a habitual phase between 160,000 and 40,000 years ago (Fig. 2). Both the number of sites containing ochre and the ratio between sites containing ochre and those containing only stone artifacts increased with each successive phase. The increase in the absolute number of ochre finds with a simultaneous expansion of the geographical distribution underlines this intensification of ochre use. The use of ochre became established as a common cultural practice in southern, eastern and northern Africa starting about 160,000 years ago, when one-third of archaeological sites contained ochre. The authors see the developments identified in ochre use as a probable material manifestation of increased ritual activity in early populations of *Homo sapiens*.

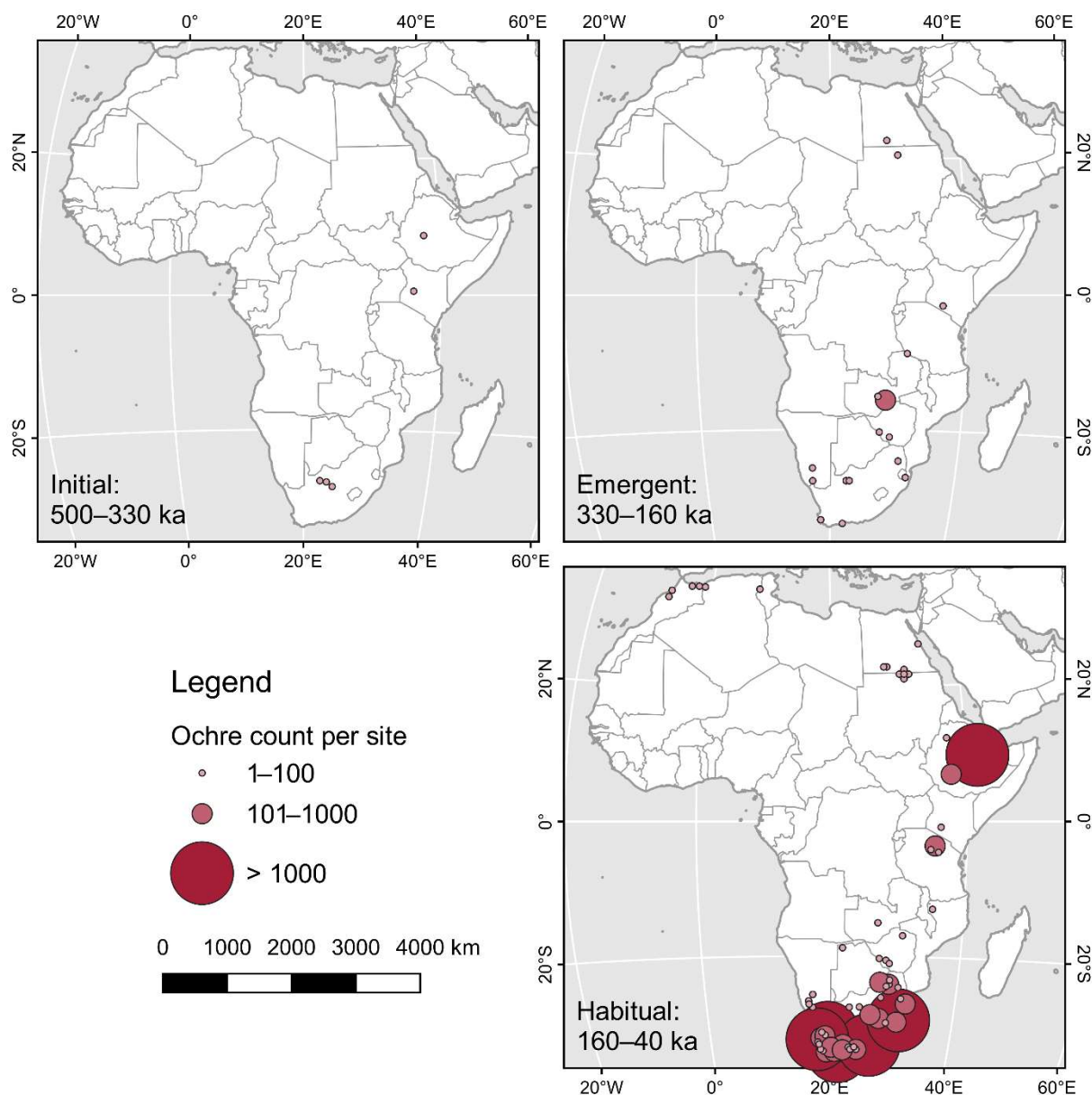


Fig. 2. Spatial distribution of sites with ochre and the number of ochre pieces in the three phases of ochre use in the Middle Stone Age. An interactive map is available for details on the individual sites: <https://www.roceeh.uni-tuebingen.de/maps/ochre-africa/> (Map: C. Sommer/ROCEEH)

An experimental study led by Dr. Christian Sommer explored the potential of large interdisciplinary and georeferenced datasets, such as ROAD, for understanding cultural connections among human species and the technologies they use, as well as their propagation in time and space. Starting from a systematic collection of archaeological information in a database (namely ROAD), the authors present a method for mapping the borders, centers and peripheries of ancient cultures, as well as the technological similarities between different

cultures. By analyzing the data, the team derived similarities between assemblages of finds, created a network, and then visualized the result using a graphical method also used in social media big data analysis. The publication by C. Sommer et al., “The use of prehistoric ‘big data’ for mapping early human cultural networks”, published in the Journal of Maps is available at <https://doi.org/10.1080/17445647.2022.2118628>.

The volume “Human Origins – Digital Future: An International Conference about the Future of Archaeological and Paleoanthropological Databases”, which is the first volume in the ROCEEH Perspectives series, was published online by Propylaeum in Heidelberg (<https://doi.org/10.11588/propylaeum.882>). This e-book follows an experimental path of publication. It contains the results of a conference organized by ROCEEH in 2020, which examined fundamental questions of digitalization and open science as well as approaches using innovative methods. Due to the online format, the contributions were limited to a maximum of 15 minutes and recorded as videos. In this regard, they summarize the content briefly and in a focused manner. In view of the digital character of the conference, this volume publishes the presentations in multimedia format, supplemented by written summaries and references. The summaries of the various sessions are presented in mind maps. The volume closes with interviews on selected topics related to the future of databases.

Field Work

In 2022 the staff of the Research Center conducted or participated in two field projects:

Africa:

- South Africa: Sibhudu Cave, Jojosi (Drakensberg Mts.). Landscape exploration (Sommer, C., Will, M., Pehnert, H., 4 weeks)
- South Africa: Sibhudu & Umbeli belli. Excavation and find analysis (Conard, N.J., Bader, G., 8 weeks)
- Tanzania: Mumba Cave. Excavation and find analysis (Conard, N.J., Bader, G., 4 weeks)

Caucasus:

- Armenia: Aghitu. Excavation and find analysis (Kandel, A.W., Samei, S., Gasparyan, B., 4 weeks)
- Armenia: Pollen monitoring in various regions (Bruch, A.A., Groth, C., 2 weeks)

Europe:

- Germany: Lone and Ach valleys. Excavation and find analysis (Conard, N.J., Janas, A., Hamzawi Zarghani, S., 12 weeks)
- Germany: Schöningen. Excavation and find analysis (Conard, N.J., weeks, J., 40 weeks).

ROCEEH Out-of-Africa Database (ROAD) and ROADWeb

In 2022, the ROAD application (ROADWeb) was made more user-friendly and functional. Examples include PHP scripts for quality control (the so-called similarity tools) and a website from which these tools can be accessed. The automatic literature import was expanded to include web page references. In addition, the implementation of the simple ROAD search on the ROADWeb entry page was changed. The reason for this was the integration of dynamic web content such as Google Fonts, which violated the General Data Protection Regulation. In the modified implementation of the simple ROAD search, Leaflet and OpenStreetMap geodata are now used, instead of the former Google JavaScript library.

A modern-looking, interactive web application for a simple ROAD search was created using the R package Shiny (Fig. 3). This web application is likely to replace the ROAD simple search on the ROADWeb homepage in 2023. A prerequisite for this is the reliable deployment of the created web application using the Shiny server. For its installation, some problems of customization still have to be resolved under the operating system that all ROCEEH servers use.

ROCEEH Shiny

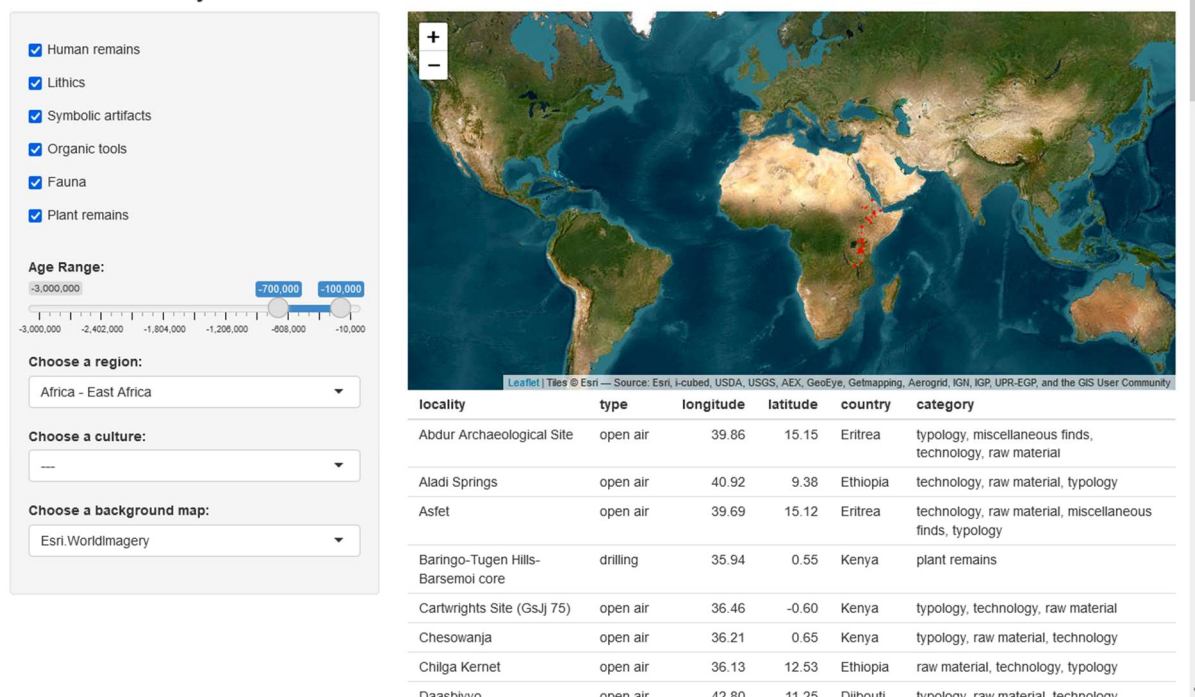


Fig. 3. ROAD “R Shiny”- Web application (Screenshot, Zara Kanaeva)

Data entry in ROAD continued with great effort: On January 10th, 2023 ROAD contained 2341 sites and 22,549 assemblages. Various PHP scripts with data queries and their outputs were written for scientists collaborating with ROCEEH. In addition, a data export was defined and implemented for the culture hackathon “Coding da Vinci Baden-Württemberg 2022”. The output of the resulting TimeFlies project can be found online at: <http://www.roceeh.uni-tuebingen.de/cdv/TimeFlies/>.

To make ROAD and its applications better known, a workshop was held in 2022 as part of the annual meeting of the European Society for the study of Human Evolution in Tübingen in September. Additionally, ROCEEH offered a seminar on ROAD for students at the University of Tübingen (October 2022-February 2023).

Project relevant conference contributions and lectures by research staff

The staff of the Research Center organized four conferences and one workshop, and led two additional workshops. They participated in 19 conferences (online and live), were lead or contributing authors in 20 lectures, and presented eight posters. They also presented the project or their own research seven times at work meetings, colloquia, lecture series and a podium discussion. The ROCEEH team participated in the COST Action, “iNEAL -

Integrating Neandertal Legacy: From past to present”, an initiative of the European Union; the Horizon 2020 project ARIADNEplus; and the “Cultural Evolution: Virtual Research Network” of the John Templeton Foundation. Prof. Dr. Friedemann Schrenk and Dr. Christine Hertler agreed to a cooperation in research and teaching on the topic, “Human evolution and paleontology in insular Southeast Asia” with Dr. Mika Puspaningrum and Prof. Dr. Irwan Meilano from Institut Teknologi Bandung, Indonesia.

Third Party Funding

To complement the financing provided by the Academy, the team sought additional funds for methodological development, case studies and visits from guest researchers and young academics. Work on material from a ROCEEH excavation (Sefunim Cave) was supported by the US National Science Foundation in 2022.

Teaching

In addition to their research activities, the team strives to impart students with the benefits and results of their work and supports graduate and postgraduate students in their qualifications:

- Lectures and seminars at the University of Frankfurt/Main: Christine Hertler, Jan-Olaf Reschke
- Lectures and seminars at the University of Tübingen: Michael Bolus, Angela Bruch, Miriam Haidle, Andrew Kandel, Christian Sommer
- Supervision of Master’s, Diploma and Doctoral theses: Michael Bolus, Angela Bruch, Miriam Haidle, Christine Hertler, Andrew Kandel, Christian Sommer
- Supervision of archaeotechnical trainees: Maria Malina, Christian Sommer

Project relevant publications by research staff and principal investigators

In 2022 the publications of the ROCEEH research center included 54 papers as well as two monographs, three anthologies and one dissertation.

ISI-listed publications: 23

1. Bader, G.D., **Sommer, C., Conard, N.J., & Wadley, L.** (2022). The final MSA of eastern South Africa: a comparative study between Umbeli Belli and Sibhudu. *Azania: Archaeological Research in Africa* 57/2, 197-238.
<https://doi.org/10.1080/0067270X.2022.2078553>

2. Bergström, A., Stanton, D.W.G., ... **Conard, N.J.**, ... Krause, J., Dalén, L., & Skoglund, P. (2022). Grey wolf genomic history reveals a dual ancestry of dogs. *Nature* 607, 313-320. <https://doi.org/10.1038/s41586-022-04824-9>
3. Blanco-Lapaz, A., Mata-González, M., Starkovich, B.M., Zeidi, M., & **Conard, N.J.** (2022). Late Pleistocene environments in the southern Zagros of Iran and their implications for human evolution. *Archaeological and Anthropological Sciences* 14: 161. <https://doi.org/10.1007/s12520-022-01615-1>
4. **Bretzke, K.**, Preusser, F., Jasim, S., et al. (2022). Multiple phases of human occupation in Southeast Arabia between 210,000 and 120,000 years ago. *Scientific Reports* 12: 1600. <https://doi.org/10.1038/s41598-022-05617-w>
5. **Conard, N.J.**, Brenner, M., **Bretzke, K.**, & Will, M. (2022). What do spatial data from Sibhudu tell us about life in the Middle Stone Age? *Archaeological and Anthropological Sciences* 14: 148. <https://doi.org/10.1007/s12520-022-01585-4>
6. **Dapschuskas, R.**, **Göden, M.**, **Sommer, C.**, & **Kandel, A.W.** (2022). The emergence of habitual ochre use in Africa and its significance for the development of ritual behavior during the Stone Age. *Journal of World Prehistory* 35, 233–319. <https://doi.org/10.1007/s10963-022-09170-2>
7. Friesem, D.E., Shimelmitz, R., Schumacher, M.L., Miller, C.E., & **Kandel, A.W.** (2022). A micro-geoarchaeological view on stratigraphy and site formation processes in the Middle, Upper and Epi-Paleolithic layers of Sefunim Cave, Mt. Carmel, Israel. *Archaeological and Anthropological Sciences* 14: 222. <https://doi.org/10.1007/s12520-022-01686-0>
8. **Hölzchen, E.**, **Hertler, C.**, Wilmes, C., Anwar, I.P., Mateos, A., Rodríguez, J., Berndt, J.O., & Timm, I.J. (2022). Estimating crossing success of human agents across sea straits out of Africa in the Late Pleistocene. *Palaeogeography, Palaeoclimatology, Palaeoecology* 590: 110845. <https://doi.org/10.1016/j.palaeo.2022.110845>
9. Luzi, E., Blanco-Lapaz, A., Rhodes, S.E., & **Conard, N.J.** (2022). Paleoclimatic and paleoenvironmental reconstructions based on the small vertebrates from the Middle Paleolithic of Hohle Fels Cave, SW Germany. *Archaeological and Anthropological Sciences* 14: 107. <https://doi.org/10.1007/s12520-022-01568-5>
10. Mahler, S., Shatilova, I., & **Bruch, A.A.** (2022). Neogene long-term trends in climate of the Colchic vegetation refuge in Western Georgia - Uplift versus global cooling. *Review of Paleobotany and Palynology* 296: 104546. <https://doi.org/10.1016/j.revalbo.2021.104546>

11. Marcazzan, D., Miller, C.E., & **Conard, N.J.** (2022). Burning, dumping, and site use during the Middle and Upper Palaeolithic at Hohle Fels Cave, SW German. *Archaeological and Anthropological Sciences* 14: 178. <https://doi.org/10.1007/s12520-022-01647-7>
12. Massilani, D., Morley, M.W., Mentzer, S.M., Aldeias, V., Vernot, B., Miller, C., Stahlschmidt, M., Kozlikin, M.B., Shunkov, M.V., Dereviank, A.P., **Conard, N.J.**, Wurz, S., Henshilwood, C.S., Vasquez, J., Essel, E., Nagel, S., Richter, J., Nickel, B., Roberts, R.G., Pääbo, S., Slon, V., Goldberg, P., & Meyer, M. (2022). Microstratigraphic preservation of ancient faunal and hominin DNA in Pleistocene cave sediments. *Proceedings of the National Academy of Sciences* 119/1: e2113666118. <https://doi.org/10.1073/pnas.2113666118>
13. Mata-González, M., Starkovich, B.M., Zeidi, M., & **Conard, N.J.** (2022). New zooarchaeological perspectives on the early Upper Paleolithic Rostamian sequence of Ghar-e Boof (southern Zagros Mountains, Iran). *Quaternary Science Reviews* 279: 107350. <https://doi.org/10.1016/j.quascirev.2021.107350>
14. Rodríguez, J., Willmes, C., **Sommer, C.**, & Mateos, A. (2022). Sustainable human population density in Western Europe between 560.000 and 360.000 years ago. *Scientific Reports* 12: 6907. <https://doi.org/10.1038/s41598-022-10642-w>
15. ter Schure, A.T.M., **Bruch, A.A.**, **Kandel, A.W.**, Gasparyan, B., Bussmann, R.W., Brysting, A.K., de Boer, H.J., & Boessenkool, S. (2022). Sedimentary ancient DNA metabarcoding as a tool for assessing prehistoric plant use at the Upper Paleolithic cave site Aghitu-3, Armenia. *Journal of Human Evolution* 172: 103258. <https://doi.org/10.1016/j.jhevol.2022.103258>
16. Schürch, B., Wettengl, S., Fröhle, S., **Conard, N.J.**, & Schmidt, P. (2022). The origin of chert in the Aurignacian of Vogelherd Cave investigated by infrared spectroscopy. *PLoS ONE* 17(8): e0272988. <https://doi.org/10.1371/journal.pone.0272988>
17. Slon, V., Clark, J.L., Friesem, D.E., Orbach, M., Porat, N., Meyer, M., **Kandel, A.W.**, & Shimelmitz, R. (2022). Extended longevity of DNA preservation in Levantine Paleolithic sediments, Sefunim Cave, Israel. *Scientific Reports* 12: 14528. <https://doi.org/10.1038/s41598-022-17399-2>
18. Tribolo, C., Mercier, N., Martin, L., Taffin, N., Miller, C. E., Will, M., & **Conard, N.J.** (2022). Luminescence dating estimates for the coastal MSA sequence of Hoedjiespunt 1 (South Africa). *Journal of Archaeological Science: Reports* 41: 103320. <https://doi.org/10.1016/j.jasrep.2021.103320>

19. Varis, A., Miller, C.E., Toniato, G., Janas, A., & **Conard, N.J.** (2022). Using formation processes to explore low-density sites and settlement patterns: a case study from the Swabian Jura. *Journal of Paleolithic Archaeology* 5: 14.
<https://doi.org/10.1007/s41982-022-00127-7>
20. Venditti, F., **Rodríguez-Álvarez, B.**, Serangeli, J., Cesaro, S.N., Walter, R., & **Conard, N.J.** (2022). Using microartifacts to infer Middle Pleistocene lifeways at Schöningen, Germany. *Scientific Reports* 12: 21148. <https://doi.org/10.1038/s41598-022-24769-3>
21. Will, M., Bader, G.D., **Sommer, C.**, Cooper, A., & Green, A. (2022). Coastal adaptations on the eastern seaboard of South Africa during the Pleistocene and Holocene? Current evidence and future perspectives from archaeology and marine geology. *Frontiers in Earth Science* 10: 964423.
<https://doi.org/10.3389/feart.2022.964423>
22. Zanolli, C., Davies, T. W., Joannes-Boyau, R., Beaudet, A., Bruxelles, L., de Beer, F., Hoffman, J., Hublin, J.-J., Jakata, K., Kgasi, L., Kullmer, O., Macchiarelli, R., Pan, L., **Schrenk, F.**, Santos, F., Stratford, D., Tawane, M., Thackeray, F., Xing, S., Zipfel, B., & Skinner, M. M. (2022). Dental data challenge the ubiquitous presence of Homo in the Cradle of Humankind. *Proceedings of the National Academy of Sciences*, 119(28): e2111212119. <https://doi.org/10.1073/pnas.2111212119>
23. Zanolli, C., Kaifu, Y., Pan, L., Xing, S., Mijares, A.S., Kullmer, O., **Schrenk, F.**, Corny, J., Dizon, E., Robles, E., & Déroit, F. (2022). Further analyses of the structural organization of Homo luzonensis teeth: Evolutionary implications. *Journal of Human Evolution* 163: 103124. <https://doi.org/10.1016/j.jhevol.2021.103124>

Other peer reviewed publications: 5

1. **Altolaguirre Zancajo, Y.** (2022). Early Pleistocene environments before, during and after the first expansion of early Homo into Southern Spain. Dissertation, Frankfurt am Main, Universitätsbibliothek Johann Christian Senckenberg.
<https://doi.org/10.21248/gups.67186>
2. Bader, G.D., Schmid, V.C., & **Kandel, A.W.** (2022). The Middle Stone Age of South Africa. *Oxford Research Encyclopedia of Anthropology*. Oxford: Oxford University Press. <https://doi.org/10.1093/acrefore/9780190854584.013.251>
3. **Bolus, M.** (2022). The late Middle Paleolithic and the Aurignacian in the Swabian Jura (southwestern Germany). In Grygiel, M., & Obst, P. (eds.), *Walking among*

ancient trees. Studies in honour of Ryszard Grygiel and Peter Bogucki on the 45th anniversary of their research collaboration. Łódź: Fundacja Badań Archeologicznych Imienia Profesora Konrada Jażdżewskiego, 63-77.

4. **Conard, N.J.**, Hassmann, H., Hillgruber, K.F., Serangeli, J., & Terberger, T. (eds.) (2022). The Homotherium finds from Schöningen 13II-4: Man and big cats of the Ice Age. Contributions of the scientific workshop at the paläon (Schöningen) from 05.06 to 07.06.2015, Heidelberg: Propylaeum (Forschungen zur Urgeschichte aus dem Tagebau Schöningen, Band 4). <https://doi.org/10.11588/propylaeum.1006>
5. Taller, A., & **Conard, N.J.** (2022). Were the technological innovations of the Gravettian triggered by climatic change? Insights from the lithic assemblages from Hohle Fels, SW Germany. *PaleoAnthropology* 2022/1, 82–108. <https://doi.org/10.48738/2022.iss1.103>

Publications without peer review: 19

1. **Dapschaskas, R., Sommer, C., Kandel, A.W., & Göden, M.** (2022). Spatial information system to examine questions about the large-scale development of cultural behavior in human evolution: The example of ochre in the African Middle Stone Age. In **Kandel, A.W., Haidle, M.N., & Sommer, C.** (eds.), *Human Origins – Digital Future. An international conference about the future of archaeological and paleoanthropological databases.* Heidelberg: Propylaeum, 39-40. <https://doi.org/10.11588/propylaeum.882.c13440>
2. Giensch, L., & **Haidle, M.N.** (2022). Menschsein verbindet. Ausstellung über die Anfänge unserer Kultur bringt Lernorte und Spitzenforschung zusammen. *Blickpunkt Archäologie* 4/2021, 279-288.
3. **Haidle, M.N.**, & Münzel, S. (2022). Lebensspuren in urgeschichtlichen Artefakten – Zum Tode von Linda Rae Owen (* 31.1.1952, † 26.2.2021). *Traces of life in prehistoric artefacts – Obituary on Linda Rae Owen. Mitteilungen der Gesellschaft für Urgeschichte Blaubeuren* 30, 155-161. <https://doi.org/10.51315/mgfu.2021.30008>
4. **Hertler, C.** (2022). The Map Module for the ROAD Database. In **Kandel, A.W., Haidle, M.N., & Sommer, C.** (eds.), *Human Origins – Digital Future. An international conference about the future of archaeological and paleoanthropological databases.* Heidelberg: Propylaeum, 43-44. <https://doi.org/10.11588/propylaeum.882.c13442>
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