



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

### **Annual Report for 2014**

The genus *Homo* spread from Africa to Asia and Europe in several waves of migration during the last 2 million years. While the habitat for australopithecines, early humans and other animals was limited by natural conditions, cultural achievements over the course of humanization permitted new ways of adapting to the environment. The Research Center "The Role of Culture in Early Expansions of Humans" (ROCEEH) asks the pivotal question: When, where, and in what form did the interplay of changing environmental conditions, biological evolution and cultural development allow the genus *Homo* to move beyond the behavioral niche of a large African ape? How did *Homo* succeed in expanding not only culturally, but also into ecologically defined niches beyond Africa? The project aims to reconstruct the spatio-temporal and phylogenetic expansion of the various hominin species, the expansion of ecological environment, as well as the expansion of cultural capacities between 3 million and 20,000 years before present, while shedding light on their causal relationship. The project focuses particular attention on the development of human capacities for cultural activities, their backgrounds and actual occurrences. Archaeological excavations in Africa, Asia and Europe help deliver this important information. At the core of the project is the interdisciplinary, web-based georelational database known as ROAD (ROCEEH Out of Africa Database) with complete GIS functionality. ROAD unifies geographical data about localities with additional information about the stratigraphical structure of layers and the archaeology they contain. In addition, ROAD assimilates information on human fossil history, climate, as well as flora and fauna, and then uses this information to model early human habitats. The results are integrated into a digital atlas detailing the development of humans and environment on the basis of a geographical information system (GIS).

Started in 2008 and projected to run for 20 years, ROCEEH is an interdisciplinary research project at the interface between natural and cultural sciences. This far-reaching, international, scientific research is carried out by a team of 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, Karl Fuchs (Karlsruhe), Hermann H. Hahn (chairman, Karlsruhe), Lothar Ledderose (Heidelberg), Joseph Maran (Heidelberg), as well as Ekkehard Ramm (Stuttgart), Prof. Dr. Ofer Bar-Yosef (Harvard), Prof. Dr. Manfred Ehlers (Osnabrück), Prof. Dr. Bernhard Eitel (Heidelberg), Prof. Dr. Wulf Schiefenhövel (Andechs), Prof. Dr. Mark Stoneking (Leipzig), Prof. Dr. Elisabeth Vrba (Yale), Prof. Dr. Zvi Ben-Avraham (Tel Aviv), Prof. Dr. Jürgen Richter (Köln), Prof. Dr. Chris Stringer (London).

**Heads of the Research Center:** in Frankfurt, Volker Mosbrugger, Prof. Dr. Friedemann Schrenk; in Tübingen, Nicholas Conard, Prof. Dr. Volker Hochschild.

**Research staff:** in Frankfurt, Dr. Knut Bretzke (administrative coordinator until Feb. 28, 2014), Priv.-Doc. Dr. Angela Bruch, Claudia Groth, Priv.-Doc. Dr. Miriam Haidle (project coordinator), Dr. Christine Hertler, Julia Hess (administrative coordinator since Aug. 1, 2014); in Tübingen, apl. Prof. Dr. Michael Bolus, Dipl.-Inf. Zara Kanaeva, Dr. Andrew Kandel, Maria Malina, Dr. habil. Michael Märker.

**Guests of the Research Center in 2014:** Dr. Eliso Kvavadze (Tbilisi, Georgia), Inga Martkoplshvili (Tbilisi, Georgia), Ronan Orain (Paris, France), Robert Ghukasyan (Yerevan, Armenien), Dr. Anne-Marie Bacon (Paris, France), Dr. Ivan Gabrielyan (Yerevan, Armenia), Dr. Marlize Lombard (Johannesburg, South Africa), Manuel Casas Gallego (Madrid, Spain), Marco Vidal Cordasco and Olalla Prado Novoa (Burgos, Spain).

### **Key aspects**

During ROCEEH's seventh year of research, the Research Center focused its efforts on the transition from the Middle to the Upper Paleolithic. Two excavations in layers dated between 60,000 and 20,000 years before present in Israel (Sefunim) and Armenia (Aghitu-3) offered a precise view into techno-cultural behavioral differences during the periods attributed to the last Neanderthals and the first modern humans (Kandel). Excavations at Sibudu (South Africa) and Hohle Fels (Germany) shared a comparable chronological and thematic focus (Conard, Malina). Analyses of archaeological materials from the Swabian Jura dated between 50,000 and 30,000 years before present also continued (Bolus).

Using the Tübingen Model of the Expansion of Cultural Capacities, ROCEEH investigated important developments in human behavior over the course of human evolution, including the ability to handle fire, causal cognition, the relationship of technology, social learning and teaching, as well as the establishment of cultural norms. ROCEEH's models and results about the development of cultural performances tie directly into the work of the Marsilius Project "Embodiment as a paradigm for evolutionary cultural anthropology" at the University of Heidelberg, as well as the working group "Anthropology of perception" of the Evangelical Study Association's Institute of Interdisciplinary Research (Haidle). Based on multifaceted strands of evidence, ROCEEH proposed a hypothesis about how "Hyperplasticity" steers the behavioral development of anatomically modern humans (Bolus, Haidle, Kandel).

Investigation of the *range expansion* and *expansion of ecospace* of Neanderthals continued with the input of additional data and the application of geographical methods such as terrain analysis and stochastic environmental modeling (Bolus, Märker). Using data from sites with remains of Neanderthals, this study confirmed that early and classical Neanderthals had different land use preferences. The results were then validated using Middle Paleolithic sites in Germany where no Neanderthal fossils have been found. This analysis supports the validity of the models generated from sites with fossils and will be expanded to include other regions of Europe in 2015.

An additional research focus involved reconstructing the habitats and living conditions of various Pleistocene hominins in Southeast Asia, a region which has increasingly become a central interest of ROCEEH because the colonization of islands allows us to study singular settlement events under well controlled conditions. ROCEEH is dedicating several projects and cooperative research to this subject (Bruch, Hertler). This includes a new analysis of the habitat and life ways of *Homo erectus* in Sangiran (Hertler). Through the Senckenberg Research Institute we have access to one of the most important collections of Pleistocene hominids from Southeast Asia. Two pilot studies afford a quantitative reconstruction of the paleoenvironment based on flora and mammalian fauna, as well as a qualitative comparison to previous studies. Together with the Biodiversity and Climate Research Center (BiK-F) we examined specific characteristics of hoofed mammals and reconstructed their diets and island-related changes in body mass. One ROCEEH doctoral thesis focuses on understanding the life ways of earlier hominin forms in Sangiran (Haupt). Continuing the comparison of ecospace of *Homo erectus* and *Homo sapiens* in Southeast Asia begun in 2013, our study concentrated

on younger periods, especially the Late Pleistocene. In the framework of two cooperation projects with the Institute of Zoo and Wild Animal Research in Berlin and the National Center for Scientific Research (CNRS) in Paris, ROCEEH reconstructed the ecospace of *Homo sapiens* in western Southeast Asia on the continent and on the island of Sumatra. Additionally, we characterized the Toba volcanic eruption and its ecological consequences for hominins.

Further aspects of early human ecospace and its quantification were examined, especially in Europe and Western Asia. This includes climatic reconstruction of the Middle Pleistocene in southern Italy and the Early Pleistocene of Central Europe, pollen analysis of the Early Pleistocene of southern Spain, and the evaluation of non-pollen palynomorphs (NPPs) from the Early and Middle Pleistocene of the Caucasus. The quantitative reconstruction of landscape openness during the Early Pleistocene of eastern Siberia contributes to understanding vegetation cover in Eurasia at the time of the first expansion Out of Africa into Southeast Asia. While these studies deal mainly with the analysis of fossil flora, a further study successfully analyzed the potential for small mammals to yield quantitative climatic and environmental data. The study at the Middle Pleistocene site of Qesem Cave (Israel) confirms that this method allows localities without fossil flora to generate comparable environmental datasets.

Newsletters providing current information on these themes can be accessed through ROCEEH's website ([www.roceeh.net](http://www.roceeh.net)).

### **Field Work**

In 2014 the staff of the Research Center conducted or participated in 12 field projects:

Africa:

- South Africa: Sibudu Cave (Conard: excavation and analysis of finds, 7 weeks)
- Tanzania: Makuyuni, Lake Manyara (field team of Märker, 2 weeks)
- Ethiopia: Melka Kunturé (field team of Märker, 2 weeks)

Arabia:

- United Arab Emirates: Jebel Faya, Sharjah (Bretzke: excavation, 3 weeks; Märker: survey, 1 week; Suhailah (K. Bretzke, survey, 1 week)

Western Asia:

- Israel: Sefunim (Kandel: excavation and analysis of finds, 5 weeks)
- Iran (M. Märker, survey, 1 week)

Europe:

- Germany: Hohle Fels (Conard, Malina: excavation, 7 weeks)
- Italy: Scaloria (Märker: survey, 1 week)
- Italy: Vernazza (Märker: survey, 1 week)

Caucasus:

- Armenia/Georgia: (Bruch: survey, 4 weeks)
- Armenia: Aghitu-3 Cave (Kandel, Märker: analysis, 4 weeks)
- Russia: FLUMEN field work (M. Märker, 2 weeks)

### **ROCEEH OUT OF AFRICA DATABASE (ROAD) AND ROADWEB**

The ROAD system combines a PostgreSQL database with WebGIS libraries to enable full WebGIS functionality and includes map servers, Javascript and php scripts. ROAD is currently available to the public with limited user rights through the project website ([www.roceeh.net](http://www.roceeh.net)). At the end of 2014 datasets with geographical, stratigraphical, paleoecological, archaeological and bibliographical information had been entered into ROAD from 4844 assemblages at 1331 localities. In addition, ROAD and ROADWeb were further tailored to meet the needs of data entry, control and use, including queries formulation. An important new module for data control allows geological profiles to be depicted as interactive graphics with detailed information about the individual geological layers, while simultaneously showing the correlated archaeological profile. We installed a tool box in the ROAD Map Module which can be used to analyze the distribution of plants and animals, as well as environmental parameters. Cooperation with two external databases, NEOTOMA Paleocology Database and the Neogene-Quaternary Mammals Database (NQMDB), was considerably expanded to allow data access through ROAD. Until now the NQMDB was not accessible to the public. Now these data have been made available to the international research community thanks to ROCEEH's efforts. The connection of NQMDB to a user surface in ROAD makes it clear how ROAD can be used as a meta-database to meaningfully evaluate external data without the owners of the data giving up their rights to the data. We also intensified the exchange of data with other large database projects such as the Collaborative Research Centre 806 "Our way to Europe".

### **Project relevant conference contributions and lectures by research staff**

The project staff participated in 25 conferences. They organized a total of six sessions and workshops, were lead or contributing authors in 44 lectures and presented 12 posters. They

also introduced the project or their work five times at work meetings, lecture series, in the *Studium Generale*, and on a radio program.

### **Third Party Funding**

To complement the financing provided by the Academy, additional funds were sought for methodological development, regional investigation and visits from guest researchers and young academics. ROCEEH received additional support from the Leakey Foundation, the German Research Council (DFG), the International Research Staff Exchange Scheme (IRSES) of the European Union, the Irene Levi Sala Care Archaeological Foundation, the National Commission for Scientific and Technological Research (CONICYT, Chile), the Leibniz Association, and the Volkswagen Foundation.

### **Teaching**

In addition to their research activities, the staff strive to impart students with the benefits and results of their work and support graduate and postgraduate students in their qualifications:

- Lectures and seminars at the University of Frankfurt/Main: Bruch, Hertler
- Lectures and seminars at the University of Tübingen: Bolus, Bretzke, Bruch, Haidle, Märker
- Supervision of Master's, Diploma and Doctoral theses: Bolus, Bruch, Haidle, Hertler, Kandel, Märker
- Supervision of archaeotechnical trainees: Malina

### **Project relevant publications by research staff**

A total of 30 project relevant publications appeared in 2014 in which the staff of the Research Center played a leading or contributing role:

1. Bachofer, F., Quénéhervé, G., Märker, M. (2014): The delineation of paleo-shorelines in the Lake Manyara Basin using TerraSAR-X data. *Remote Sensing* 6(3), 2195-2212. doi: 10.3390/rs6032195.
2. Bolus, M. (2014): Die Erfindung der Kultur – Lebensweisen früher Menschen. *Jahrbuch der Heidelberger Akademie der Wissenschaften für 2013*, 136-138.
3. Bolus, M., Märker, M. (2014): Neue Methoden bei der Suche nach Neanderthalerfundstellen. *Senckenberg - natur forschung museum* 144(7/8), 290-292.

4. Borrelli, P., Märker, M., Panagos, P., Schütt, B. (2014): Modeling soil erosion and river sediment yield for an intermountain drainage basin of the Central Apennines, Italy. *Catena* 114, 45-58.
5. Bretzke, K., Conard, N.J., Uerpmann, H.-P. (2014): Excavations at Jebel Faya – The FAY-NE1 Shelter Sequence. *Proceedings of the Seminar for Arabian Studies* 44, 69-82.
6. Bruch, A.A., Kandel, A.W., Lordkipanidze, D. (2014): The role of the Southern Caucasus on early human evolution and expansion – refuge, hub or source area? *Antiquity* 088 (339). <http://antiquity.ac.uk/projgall/bruch339/>
7. Bruch, A.A., Scharrer, S., Gabrielyan, I. (2014): Was uns Pollenkörner über die Umwelt früher Menschen verraten können. *Senckenberg - natur forschung museum* 144(7/8), 256-261.
8. Conard, N. J., Malina, M. (2014): Vielfältige Funde aus dem Aurignacien und ein bemalter Stein aus dem Magdalénien vom Hohle Fels bei Schelklingen. *Archäologische Ausgrabungen Baden-Württemberg* 2013, 58-63.
9. Conoscenti, C., Agnesi, V., Angileri, S., Cappadonia, C., Rotigliano, E., Märker, M. (2014): A GIS-based approach for gully erosion susceptibility modelling: A test in Sicily, Italy. *Environmental Earth Sciences*, 70 (3), 1179-1195. doi: 10.1007/s12665-012-2205-y.
10. Garofoli, D., Haidle, M.N. (2014): Epistemological problems in cognitive archaeology: an anti-relativistic proposal towards methodological uniformity. *Journal of Anthropological Sciences* 92, 7-41. doi: 10.4436/JASS.91003.
11. Haidle, M.N. (2014): Building a bridge – an archaeologist’s perspective on the evolution of causal cognition. *Frontiers in Psychology* 5, Article 1472, 1-15. doi: 10.3389/fpsyg.2014.01472.
12. Haidle, M.N. (2014): Eine enge Beziehung: Evolution von Kognition und Kulturfähigkeit. In G. Jüttemann (Ed.), *Entwicklungen der Menschheit. Humanwissenschaften in der Perspektive der Integration*. Papst Science Publishers, Lengerich, 119-126.
13. Haidle, M.N. (2014): Mensch und Werkzeug – eine *Amour fou*. *Senckenberg - natur forschung museum* 144(7/8), 242-245.
14. Haidle, M.N. (2014): Examining the evolution of artistic capacities: searching for mushrooms? In C. Sütterlin, W. Schiefenhövel, C. Lehmann, J. Forster, G. Apfelauer (Eds.), *Art as behaviour. An ethological approach to visual and verbal art, music and architecture*. Bis-Verlag der Carl von Ossietzky Universität Oldenburg, Oldenburg, 237-251
15. Haidle, M.N., Mosbrugger, V. (2014): Die Rolle der Kultur in der Evolution des Menschen. In H. Parzinger, S. Aue, G. Stock (Eds.), *ArteFakte: Wissen ist Kunst – Kunst ist*

- Wissen. Reflexionen und Praktiken wissenschaftlich-künstlerischer Begegnungen. Bielefeld: Transcript-Verlag, 27-36.
16. Hertler, C., Bruch, A.A., Märker, M. (2014): Ecospace — der ökologische Raum von Hominiden. *Senckenberg - natur forschung museum* 144(7/8), 262-265.
  17. Kandel, A., Gasparyan, B. (2014): Seit wann leben Menschen im kaukasischen Hochgebirge? *Senckenberg - natur forschung museum* 144(7/8), 288-289.
  18. Kandel, A.W., Gasparyan, B., Nahepetyan, S., Taller, A., Weissbrod, L. (2014): The Upper Paleolithic Settlement of the Armenian Highlands. In M. Otte, F. Le Brun-Ricalens (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. ERAUL* 140: 39-60.
  19. Kandel, A.W., Mentzer, S.M., Noback, M.L., Reyes-Centeno, H. (2014): Third Annual Meeting of the European Society for the Study of Human Evolution. *Evolutionary Anthropology* 23, 45-46.
  20. Kirscher, U., Gabrielyan, I., Scharrer, S., Bruch, A.A., Kuiper, K., Bachtadse, V. (2014): High resolution magnetostratigraphy and radiometric dating of Early Pleistocene lake sediments from Southern Armenia. *Quaternary International* 328-329, 31-44. doi: 10.1016/j.quaint.2013.06.010
  21. Lombardo, L., Cama, M., Märker, M., Rotigliano, E. (2014): A test of transferability for landslides susceptibility models under extreme climatic events: application to the Messina 2009 disaster. *Natural Hazards* 74 (3)1951-1989. doi: 10.1007/s11069-014-1285-2.
  22. Riehl, S., Marinova, E., Deckers, K., Malina, M., Conard, N.J. (2014): Plant use and local vegetation patterns during the second half of the Late Pleistocene in southwestern Germany. *Archaeological and Anthropological Sciences* 2014: 1-17. doi: 10.1007/s12520-014-0182-7
  23. Schrenk, F., Hertler, C. (2014): Ursprung und Ausbreitung früher Menschen. In C. Trümpler, J. Blume, V. Hierholze, L. Regazzoni (Eds.), *Ich sehe wunderbare Dinge - 100 Jahre Sammlungen der Goethe-Universität. Hatje Cantz, Ostfildern*, 286-287.
  24. Sharma, J., Alimohammadian, H., Bhattacharyya, A., Ranhotra, P.S., Djamali, M., Scharrer, S., Bruch, A.A. (2014): Exploratory palynological analysis of Quaternary lacustrine deposits around Damavand volcano, Northern Iran. *Geopersia* 4(1), 1-10.  
[http://jgeope.ut.ac.ir/article\\_51188\\_6934.html](http://jgeope.ut.ac.ir/article_51188_6934.html)
  25. Soto-Bauerle, M.V., Märker, M., Rodolfi, G., Sepúlveda, S.A. (2014): Assessment of morphodynamics triggered by palaeolandscape features in the Tongoy Bay, Coquimbo

- Region, Central Chile. *Geografia Fisica e Dinamica Quaternaria*, 37 (1), 51-66. doi: 10.4461/GFDQ.2014.37.6.
26. Taller, A., Bolus, M., Conard, N.J. (2014): The Magdalenian of Hohle Fels Cave and the resettlement of the Swabian Jura after the LGM. In M. Otte, F. Le Brun-Ricalens (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. ERAUL 140, 383-399.
27. Utescher, T., Bruch, A.A., Erdei, B., François, L., Ivanov, D., Jacques, F.M.B., Kern, A.K., Yu-Sheng (C.) Liu; Mosbrugger, V. (2014): The Coexistence Approach - theoretical background and practical considerations of using plant fossils for climate quantification. *Palaeogeography, Palaeoclimatology, Palaeoecology* 410, 58-73. doi: 10.1016/j.palaeo.2014.05.031
28. Vogel, S., Märker, M. (2014): Analysis of post-burial soil developments of pre-AD 79 Roman paleosoils near Pompeii (Italy). *Open Journal of Soil Science*. doi: 10.4236/ojss.2014.410035
29. Will, M., Kandel, A.W., Conard, N.J. (2014): Coastal adaptations and settlement systems on the Cape and Horn of Africa during the Middle Stone Age. In N.J. Conard, A. Delagnes (Eds.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age*, Vol. IV. Tübingen: Kerns Verlag, 47-75.
30. Zakerinejad, R., Märker, M. (2014): Prediction of gully erosion susceptibilities using detailed terrain analysis and maximum entropy modeling: A case study in the Mazayejan Plain, Southwest Iran. *Geografia Fisica e Dinamica Quaternaria*, 37(1), 67-76. doi: 10.4461/GFDQ.2014.37.7.