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The Role of Culture in Early Expansions of Humans



**HEIDELBERGER AKADEMIE
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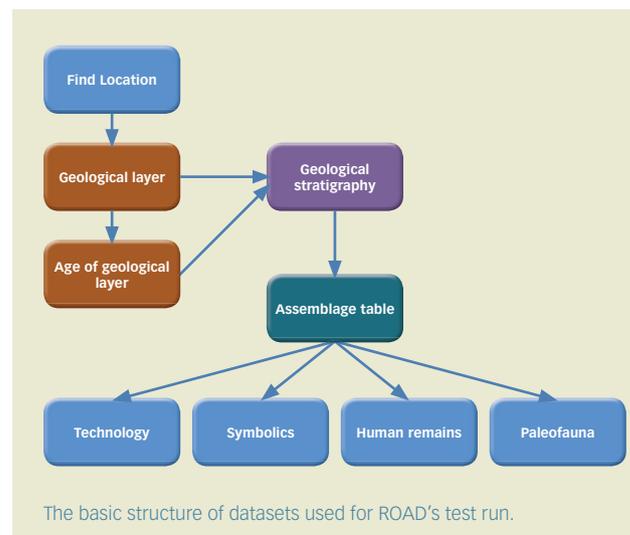
Editorial

The second newsletter of the research center “The Role of Culture in Early Expansions of Humans” (ROCEEH) examines the project’s research interests in greater depth and includes news items collected through 31 March 2010. This issue highlights our progress in setting up the ROCEEH Out-of-Africa Database (ROAD) and in conducting multidisciplinary field research in Makuyuni, Tanzania.

ROAD Test Run

The ROCEEH project incorporates a large array of variables from the fields of geology, geomorphology, paleontology, paleobotany, paleoanthropology and archaeology, assimilating these data in vector, raster and text formats. To assess the role of culture in early expansion of humans, ROCEEH developed and implemented a geo-relational spatial information system which we named the “ROCEEH Out of Africa Database” (ROAD). The complex structure of ROAD resulted from in-depth discussions among staff members and with outside experts about objects, contents and relationships of the various disciplines that were then incorporated into the database in a holistic way. The different themes tackled by ROCEEH are translated into objects, object keys, relationships among objects, and descriptive attributes. The process of defining the preliminary, conceptual georelational database model was completed in late 2009, and will be supplemented and improved as new disciplines that are not presently part of the database model are identified in the future.

To test the ROAD system we designed its first experiment using a unique set of archaeological information sampled from the time from 3 Ma–20 ka years and spanning Southern Africa. The data encompass find locations, their geology,



and most importantly, the archaeological, paleobiological and climatic data accessible through these different locations. To clarify the spatial distribution of archaeological and paleontological sites, environmental information including aerial photography, satellite data and climate reconstructions were added to ROAD at several different levels.

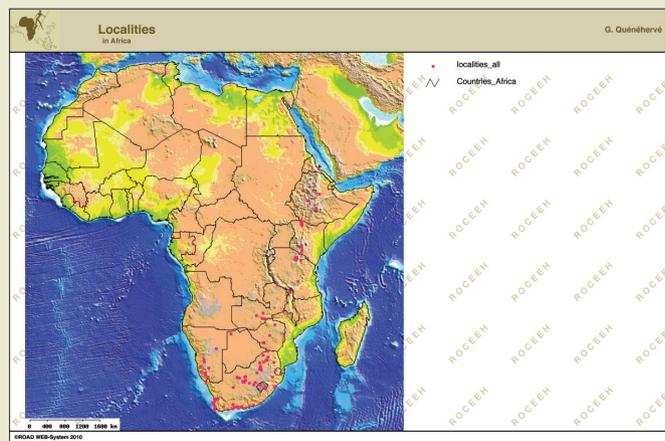
Table 1: Categories contained in the assemblage table.

Dataset	Examples of Data Content
Geological contexts and their chronological relations	Data about site deposits including stratigraphical subunits and dates that relate them to each other with respect to absolute or relative chronology.
Human remains	Data about human fossils and information they contribute to the debate, including species, brain capacity, size.
Archaeological data	Data about stone and organic tools, their typology, technology and raw material. Symbolic behavior including art, music, and personal adornment.
Paleoecological data	Data about paleofauna at different localities, including taxa, ecology and taphonomy. Data about paleoflora including macroplant remains, pollen.
Paleoclimatic data	Data about paleoclimatic conditions including OIS stage, temperature, precipitation, sea level.
Topology and hydro-geographical information	Different digital elevation models at 5 m, 10 m, 30 m, 90 m spatial resolution, and bathymetry at 1 km resolution. Derivatives of the DEM including primary and secondary topographic indices were stored in ROAD; information about river networks and hydromorphological information.

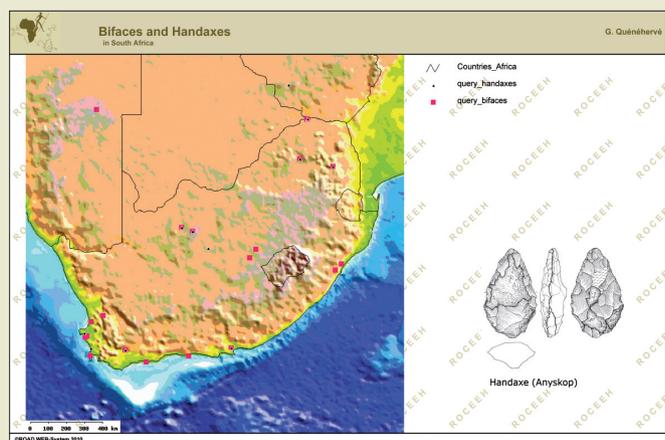
Combining these datasets using the ROAD interface, we were able to successfully conduct the first spatial and semantic analysis of the data. Table 1 presents the different categories that can be queried to answer particular research questions related to the spatially and temporally defined test area.

First analyses using the ROAD test run dataset were carried out in late 2009 and early 2010. The objectives of these analyses were to test the system technically and to develop procedures for data entry and analysis. The visualization of the assessed information can be executed at different levels. For now, the available data in ROAD will be used to establish cartographic representations of the individual archaeological, paleontological and paleoecological sites and localities in their geographical context. Relevant physiographic information on climate, vegetation, geology and soils at different chronological periods is also accounted for in these correlations. The first results can already be viewed in ROAD, mapped on present day physiographic features, or on selected paleoenvironmental reconstructions for biomes from glacial or interglacial periods. Simplified examples show sites in Southern or Eastern Africa between 3 Ma and 20 ka plotted with respect to topography and bathymetry.

The representation of more detailed research questions such as the distribution of bifacially retouched points, Howiesons Poort segments or particular implements that imply a symbolic character can also be plotted and then compared to different sea-levels, biomes, faunal zones or, to give another example, the mean encephalic volumes of the associated hominid remains. If needed, the data can be easily preformatted and exported for further statistical treatment in stand-alone GIS applications. The ROAD database can be viewed on www.ROCEEH.net and can be tested with limited access by public users (UserID: public/Password: roceeh).



Map of find locations entered to date in Southern and Eastern Africa.



Map of a query for handaxes and bifaces in Southern Africa.

Fieldwork in Makuyuni, Tanzania

With its extensive fossil record beginning with the oldest known hominid localities, East Africa plays a key role in our understanding of human evolution. In the last seven million years the region was inhabited by all of the major representatives of hominins. The region bears testimony to the earliest known stone artifacts as well. Therefore, East Africa represents a significant source region for studying hominin expansions and permits the assessment of ecological and cultural spaces occupied by the various hominin taxa.

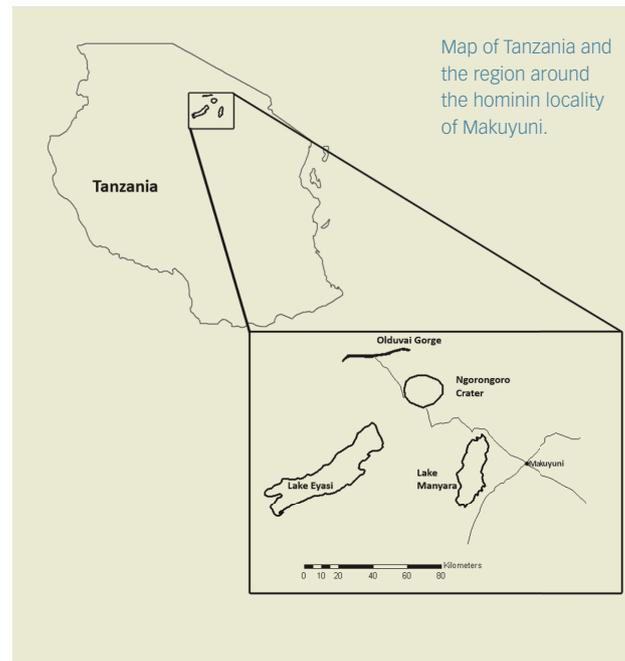
The period following the initial Out-of-Africa event about 1.8 million years ago seems at first glance to be uneventful. Until the ultimate appearance of anatomically modern humans about 160,000 years ago, the hominin fossil record in East Africa is patchy and not well understood. However, this period witnessed major environmental fluctuations that had a distinct impact on East African environments and ecosystems. The East African Rift represents a chief feature of the landscape. Representing a natural corridor, the rift may have functioned as a natural environmental highway, facilitating and/or hampering dispersal processes. Climatic shifts and ecologically structured landscapes certainly had an impact on hominin distribution patterns. For these reasons, the region is of enormous interest for fieldwork and model testing at the ROCEEH research center. ROCEEH has been active in the region since its inception in 2008 and organized an international, interdisciplinary field school in August 2009.

The paleobotanical record in East Africa is patchy and climate analyses based on such data are still lacking. Our ongoing research aims to fill this gap to help understand the impact of global climatic fluctuations on the African continent and its consequences for specific regions. Other proxies serve to correlate global climatic change with regional landscape development. For example, recent studies of lake development along the East African Rift system by Martin Trauth (Potsdam) and colleagues demonstrate that cool periods with pronounced aridity were associated with increased variability in lake levels within the rift valley.

The ROCEEH project contributes to the characterization of hominin environments and modes of living in East Africa in the critical period between 1.65 and less than 1 million years ago through a field project conducted in the Lake Manyara region. The hominin locality Makuyuni is located at the southern end of the Gregory Rift in the Manyara Basin.

Stratigraphy

Lying in the vicinity of the intensively studied World Heritage Site of Olduvai Gorge, the deposits at Makuyuni are situated in the rift valley proper. Two formations were identified by previous field campaigns during the 20th century. The Lower Manyara Beds are biostratigraphically correlated with



the transition from Olduvai Beds II to III, indicating an age of 1.65–1.33 Ma, while the Upper Manyara Beds are considered to range from 1.33–1.2 Ma based on faunal correlations with Olduvai Bed III. However, Ring (Christchurch) and colleagues suggest younger ages of 700–400 ka for the Upper Manyara Beds. Lower Manyara Bed deposits consist of fine-grained gray mudstones, siltstones and sandstones indicating a lacustrine depositional environment, while Upper Manyara Beds represent fluvial deposits. According to the spatial distribution of the lower bed deposits Paleolake Manyara must have had a considerably broader extent. If the extension event reflected by Lower Bed deposits correlates with the peculiar pattern of the amplifier lakes in the rift valley found by Trauth (Potsdam) and colleagues, younger ages must be assumed for the Lower Manyara Beds. Among the primary targets of the recent field activities was the collection of samples for argon-argon dating to obtain more robust dates for the Lower and Upper Manyara Beds. Processing and evaluation of these samples is presently underway. Younger ages for the Lower and Upper Manyara Beds would cast doubt on straightforward chronological correlations of the formations in the Lake Manyara Basin with the sequence in Olduvai. However, faunal comparisons might reveal a yet more intriguing perspective, namely ecological differences among contemporaneous landscapes west and east of the Ngorongoro plateau, both of which were inhabited by hominins about a million years ago.

Paleoecology

Fossils collected during field campaigns of the mid-90s yielded a large sample of mammalian specimens. By evaluating the original sample and supplementing it through



The succession of ecozones around present day Lake Manyara.

further field efforts, the ROCEEH team reconstructed the faunal composition and paleoecology of bovid communities in the Lower and Upper Manyara Beds. Preliminary results show that the bovid fauna of the Lower Manyara Beds preferred open bushland similar to today's prevailing environmental conditions.

The discovery in 2006 of a complete and well preserved skull of a cercopithecine monkey, a Pleistocene precursor of a baboon, and a cane rat mandible in 2009 corroborate such an interpretation of the environment preserved in lower bed deposits. Most of the mammalian taxa associated with lower bed deposits rely on abundant freshwater resources available either along river systems or through changes in lake chemistry as compared to present conditions. This might reflect conditions similar to those described for the amplifier lakes along the East African Rift.

The faunal assemblages in the Lower Manyara Beds are characterized by carnivore activities, as Charles Saanane (Dar es Salaam) discovered during his ongoing research in Makuyuni. Rebekka Volmer (see Who's Who?) is currently studying competitive relationships in carnivore guilds, their impact on structure and other structural shifts.

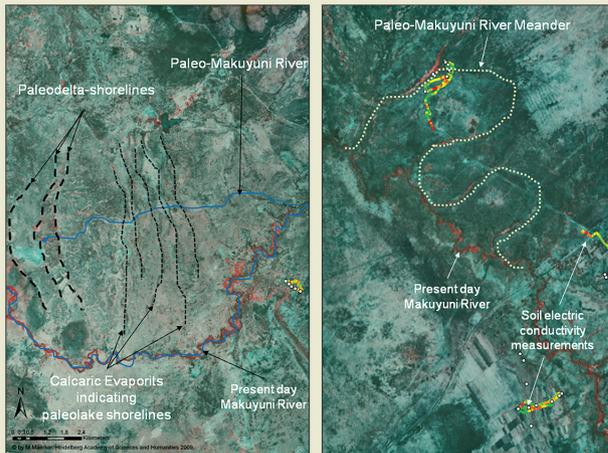
In contrast to the environment of the Lower Manyara Beds, bovid communities of the Upper Manyara Beds reflect a rather closed woodland environment, but also marked by an abundant freshwater supply in river systems. The present environment around Lake Manyara represents a succession ranging from lake flats devoid of vegetation to dense woodlands and forests at the base of the rift es-

carpment. In view of the wide distribution of fossil bearing sites in the rift system, studies of the spatial patterning of ecozones count among the important goals of the ongoing fieldwork.

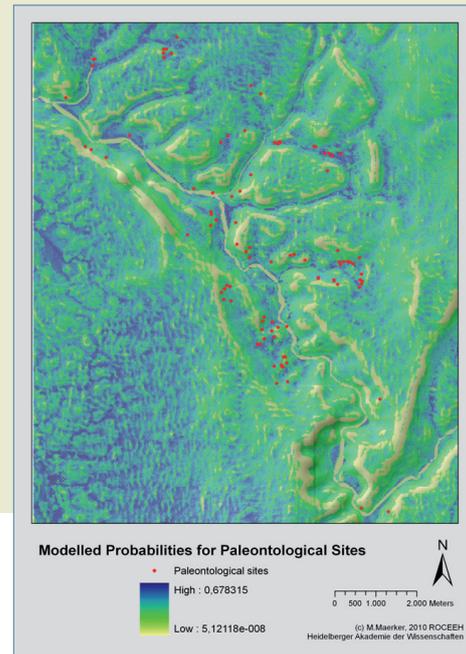
Spatial distribution

The large number of find locations with fossil vertebrates and artifacts detected during our field campaign in 2009 suggested the need for a more in depth analysis of the spatial distribution of these sites with regard to present day environmental characteristics and processes. A first look at the tectonic characteristics, geomorphology and soils shows that we can describe paleogeomorphological conditions with an integrative spatial modeling concept using GIS, remote sensing and sophisticated statistical methodologies. An analysis of satellite data reveals paleomeanders, old shorelines of Lake Manyara and delta deposits of the Makuyuni River.

To methodically describe these paleomorphological conditions, we assessed present day surface characteristics and processes as the focus of our March 2010 field campaign. We collected data on modern geomorphological processes, the physical and chemical composition of soil, and relevant hydrological processes. To achieve this, we collected soil samples, measured soil electric conductivity, set up a weather station and calculated soil infiltration rates. Moreover, we gathered information about vegetation and landuse to provide the research team in Makuyuni with detailed vegetation, soil, geological and geomorphological maps. These cartographic sources will be used to describe the present day transport processes that will be included in the Ph.D. thesis of Geraldine Quénéhervé (see Who's Who?).



Identification of paleolandscape features near Makuyuni.



Distribution of potential find localities in the Makuyuni area.

Following this integrative approach that takes into account a variety of data sources such as topography, spectral satellite information, field observations and stratigraphic characteristics, we analyzed occurrence probabilities for paleontological finds.

This analysis helped us in the March 2010 field campaign to focus on sites with the highest probabilities and to differentiate the relevant paleoenvironmental characteristics preserved in the Lower and Upper Manyara Beds.

Hominins and artifacts

The fossil-bearing deposits at Lake Manyara also yielded two hominin specimens. While the fragmented nature of the tooth and skull do not permit a robust taxonomic identification, these finds demonstrate that hominins were part of the ecosystems surrounding Paleolake Manyara. The collections include lithic artifacts that are being studied by Liane Giensch (Bonn) within the framework of her doctoral thesis. Many artifacts are surface finds, but test excavations over the past two years show that an assemblage of small-sized quartz flakes is associated with Lower Manyara Bed deposits. As is the case with the faunal remains, chronospatial patterns have yet to be demonstrated.

The reconstruction of physiographical and paleoecological features of landscapes inhabited by Pleistocene hominins in the rift valley is an important step in our understanding of hominin expansion patterns. Improved data on environment, paleoecology, hominins and especially their behavior are key in generating hypotheses about corridors and barriers to dispersal. Studies of hominin behavior based on artifact assemblages permit the assessment of subsistence and landuse patterns. The present fieldwork sheds new light on the role of topographic features such as the rift valley and allows an evaluation of the relative impact of natural and cultural factors in hominin expansions.

(C. Hertler, M. Märker, A. Bruch)

ROCEEH Workshops

“Human Expansions and Global Change in the Pleistocene—Methods and Problems”
 Joint Symposium of ROCEEH and BIK-F
 (Biodiversity and Climate Research Center, Frankfurt)
 Frankfurt, Germany, 16–20 November 2009

A symposium at the Senckenberg Research Institute and Natural History Museum in Frankfurt brought together more than 90 scientists addressing methods and problems in the examination of environmental factors and their effects on human dispersals in the Pleistocene. The first day focused on the crosslink between human expansions and global change in the Pleistocene. The keynote speakers addressed topical subjects including the implications of phylogeny and cladistics on the discussion of multiple dispersal events out of (and even into) Africa; the use of data from modern and extinct primates as an approach to hominin dispersals; the importance of the Dead Sea Rift as a corridor for migration of early humans; and South African environmental change during the late Pliocene and Pleistocene. The evening lecture by Nicholas Conard (Tübingen) highlighted the contribution of art and music to the colonization of western Eurasia by modern humans.

Over the next days, one session was held about methodological approaches to understanding ecology and vegetation during episodes of human expansions. A second session provided an overview of Late Pliocene/Pleistocene to Holocene environmental archives from Africa and Asia. A third session on infrastructure introduced examples of

databases from the National Museum of Norway, ArcheoInf and Neotoma. The program also included this year's G.H.R von Koenigswald Lecture given by Elisabeth Vrba (Yale University) on Paleoclimate and Evolution with Emphasis on Human Origins. After the plenary sessions, the symposium continued with a series of workshops: Michael Märker (ROCEEH) chaired infrastructure and databases; Katharina Neumann (Frankfurt) covered phytolites; Christine Hertler (ROCEEH) led paleoecology; and Angela Bruch (ROCEEH) focused on reconstructing climate. The abstract volume and selected presentations can be accessed on www.roceeh.net.

Forthcoming

- Reconstructing the paleoenvironment of early humans: methods and materials.
ROCEEH-workshop **(29 March–02 April 2010)** in Addis Ababa, Ethiopia:
<http://www.roceeh.net>.
- Session "Databases—how to make them attractive for external users and contributors" by Espen Uleberg and Michael Märker.
XXXVIII Annual Conference on Computer Applications and Quantitative Methods in Archaeology (CAA) **(06–09 April 2010)** in Granada, Spain:
<http://www.caa2010.org>.
- Symposium "The Aurignacian of the Swabian Jura, southwestern Germany" by Christopher Miller and Nicholas Conard.
75th Anniversary Meeting of the Society for American Archaeology (SAA) **(14–18 April 2010)** in St. Louis, Missouri, USA:
<http://www.saa.org/AbouttheSociety/AnnualMeeting/tabid/138/Default.aspx>.
- Symposium 24 "Early Pleistocene terrestrial climate and vegetation – the environment of early humans" by Angela Bruch and Suzanne Leroy.
8th European Palaeobotany-Palynology Conference (EPPC) **(06–10 July 2010)** in Budapest, Hungary:
<http://www.eppc2010.org>.
- "Hominid environment, ecology and dispersal in South Africa."
ROCEEH Workshop **(09–10 November 2010)** at the Institute for Human Evolution, Johannesburg, South Africa.
- Symposium "Culture or environment? Causes and consequences of the geographic expansions and contractions of Pleistocene hominins" by Angela Bruch and Nicholas Conard.
XVIII International Union for Quaternary Research (INQUA) Congress **(20–27 July 2011)** in Bern, Switzerland:
<http://www.inqua2011.ch>.

Who's who?

Geraldine Quénéhervé and Rebekka Volmer



Geraldine Quénéhervé conducting field work in Makuyuni, Tanzania.

Geraldine Quénéhervé completed her studies in geography, geology, geographical information systems and urban planning in Tübingen, Stuttgart and Adelaide (Flinders) in May 2009. Her interest lies in geomorphology, transportation processes and GIS-modeling. Her regional focuses are the Mediterranean and East Africa. She recently began her Ph.D. program in the Department of Geography at the University of Tübingen studying dynamic processes in the modern and ancient landscapes of Tanzania. Since September 2008 Geraldine Quénéhervé is a member of the ROCEEH team and works mainly on spatial data preparation and visualization using the ROAD system.



Rebekka Volmer studying faunal remains in Frankfurt.

During her studies in biology in Frankfurt, Rebekka Volmer specialized in anthropology, ecology and paleobiology. Within the framework of the project "Human Origin Patrimony in Southeast Asia," she attended several international courses and conducted field work in Europe and Southeast Asia. She conducted her diploma thesis about carnivore guilds in Pleistocene Indonesia. Since 2007 she is working on her Ph.D. study entitled "Structure and shared exploitation of food resources in fossil carnivore guilds: Is there an unoccupied niche for predatory hominins?" in the Department of Ecology, Evolution and Diversity at the University of Frankfurt. Her study contributes to ROCEEH by evaluating the attractiveness of fossil habitats for humans with respect to resource competition. She joined the ROCEEH team in 2008 and is responsible for entering paleobiological data into ROAD. She also uses ROAD to analyze compositions and changes of fossil carnivore guilds with regard to time, geography and culture.

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