01
10 www.uni-koeln.de

forschung 365

Das Wissenschaftsmagazin der Universität zu Köln
The University of Cologne's Journal of Science

Afrika Africa

**Von Afrika nach Europa
Welchen Weg nahmen unsere Vorfahren?**

***Our Way to Europe
Which Route did our Ancestors take?***

Zu trocken für Malaria? Verändert der Klimawandel die Ausbreitung des Tropenfiebers?
Too dry for Malaria? *Could Climate Change alter the Spread of this Tropical Fever?*

Mittel für den Frieden Welche Möglichkeiten der Konflikttransformation gibt es für Nord-Uganda?
Establishing Peace after Conflict *Possibilities for transforming Conflict in North Uganda*

Goldschatz in der Sahara

Geologen heben Klimaarchiv im Ounianga Kebir

Treasure in the Sahara

Geologists excavate Climate Archive at Ounianga Kebir

Robert Hahn

Auf dem Weg des Menschen nach Europa bahnte ihm das Klima den Weg. Trocken- und Feuchtzeiten legten die Wanderwege unserer Vorfahren fest. Im Rahmen des Sonderforschungsbereiches 806 „Our Way to Europe", der den Weg des modernen Menschen von Afrika nach Europa nachzeichnet, will der Kölner Geologe und Geoarchäologe Stefan Kröpelin von der Forschungsstelle Afrika am Institut für Ur- und Frühgeschichte die Klimageschichte der Sahara erforschen. Dafür begibt sich der Wissenschaftler an einen der abgelegensten Orte der Welt: In Ounianga Kebir mitten im Nirgendwo des Dreiländerecks zwischen dem Tschad, Libyen und dem Sudan will Kröpelin einen einzigartigen Datenschatz heben.

Climate changes paved the way to Europe for modern man: it was the dry and rainy seasons that determined the routes that our ancestors took. Within the framework of the Collaborative Research Centre 806 "Our Way to Europe", which is tracing the route modern man took from Africa to Europe, the Cologne geologist and geoarchaeologist Stefan Kröpelin from the African Research Centre at the Institute of Prehistoric Archaeology is researching the history of the climate of the Sahara. For this, the archaeologist is travelling to one of the most remote places in the world, Ounianga Kebir, located at the tri border area of Chad, Libya and Sudan, where he hopes to discover a unique treasure.

Meteoritenfeldern. Ein Lebenswerk und eine Herausforderung für Kröpelin. „Ich würde sagen, das ist im Grunde immer noch die unerforschteste Region der Erde. Die Antarktis ist da besser bekannt", resümiert der Kölner Afrikaforscher. „Es ist noch unendlich viel zu tun."

At the bottom of the desert lake Yoan are sediments of a very unique quality that look like they will provide the researcher with insight into the prehistoric climate of the area. On his expedition Kröpelin and his team have to cross thousands of kilometres of savannah and desert before they will be able to start drilling under water. The expedition is heading to lake Yoan at Ounianga Kebir, a group of small desert lakes located in northeastern Chad in the driest and most isolated part of the Eastern Sahara. Kröpelin visited the intriguing salt-water lakes for the first time in 1999. After carrying out initial test drilling, he was quickly able to establish that there was a lot more to lake Yoan. The bottom of the more than twenty-five meter deep lake consists of fine-layered sediments. This discovery was a stroke of luck as the deposits, which have been layered on top of each since the emergence of the lake eleven thousand years ago, were so clearly distinct from one another that the summer and the winter deposits were decipherable.

The high resolution of the drill core provided the geoarchaeogists with the means to trace climate changes of the seasons of every year. It became very clear that further drilling would be necessary to penetrate further into the past of the lake and its surroundings.

A Climate Archive with a high resolution

The opportunity to do this arose during the course of the Collaborative Research Centre "ACACIA" in 2003 and 2004. The Cologne geoarchaeologists drilled a core which was almost nine meters long, and in which sediments of the last 6,000 years could be seen. This was no easy task, as Stefan Kröpelin remembers: "We did it all in dinghies in one of the windiest places on earth. Sometimes the waves were over a meter high. And then we had to aim for a drill hole which was 26 meters under the water and then pull the drill rod with the core back out of the drill hole and 26 meters of water." The adventurous working conditions did not, however, put the geoarchaeologist off, as he knew that treasures were to be found in the core. The layers, which are up to 1.3 mm thick, hold fossil algae, insects, pollen and spores, which provide information on prehistoric climate and environmental conditions. The layers and C14 data provide an exact chronology of the climate right up to the atom bomb testing in 1964 and the present day. "This is the most detailed climate archive in the whole of Africa to my knowledge", explains Kröpelin. "There is nowhere else where one can gain data on the individual seasons or where information on each individual year can be gathered. We now have findings for the last 6,000 years and if everything goes well, we will soon have information on the last 12,000 years." The geoarchaeologist hopes to unearth sediments from the Holocene period during the expedition which started at the beginning of 2010.

New drilling in the Collaborative Research Centre

For this, the researcher will be using much heavier equipment. The drilling rods will be fixed to a platform and driven into the bottom of the salt-water lake. "I hope that we will be able to drill 20 or 25 meters deep so that we will have the whole Holocene in this excellent resolution," says Kröpelin. "If we achieve that, we will have the first complete climate history of the Sahara." From the topmost sediment layers, he will be able to make prognoses about actual climatic developments, he says: "We are able to investigate future climatic developments using the topmost layers. For example, whether the climate will become dryer or wetter." The drilling will not be easy, as it requires a lot of physical labour. The hollow drill has to be driven into the bottom of the lake manually, which gets more difficult the deeper they go. The approx. 20 meter long sediment core including the rods has to be pulled from the depths of the lake manually otherwise there would be a danger that vibrations caused by pneumatic drilling could destroy layers of sediments. The weather could also disrupt the expedition. "In the worst case scenario, we will have two weeks of windy weather, which will cause a cessation of all work," says Kröpelin. "If we are lucky and there is no wind, we will get almost everything done in a week."

A Goldmine not only for geologists

The project's drilling point is really a sensation, as Lake Yoan should not really exist in the first place. In the desert heat six meters of water evaporates from the surface of the four-square-kilometre lake annually – which is roughly the annual water consumption for the city of Cologne. However, the lake has a secret: it is fed by an ancient underground reservoir, which compensates the enormous evaporation loss. Despite this the water is salty, just like the water in the other 14 lakes at Ounianga Kebir and the neighbouring Ounianga Serir. These are the remains of early Holocene Mega Chad, which was once one of the largest lake systems on earth. The leader of the expedition is very taken by the place: "One can really say that it is a gold mine. There are very few lakes in the Sahara in general, never mind lakes with these types of sediment conditions." The excellent quality of the sediment is due to the fact that this group of lakes has remained undisturbed for thousands of years. In this no man's land in the middle of the Sahara, a thousand kilometres from the nearest city, the sediments have remained untouched and undisturbed at

Probenentnahme in einer kaum zugänglichen Region. Vor allem die Sandstürme mit Sicht bis zu wenigen Metern erschweren die Arbeit der Wissenschaftler. Ihr Interesse gilt den fein geschichteten Sedimenten des Yoan Sees von Ouninga Kebir. Sie bergen ein einzigartiges Klimaarchiv.

Gathering specimens in regions that are difficult to access. It is the sandstorms in particular, which hinder visibility, that make the scientists' work difficult. They are interested in the fine-layered sediments from Lake Yoan's Ouninga Kebir, which contain a unique climate archive.

Dr. Stefan Kröpelin

the bottom of the lake. "Even today not even the oil companies venture into this area," explains Kröpelin.

The main interest for Kröpelin is the climate archive at the bottom of the lake, which will provide them with information on the so-called terrestrial ecological system. The sediments also provide information on the lake inhabitants at Ounianga Kebir. Due to the fact that the inland lake has been isolated for thousands of years, data on the history of the lake and its inhabitants can be gathered from the lake's fossils. The unaffected development of individual animals and plants is sure to be of interest to geneticists, says Kröpelin: "The biology and genetic information in this lake alone is highly interesting. Many species endured over 10,000 years of extreme arid conditions." Kröpelin also hopes to discover something about the Pleistocene period. "For this we will need very heavy machinery and that would be part of the next grant application," explains Kröpelin.

Climate history of the continent

The findings from the project will be an important cornerstone in numerical climate models, which provide information important for research on future climate changes. The area around Ounianga Kebir is especially suitable for this type of research: for one, it is located in a relatively homogenous area, the Sahara, which covers over a third of the African continent. This means that researchers working there are in a position to gather conclusive evidence about climate change in an area that covers eight and a half million square kilometres. In addition to this, Africa is an inhabited continent, which means that climate changes actually affected humans. Findings on the climate from the Arctic or Antarctic, in contrast, cannot be applied to inhabited continents. "Due to the fact that Africa is divided by the equator, it is possible to compare the climate history of the northern hemisphere with that of the southern hemisphere," explains Kröpelin regarding the relevance of the findings. "I would say that a sediment core from this region is much more substantial than any ice core from the Antarctic, that is, if one is interested in the fate of the inhabitable continents," says Kröpelin.

Using the findings obtained from research from the last 30 years, the Cologne scientists can describe developments for the last 12,000 years. The Sahara, today one of the world's most arid territories, became in approx. 8,500 BCE a fertile savannah landscape that provided humans and animals with sustenance. It was a paradise for semi-sedentary hunters and gatherers, and later for nomadic cattle herders. The reason for this was the annual monsoon that had moved from the south tropics to northern areas. A "green Sahara" was the consequence of these wet monsoons. Grass, bushes and acacia grew where today we have sand dunes. The rivers and lakes there even had crocodiles as inhabitants. Humans settled in this area and traces of them can be found in many places. The rock paintings of the Gilf Kebir Plateau in Egypt, where there is the well-known "Cave of Swimmers", document the fact there was open expanses of water in this area. However, 5,300 BCE at the latest saw the nomad pastoralists withdraw to more fertile areas. It became arid and humans migrated towards south or to the Nile Valley, from where the Pharaoh high civilization originated.

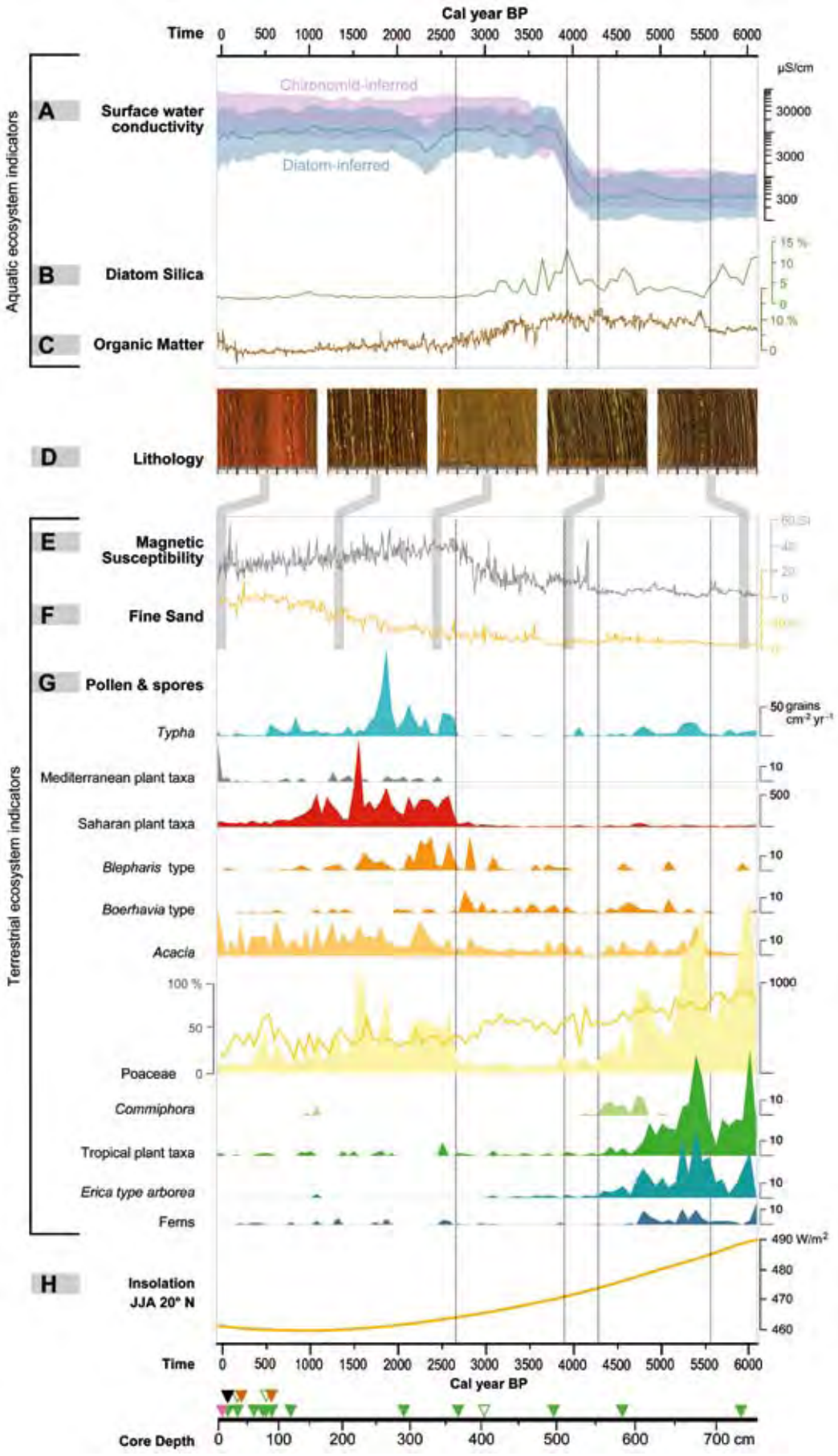
Untouched for thousands of years

The drilling at Ounianga Kebir is yet another highlight from the so far 30 years of research of the Eastern Sahara undertaken by Cologne scientists. The researchers take a methodically and spatially broad approach to their research: findings include geological, archaeological, archaeobotanical and archaeozoological research data. Data from the research carried out in locations all over the eastern Sahara have been gathered and evaluated which means that the scientists have a reliable and authoritative overview of the prehistoric climate change of the area. The findings are assessed collectively. This is because it is very likely that individual areas of the Eastern Sahara may have seen very differing climatic developments. "We are talking about an area that is as big as Western Europe. We have data pertaining to thousands of places. To gather information from just one spot would not be representative," says Kröpelin. The Eastern Sahara has been uninhabited for 5,000 years and is therefore a unique territory for research; climate archives and archaeological findings have been preserved like a fly in amber. Climate change, environmental developments, and prehistoric settlement and adaptation strategies of the early inhabitants of the Sahara can all be investigated in this area as it has remained undisturbed by humans for thousands of years.

Unexplored territory

The Sahara of northeast Chad into which the Cologne expedition is venturing, is despite the sporadic visiting of scientists still largely unexplored. The chance to once again venture into uncharted territory really appeals to the geologist Kröpelin. "These are some of the last areas on earth left for a geographer or geologist to investigate," says Kröpelin. "Soon we will have to go to Mars or the Moon to find new territories to discover and explore."

Numerous discoveries are yet to be made in the area, which is practically uninhabited and comprises a territory of two million square kilometres: climate archives, petroglyphs, unknown species and meteor fields can all be investigated in this area. This is work for a lifetime and a challenge for Kröpelin. "I would say that this is the most unexplored area on earth. More is known about the Antarctic," says Kröpelin summing up. "There is still so much to do."



Entwicklung der Ökosystem-Komponenten im Wasser und an Land in den vergangenen 6000 Jahren: Die Grafik hebt einschneidende Veränderungen des Klimas hervor. Zu beobachten ist u.a. die Entwicklung verschiedener Vegetationen.

Development of the components of the ecological system in water and on land over the last 6,000 years: the image highlights dramatic climate changes. The development of the different vegetations can, for example, be observed.