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FROM MEGACHAD TO MICROCHAD – ENVIRONMENTAL CHANGES DURING THE HOLOCENE

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Summary

Transgressions and regressions of Lake Chad played an important role in the younger landscape history of NE-Nigeria which also have caused great changes in the conditions for the biosphere. Investigations focused on the late Pleistocene and Holocene landscape development of the surroundings of Lake Chad, which have more or less been influenced by the lake in several scales both spatially and temporally.

The „Lantewa dune field“ had not been subject to lake transgression, whereas the „Gudumbali dune field“ was submerged during the Megachad phase around 6,500 BP. After regression, a younger beach ridge was formed as well as a lagoon which covered the area south to the lake. A further regression formed the recent lake. Moreover, recent subsidence is of special importance and must be taken into consideration.

Contemporary to the desiccation progress of the Sahara the lagoon south to the lake dried up. Since that time, the size of the lake is similar to the actual size – before the drought of the seventies, when Lake Chad changed to Lake Microchad giving space for settlements and economic activities on the former lake floor. Lake level rises and falls can be observed in the scale of decades.

The outlined landscape development has a determining influence on the landuse potential today. Not only ancient cultures depended on the environmental settings, also the present population adjust to changes in their environment. New settlements on the former lake floor grow and the region becomes more important in food production and livestock husbandry.

Résumé

DU MÉGATCHAD AU MICROTCHAD – CHANGEMENTS DE L'ENVIRONNEMENT PENDANT L'HOLOCÈNE : Les transgressions et régressions du Lac Tchad jouent un rôle important dans l'histoire récente du paysage du Nord-Est nigérian. Elles ont aussi entraîné des changements importants de l'environnement physique. Des recherches se sont consacrées à l'histoire du paysage du pleistocène tardif jusqu'au holocène, période pendant laquelle l'environs plus

ou moins influencés par le lac, à des échelles différentes aussi bien dans l'espace que dans le temps.

L'erg de Lantewa n'a pas été submergé par les transgressions du lac, alors que l'erg de Gudumbali a été submergé pendant la phase Mégatchad aux alentours de 6,500 BP. Après la régression, une crête littorale plus jeune s'est formée en même temps qu'une lagune couvrant la zone au sud du lac. Une régression ultérieure a créé le lac actuel. En plus, la subsidence récente joue en rôle important et doit être prise en considération.

Parallèlment à la dessiccation du Sahara, la lagune au sud du lac s'est asséchée. Depuis ce temps, le lac occupe la même surface qu'actuellement – c'est-à-dire avant la sécheresse des années 70, quand le Lac Tchad est devenu le Lac Microtchad, en libérant des surfaces étendues, utilisables maintenant pour la colonisation et pour des activités économiques. Des montées et régressions du lac peuvent être observées dans une échelle de décennies.

Le développement du paysage résumé ci-dessus exerce une influence importante sur l'actuel potentiel de l'exploitation. Non seulement les anciennes civilisations dépendaient des conditions environnementales, mais la population d'aujourd'hui doit également s'adapter aux changements de son environnement. La colonisation de l'ancien fond du lac est d'une grande importance pour la production alimentaire et pour l'élevage.

Introduction

The investigations carried out within the project in NE-Nigeria since 1989 have been focussing on the late Pleistocene and Holocene landscape development of the south eastern Chad basin. Areas of interest include palaeodune fields, clay plains and former beach ridge systems of Lake Chad.

Transgressions and regressions of Lake Chad played an important role in the younger landscape history of NE-Nigeria and have also caused great environmental changes. The term „Megachad“ is well known and describes an enormous lake with an extension comparable with the Caspian Sea of today. The term „Microchad“ stands for the other recent extreme in terms of the lake dimensions varying during the times.

Environmental changes in the surroundings of Lake Chad are closely connected with transgressions and regressions of the lake. These lake level changes can be climatically induced as well as non-climatically, due to human impact. Nearly all land units have more or less been influenced by the lake, spatially as well as temporally. It is important, though, to notice the scales of the changes. Some changes took place in a millennial scale, some in the scales of centuries or decades, and at least – as can be observed every year – in a seasonal scale.

The environment

NE-Nigeria can be divided into several land units (Fig. 1). Linear dunes are typical for a great part of the *Lantewa Dune Field* in the west. The *Gudumbali Dune Field* appears to be a low wavy sand cover, interrupted by flat depressions with clay sediments and is in parts characterised by short transversal dunes. The Lantewa dune field is separated from the Gudumbali dune field by the *Bama Ridge Complex*, an assembly of several older shorelines belonging to former greater extensions of Lake Chad. Remnants of linear dunes can also be found in the southern part of the adjacent *Bama Deltaic Complex* in the East. The *Chad Lagoonal Complex* is dominated by extended dark clay plains with sandy areas, which often have island-like character being the tops of a buried dune field. Towards the Lake, the *Ngelewa Beach Ridge* separates the *Chad Lacustrine Plains* from the above mentioned land units marking a former lake level which was slightly higher than the recent one.

Climatic changes and their effects in a millennial scale

The main formation phase of the linear dune field is attributed to the *Kanémien* between 20,000 and approx. 12,000 BP. During that time Lake Chad is thought to have been dried up completely, because the whole lake bottom appears to be an old dune relief, today still visible in the eastern archipelago part of the lake. When the climate turned to wetter conditions, the lake appeared again and rose quickly to a moderate maximum around 9000 BP. After a short dry phase around 7500 BP which is, however, still uncertain Lake Chad rose around 6500 BP to its highest level of 320 m above sea level. The coast of this huge inland sea on the Nigerian territory was again the Bama Ridge. At that time, Lake Megachad built up the youngest beach ridge of the Bama Ridge Complex, which can clearly be recognised as a thin stripe on satellite images and as a flat ridge on the ground, e.g. about 5 km to the west of Gazargamo (Fig. 2).

Findings of charcoal in the Konduga sandpit enabled us to date this Megachad-Phase for the first time in Nigeria. Ages of 6350±250 BP (THIEMEYER 1992) and 6180±60 BP (BREUNIG 1993), respectively, prove the existence of Lake Megachad. The greater part of the Bama Ridge Complex, however, must be older than the last formation of the Lantewa dune field because the linear dunes pass across the older beach ridges except the youngest one.

Additionally, there is not only morphological, but also pedological evidence for this sequence. Older linear dunes as well as the older beach ridges carry mostly Chromic Arenosols, the youngest beach ridge, however, is characterised by weaker developed Cambic Arenosols.

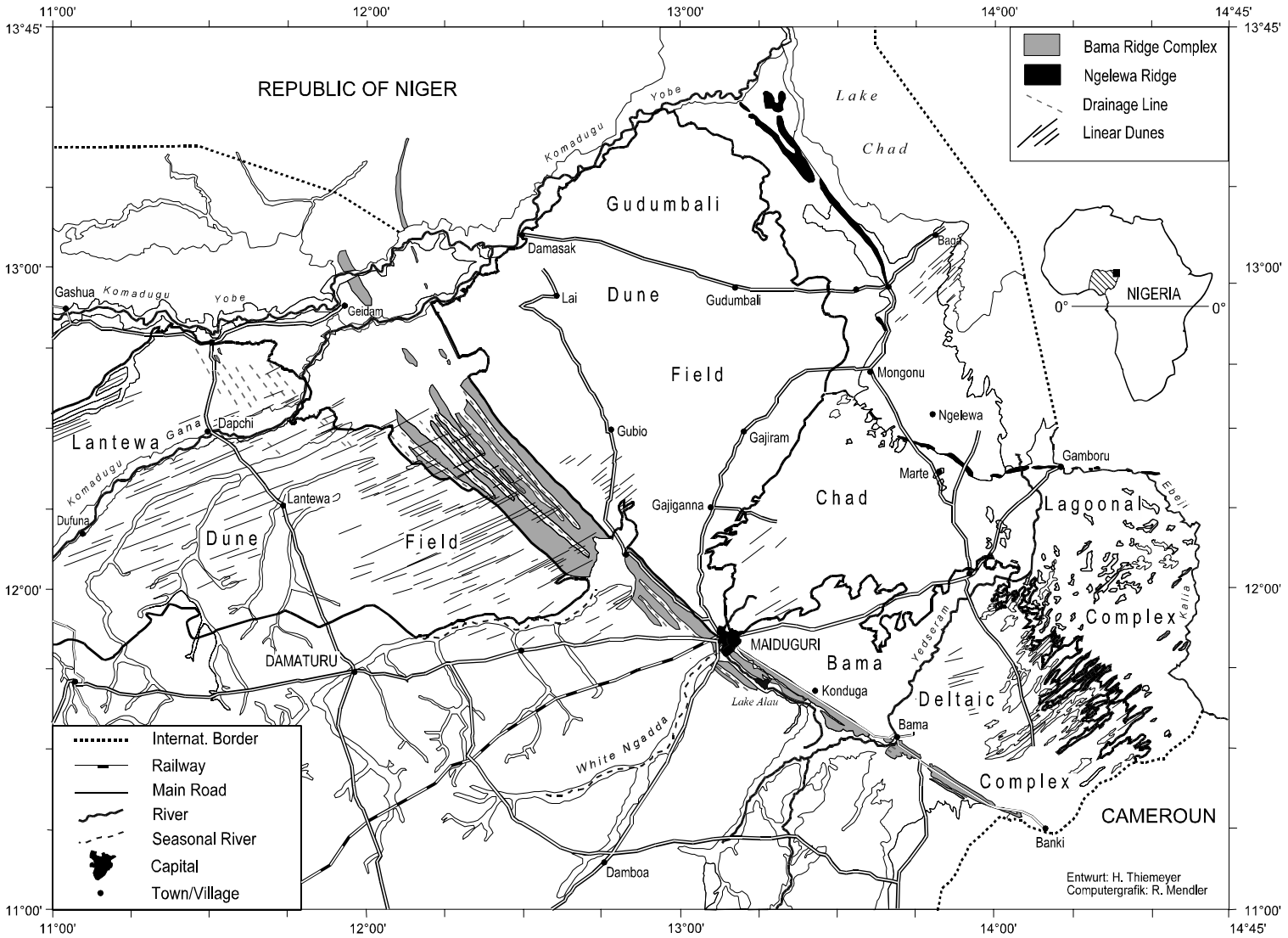

Fig. 1 Land units in NE-Nigeria

The intensity of soil development is among others a result of the time which has passed and helps us to differentiate between several geomorphologic units.

Lake Chad must therefore have had a 320 m-level several times in the past, but only the last took place in the Middle Holocene. Moreover, samples for OSL datings have been taken from four sections between Garin Gada in Nigeria and Yagoua in Cameroon in order to confirm the few radiocarbon-datings with an additional method. But their analysis has not been completed yet and we hope to get the data towards the end of this millennium.

Fig. 2 The Bama Ridge about 5 km West of Gazargamo (Photo: H. Thiemeyer 1997)

The Gudumbali dune field was submerged during the Megachad phase. Parts of this dune field existed before and had been flooded by the rising lake without destruction of older dune remnants. Clay sedimentation had taken place in the former interdune depressions. When Lake Chad shrank again, the dune sands reappeared and – after some aeolian reworking – formed the recent surface of the transversal dune field. The Ngelewa Beach Ridge was formed close to the lake as well as a extended lagoon which covered the area south of the lake behind this beach ridge. The clay sedimentation, which stopped in the Gudumbali dune field with the regression of the lake, proceeded in the younger lagoon. These black clays are locally known as *firgí*. The clay sediments are divided into two distinguishable layers with different physical properties according to different sedimentation processes (SKORUPINSKI 1999). As a result, the maximum radiocarbon age of the beginning of the deposition is

between 11,400 and 10,300 a calBP. This age corresponds well with the climatic changes at the beginning of the Holocene period.

Usually, tectonic aspects have no influence during the youngest phases of the Quaternary landscape development. However, recent subsidence is likely to take place in the area of investigation and must therefore be taken into consideration. Many lineaments can be recognised on satellite images which have affects on the land surface. In the slightly higher „square“ of the Gudumbali dune field clays occur only in the interdune areas, while most of the clays have been deposited to the south east of a more or less straight line approximately from Mongonu to Maiduguri. In my opinion, this is the most possible explanation for the spatial distribution of sands and clays within the Nigerian Megachad area. Around 3,000 BP, the archaeological site of Gajiganna is situated at the edge of this lagoon which was an important food resource at that time. The settlements of the firgí plains started just after the water retreated and when the sandy islands reappeared and became safe places for habitation.

This further regression formed the recent lake. Since that time, the lake has – with variations, however (MALEY 1981) – approximately the recent size – before (!) the drought of the seventies, when Lake Chad changed to Lake Microchad giving space for actual settlements and economic activities on the former lake floor.

The scale of decades to centuries

The lake level highly depends on the annual discharge of the Chari which is controlled by the rainfall conditions in the catchment area. Changes in humidity with wavelengths of some decades lead to naturally induced changes of lake level and size. In connection with a decrease of the mean annual rainfall, environmental changes can be observed in the whole sudano-sahelian region. These changes, however, should be labelled as aridification.

But aridification can cause desertification. Population growth and groundwater exploration by modern techniques during the 1970s drought have had serious effects on the natural potential of areas with weak resources. Overgrazing for example led to sand remobilization. Undoubtedly, there are areas of desertification in NE-Nigeria with morphodynamic processes like those in deserts. Overgrazing symptoms are visible in the vicinity of villages, boreholes and cattle tracks. Farming too leads to the removal of the protective grass cover. The extent of the damage is not yet as spectacular as at the edge of the desert and is in most cases reversible, but the danger that the ecosystem becomes unstable is always present.

The actual size of the lake is the result of a recent drastic shrinkage often thought to be symbolising a widespread environmental degradation. In the last 30 years, the lake area has shrunken from about 25,000 km² to about 1,500

km² only. The discharge of the Chari decreased from 40 km³ in the 1960s to approx. 15 km³ in the 1990s due to reduced rainfall in the Sudano-Guinean zone (KADOMURA 1997). But the Sahara does not spread out to the South and no dune encroachment can be observed in the Sahel! The serious above-average decrease of the annual discharge of the Chari is, however, influenced by human impact, like irrigation projects and related dam constructions which serve mainly for rice cultivation in the lower Logone plains in Cameroon and southern Chad.

The third scale: Years

This third rhythm is a seasonal flooding and shrinking of the lake, which is also controlled by the influx of the Chari system. It depends highly on the variability of rainfall on the one hand and, as already pointed out, on the water management on the other hand. Due to the climatic variability, Lake Microchad, however, could rise again as it is happening for centuries – if man prevents misuse of water! During the drought of the seventies, the northern pool of Lake Chad dried up completely. The recent phase of Microchad has given space for new settlements on the former lake floor and the establishment of economic activities, which may become endangered, when the lake rises again (Platte and Krings, this volume).

In general, the land use potential today depends highly on the outlined landscape development. In sandy areas the potential is low due to light sandy soils and especially in times with scarce vegetation cover. With the help of a geographical information system and interpretations of particular air photographs and satellite images as well as already available maps and data it seems to be possible to provide up-to-date land use information and to map the changes.

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