

# Paleoenvironment and hydrological characteristics of the eastern Congo basin, Central Africa

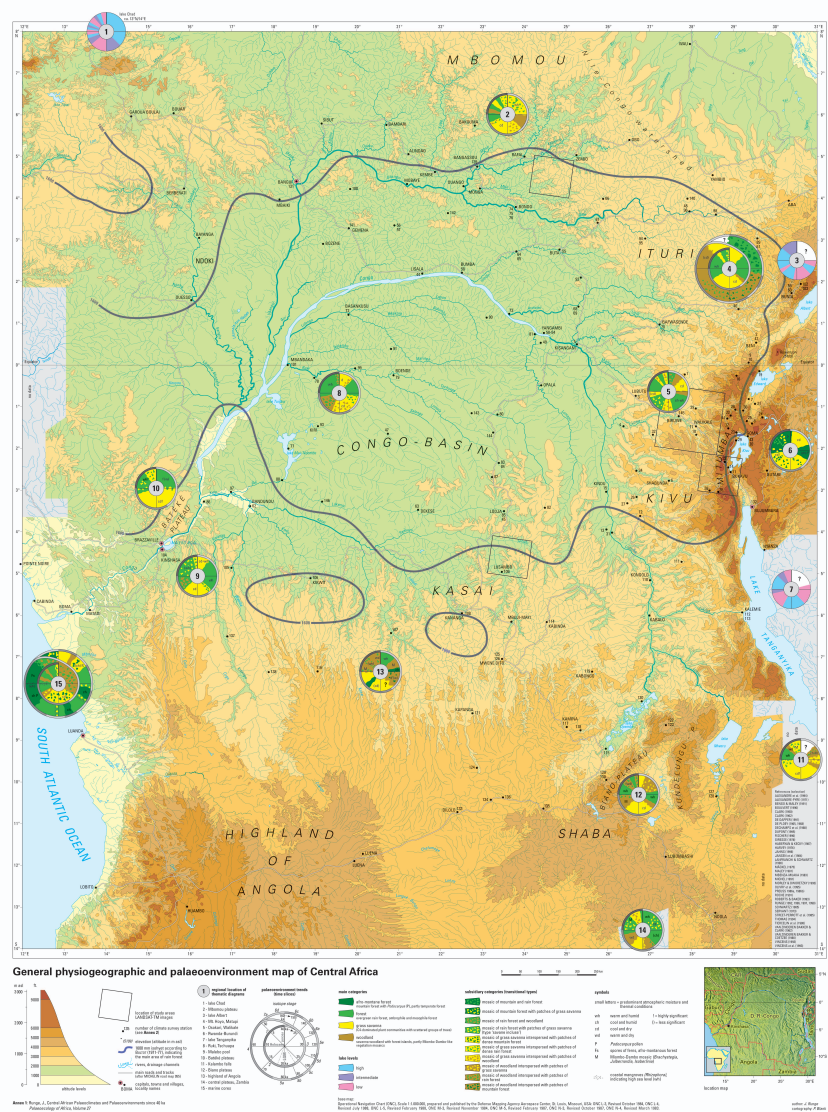
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## Abstract

A great deal of paleoenvironmental research on tropical alluvia and slope sediments assumed the long-term persistence of stable climates and associated rainforest vegetation in the Congo basin during the Quaternary. Geomorphological, paleo-hydrological and ecosystem history research in the eastern Congo basin (Kivu, DR Congo) has provided evidence of the frequent occurrence of multi-layered alluvia and fans in river valleys and plains as well as stratified slope deposits (hill-wash, stone-lines, pedo-sediments) that reflect former modifications of the environment. Numerous radiocarbon data indicate that ecosystems within the Congo basin are highly sensitive to climate change through modification of surfaces and run-off dynamics. A stratigraphic record characterized by variable sediment layers of 2.0–5.5 meters thick spans the Holocene and the Pleistocene back to 50 ka BP (completed by finds from Cameroon and Central African Republic). Buried stone-lines and paleo-soils indicate once drier, more open landscapes under alternating wet and dry climates in currently humid and semi-humid regions. A conceptual morpho-dynamic model is presented and summarizes process related response to former environmental modifications.





# W-48 Paleoenvironment and hydrological characteristics of the eastern Congo basin, Central Africa



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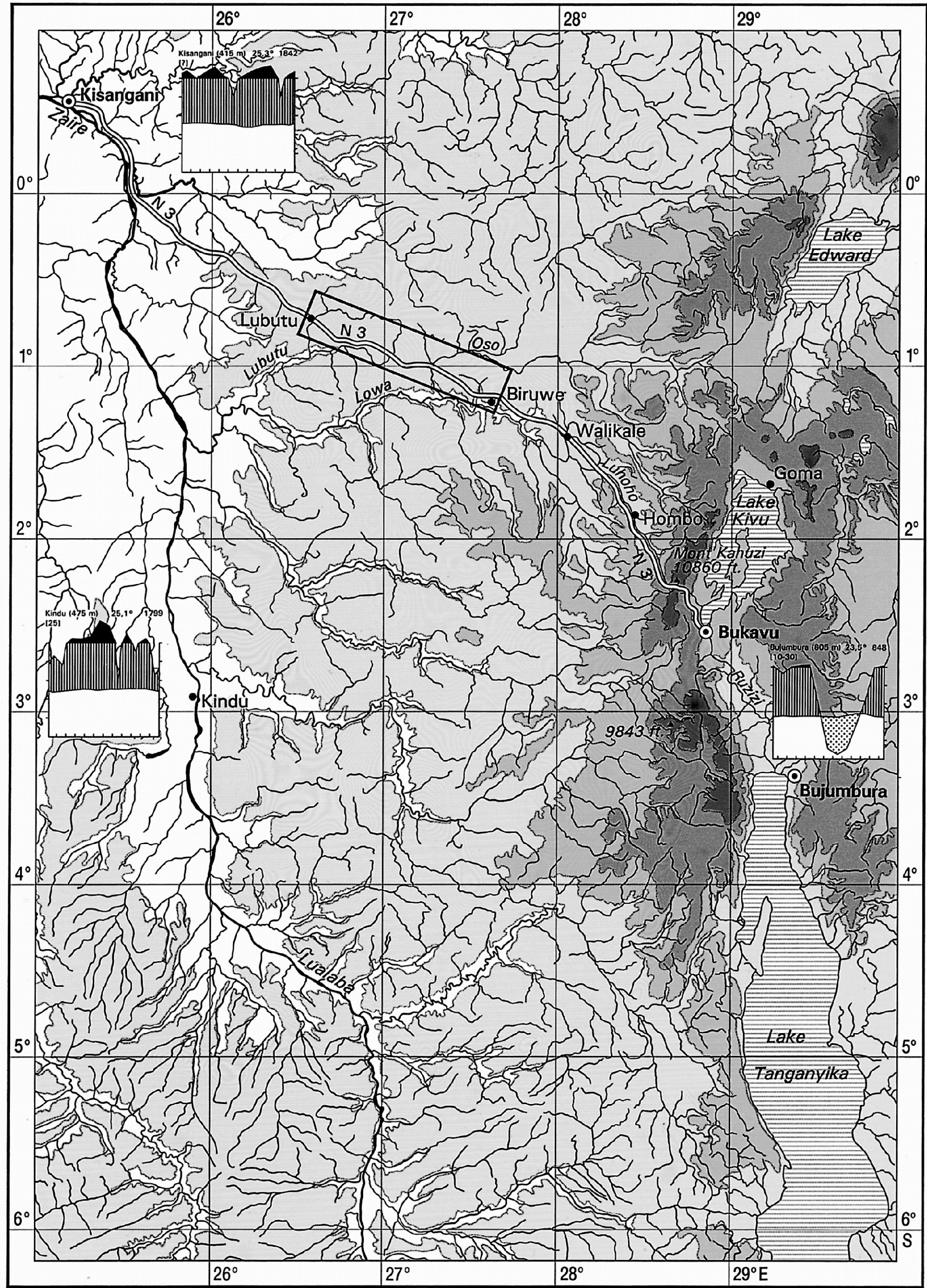


Fig. 1: Location map of the eastern Congo (RUNGE 1992:111)

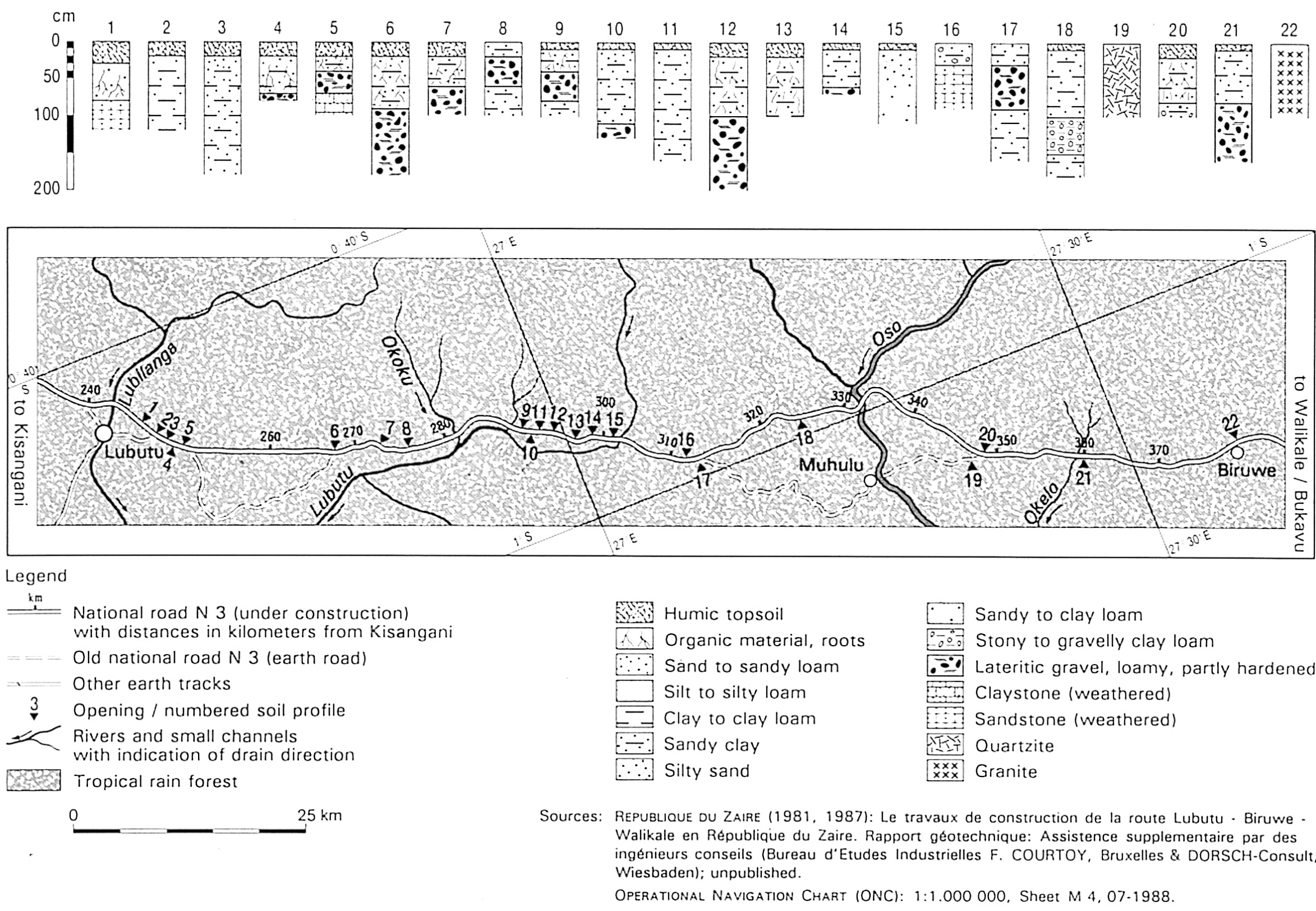


Fig. 2: Multi-layered soils and sediments within postulated Quaternary rainforest refuge areas (see Fig. 1)



Fig. 6: Osokari field site with LGM aged tree trunks below "stone-line" (in pallid zone!)

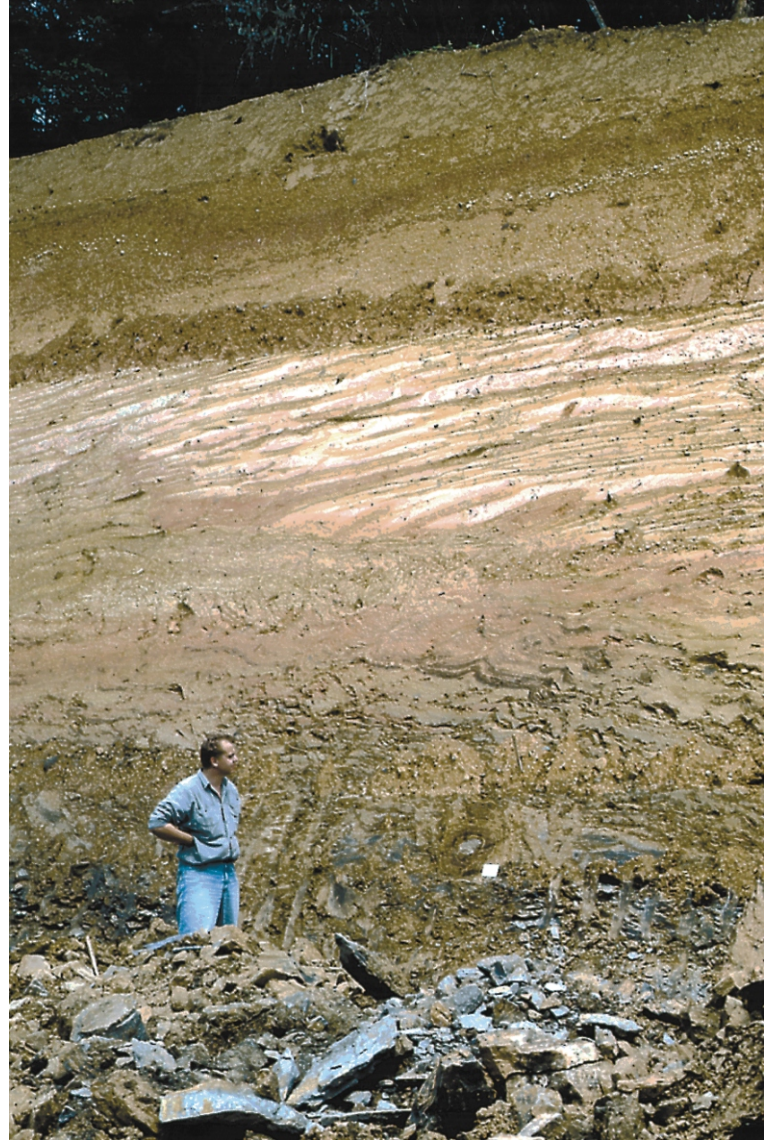


Fig. 7: Fossil tree trunk at Osokari within pallid and mottled zone (Fig. 5)



Fig. 8: Lateritic gravel and debris within "stone-lines"



Fig. 9: Blocky, quartzitic detritus under recent rainforest



Fig. 10: Holocene paleosol and and "cut and fill" features in multilayered pedo-sediments

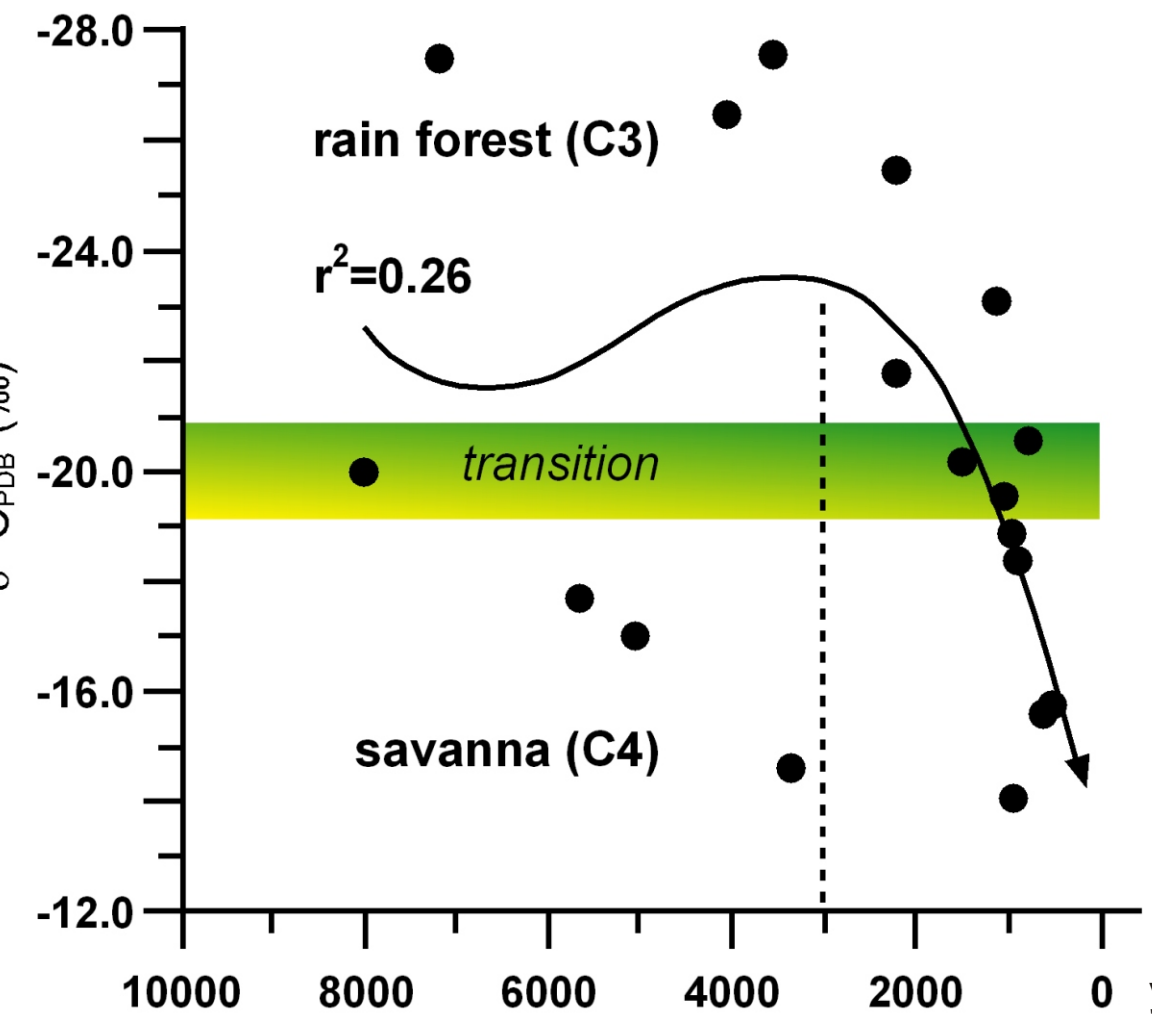


Fig. 11: Holocene vegetation dynamics evidenced by stable carbon isotopes (Mbamou, RUNGE 2002)

## Results I

Determination of stable carbon isotopes ( $^{13}\text{C}$ ) in organic rich alluvia on the northern edge of the Congo basin (CAR), supplemented by  $^{13}\text{C}$  data, gave evidence for varying composition of C3 (forest) and C4 (mainly savanna) plant cover during the Holocene (Fig. 11). Greater extend of rainforest occurred around 8 ka (African Humid Period) and between 2,5-3 ka, whereas drier, savanna dominated vegetation patterns prevailed around 5-6 ka and from 1 ka to the present. Since 3 ka the "First Millennium Crisis" with a breakdown of rainforest ecosystems and modified paleohydrology is clearly recognizable.

## Introduction

Vegetation cover controls surface runoff and morphological processes. Suspended sediment load of rivers in the eastern Congo is rather low when compared with other large river systems. However, during the ice ages (mainly at the Last Glacial Maximum, LGM, 24-18 ka) a more seasonal and drier climate prevailed, and subsequently rainforests were reduced in area and open savannas and woodlands shaped the landscape. Sediment flux of rivers and on slopes changed considerably. Generally, it is assumed that rainforest took refuge in the eastern Congo and in isolated mountain "core areas" on the Central African Rift.

This study investigated for over 10 years soil and sediment properties along a landscape transect between Kisangani and Bukavu to understand and reconstruct paleoenvironmental as well as paleohydrological characteristics and vegetation dynamics in the eastern DR Congo.



Fig. 3: Soil profile discontinuities such as "stone-lines" near Butare (Rwanda, RUNGE 2002)

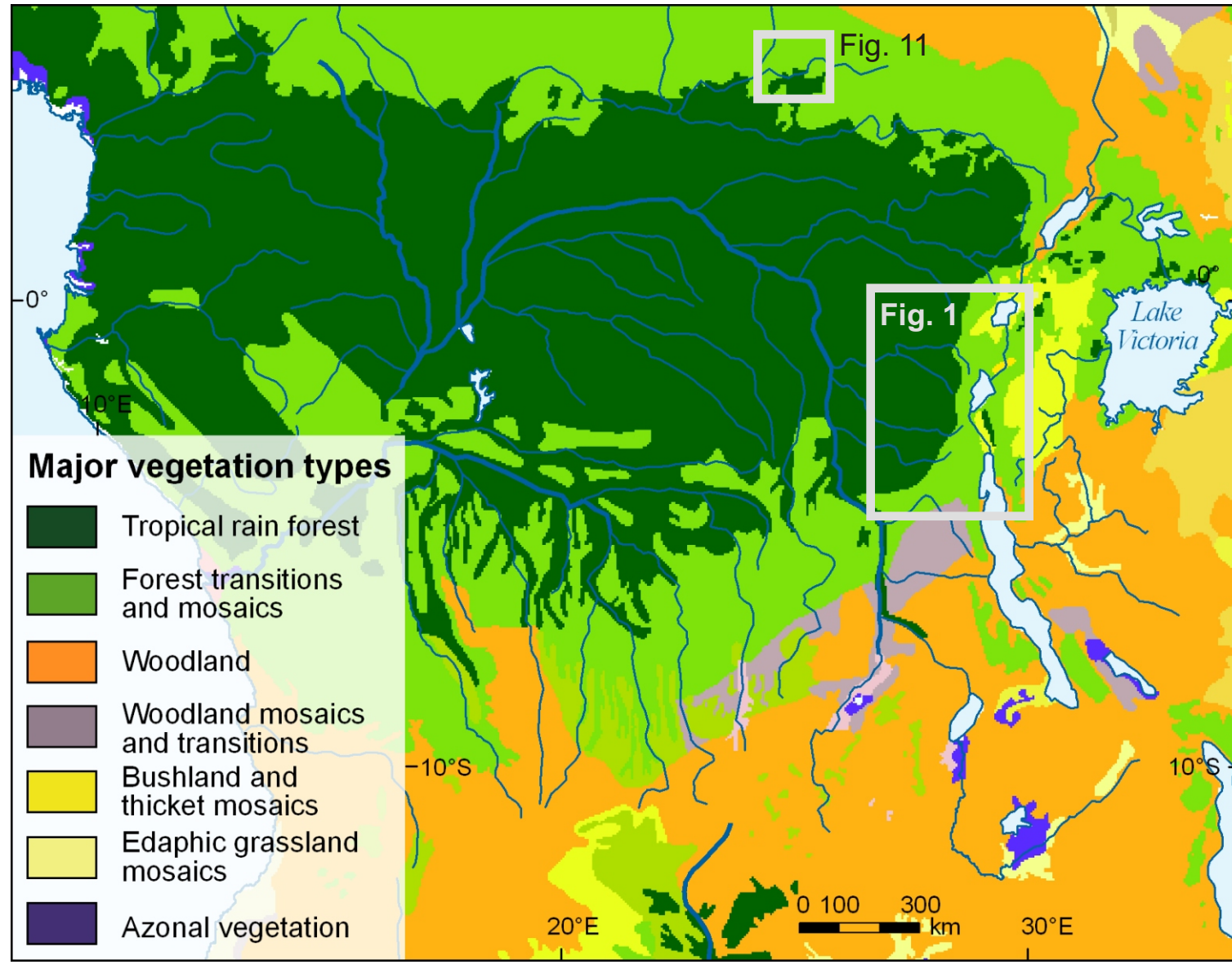


Fig. 4: Low suspended sediment load in the Lova River, a right bank tributary of the Congo-Lualaba drainage system (RUNGE 1994)

## Methods

Field work surveyed a 200 km long section of the new Kisangani-Bukavu road passing through the postulated "core area" (Fig. 1). This region is characterized by high biodiversity, and therefore, long-lasting environmental stability is assumed (hypothesis). Large exploration openings and prospection drillings within the dense and inaccessible rainforest (1800-2500 mm/yr precipitation) rendered possible insights into the climatic history of this landscape (Fig. 2, 3-10). An underlying question was whether geomorphological, pedological and geochemical properties of weathered pedo-sediments would lead to a verification of the "core-area model" or not. In other words, will sediments and soils reflect signs of former stable or instable environmental conditions due to morpho-dynamic activity (with fluxes of debris/suspended load in catchments) controlled and triggered by modifications in climate and vegetation cover during the last 40,000 years (LGM and before)?

Fig. 5: Soil properties of multi-layered pedo-sediments, see Fig. 6, 7 (RUNGE 2000:253)

## Results II

Most of the pedo-sediments and alluvial deposits show undulating brown to yellow hillwash layers, several centimeters to several meters in depth, underlain by similarly undulating stone-lines (Fig. 3, 6-9). Fossil tree trunks within the ferrallitic section of the profile (Fig. 6, 7) give radiocarbon dates up to 36-12 ka (LGM, before and after). Hillwash and paleosols containing charcoal were dated up to 5-2 ka (Fig. 10). A decrease of finer and coarser sediment supply took place during the transition from arid to humid climate around 13 ka. Stone-lines in eastern Congo could therefore be interpreted as a stratigraphical "marker" at the onset of the Holocene. In conclusion, the Congo basin (core-area) was much drier during the Late Quaternary than it was commonly believed before.

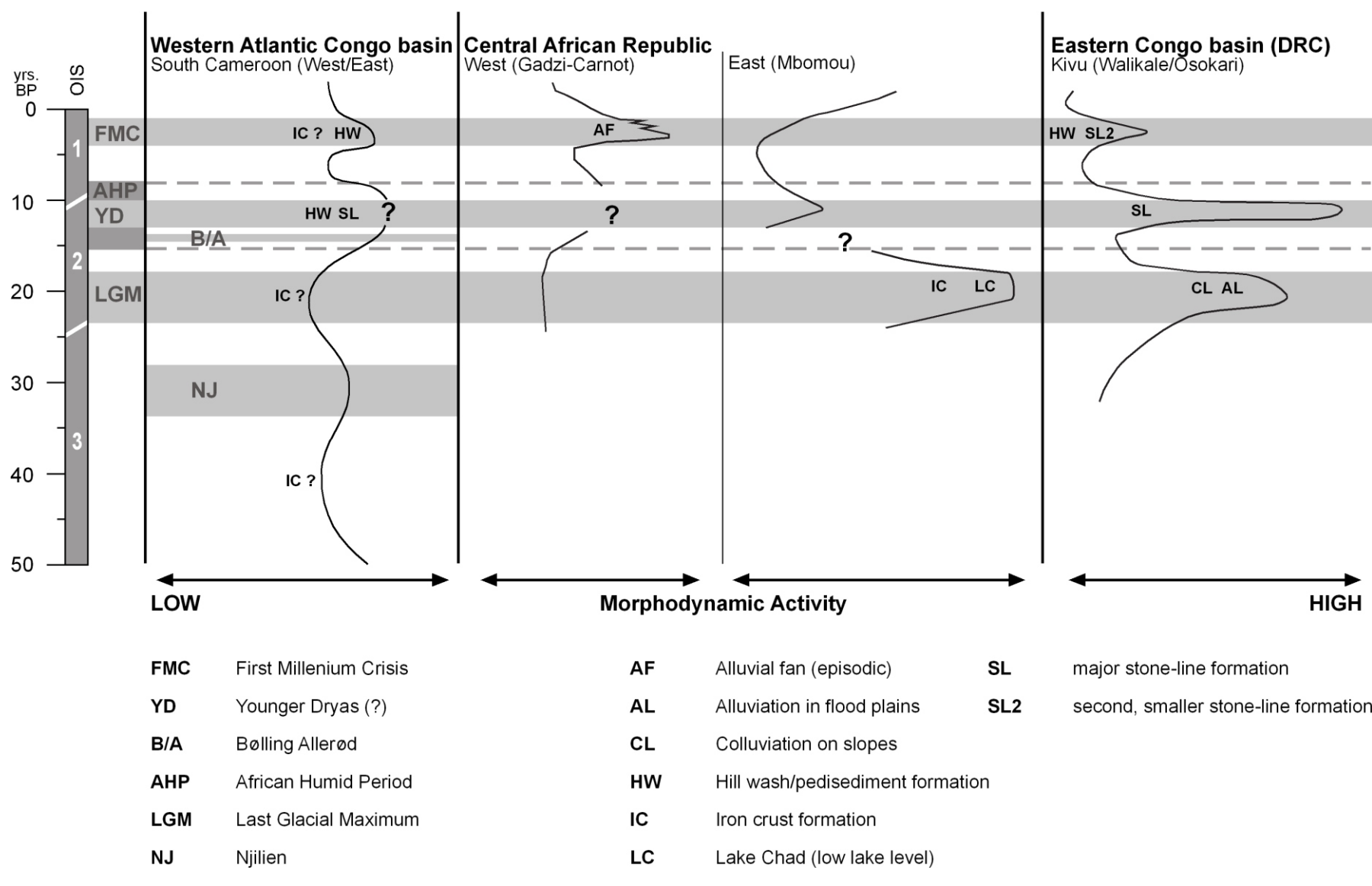


Fig. 12: Synopsis - Congo basin's paleoenvironments since 50 ka (RUNGE 2014)