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Vegetation reconstruction to the mid-Holocene transition in Sahel and Sahara: first palynological results of a lacustrine record from the Mega-Lake Chad

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One of the most prominent environmental changes over the past 10,000 years is the abrupt change observed during the mid-Holocene, ca. 5500 years ago, in northern Africa with the transition from the "green Sahara" to the present hyperarid desert. Sedimentary records show that the current area of the Sahel and part of the Sahara was moister during the Late Pleistocene to middle Holocene (between ∼14 to 5.5 kyr cal BP), period known as the African Humid Period (AHP) [1]. The end of the AHP and the transition to the present arid climate was triggered by Earth orbital changes and the decrease of the African monsoon influence in response to a weaker insolation of the Northern Hemisphere during summer. However, many questions related to this climate change are unresolved and the timing, duration, mode and spatial pattern of the AHP termination are still matter of debate [2, 3].

Lake Chad represents a key site for investigating these questions, with a drainage basin that extends from 5° to 25°N and 8° to 28°E. Lake Chad is ideally located to document paleoclimatic and paleovegetational changes that occurred at a regional scale. Furthermore, during the past humid periods, numerous sedimentological and paleontological evidences testify the existence of giant water bodies. The last lacustrine episode occurred during the AHP, where the paleolake, called the Mega-Lake Chad, had a surface area of more than 350,000 km2 [4]. Here we present the first palynological results obtained from a core collected in Lake Chad that encompasses the mid-Holocene transition.

Pollen-based biome reconstructions were made using the biomization method, where the pollen data are assigned to plant functional types (PFT) and biomes. This method was also applied to modern pollen rain data [5] around Lake Chad in order to (i) establish a modern calibration, and (ii) to compare fossil pollen assemblages and the reconstructed potential biomes within the core with the modern pollen vegetation representation.

When compared with the local vegetation, the biomes from the modern dataset are correctly reconstructed for most of modern samples, except for those collected in desert area. Pollen types from southern and moister biomes are better represented in the sample with direct influence of fluvial flood supply (Chari river delta station). For all fossil samples the dominant potential biome reconstructed is savanna. However, both pollen assemblages and biome scores affinity indicate an important change evidencing a higher contribution of southern moister biomes before 6 kyr cal BP. These results could indicate a modification in the fluvial transport likely associated with a decrease in rainfall in the southern part of Lake Chad basin, reducing the transport of pollen types of distant biomes after 6 ka. From 6 kyr cal BP onwards, fossil samples present very similar characteristics (pollen types and percentages, and biome scores affinities) with the modern sample collected in the Chari river delta station suggesting that comparable conditions to modern ones probably established in the Chad basin at this time.

These first results show the highly promising potential of lacustrine records retrieved from Lake Chad and highlight the need to develop a higher resolution dataset spanning the entire Holocene. A more detailed and thorough study involving mutliproxy quantification and ecosystem modelling will allow us to better understand the mid-Holocene climatic transition and will provide an original contribution to the active debate about the AHP termination.

[1] DeMenocal et al. 2000, Quaternary Science Reviews 19, 347.
[2] Kropelin et al. 2008, Science 320, 765.
[3] Brovkin and Claussen 2008, Science 322, 1326.
[4] Leblanc et al.2006,Palaeogeography Palaeoclimatology Palaeoecology 239, 16.

[5] Maley 1972, Pollen et Spores XIV, 263.