

Continental palaeovegetation changes at hominid sites in East Africa during the Cenozoic

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The longest record of hominid fossils comes from East Africa, a region now characterized by a great diversity of plant ecosystems and habitats resulting from a complicated geological setting and a particular climatic regime linked to its latitudinal position on both sides of the equator. These habitats are distributed along large climatic gradients, both in rainfall and temperature offering a great diversity of possible refuges. Reconstructing evolution of environmental changes needs to take into account the time scale. But we must keep in mind the diversity of spatial distribution of large scale ecosystems in a more sophisticated approach than the simplistic forest/savanna distinction. Present knowledge of global climatic changes provide evidences for trends that are expected to be in the same direction at all the hominid sites (even if buffered or amplified by local effects). However, the amplitude of the changes in the local or regional environmental variables need to be quantified in order to assess limiting factors and consequences on available biomass, possible refuge and migrations that are relevant to evolutionary processes. This presentation illustrates some quantified environmental changes documented by palaeobotanical record in different ecosystems throughout the Cenozoic.

In Tanzania, Eocene 57 Myr fossil leaves attest of an existing dry Miombo woodland by 5° South latitude. The 600 mm/yr seasonal rainfall estimated on leaf morphology (Jacobs, 2004) precludes any continuity of the rainforest from the west to the Indian coast at that time.

In Ethiopia, the revisited fossil pollen record at Chilga, 12° N (Yemane et al.1987) in the northern Ethiopian highlands is now attributed to the Oligocene (27 Myr). It documents a swamp seasonal forest having floristic affinities with guineo congolian vegetation. Grass pollen are present but under low percentages hardly reaching 20% in a few stratigraphic layers, whereas the associated fauna includes large paenungulated herbivores.

New pollen data from the DSDP core 231, offshore the Arabian coast at 14° N, provides evidence for extensive grassland existing in the horn of Africa since 13 Myr. The pollen diagram shows high grass pollen percentages (50%) during the lower Miocene and again in the lower Pliocene around 5 Myr, while very high fluctuations are observed during the Plio/Pleistocene but not over 30%, a sign attesting predominance of shrub steppe vegetation over grassland implying increased aridity although the progressive trend illustrated by isotopic studies on land hominid sites is not clearly expressed in the marine record.

In the Ethiopian rift, high amplitude temperature (5 to 10° C) and rainfall variations (300 to 400 mm/yr) have been estimated

for the Hadar Pliocene pollen sequence at 11°N. The changes are in good timing correspondence with that registered in deep sea isotopic record, notably the MG2 isotopic event 3.3 Myr ago. Variable biomes, providing different habitats, are therefore documented within the half million years interval of *Australopithecus afarensis* fossil occurrences (Bonnefille et al., 2004).

For other Plio-Pleistocene data summarized earlier (Bonnefille,1995), no quantification are available yet. The strongest vegetation change was documented at Gadeb at 8° N. It concerns the mountain forest and the afroalpine vegetation of the large South Ethiopian highlands. At 2.5 Myr, a well documented descent in a vegetation belts corresponds to a 5 to 7° C cooling (Bonnefille, 1983) and was contemporaneous with grasslands expansion in the Turkana Basin.

At that time, the forested areas may have been strongly reduced, pinched between extension of arid steppes and afro-alpine shrub vegetation.

In conclusion, although the continental record remains discontinuous, direct and well dated information on past vegetation can still be gathered from many unexplored organic deposits preserved in Kimberlite sites or inter-trapps basins. More investigation for pollen of near shore cores from the Indian ocean would be also worthwhile. But a continuous lacustrine long sequence is the priority for providing continuity in environmental vegetation changes on the long term. A modern pollen data set is now available, and serves as a calibration to estimate amplitude of the climatic variations, a procedure applicable to long lacustrine pollen sequences anywhere in East Africa.

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