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CLANIMAE: Climatic and Anthropogenic Impacts on African Ecosystems

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Global studies of historical land use focusing on the large-scale landscape change that can potentially affect global climate (via effects on surface albedo, aerosols, and the carbon cycle) have concluded that the impact of pre-colonial East African cultures on regional ecosystems was limited, due to very low mean population density. This contrasts with the paradigm in East African archaeology and paleoecology that the onset of anthropogenic deforestation started at least 2500 years ago, following the introduction of iron metallurgy by Bantu immigrants. This conflict highlights the present lack of real data on historical climate-environment-human interactions in East Africa, which are eminently relevant to sustainable natural resource management and biodiversity conservation in a future of continued population growth and global climate change.

CLANIMAE responds to the urgent need of a correct long-term perspective to today's climate-environment-human interactions in East Africa, by reconstructing simultaneously the histories of past climate change and of vegetation and water-quality changes over the last 2500 years, through multi-disciplinary analysis of dated lake-sediment records. The climate reconstructions integrate information on biological, geochemical and sedimentological indicators of past changes in the water balance of the study lakes, which cover the climatological gradient from (sub-)humid western Uganda to semi-arid eastern Kenya. Reconstruction of past terrestrial vegetation dynamics is based on analyses of fossil plant pollen and phytoliths, plus the fossil spores of fungi associated with the excrements of large domestic animals as indicators of lake use by pastoralists. The evolution of water quality through time is reconstructed using silicon isotopes in diatom algae as proxy indicator for past phytoplankton productivity, and paleoecological analyses of fossil diatoms and aquatic macrophytes, following calibration of diatom and macrophyte species distribution against lake trophic status and turbidity in the modern-day regional lake gradient.

The integrated paleoecological research method of this project addresses the question of past climate-environment-human relationships at the time scale at which the relevant processes have actually occurred. This will allow us to 1) separate the influences of natural climate variability and human activity on East African ecosystems, 2) determine the exact timing and relative magnitude of indigenous (pre-20th century) anthropogenic land clearance compared to recent landscape alteration, 3) determine the severity of lake water-quality losses due to siltation and excess nutrient input directly linked to deforestation and agriculture, compared to those associated with natural ecosystem variability, and 4) assess the resilience of African ecosystems, and prospects for the restoration of disturbed ecosystems if human pressure were to be reversed.