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Phytolith analysis to compare changes in vegetation structure of Koobi Fora and Olorgesailie Basins through Mid-Pleistocene-Holocene Periods.

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Abstract

The Koobi Fora and Olorgesailie Basins are renowned hominin sites in the Rift Valley of northern and central Kenya, respectively, with fluvial, lacustrine and tuffaceous sediments spanning the Pleistocene and Holocene. Much research has been done on the fossil fauna, hominins and flora with the aim of trying to understand when and how the hominins evolved, and how the environment impacted on their behaviour, land-use and distribution over time. One of the most important factors in trying to understand the hominin-environment relationship is firstly to reconstruct the environment.

Important environmental factors are the climate, rate or degree of climate change, vegetation structure, floral and faunal resources. Vegetation structure/composition is a key component of the environments. It has been hypothesized that the openness and/or closeness of vegetation structure played a key role in shaping the evolutionary history not only of man but also other mammals. Various proxies have been studied to determine and reconstruct vegetation history. They include: fossil pollen, stable isotopes, fossilised wood and phytoliths.

This study applied phytolith analyses to reconstruct the vegetation history of the Koobi Fora and Olorgesailie Basins during the Pleistocene to Holocene periods respectively. Firstly, modern phytolith analogues from plants and surface soils were used to interpret the past vegetation from fossil phytolith assemblages. Four vegetation structures were clearly recognisable: grasslands, wetlands/riparian, woodlands/forests and mixture of woody and herbaceous dicotyledons.

Although the proposed goal of this study was to compare temporal changes in phytolith assemblage, hence vegetation structure for the two basins, this was not achieved due difference in the sampling strategies available for the two basins. A continuous sediment core was drilled from the Olorgesailie

Basin representing ~970kyr to ~77kyr, while in Koobi Fora sampling was done from well dated archaeological and geological exposures representing the early Pleistocene period (2.525-2.51Ma) and the Holocene period (9.6kyr to 0.93kyr), lacking mid-late Pleistocene deposits Determining the vegetation structure from both basins was possible. Two approaches were applied, a general approach for vegetation reconstruction (phytolith abundance) and phytolith indices (aridity and tree cover indices). Phytolith assemblages from paleosols deposited between 1.525Ma and 1.52Ma suggest a general vegetation cover dominated by woodlands which shifted to woody mixed grasslands that resemble present savanna habitats and a moister grassland habitat is also reflected. From ~970kyr to ~77kyr the vegetation structure comprised open grasslands, wooded grasslands, woodland/forest, and wetland/riparian/riverine habitats. These habitats fluctuated and the environments were unstable. The rate of fluctuations changed from high to low throughout the Olorgesailie sequence. From the Koobi Fora samples the Early Holocene (~9.6kyr to ~4.2kyr) was similar to the Early Pleistocene with woodlands remaining dominant, mixed grassland always present and a mosaic vegetation. A clear vegetation shift is noted during the late Holocene period (~1.34kyr to 0.93kyr), where woodlands declined while Chloridoideae grasses increased significantly indicating arid habitats similar to present-day savanna grasslands

For future research directions it will be a valuable opportunity to have a long sediment core drilled from either the current Lake Turkana basin or a paleolake basin from which phytolith data can be analysed and studied to give a continuous vegetation reconstruction history.