

BIOMARKERS RECORD CHANGES IN THE DEPOSITIONAL ENVIRONMENT OF PALEOLAKE OLDUVAI CONCURRENT WITH INCREASED HOMININ DIVERSITY

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Introduction

Olduvai Gorge, located within the East African Rift in Tanzania, is well known for numerous hominin fossils and extensive and ongoing research in hominin evolution (Hay, 1990). In 2014, the Olduvai Gorge Coring Project (OGCP) recovered a sequence of cores, covering most of the Pleistocene, providing a long-term stratigraphic record of paleolake Olduvai and the surrounding region. Such sediments allow for higher resolution examination of organic geochemical proxies than is possible from outcrops, without the increased risk of degradation due to exposure in outcrops. Core 2A contains an organic-rich (>1 % C_{org}) section correlated to Upper Bed I (UBI) deposits within the gorge. The UBI core sequence includes dated volcanic tuffs identified as Tuffs 1F (1.803 ± 0.002 Ma) and 1B (1.848 ± 0.003 Ma) (Deino, 2012; McHenry, 2012). This study focuses on ~ 50 kyr interval that includes these tuffs and encompasses a critical period in hominin evolution, which is associated with an increased diversity of hominin species (Magill *et al.*, 2016).

Outcrop exposures of UBI confirm that the extent, depth, and location of paleolake Olduvai varied through time (Hay, 1976; Maslin *et al.*, 2014). Changes in color and grain size and a decrease in average TOC from >2 % to <<1 % in UBI within Core 2A provide evidence of lake shallowing. Several controls could cause this change in depositional setting including variable volcanoclastic inputs, tectonic activity, climate-driven aridity, or a combination of these factors. This study focuses on biogeochemical analyses of samples representative of the sedimentary transition from dark anoxic claystone containing pyrite to light-colored sandy claystone. Understanding of temporal variations in paleolake Olduvai based on molecular and isotopic proxies will help document how changes in aquatic and terrestrial environments might promote adaptations of hominins who were dependent on resources connected with the lake.

Initial Results

Sedimentary biomarker compositions from Core 2A samples between Tuffs 1F and 1B (66.3 – 71.7 m depth) provide evidence of a change in depositional setting (**Figure 1**). The anoxic claystone at the base of this section contains: (i) a series of *n*-alkanes dominated by high odd-numbered homologues (C₂₇-C₃₅, maximizing at C₃₃; CPI values 7.1-9.7 for C₂₇-C₃₅) indicative of plant waxes, (ii) a suite of alkenones derived from haptophyte algae, with a distribution (C₃₇, C₃₉ alken-2-ones; C₃₈, C₄₀ alken-3-ones) typical of a saline lake (Sheng *et al.*, 2016) except that alkadienones are dominant and alkatetrenones absent, (iii) several microbial C₂₇-C₃₂ hopanes, including a 3-methyl-C₂₇ hopane homologue, and (iv) A-norsteranes attributed to sponges (van Grass *et al.*, 1982). The biomarkers within the sandy claystone from the upper portion of this section are also dominated by plant wax *n*-alkanes, typically maximizing at C₃₁ (CPI values

7.2-9.7 for C₂₇-C₃₅), complemented by abundant series of both *n*-alkan-2-ones and *n*-alkan-3-ones that are likely soil derived (Bai *et al.*, 2006). Thus, initial assessment of biomarker composition reveals a dominance of terrestrial vegetation (*n*-alkanes) augmented by algal, bacterial, and sponge inputs in the lower part of this stratigraphic interval within UBI and by soil derived alkan-2-ones and alkan-3-ones in its upper part.

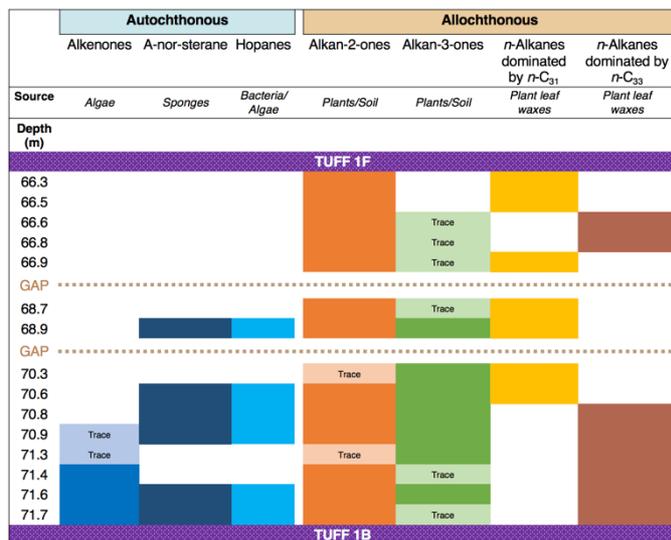


Figure 1 Summary of occurrences of source-diagnostic biomarkers in a stratigraphic interval of OGCP Core 2A showing distribution variations reflecting environmental changes in paleolake Olduvai.

Preliminary Conclusions

Investigation of the biomarker distributions in sediments recovered by the OGCP provides evidence of a shift in inferred sources of organic matter from a combination of aquatic and terrestrial sources to a dominance of the latter during a stratigraphic interval within UBI that corresponds to a transition in the depositional environment of paleolake Olduvai.

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