Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.32820

# Combined molecular and isotopic proxies to understand human-environment interactions in the Maya lowlands

**BENJAMIN GWINNETH**[1], KEVIN JOHNSTON[2], ANDY BRECKENRIDGE[3] AND PETER M J DOUGLAS[4]

[1]Université de Montréal
[2]Independent Scholar
[3]University of Wisconsin-Superior
[4]McGill University

Understanding past societal responses to climate change requires proxy indicators of human population, climate and land-use change. We apply a range of proxies to a lake sediment core from Laguna Itzan, a cenote adjacent to the ancient Maya population centre of Itzan, to examine the response of the lowland Maya to climatic and environmental change, which remains poorly understood. By combining molecular proxies for population (faecal stanols) and biomass burning (polycyclic aromatic hydrocarbons or PAHs) with isotopic analyses of plant wax n-alkanes as proxies for vegetation change ($\delta^{13}C$) and palaeohydrology ($\delta^{2}H$), we show the complex interplay of environmental and societal changes over 3300 years. Faecal stanols suggest at least three periods of significant population decline associated with precipitation change, including between 3300 and 2900 cal yr BP and 1860-1670 cal yr BP, as well as the widely documented Terminal Classic drought (1220-1050 cal yr BP). The use of PAHs provides a record of fire history from both hearths as well as from vegetation burning associated with hypothesised slash and burn land clearance, or swidden, agriculture. Fire history can be linked with records of vegetation change inferred by $\delta^{13}C$ of n-alkanes, which fluctuate between more negative values associated with forest ($C_3$) vegetation and more positive values associated with maize ($C_4$) agriculture. Our data show that population and land use appear to be variable, with a transition from generally more intense fire use and $C_4$ plant agriculture during the Preclassic (3500-2000 BP) to dense populations and reduced fire use during the Classic period. This is consistent with other evidence for a more urbanised and specialised society in the Classic (1600-1000 BP), and less changing land use over time. We do not find evidence extreme drought in the hydrogen isotope leaf wax record ($\delta^{2}H_{lw)}$ at this site, implying that climate change was not a primary driver of observed variability in land use or population. This suggests that climate change was not a major control on Maya societal development and undermines the hypothesised link between drought and Classic Maya “collapse” since collapse is inferred to have begun in the southwest lowlands.