

Plant-wax isotope records of drought and ancient societal adaptation in the Maya Lowlands

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Paleoclimate records indicate that severe droughts in the Maya Lowlands occurred during the Terminal Classic period (800 to 1000 CE), suggesting that widespread collapse of ancient Maya societies at this time was driven by climatic change. However, key unresolved questions prevent the direct attribution of societal collapse to drought impacts. Specifically, the best available evidence for drought comes from the drier northern Maya Lowlands, and it is unclear why societal disruption was more pronounced in the more humid southern Maya Lowlands. Further, there is little evidence to constrain how the ancient Maya responded to earlier droughts over the course of 3500 years of complex society.

To help address these questions we apply hydrogen (δD_{wax}) and carbon ($\delta^{13}C_{wax}$) isotopic records of plant waxes from two lake sediment cores from the northern and southern Maya Lowlands to assess patterns of aridity and C_4 plant abundance. δD_{wax} records confirm the occurrence of drought in both the northern and southern lowlands during the Terminal Classic and also indicate drought in the southern Lowlands during the Early Classic period (200 to 600 CE). δD_{wax} in modern lake sediments and soils from across the Maya Lowlands is correlated with spatial variability in annual precipitation, and comparison of δD_{wax} records from the two lake cores provides an indicator of relative hydroclimate change in the northern and southern Lowlands. This comparison points to relatively stronger drought in the southern Lowlands that likely contributed to the greater extent of societal disruption there. $\delta^{13}C_{wax}$ records indicate decreasing C_4 plants in both lake catchments during the Early Classic period, consistent with archaeological evidence for a shift from extensive upland agriculture to intensive wetland agriculture. Lower $\delta^{13}C_{wax}$ values coincide with evidence for drought in the southern Lowlands, suggesting that this change in land use occurred in response to climate change. These results imply that the ancient Maya adapted to earlier drought intervals, but that these adaptations largely failed during the more intense droughts of the Terminal Classic.