The Maya Terminal Classic Drought replicated in two stalagmites from Columnas Cave, NW Yucatán

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During the Terminal Classic Period (c.800-1000CE) most major Maya centres in the lowlands of the southern Yucatán Peninsula declined and were then abandoned, in what would come to be known as the Classic Maya Collapse. The causes of this societal transformation remain open for debate in modern archaeology. Over the past 25 years, palaeoclimatic records from lake sediments and speleothems have prompted discussion about the role abrupt climate change may have played in the decline. These records largely indicate the existence of a Terminal Classic Drought, a period of increased drought frequency that is approximately contemporaneous with the Collapse.

The high temporal resolution of speleothem archives makes them an important tool in assessing the validity of these records. Previous work has demonstrated the prevalence of drought in the lowlands of both northern and southern Yucatán during the Terminal Classic and Early Postclassic Periods. However, it has been difficult to build a detailed understanding of regional rainfall changes owing to the large spatial and temporal variability of precipitation over the Peninsula, as observed in the modern day.

Here we report a high-resolution (100μm), absolutely-dated, replicated record of δ¹⁸O and δ¹³C variations in two stalagmites from Columnas Cave (Rancho Hobonil) near the Puuc Hills, a dominant region of Maya settlement in north-western Yucatán during the Terminal Classic. The oxygen and carbon isotopic records of the speleothems (designated Hobo-5 and Hobo-6), located <10m apart in the farthest reaches of the cave, can be correlated with one another in great detail. The highest δ¹⁸O values in both speleothems occur during the Terminal Classic Period, coupled with the onset of an extended period of consistently high δ¹³C values. These are interpreted as representing a period of increased drought frequency; as documented from sediment cores in
nearby Lake Chichancanab, located ≈30km from Columnas Cave. These replicated records provide strong evidence for highly variable climatic conditions in the Terminal Classic, when the Puuc Maya underwent several boom-bust cycles. Ultrahigh-resolution (10µm) SIMS isotope and synchrotron µXRF analyses during this critical period have been undertaken to test if an annual record of climatic changes can be developed.

Radiocarbon data across the Terminal Classic also displays a single abrupt increase in 14C content around 1000CE, indicating a decrease in the dead carbon fraction. This event occurs close in time to the 994CE solar proton event documented in tree rings. If these events are indeed synchronous, it would constitute the first instance of the cosmogenic radiocarbon event being recorded in a speleothem, which would provide a valuable absolute correlation horizon.