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Stalagmite stable isotope record of recent tropical cyclone events



Amy Benoit Frappier; Dork Sahagian; Scott J. Carpenter; Luis A. Gonzalez; Brian R. Frappier
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Abstract

We present a 23 yr stalagmite record (1977–2000) of oxygen isotope variation, associated with 11 tropical cyclones (TCs), from Actun Tunichil Muknal cave in central Belize. High-resolution microsampling yielded a record of monthly to weekly temporal resolution that contains abrupt decreases (negative excursions) in calcite $\delta^{18}\text{O}$ values that correspond with recent TC rain events nearby. A logistic discriminant model reliably identified TC proxy signals using the measurable parameters $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values, and single point changes in $\delta^{18}\text{O}$ value. The logistic model correctly identified 80% of excursions as TC events and incorrectly classified only 1 of nearly 1200 nonstorm sampling points. In addition to enabling high-resolution TC frequency reconstruction, this geologic proxy also provides information about the intensity of individual TCs. A multiple regression predicted TC intensity ($R^2 = 0.465$, $p = 0.034$) using sampling frequency and excursion amplitude. Consistent with previous low-resolution studies, we found that the decadal average $\delta^{18}\text{O}$ value was lower during the 1990s when several TCs produced rainfall in the area, but higher during the 1980s when only one TC struck. Longer, accurately dated, high-resolution speleothem stable isotope records may be a useful new tool for paleotempestology, to clarify associations between highly variable TC activity and the dynamic range of Quaternary climate.

GeoRef Subject

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Actun Tunichil Muknal Cave

Latitude & Longitude

N17°00'00" - N18°00'00", W89°00'00" - W88°00'00"

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