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Advancements in TEX_{86} Speleothem paleothermometry

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Speleothems offer a robust archive for reconstructing past temperature due to the relative stability of cave environments and their suitability for precise radiometric dating. The speleothem TEX_{86} paleothermometer is a relatively recent approach that yields low analytical temperature uncertainty (±0.30 °C) and is only limited by the concentration of lipid molecules fossilized in the speleothem. To date, however, this approach has largely been limited to low-resolution sampling and applied primarily to conventional speleothems (i.e. stalagmites, stalactites, flowstones). Here we test the fidelity of TEX_{86} analysis across various sampling approaches/resolutions and consider how stratigraphy and location (distance from growth axis) affect TEX_{86}-derived temperature. Additionally, TEX_{86} analysis is applied to a range of speleothems, including some affected to varying degrees of diagenetic alteration. These data allow us to assess the potential for developing reliable paleotemperature records with this thermometer.

We find that milled powders can be used for TEX_{86} analysis when speleothems have high GDGT concentrations. Comparable temperatures are obtained from both milled powders and coeval whole pieces. Results indicate that sampling for TEX_{86} can be extremely malleable, adaptable to suit the climatic event of interest. This is demonstrated by capturing the temperature variability at both orbital-scale variability to millennial-scale events. We also find that TEX_{86} is possible on other speleothems, suggesting that scientists are not limited to the conventional stalagmites and flowstones for reconstructing temperature.