ABSTRACT FINAL ID: PP31C-1877

TITLE: Oxygen isotope relationships between rainfall, dripwater and speleothem calcite from Westcave, central Texas, USA: Possible implications for paleoclimate study

SESSION TYPE: Poster

SESSION TITLE: PP31C. Climate Reconstruction From Speleothems: Spatial and Temporal Interrelationships of Global Climate Events and Their Local Characteristics III Posters

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ABSTRACT BODY: Paleoclimate conditions such as temperature and rainfall amount can be inferred from oxygen isotope ($\delta^{18}O$) records of speleothems. Understanding the environmental controls on oxygen isotope variations in speleothem calcite will improve such inferences. Westcave preserve, located in central Texas, contains a small, shallow, and well-ventilated cave where year-round speleothem growth is primarily influenced by temperature, which ranges up to 20 °C seasonally. This provides an opportunity to examine the relationships between temperature and rainfall, dripwater and speleothem calcite $\delta^{18}O$ as a means to assess speleothem $\delta^{18}O$ as a paleoclimate proxy.

Over the study period from April 2009 to June 2011, rainfall $\delta^{18}O$ values ranged from -10.5 to 1.0 ‰ (VSMOW), whereas dripwater $\delta^{18}O$ values ranged from -4.8 to -3.9 ‰ (VSMOW). The small range of 1.1 ‰ in dripwater $\delta^{18}O$, compared to a rainfall $\delta^{18}O$ range of 11.5 ‰, indicates a well-homogenized water reservoir feeding the Westcave speleothems. Calcite grown on a sequence of artificial substrates placed under three active drip sites in the cave has $\delta^{18}O$ values ranging from 6.6 to -3.1 ‰ (PDB). When compared to expected $\delta^{18}O$ of calcite in equilibrium with its associated dripwater (calculated using measured cave temperatures and published calcite-water oxygen isotope fractionation factors), measured calcite $\delta^{18}O$ are either in isotope equilibrium, or deviate from it up to 2.0 ‰, indicating possible influence of kinetic fractionation. Nevertheless, the 3.5 ‰ seasonal variation in $\delta^{18}O$ values of substrate calcite displays a strong negative correlation with temperature, including water temperature, cave air temperature and outside air temperature from a nearby weather station. These correlations, along with relatively narrow seasonal range in dripwater $\delta^{18}O$ values, indicate that temperature is the most important factor controlling speleothem calcite $\delta^{18}O$ in this setting, allowing for the potential preservation of seasonal temperature variations in speleothem calcite from this cave.

KEYWORDS: [1041] GEOCHEMISTRY / Stable isotope geochemistry, [4958] PALEOCEANOGRAPHY / Speleothems.

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