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One-Page Executive Summary

Background. A fundamental method in paleoclimatology is the use of modern relationships between climate parameters (i.e. temperature) and the stable isotopes of precipitation ($\delta^{18}O$ and δD) to interpret isotopic records of geologic materials and their relationship to paleoclimate. Certain aspects of a landscape, such as topography, proximity to oceans (i.e. coastlines vs. inland), and seasonally large temperature swings can all affect the isotopic evolution of oxygen in precipitation. Specifically, in the central United States, studies have reported a strong seasonal variation in the $\delta^{18}O$ values of precipitation (Welker, 2000; Dutton et al., 2005; Sjostrom and Welker, 2009). This is primarily due to two reasons: 1) there is extreme seasonality in mid-continental regions compared to coastal regions that have relatively stable annual temperatures, and 2) there are several primary air sources, each with distinct oxygen isotopic values, that deliver precipitation to the mid-continental United States, through time. Due to these processes, interpreting $\delta^{18}O$ records from the mid-continent of North America is difficult, and there remains a lack of understanding of climate evolution in this region.

Motivation & Goal. The Penultimate Interglacial ("PIG") period is a climactically warm interval, similar to today, in Earth's history that spans approximately 250,000 – 190,000 years (250 – 190 ka) ago. Current knowledge about climate variability during the PIG is primarily based on deep-sea sediments and an Antarctica ice core. There are minimal terrestrial proxies that have been used to study climate dynamics during the PIG. Cave calcite deposits, or speleothems, show promise for providing regional constraints on climate at these times since their growth can be dated back through the PIG. Speleothems from the mid-continent of North America have been collected to analyze oxygen isotope ($\delta^{18}O$) values during the PIG to characterize climactic changes during the PIG, and further our understanding of climate dynamics during this period of time in Earth's history.

Required data. Preliminary data for this project includes an age chronology of the two speleothem samples that reveal they grew during PIG (CM1 grew 208 – 200 ka, CM14 grew 229 – 199 ka. In addition, a set of mm-scale calcite samples were drilled for oxygen isotope data, and an age model (OxCal) using Bayesian statistics will be used to correlate the timing of oxygen isotope values during the time of growth. In addition, a collection of published oxygen isotopic records of speleothems from other regions of the world (Israel, Austria, and Portugal) will be compiled to conduct statistical analyses.

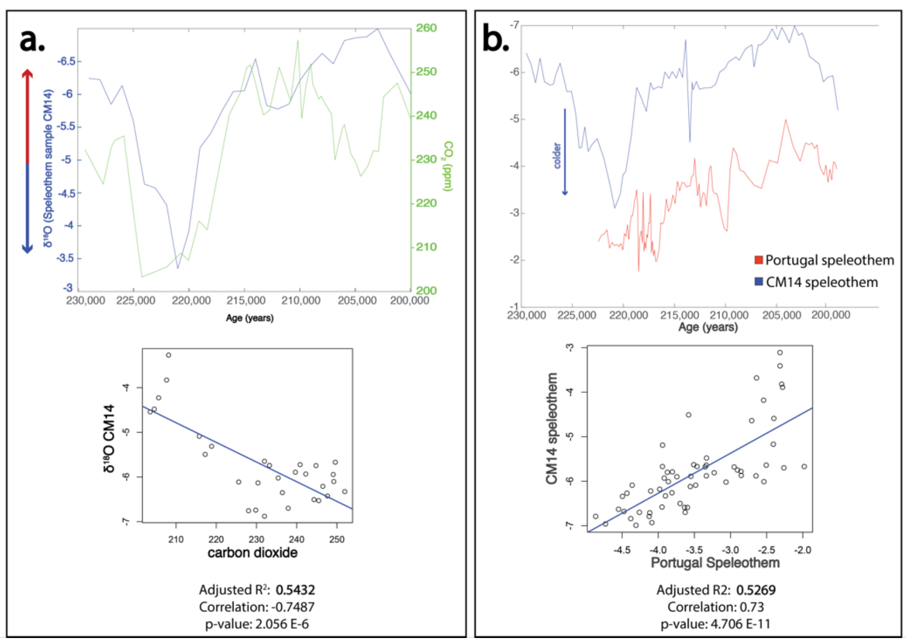

Figure 1 – examples of linear regressions used for this project. a. $\delta^{18}O$ of speleothem sample CM14 linearly regressed with carbon dioxide concentrations (ppm) during the PIG. **b.** $\delta^{18}O$ of sample CM14 linearly regressed with $\delta^{18}O$ data from a speleothem from western Portugal.

Methods. A series of linear regressions will be used to understand the isotopic evolution of samples CM1 and CM14 during the PIG **(Fig. 1)**. The $\delta^{18}O$ in these two speleothems will be linearly regressed with global climate data (greenhouse gas concentrations and ice volume), as well as regional $\delta^{18}O$ speleothem records from Israel, Portugal and Austria. By linearly regressing these sets of data, we will ultimately better understand what climatic mechanisms are affecting $\delta^{18}O$ isotopes in North American speleothems through time (i.e. greenhouse gas warming, North Atlantic Ocean circulation patterns, etc.)