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Trace element and stable isotope variations in three coeval West Virginia speleothems spanning the LGM and Younger Dryas

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Three coeval stalagmites from Culverson Creek Cave, West Virginia, grew largely uninterrupted for approximately 15,000 years across the Last Glacial Maximum to early Holocene. Stable isotope carbon and oxygen and high resolution trace element (Sr/Ca) chronologies are supported by 63 Th-230 age dates. The timing of Heinrich events 1 and 2, LGM, B/A and YD are well-constrained by abrupt shifts in the high-frequency oscillations observed in both stable isotope and trace element analyses, providing a detailed paleohydrological chronology for the mid-Appalachian region during this time.

The oxygen isotope curves obtained for these speleothem are largely supported by GRIP and GISP2, as will be demonstrated by time-series comparison. The stable isotope chronology is, however, markedly different from many speleothem chronologies from other regions. We present a comparison of this mid-Appalachian record with those of other regions, as well as an interpretation of the various climatic mechanisms controlling speleothem deposition.

In addition to this chronology, we also present a new technique for trace element analysis (Sr/Ca) through microbeam X Ray Fluorescence. Trace element ratios in speleothems (Sr/Ca, Mg/Ca, Ba/Ca) have been used to interpret the hydrogeochemical processes in the epikarst zone as well as the partitioning that occurs at the calcite-water interface. During periods of low rainfall, trace element ratios generally increase as a result of the longer residence time of water in the soil and epikarst zones. High-resolution time series analyses of these elements in speleothems provide evidence for changing paleohydrological and geochemical conditions over time. This non-destructive and non-contact method could serve as a viable alternative to conventional methods and prove important in future paleoclimate research.