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Spatial variability in initial 230Th/ 232Th ratios in central Texas

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Stalagmites record many climatic events by incorporating climate sensitive isotopes, information on water availability, or processes affecting the cave such as temperature variation or carbon dioxide variation. This information can be useful in understanding past climates and predictions for the future. The goal of this project is to reduce the amount of error in age determinations of stalagmites from central Texas caves. The central Texas area faces the potential of significant climate change, making local paleoclimate records important for modeling our future conditions. The stalagmite samples from Westcave Preserve, Natural Bridge Caverns, and Inner Space Caverns are very young and previous attempts at age determination have been hampered by a large uncertainty on the ages determined. Having accurate dates on the young speleothem samples will provide a time series of anthropogenic impacts on central Texas. The method used to date these samples is the ^{238}U-^{234}U- ^{230}Th disequilibrium method, which uses the ratio of the radioactive isotope ^{234}U and its daughter product ^{230}Th to calculate the time that has passed since the deposition of the calcite in the speleothem. This method is used because it can be assumed that the only source of ^{230}Th in the sample is from the decay of uranium. There is potential for large uncertainty with this method because there is a certain amount of detrital ^{230}Th that can be incorporated into the growing calcite from the environment. If this amount of initial detrital ^{230}Th is quantified then it is possible to decrease the amount of uncertainty from this method. ^{232}Th is used in this method because it is not related to the decay series from 238U and its half-life is long enough to account for changes in the ^{230}Th being added to the system.

We can determine a value for the initial ^{230}Th/^{232}Th ratio at the drip sites forming speleothems in central Texas caves, which provides a more accurate age. This study determines the initial amount of ^{230}Th/^{232}Th present in modern calcite in order to provide a more accurate method for dating attempts in central Texas speleothems. Results from this study show that initial ^{230}Th/^{232}Th ratios can be determined from calcite grown on glass substrates and that the ratios found reduce age uncertainty from older samples in Westcave. Samples from Westcave glass substrates show initial ^{230}Th/^{232}Th values of 5.96 ± 0.6 ppm, 5.8 ± 0.56 ppm, 15.29 ± 0.67 ppm, and 14.6 ± 0.83 ppm. Natural Bridge Caverns and Inner Space Caverns show similar trends in initial ^{230}Th/^{232}Th values, values that differ from the assumption commonly used in the ^{238}U-^{234}U- ^{230}Th disequilibrium method.

Keywords: ^{230}Th, ^{238}U, speleothem, central Texas, isotopes, climate, climate change.