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Preliminary studies of Pliocene speleothems from the Nullarbor Plain, southwest Australia

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The Pliocene (∼2.58-5.33 Ma) is an important time interval for study of the Earth's climate system due to its potential as an analogue for future climates. However, there is a significant lack of terrestrial archives of palaeoclimate information for this period, and even fewer reliable estimates of palaeotemperature. There is also a distinct lack of data from Southern Hemisphere locations. This project is part of a larger study that aims to address these gaps by providing palaeohydrological and palaeotemperature reconstructions for the Pliocene using speleothems obtained from caves beneath the Nullarbor Plain, southern Australia. While to date, studies have largely focused on broad scale features for the entire Pliocene, this project will provide high-resolution records for specific time intervals (i.e. individual stalagmite growth periods) within this time frame. This research will provide a unique dataset of Pliocene climate that will have practical applications in informing the next generation of climate models future climate change.

U-Pb dating of numerous Nullarbor speleothems shows that their growth spans from the late Miocene, through the Pliocene, and into the Pleistocene (Woodhead et al. in prep). A preliminary high-resolution study of two stalagmites (BT and M2) from Matilda Cave, both dated using the U-Pb method, will be presented. Stable isotope and fluid inclusion analyses were undertaken on both stalagmites. Modern rainfall samples from the region will be used to isotopically fingerprint dominant sources of modern precipitation, providing a basis on which to interpret conditions at the time of speleothem deposition.

The presence of fluid inclusions suitable for analysis appears to be variable both spatially within the cave, and temporally. Thus sample BT provided water contents consistently too low for accurate fluid inclusion analyses, while sample M2 provided utilisable water contents during some growth periods but not in others. While the preliminary results indicate some significant climatic changes during the growth period, further analyses are required for more detailed interpretations of palaeoprecipitation.

The high-resolution stable isotope analyses of both samples reveal variations in both δ18O and δ13C throughout the growth periods of the stalagmites. The analysis of these results indicates that, while the climatic conditions were largely stable, there are fluctuating levels of climatic variability on millennial timescales.