



New speleothem growth in New St Michaels Cave, Gibraltar: comparison of high resolution oxygen isotope data with local rainfall oxygen isotopes and the instrumental record

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New St. Michael's Cave was discovered in 1942 when an access tunnel driven into the lowest part of the well known St Michaels Show Cave exposed a new rift system that lead to a series of highly decorated chambers containing a lake. Approximately 150m from the entrance rift is a wet area with active flowstone and straw formation with small stalagmites partially overgrowing broken debris. A specimen of an actively growing stalagmite approximately 10 cm tall containing growth from 1942 - present was collected for dating, high resolution oxygen isotope profiling by laser ablation and trace element analysis. A 50 year record of weather and monthly rainfall $\delta^{18}\text{O}$ data exists for a station 1 km from the cave entrance and this project site provides an opportunity for calibration with the instrumental climate record at potentially sub-annual resolution.

The specimen consists of 45 mm of pale amber laminated calcite draped over strewn roof straws damaged during the early exploration of the system. U-Th dating of the base of the new growth gives an age of 90 ± 20 years and this is consistent with the number of growth bands counted from the top of the specimen. The lower portion of the specimen has a complex growth history with U-Th dates obtained so far giving Pleistocene ages around 180ka.

Trace element compositions of post 1942 calcite are not unusual and fall within the range of variation observed in Pleistocene calcite from the same site. There is no evidence yet for the catchment hydrology of the sampling site having being adversely

affected by building or change of land use. Oxygen isotope compositions of young calcite vary from -3 to -5 permil and Hendy tests reveal less than 1 permil variation for $\delta^{13}\text{C}$ and less than 0.3 permil variation for $\delta^{18}\text{O}$ within 2 cm of the axis of the new calcite growth. Axial $\delta^{18}\text{O}$ data have been obtained for young laminated calcite by laser ablation at 500 micron resolution. These data enable precise calibration of speleothem calcite oxygen isotope record to the local rainfall record at up to annual resolution.

The annual variation of Gibraltar monthly rainfall $\delta^{18}\text{O}$ data from 1960-2000 shows decadal variations of around 1 permil but seasonal variations of up to 4 permil are seen from the wet winter season to the dry summer season. Therefore a monthly sampling program was established in June 2004 to monitor seasonal variations in the cave environment and hydrology in collaboration with members of the Caves section of the Gibraltar Ornithological and Natural History Society (GOHNS). External air, soil, gas and a transect of air samples into the cave have been collected for CO_2 and CH_4 $\delta^{13}\text{C}$ analysis; drip and lake water samples are collected for DIC $\delta^{13}\text{C}$, $\delta^{18}\text{O}$, anion and trace element analysis. Results of this ongoing study will be presented.