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Radiocarbon bomb pulse chronologies for young speleothems in southeast Australia

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In southeast Australia a current paucity of high-resolution, well documented palaeoclimate records is confounding efforts to quantify past periodicity, intensity and duration of drought periods. Speleothems comprise an ideal archive for recording high-resolution late Holocene climate trends, particularly where an overlap with instrumental records can be used to calibrate proxy data. A limitation to using young speleothems for such studies is obtaining a good chronology as uranium-series dating can seldom be used for samples younger than a few hundred years.

The solution, utilised here, is to employ accelerator mass spectrometry (AMS) ^{14}C techniques on small ($<$10mg) subsamples to locate the position where speleothem radiocarbon begins to rise above modern ambient levels indicating infiltration of atmospheric CO_2 tagged by bomb pulse radiocarbon. This can be used as a secure chronostratigraphic marker. The radiocarbon profile of a stalactite shawl from Jenolan Caves (33˚49'14"S, 150˚1'17.2"E), near Sydney, shows a clear pre-bomb ^{14}C signature, a rapid increase after the early 1950s, and a peak value followed by a slowly decreasing tail, allowing an appraisal of the carbon cycle in this cave system. Laser ablation inductively coupled plasma mass-spectrometric (LA-ICPMS) trace element analysis was carried out on the same sample, with overlapping and parallel laser tracks showing good reproducibility indicating homogeneity across the growth surface. Long-term Mg/Ca trends are consistent with the instrumental rainfall record and shorter term variations of Sr/Ca, Ba/Ca, P/Ca and Mg/Ca may reflect sub-decadal events and even

annual cyclicity. This gives us confidence to extend the study to pre-instrumental times in the same region.