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One thousand year palaeohydrological record derived from SE Australian stalagmites

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Essential to successful water management in SE Australia is a thorough understanding of current and past rainfall patterns. Historically rainfall records only span the last 150 years and terrestrial archives such as speleothems, flood plain and lake cores and pollen cores are being utilised to generate pre-instrumental flood and drought histories. In this paper we present a $\sim$ 1,000 year palaeohydrological record based on two speleothems from the same chamber in Wollondilly Cave, Wombeyan Karst Conservation Reserve, SE Australia. Prior to this study the geochemical record of two active stalagmites from the same cave system was evaluated with respect to the instrumental record. Chronology was obtained using accelerator mass spectrometry (AMS) ^{14}C measurements together with trace element cycle counting. The most reliable palaeohydrological proxies found were magnesium (Mg), phosphorus (P) and yttrium (Y) which were able to be confidently related to dry/wet periods (Mg) and high infiltration events (P and Y). Oxygen isotopes trended positively with documented Interdecadal Pacific Oscillation (IPO) phase changes where negative δ^{18}O anomalies aligned with negative phases of IPO and conversely positive δ^{18}O anomalies aligned with positive phases of IPO. During negative phase of the IPO there is a higher probability of La Niña events bringing above average rainfall to the region. Modern stalagmites recorded the negative IPO (1945-1977) by low Mg, phases of elevated P and Y, and negative δ^{18}O anomalies.

Chronology was obtained on the two $\sim$ 1,000 year stalagmites by locating the bomb pulse using AMS^{14}C at the top and paired U-series/14C measurements made on the basal sections. Basal ages were $\sim$4 – 5ka, though only the top $\sim$ 7 cm has been analysed thus far. Growth rate for each stalagmite is estimated at $\sim$ 0.05 mm year^{-1}. Ages are still being further refined. Preliminary δ^{18}O values show clear changes in trends back to $\sim$ 700 AD. Between AD 750- 850 and AD 1050 – 1300 there were persistent strong negative δ^{18}O values and these are tentatively linked to negative phases of the IPO. Between AD 850-1050 and AD 1300-1700, δ^{18}O cycles appear shorter in duration and with increased variability than experienced the last 200 years. Carbon isotope anomalies become increasingly negative from $\sim$ AD 1800 to present whilst between $\sim$ AD1350 - 1750 the values were consistently positive. Trace element data are not yet finalised, but preliminary results indicate higher Mg variability during the period $\sim$AD 1850 to $\sim$ AD 1100 than has occurred during the last 150 years.