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Deciphering ENSO periodicity in an annually resolved speleothem from Fiji

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A laminated speleothem from Voli Voli cave Fiji, dated by U-Th methods, spans a 1500 year interval across the transition between the Medieval Climate Anomaly and the 'Little Ice Age'. The speleothem shows a visual change in lamination fabrics with age; the older part is characterised by calcite containing thin layers of clay interspersed with white calcite in the older part, followed by a marked transition to continuous deposition of white and clear laminated calcite towards the top. The older record is also characterised by elevated δ^{13}C values which in the presence of detrital layers are highly coupled with δ^{18}O, with a transition marked by a rapid decrease in δ^{13}C dated at 1200-1300 AD. No major shifts are observed in δ^{18}O values measured at 2 mm resolution and these data show a simple trend that monotonically decreases by $\approx$0.5‰Ḣowever high-resolution micromilling reveals smooth oscillations in δ^{18}O which span multiple laminae and a major question is whether these cycles are annual or related to longer term changes controlled by ENSO. Cave monitoring of relationships between local processes and seasonal weather patterns has been carried out since 2009. Voli Voli cave is a descending passage that terminates in a fissured cliff facing the SE trade winds and cave monitoring shows that high cave air CO_2levels decline near the cave termination as a result of weak ventilation by atmosphere driven by wind strength. Trade winds develop during the dry winter season and high resolution δ^{13}C profiles across laminae shows regularly spaced peaks which are correlated with cycles in P and Sr. These are interpreted as annual markers driven by rainfall and pCO_2 which rises during the wet summer season when ventilation is weakest. These observations define the δ^{18}O cycles as being multi-annual possessing a similar wavelength of 3-6 years similar to ENSO. The Voli Voli record also provides clear evidence of an underlying climatic change around AD1300 from aridity to wetter conditions and further work will provide more detailed information on ENSO behavior across this transition.