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Post-glacial evolution of tropical monsoon precipitation from east Indonesian speleothems

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The monsoon climate of Indonesia is the critical factor controlling food production, so it is of great significance and urgency that we gain a firmer grasp on the parameters that control monsoon variability. This study aims to establish a high-resolution record of Australasian monsoon dynamics during the Holocene and explore the teleconnections to higher latitudes using multiple speleothems from eastern Indonesia.

Precise uranium series dating of two actively growing speleothems measuring $\sim$1.25 (LR06-B1) and $\sim$1.61 (LR06-B3) metres in length from Liang Luar cave (Flores, eastern Indonesia), reveal basal ages of $\sim$12,846 $\pm$ 103 and 23, 605 $\pm$ 171 years respectively. Twenty-one U/Th dates from LR06-B3 reveal a relatively consistent growth rate, with the exception of a hiatus between $\sim$8.6ka and $\sim$6.5ka. Isotope results of daily rain samples reveal that the "amount-effect" is the dominant control on wet and dry season rain, and that there is a strong moisture source effect, with wet season rainfall originating from the northwest much more isotopically depleted than dry season rain originating from the south-east trade winds.

The δ^{18}O record from LR06-B3 shows a general increase in monsoon intensity from the beginning of the record to $\sim$2000 years BP: this more or less follows insolation changes over the Australian continent. This result suggests that during times of enhanced insolation over Australia, the thermal contrast between land and ocean is elevated, resulting in a stronger Australasian monsoon. Comparison of our record with that of Dongge Cave reveals an anticorrelation during the Holocene, further supporting the hypothesis that tropical monsoon intensity is largely controlled by changes in insolation in both the Northern and Southern Hemisphere. The $\delta^{13}C$ record from LR06-B3 shows a good correlation between Mg/Ca and Sr/Ca ratios, suggesting that prior calcite precipitation is the dominating factor controlling trace element composition.

One of the pressing questions from this study is what are the mechanisms controlling changes in $\delta^{18}O$ at millennial time scales? On the centennial to decadal timescale Mg/Ca and $\delta^{13}C$ values have a similar structure to $\delta^{18}O$ values (seemingly controlled by the rainfall amount), however they do not share similar long-term trends. Therefore, at the millennial time-scale, changes in $\delta^{18}O$ may represent changes in moisture sources or simply changes in the isotopic composition of the sea water from which the moisture originates.