Temporal variations in rainwater and dripwater geochemistry in Malaysian caves

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Gunung Mulu & Gunung Buda (4N, 115E)

- fieldtrips in October, 2003
  March, 2005

- rainwater, dripwater collection program
**Why Northern Borneo?**

- ENSO sensitivity
- huge decorated cave systems
- reconstruct Warm Pool precip using $\delta^{18}$O of stalagmites
daily station rainfall available since June 1998; met station coming soon

stations 50km apart show marked differences
Isotopic timeseries

Rainwater $\delta^{18}O$

Dripwater $\delta^{18}O$

Station rainfall (1 month ave)
‘Clean’ version of timeseries

Rainwater
5-6 per mil intra-annual variability in rainfall δ\(^{18}\)O; seasonal cycle?

Dripwater
2-3 per mil variability in dripwater δ\(^{18}\)O

dominating by intraseasonal (MJO) variability

Rainfall

Timeseries of rainwater and cave dripwater δ\(^{18}\)O

water in equilibrium with -9‰ calcite at 29°C

Calcium carbonate in equilibrium with -9‰ calcite at 29ºC

5-6 per mil intra-annual variability in rainfall δ\(^{18}\)O; seasonal cycle?
Drip-rate vs. $\delta^{18}O_{\text(drip)}$

‘fast’ drip = ~20 drips per minute located 250m into cave

‘slow’ drip = ~6 drips per minute located 100m into cave

weak positive drip-rate trend over sampling period
Mg/Ca and Sr/Ca timeseries

\[ R(\text{Mg/Ca}, \text{Sr/Ca})_{\text{fast}} = 0.41 \]
\[ R(\text{Mg/Ca}, \text{Sr/Ca})_{\text{slow}} = 0.70 \]

‘fast’ and ‘slow’ drips show similar pattern of change
relationship to rainfall and/or drip rate uncertain
**Mg/Ca and $\delta^{13}C$ timeseries**

weak inverse relationship b/t $d^{13}C$ and Mg/Ca
⇒ prior precipitation

huge variations in both $d^{13}C$ and Mg/Ca;
no clear relationship to rainfall, seasons
High-resolution dripwater sampling over 24 hours

only parameter that doesn’t show diurnal variations is Mg/Ca

What it’s not: temperature rainfall humidity

What it could be: cave ventilation (ideas?)
Conclusions & Questions

Tentative evidence for amount effect in d18O of rainfall
- signature in d18O of drips less clear
- modern calcite in equilibrium with measured dripwater d18O

Strong correlations between Mg/Ca and Sr/Ca, but weaker between Mg/Ca and d13C

Diurnal variability of dripwater geochemistry

Still waiting for huge El Niño or La Niña event….

see Jud Partin’s talk on Sunday