

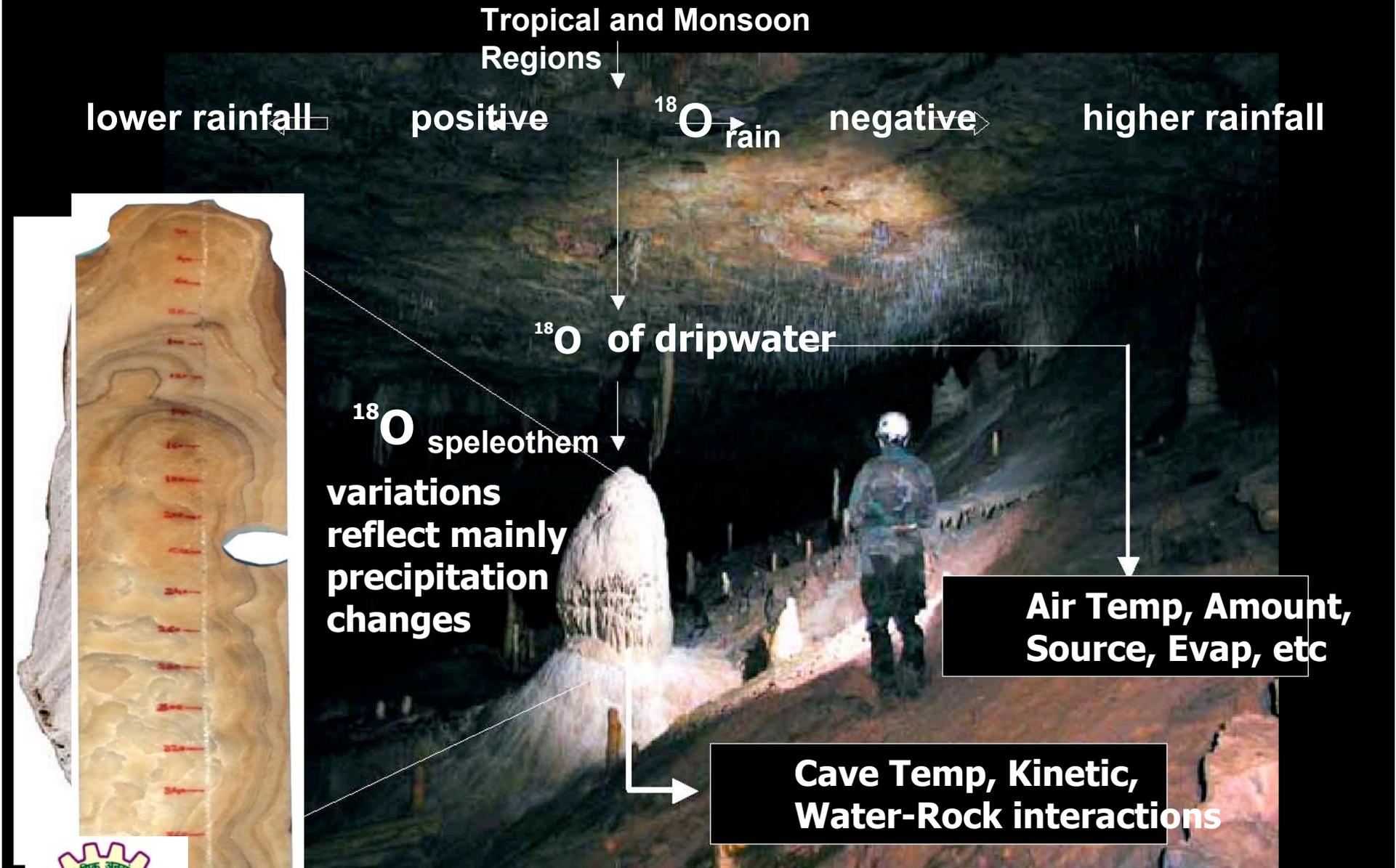
# Paleomonsoon variations in Himalaya during ~ 2300 to ~ 800 yrs BP: Inference from oxygen and carbon isotopes of speleothem

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# Speleothems as Climate Proxy

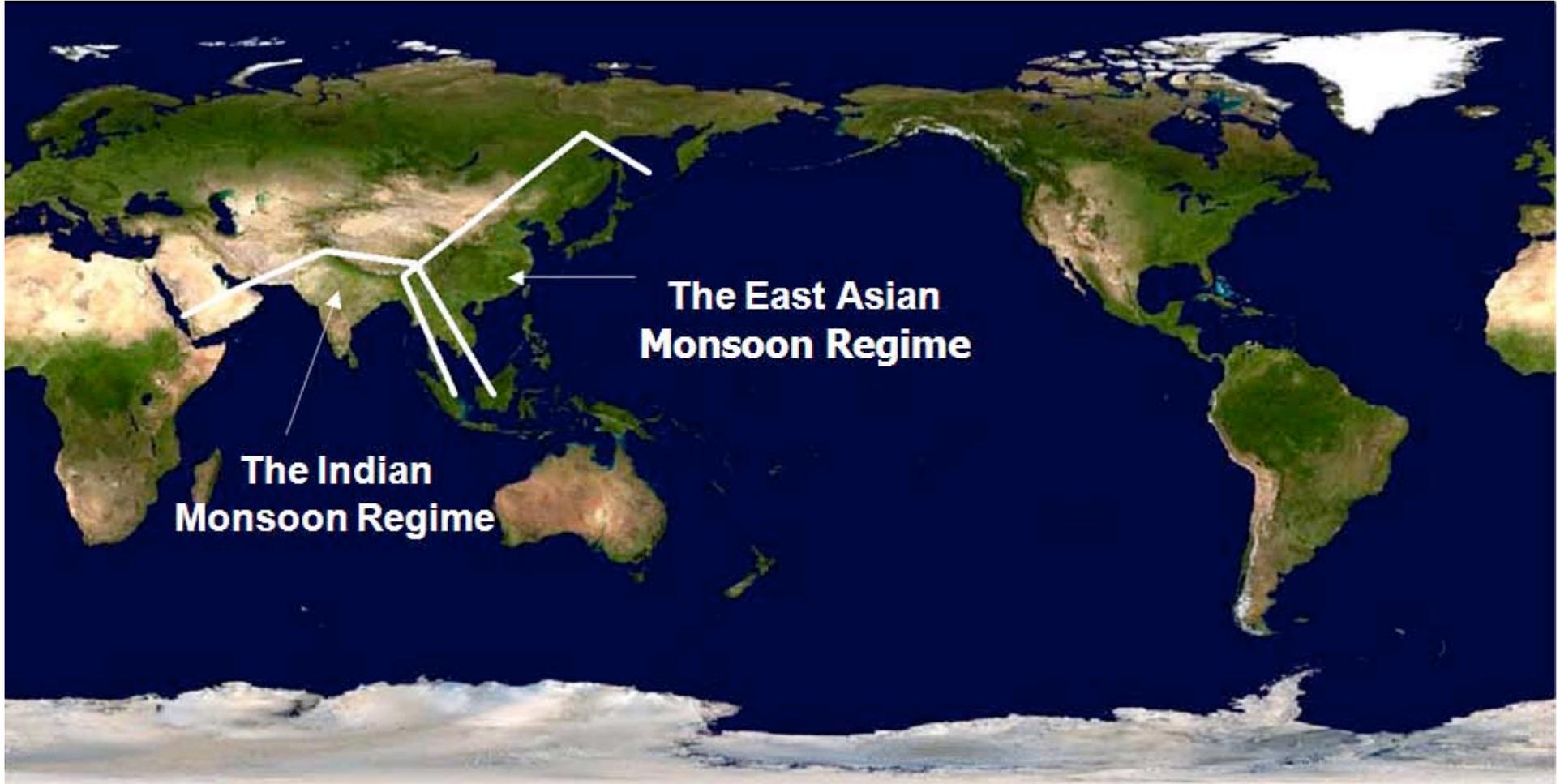


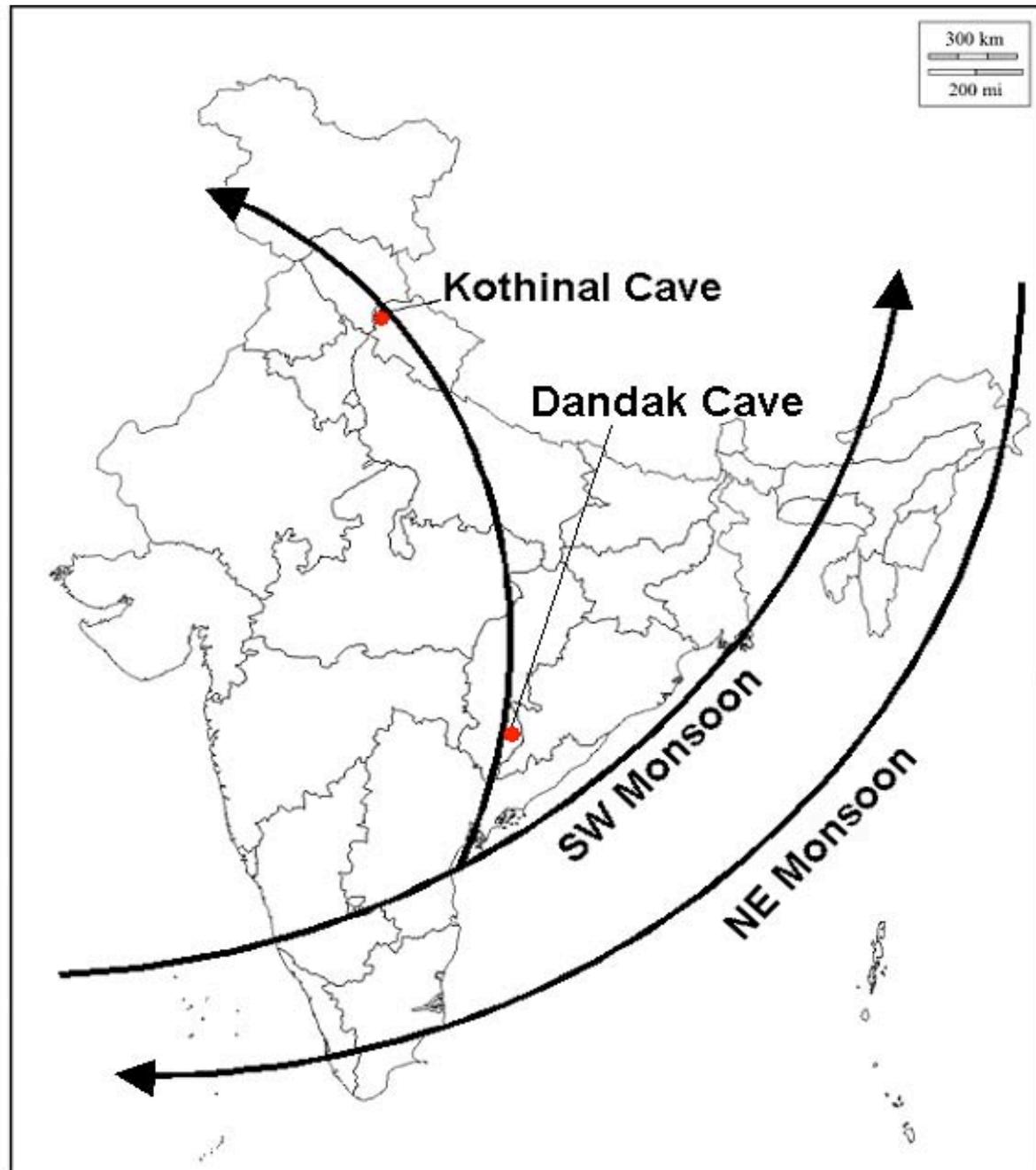
- \* **Recent studies have shown that speleothems can be excellent archives of rainfall compared to marine proxies.**
- \* **The instrumental records (~ 150 yrs) of ISM reveals strong interannual to multi-decadal climate variability.**
- \* **Longer records of ISM variability are important in order to evaluate the longer intervals of monsoon failure of the past and assess future risk. However there is a scarcity of data for the last 2 kyr.**
- \* **Oxygen isotopic compositions ( $\delta^{18}\text{O}$ ) of speleothem from tropical regions is primarily controlled by the  $\delta^{18}\text{O}$  of the precipitation and/or fraction of the water vapour removed from maritime air masses as they move away from their source region.**



- \* **In tropical caves,  $\delta^{18}\text{O}$  of calcite layers on a growing speleothem is depleted with increasing precipitation.**
- \*  **$\delta^{13}\text{C}$  in speleothems depend upon type of vegetation (C3 or C4), dripping rate of water, rate of bedrock dissolution and seasonal variations in the soil  $\text{pCO}_2$  in a complex fashion.**
- \* **Several continental and marine climate records indicate pronounced shifts in ISM intensity throughout the Holocene.**
- \* **Paleomonsoonal reconstruction studies from the North Indian Ocean sediments suggest a considerable decrease in the monsoon intensity over the last 2 kyr followed by an increase in last ~400 years.**







**Kothinal cave** : **N 30° 48'**  
**E 78° 01'**

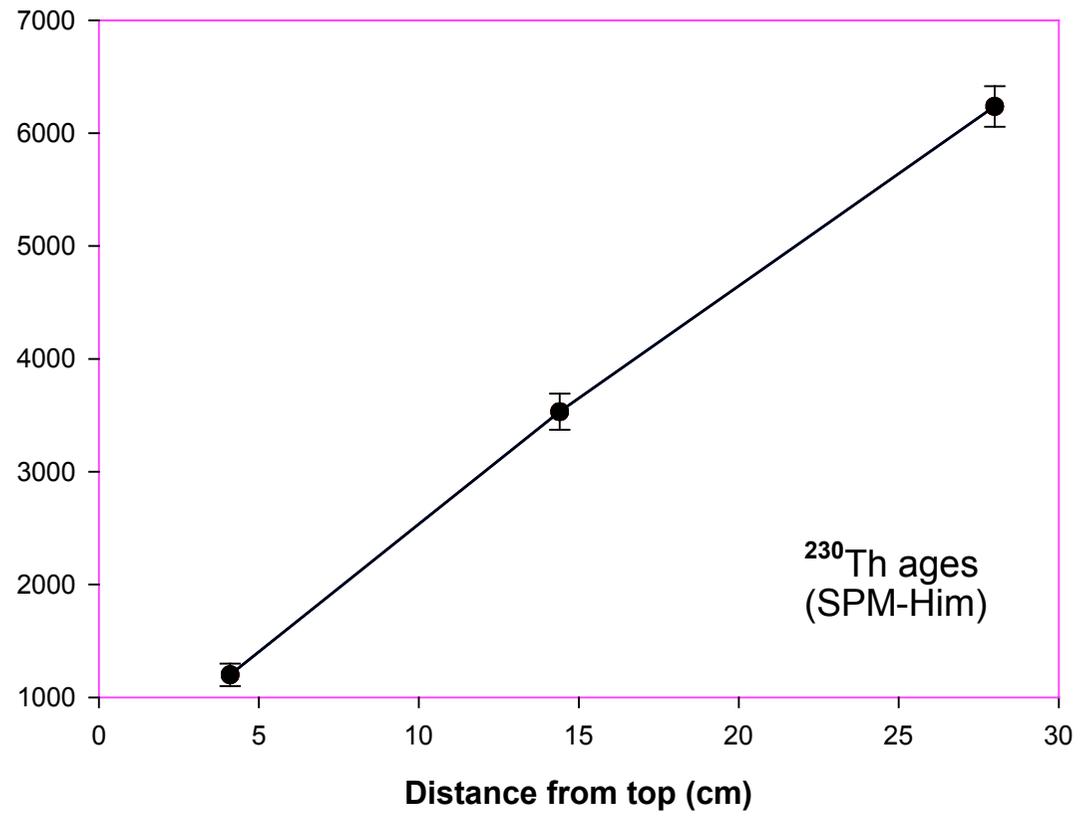
**Altitude** : **1927 m**

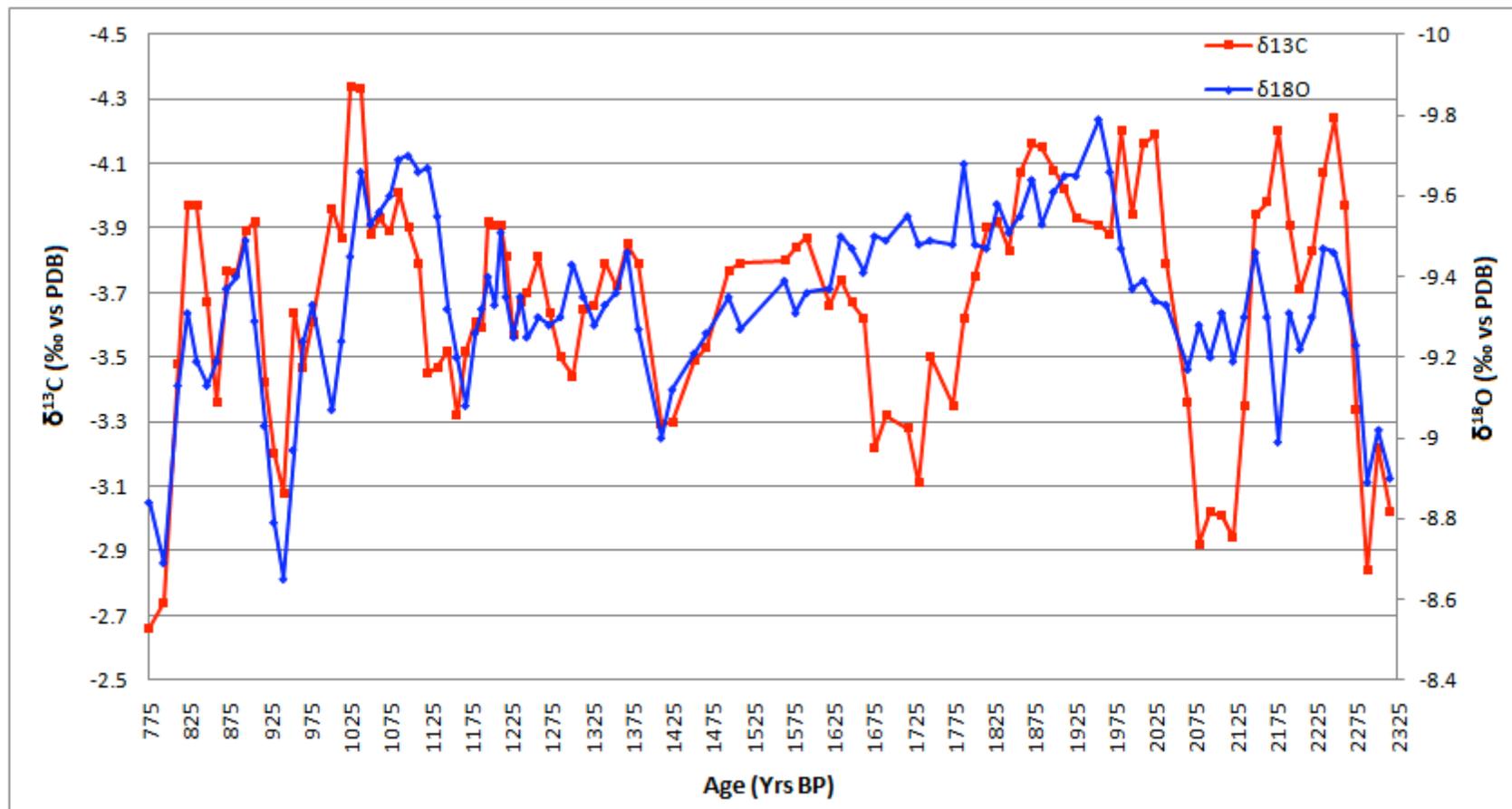
**Annual Rainfall** : **~ 150 cm / yr**

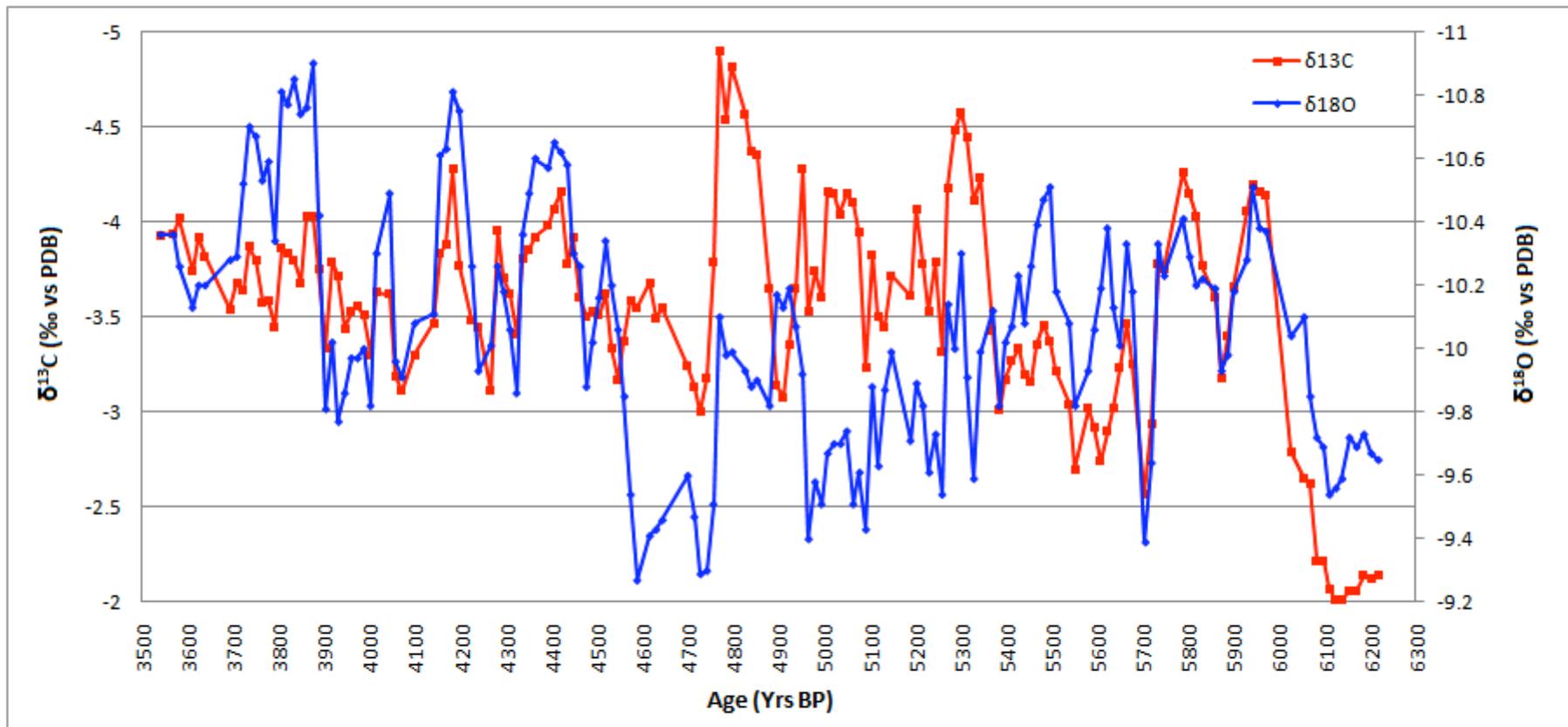
**Host Rock** : **Limestone (20 m thick cover)**

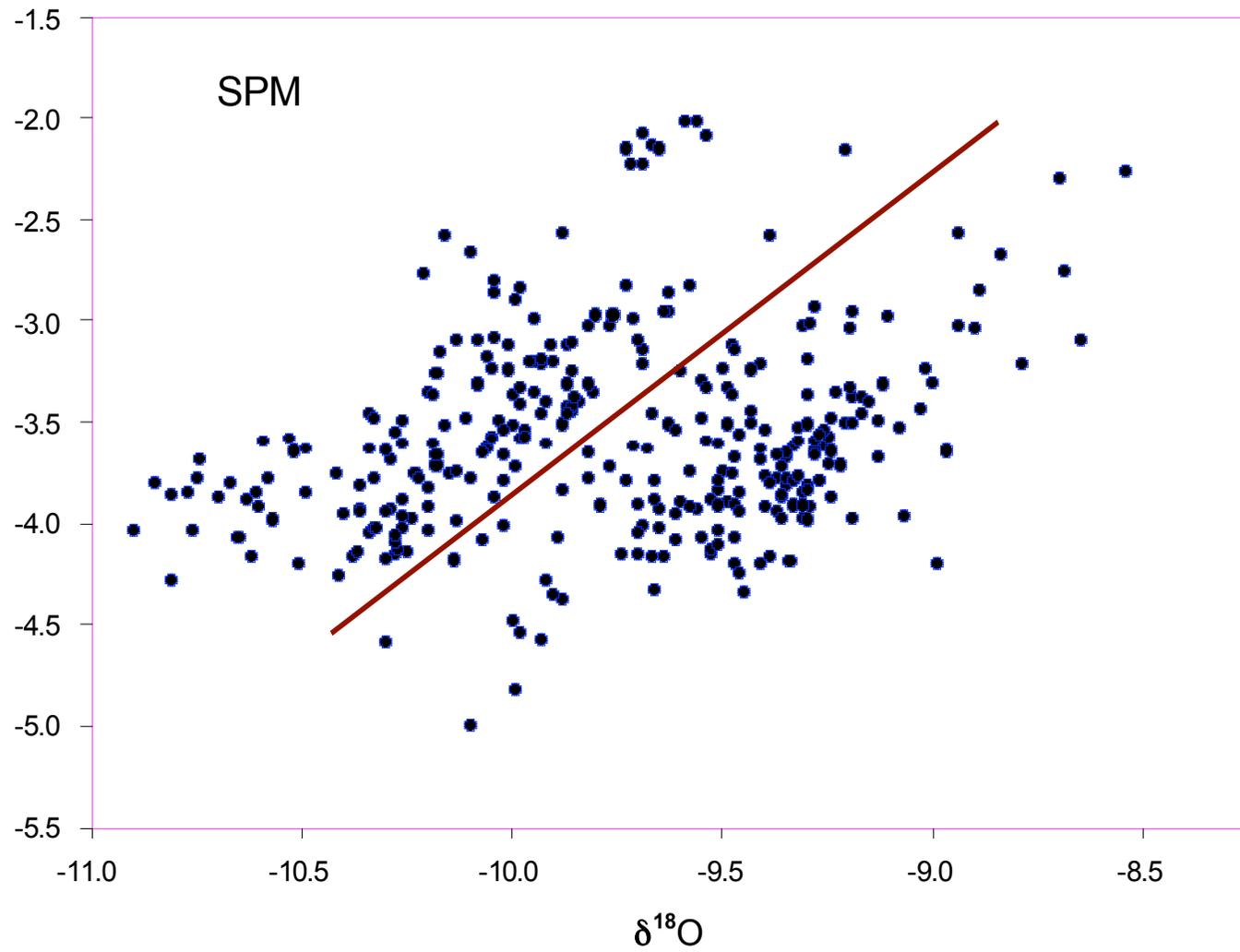
**Vegetation cover** : **Oak, Xerophytic plants**



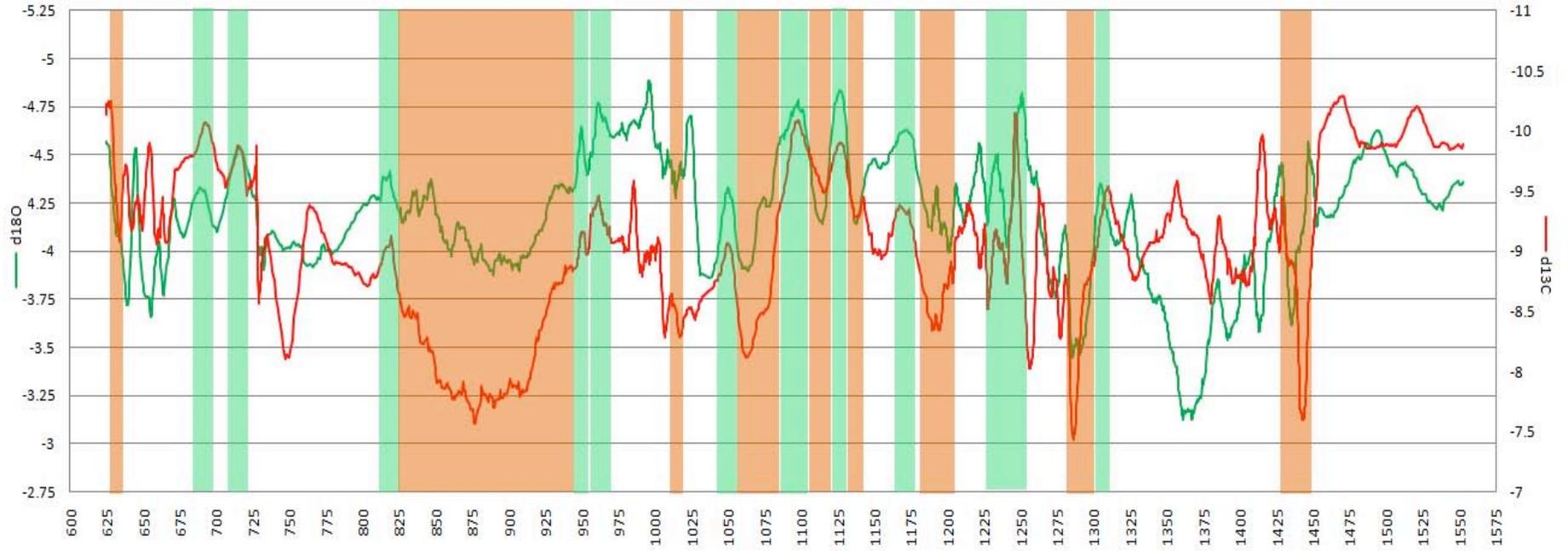








### Dandak Cave

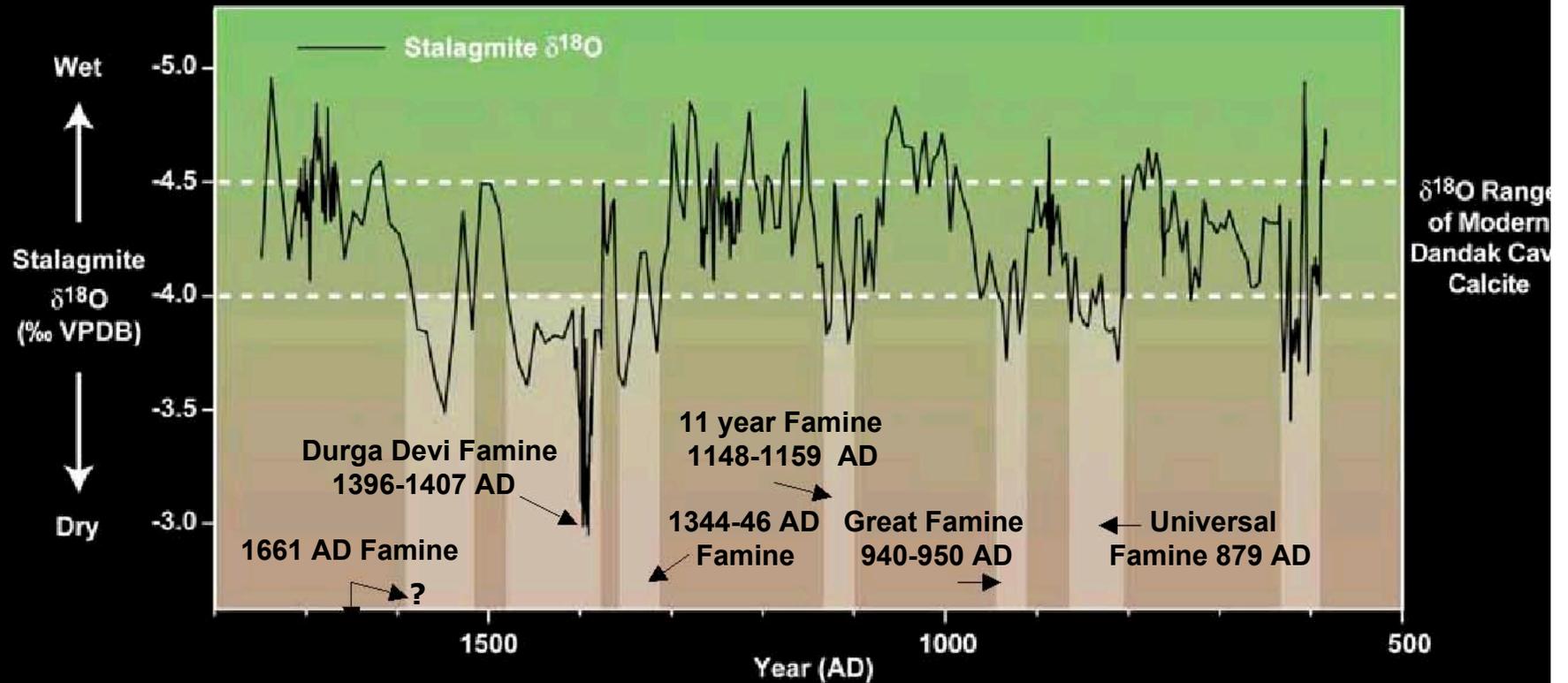


Calendar year (AD)

Sinha, A. et. al., GRL. 2007



## Dandak Cave Indian Monsoon Precipitation Record

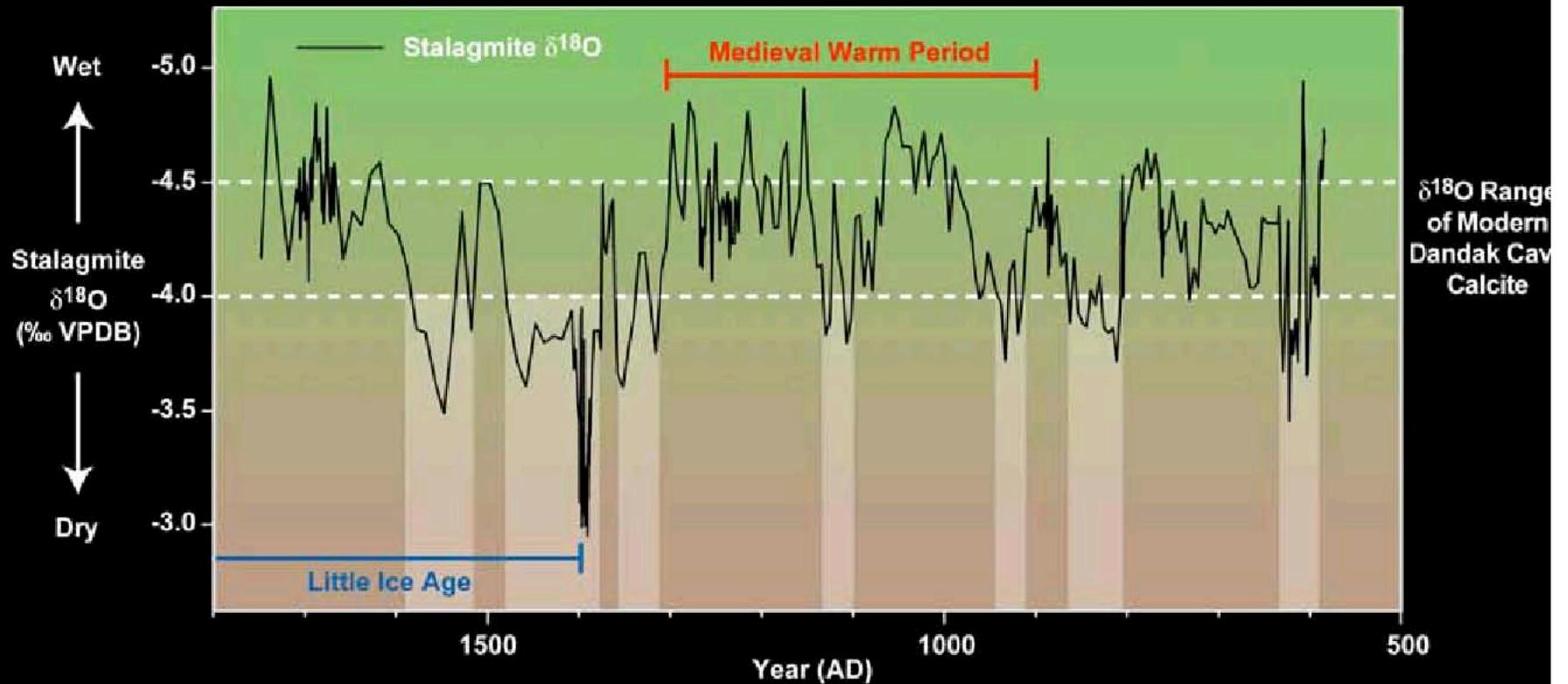


Multi-Decadal to Centennial Length  
Episodes of Reduced Monsoon Rainfall

Theoretical and Observational Considerations  
Suggest Rainfall Reduction of 15-30% Compared  
to the Present - amounting to 'Mega-Droughts'

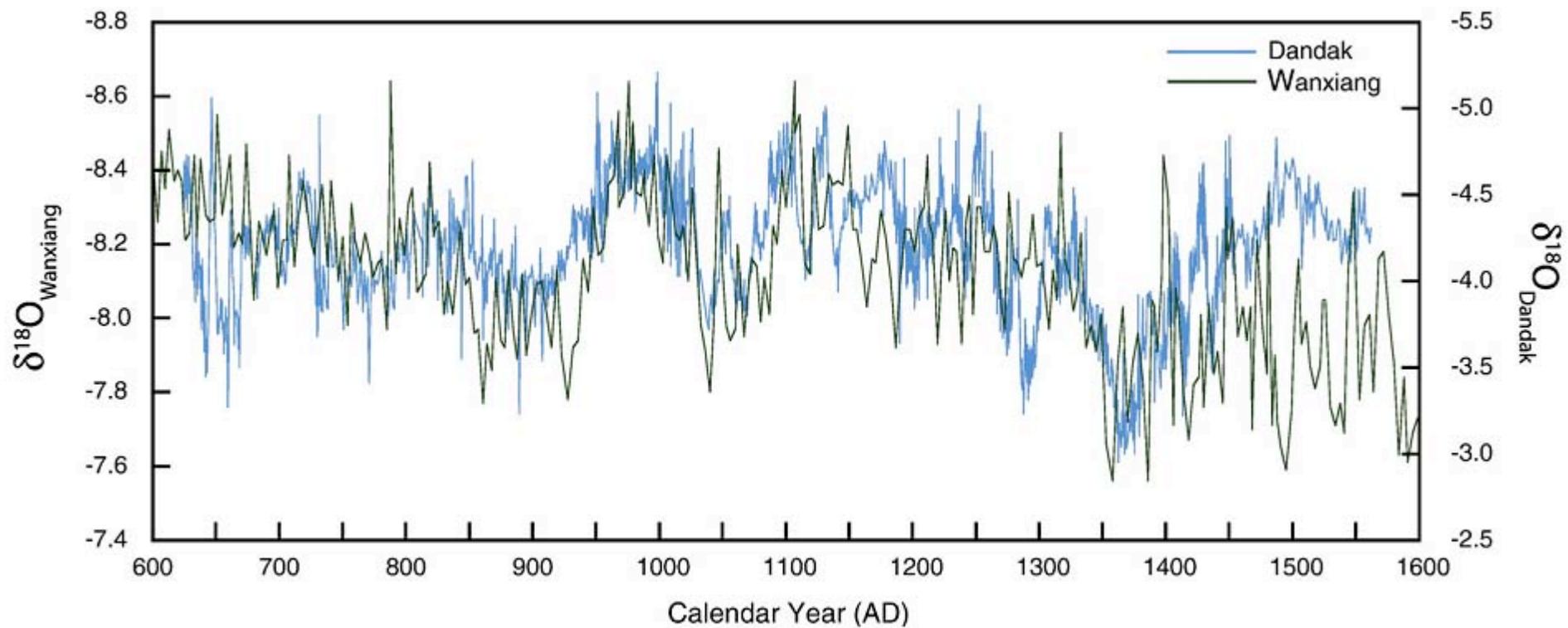


## Dandak Cave Indian Monsoon Precipitation Record



Longer intervals of more reduced rainfall during LIA compared to MWP





**Berkehammer, M. et. al., EPSL, 290: 2010**



# Conclusions

- Our record and other speleothem records suggest large changes in the Indian monsoon rainfall for the last 2000 years.
- Oxygen isotopes through time clearly identify dry and wet conditions.
- There is a positive correlation between  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  suggesting that both tracers are controlled dominantly by the rainfall.
- Positive pulses in oxygen isotopes in Dandak speleothem coincides with the past famine events.

**Thank You**