Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11124

A multi-proxy reconstruction of East Asian Monsoon precipitation dynamics on the Western Chinese Loess Plateau over the past 140,000 years

LOUISE FUCHS[1], JINGJING GUO[1], ENNO SCHEFUSS[2], YOUBIN SUN[3], JIBAO DONG[3], MARTIN ZIEGLER[1] AND FRANCIEN PETERSE[1]

[1]Utrecht University
[2]MARUM - Center for Marine Environmental Sciences, University of Bremen, Germany
[3]Institute of Earth Environment, Chinese Academy of Sciences

Presenting Author: l.fuchs@uu.nl

Past changes in East Asian Monsoon (EAM) climate have been inferred from the stable oxygen isotopic composition ($\delta^{18}O$) of cave speleothems. However, the interpretation of the speleothem records is complex as the $\delta^{18}O$ signal is influenced by multiple factors. Here we use a multi-proxy approach to reconstruct EAM precipitation dynamics over the past 140,000 years recorded in the Yuanbao loess-paleosol sequence on the western Chinese Loess Plateau (CLP). First, we derive precipitation-induced changes in soil pH from soil bacterial membrane lipids (brGDGTs). Second, the hydrogen isotopic composition of plant waxes ($\delta^{2}H_{wax}$) in the same sequence is used to infer the isotopic composition of meteoric water. Finally, we determined the $\delta^{18}O$ composition of soil water using snail shell $\delta^{18}O_{snails}$ and clumped isotope analyses to provide an independent precipitation record in addition to the $\delta^{2}H_{wax}$.

All our proxy records vary in concert, providing confidence in the timing and direction of trends. Our isotope records display the alternation of a dominating summer monsoon and winter monsoon, resembling that of the speleothem $\delta^{18}O$ record, and supporting Northern Hemisphere Insolation (NHI) as its main driver. The high resolution of the records enables to reconstruct millennial scale variations in precipitation during MIS3, where Heinrich Events 5 and 4 are recognized in enriched $\delta^{2}H_{wax}$, illustrating the sensitivity of Yuanbao to both North Atlantic climate and the EASM as it is located at the convergence of both systems.

Notably, our $\delta^{2}H_{wax}$ shows a reversed trend compared to the speleothem $\delta^{18}O$ during the Last Glacial Maximum (LGM), indicating that another factor overprints the NHI forcing. Possibly, the extent of the NH ice volume at that time has strengthened the Westerlies and blocked the EASM. The long moisture transport pathway of the Westerlies and low temperatures may then have resulted in the depleted values in the $\delta^{2}H_{wax}$ record.

Thus, our multi-proxy approach reveals that although precipitation dynamics seem to be mainly driven by insolation, this signal can be overprinted by North Atlantic climate events brought by stronger Westerlies during glacial conditions.