



East Asian summer monsoon climates and cave hydrological cycles over Dansgaard-Oeschger events 14 to 11 revealed by a new Hulu stalagmite

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A new Hulu stalagmite was ^{230}Th dated and measured by multi-proxies, including $\delta^{18}\text{O}$, $\delta^{13}\text{C}$ and trace element ratios. A ~ 10 -yr-resolved $\delta^{18}\text{O}$ record from 51.59 to 42.58 ka provides two new aspects of millennial-centennial oscillations of climate. A highly similar pattern of Dansgaard-Oeschger (DO) cycles as recorded in Greenland ice cores is observed, including the rapid transition (duration < 80 yr) and synchronization (difference < 35 yr) at the onset of DO-12. Centennial-scale monsoon oscillations during the Greenland interstadials are indicative of the instability of hydroclimate system. After a removal of remote maritime moisture signals from our $\delta^{18}\text{O}$ record, proportions of water vapor from the short-distance sources increase during cold stadials, thus we propose that the westerly jet plays an important role in controlling the moisture inflow to the East Asia. Furthermore, proxies for cave environmental changes, including $\delta^{13}\text{C}$ and trace element ratios, display a resemblance to the $\delta^{18}\text{O}$ record even at centennial scales. This suggests that changes in hydrological processes, soil and vegetation at cave site all have sensitive response to monsoon climates. These findings demonstrate that calcite $\delta^{18}\text{O}$ at Hulu Cave integrates multiple hydroclimatic processes, thus providing a basis for further interpretation of Chinese cave $\delta^{18}\text{O}$.