Northern African Hydroclimate Dynamics During Marine Isotope Stage 7 Revealed by Speleothem Records from Tunisia

*Mesut Kolbuken[1], Yun-Chuan Chung[1,2], Hatem Dhaouadi[3], Chuan-Chou Shen[1]

1. High-Precision Mass Spectrometry and Environment Change Laboratory (HISPEC), Department of Geosciences, National Taiwan University, Taipei, 106319, Taiwan, ROC, 2. Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland, 3. Research Laboratory of Environmental Chemistry and Clean Processes (LR21ES04), Department of Chemistry, Faculty of Sciences, University of Monastir, Monastir, Tunisia

Marine Isotope Stage 7 (MIS 7; ~245–185 thousand years (ka, relative to 1950 AD)) represents a complex interglacial period marked by pronounced orbital-scale climate variability, yet hydroclimate dynamics in North Africa during this interval remain poorly constrained due to the scarcity of high-resolution terrestrial archives. Here we present a new speleothem record from northern Tunisia that provides insights into regional hydroclimate variability during MIS-7. High-precision U–Th dating establishes a robust chronology, while stable oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) isotope records document changes in regional hydroclimate. The speleothem record reveals pronounced millennial and orbital-scale variability, with intervals of isotopically low $\delta^{18}O$ ($\delta^{13}C$) values indicating enhanced precipitation (enhanced soil/vegetation activity) during interglacial substages, likely associated with the southward shift of the mid-latitude westerlies and intensified Mediterranean storm track. Conversely, high $\delta^{18}O$ ($\delta^{13}C$) values correspond to drier conditions (low soil/vegetation activity) during glacial transitions and cooler substages likely due to northward displacement of the mid-latitude westerlies and weak Mediterranean storm track. Comparisons with proxy records from the North Atlantic and the Mediterranean regions suggest a strong coupling between insolation forcing and large-scale atmospheric circulation. These findings highlight the sensitivity of North African hydroclimate to orbital forcing during MIS 7.

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