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A Late Holocene multi-proxy speleothem record from NW Türkiye

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NW Türkiye is uniquely positioned between climatic influences from the North Atlantic, Mediterranean and Eurasia. Variability in climate systems through the Late Holocene is thought to have influenced major historical transitions, such as the 'Bronze Age Collapse', and during periods including the 'Roman Climate Anomaly' and the 'Little Ice Age'. The region is noteworthy considering its geographical and historical significance over the last 4,000 years as a landscape for Ancient Greece Colonisation, the Roman Byzantine and Ottoman Empires and proximity to the common focal-point of modern-day Istanbul (Byzantium, Constantinople) which received much of its water from the cave's locality. With the Eastern Mediterranean a hotspot for agricultural drought (Dabanlı et. al; 2017), which has impacted societies historically, the region warrants the study of spatio-temporal human-climate interactions.

Given the scarcity of sub-decadal palaeoclimate records regionally, and heterogeneity of Eastern Mediterranean climate generally (Jacobson et. al; 2021), stalagmite U-1 from Uzuntarla cave in Thrace helps fill this gap. Speleothem U-1 was dated using a combination of U/Th and ^{14}C dates. The chronology is further refined by aligning distinct growth-shifts with well-dated and strong historical earthquakes. Using the combined evidence of calcite fabric and growth laminae changes, stable isotope ($\delta^{13}C$, $\delta^{18}O$), trace elements (Mg/Ca, Sr/Ca, P/Ca) and fluid-inclusion analysis, we find that U-1 is highly sensitive to changes in cold-season regional precipitation, seasonality and temperature. For example, increases in $\delta^{13}C$ often coincide with narrowing of growth-laminae and increased Sr/Ca suggesting a unified influence by reduced drip-rate during poor recharge conditions. Effective infiltration is between Oct:Mar, making $\delta^{18}O$ a combined indicator for Fall:Winter:Spring seasonality balance and temperature. Initial fluid inclusion temperature estimates are promising with work ongoing, however other factors are worth discussing such as aeolian oceanic Mg inputs.

Initial results, often complimenting other regional palaeoclimate records, paints a picture of dynamic changes in climate over the last 3,900 years BP spanning key historical transitions. Speleothem U-1 describes a large shift in aquifer-recharge and seasonality preceding the Bronze

Age Collapse impacting SW Asia around 1190 BCE. Recharge then peaks anomalously in 650-690 BCE during the Homeric Minimum, coinciding with the Greek Colonisation and Byzantium's founding ~667 BCE. The acclaimed Roman Climate Anomaly (150 BCE-200 CE) is without wet-anomalies but stable for U-1, with later evidence of aridification. Wetter and stable conditions follow during 200-600 CE, a period encompassing defining historical events including the establishment of Constantinople as a powerhouse of the East Roman Empire and major infrastructure development including aqueduct expansion into Thrace. The Medieval Climate Anomaly (950-1250 CE) is defined by wet conditions during 760-1100 CE transitioning into lower aquifer recharge between 1100-1220 CE. Finally, the Little Ice Age (1400-1700 CE) shows highly variable conditions, but generally transitions from a wetter and colder period to lower aquifer recharge between 1220 and 1760 CE.

REFERENCES

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