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A critical evaluation of the 4.2 ka BP event using new high resolution evidence from stalagmites in the Middle East

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The 4.2 ka BP event occurs during a period of rapid climate change (RCC), characterised by widespread aridity and has been used to explain the collapse of a number of Early Bronze Age societies in the Middle East. Although the 4.2 ka BP event has been recognised in a large number of palaeoenvironmental archives, the precise nature, chronology and extent remains controversial. This is mainly attributable to the paucity of precisely dated and highly resolved palaeoenvironmental records, which are essential when considering the nature of the 4.2 ka BP event which may have only persisted for several decades. The use of records with few dates and therefore poor chronologies means that synchronicity between events occurring during the RCC period (between 4.2 and 3.8 ka BP) and the nature and extent of climatic events are difficult to resolve. Therefore, high resolution records with precise and accurate chronologies are imperative to reduce the uncertainties when attempting to identify distinct events in palaeoclimatic records. Terrestrial carbonates, including speleothems, are able to be accurately and absolutely dated utilising U-series methods and, using different analyses, can be investigated for isotopic and elemental markers. This combination is essential for elucidating the precise nature, timing and extent of the 4.2 ka BP event.

This research presents several highly resolved and well dated speleothem records from Sofular and Ovacik caves in northwestern Turkey and Qunf Cave in Oman, to investigate the exact timing, duration and magnitude of the 4.2 ka BP event in unprecedented detail. These sequences currently have 19 U-Th dates covering a 1000 year period, combined with stable isotope analyses at resolutions of ∼0.8, ∼2.5 and ∼4 years respectively. Initial results from the high resolution Sofular record identify 3 excursions greater than two standard deviations from the mean, indicating rapid climatic change, but these are all associated with increased precipitation. Results from the Ovacik record also identify 3 excursions but these are associated with both drier conditions and increased precipitation. The sequence from Qunf Cave in Oman shows no significant event at 4.2 ka BP; although a longer term reduction in Indian Ocean Monsoon precipitation is identified, reaching current levels at c. 4.0 ka BP, coincident with the ‘collapse’ of the Akkadian civilisation. This research suggests that a mosaic of impacts, dependent upon regional conditions and topography is likely and that the ‘widespread’ aridity associated with the event was perhaps only regional. These results also have important ramifications considering current arguments concerning the global extent of the 4.2 ka BP event. Furthermore, these datasets question the validity of proposing the use of the 4.2 ka BP event (GSSP: stalagmite KM-A, Mawmluh Cave, northeast India) as a chronostratigraphic boundary to divide the Middle and Late Holocene Sub-series/Sub-epoch.