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Speleothems from the Eastern Mediterranean, Arabian Peninsula and Fertile Crescent: Water Limited Environments in the SISAL Database

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The Middle East presents one of the most complicated and heterogeneous climate settings for its size. The region spans the transition between temperate Mediterranean climate in the Levant to hyper-arid sub-tropical deserts in the south, with complex alpine topography in the northeast feeding the Euphrates and Tigris rivers which supports life in the southeastern Fertil Crescent. Climate projections predict severe drying in major parts of the Middle East in response to global warming with a considerable impact for society. In the past, climate reconstructions and archaeological excavations suggest that changes in the regional hydroclimate was a primary driver in human expansions out of Africa, the Neolithic revolution, and the development of the first complex societies. This highlights the importance of understanding both past and future climate perturbation in the Middle East. Region-scale analysis can be achieved by making use of large spatio-temporal networks of terrestrial (and aquatic) geological climate archives, where each dataset can potentially provide paleoclimate information on local, regional and global climate events. Such reconstructions should improve our understanding of past variations in the hydro-climate of the Middle East.

We discuss 21 Middle East (EM) speleothem stable oxygen isotope (δ^{18}O) records from 14 sites that are in the SISAL_v1[1] database. These include sites in Lebanon, Israel, The West Bank, Arabia, and parts of Turkey. Ultimately, the available speleothem δ^{18}O time series are investigated during the Holocene by applying a standardization technique to identify common trends in the δ^{18}O time series. Changes in speleothem δ^{18}O values from this region primarily indicate changes in past precipitation amounts. Accordingly, common trends in ME speleothem δ^{18}O time series reflect past regional climate changes associated with variations in the main synoptic pattern in the region, Mediterranean cyclones. The standardization technique calculates the median and the 25% and 75% quantile of a time window (bin) of the normalized δ^{18}O time series. To identify trends on different time scales (Holocene to millennial) and to test the reliability of the standardization technique for speleothem δ^{18}O time series we vary the length of the bins. Furthermore, we show the potential of the standardization technique to resolve abrupt climatic oscillations, such as the 4.2 kyr or 8.2 kyr events. The common trends in the standardized time-series for the EM speleothem records is then tested against Mediterranean archives. For example, pronounced isotopic signals on the Middle East speleothems trace the occurrence of past sapropels (10.8-6.1 and 126-121 ka), in line with their marine imprint, which occurs when specific interplay of monsoonal/Atlantic/Arctic climatic systems takes place[2].

Finally, recommendations for future speleothem-based research are given, on one hand, making use of the SISAL database and on the other hand by the identification of potential regions for the generation of new speleothem proxy time series.

1. Atsawawaranunt, K. et al. Earth Syst. Sci. Data 10, 1687-1713, doi:10.5194/essd-10-1687-2018 (2018). 2. Martrat, B., et al. Quaternary Science Reviews 99, 122-134, doi:10.1016/j.quascirev.2014.06.016 (2014).