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Mid-late Holocene palaeoclimate of northern Jordan from speleothem geochemistry

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The southern Levant region (encompassing the modern countries of Israel and Jordan) is a climatically sensitive area due to the proximity of the Negev and Arabian Deserts to the south and east. Although there is a general pattern of decreasing rainfall to the south and east of the region, local topographic features, most notably the Dead Sea Rift Valley, have a significant effect on detailed rainfall patterns. Our understanding of the Holocene climate of the southern Levant is principally known from records obtained to the west of the Dead Sea Rift, on the borders of the Negev Desert and from the lakes within the rift valley itself. Palaeoclimate records from the more interior regions, such as Jordan, are fewer in number and, generally at lower stratigraphic resolution. A recent archaeological survey has revealed the existence of limestone caves in northern Jordan, many of which were previously unknown to academics working in the region. These caves contain a variety of architectures, including stalagmites, stalactites, flowstones and soda straws. We present geochemical data (oxygen and carbon-isotopes, and uranium-series dates) from a small speleothem that provides the first detailed mid-late Holocene climate record for the area east. The new data are similar in value and contain similar magnitude shifts to previously published data from Israel (Soreq and Nahal Qanah Caves) and Lebanon (Jeita Cave). Through comparison with these other speleothem records we suggest that the oxygen-isotopic composition of the Jordanian speleothem is consistent with rainfall from Mediterranean-sourced weather systems that evolved to lighter isotopic compositions through rainout of 18O as they moved into the interior of the southern Levant. The Ras Muneef GNIP monitoring station provides a limited record of precipitation rates and isotopic compositions of rainwater. Combining this data with the speleothem data, suggests that Holocene temperatures in northern Jordan were broadly similar to present day mean annual temperatures and that the fluctuations in 18O are likely the result of changes in the amount of precipitation.