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Late Pleistocene and Holocene Climatic Variability in the Carpathian-Balkan Region

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A speleothem perspective on millennial-scale climate change in south-eastern Europe during the last glacial

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High-resolution stable O isotope data from two U-Th dated speleothems from Romania, one from Tăuşoare cave in N Romania spanning the last 68 ka, and one from Ascunsă cave in S Romania spanning the interval between 47 ka and 30 ka BP record a regional N-S climate contrast in SE Europe during marine isotope stage 3. The Tăuşoare data-set records "Heinrich-stadial" type cold events (low $\delta^{18}O$) throughout MIS 3. While the magnitude of speleothem $\delta^{18}O$ variability in N Romania is much less pronounced in comparison to Sofular cave in NW Turkey, the pacing is generally similar. That suggests a common response to Atlantic millennial scale climate variability as observed in the Greenland record, but without the magnification of the $\delta^{18}O$ signal observed in NW Turkey due to a local Black Sea source effect. The short time-interval recorded in Ascunsă cave (S Romania), however, shows virtually no similarity in $\delta^{18}O$ with the corresponding section at Tăuşoare in N Romania, but instead resembles the record from Soreq cave (Israel). This apparent isotopic contrast, however, is unlikely to reflect fundamental climatic dissimilarity between N Romania and Turkey on one hand, and S Romania and Israel on the other, since several published pollen data-sets from Greece – situated between the latter two sites – have clearly confirmed a climate response throughout SE Europe similar to the millennial scale climate variability recorded in Greenland during MIS3. A more likely explanation for the isotopic contrast is a different slope of the relationship between rain-out temperature and O isotopes in rain water over S Romania and Israel - equal to a different sensitivity of speleothem calcite $\delta^{18}O$ with respect to temperature change. This requires a different source of moisture compared to N Romania. Because speleothem records from S Romania and Israel closely resemble the $\delta^{18}O$ of marine surface planktonic foraminifera tests from the eastern Mediterranean, that other source should be the Mediterranean Sea in both cases. While temperature fluctuated in a coherent fashion from Greenland to the Eastern Mediterranean, moisture sources differed across the Balkan. The S Balkan – here, regions to the South of Ascunsă cave in the S Carpathians, the Southern Black Sea, and the Eastern Mediterranean were dominated by local sources of moisture rather than the Atlantic moisture prevailing over N Romania. In fact, Atlantic moisture must have been broadly absent in the S Balkan, otherwise the cold events recorded in N Romania would have been recorded in S Romania as well. Essentially, this suggests that the exposure of the S Balkan to cold Atlantic air masses must have been rather limited during MIS 3 in general. Such muted cold conditions over the S Balkans may have favored the dispersal and survival of anatomically modern humans into SE Europe even between interstadials.