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A new paleoclimate record for the Western Mediterranean covering MIS 5 to 3 based on speleothems from Cueva Victoria (SE Spain)

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Here we present three flowstone records from Cueva Victoria, SE Spain. Present-day climate of SE Spain is classified as Bsk (semi-arid with dry summer months, less than 10 mm/month precipitation) according to the Köppen scheme with sparsely developed vegetation. The flowstones were precisely dated by the MC-ICPMS ^{230}Th/U-method and cover the period from the last interglacial to Marine Isotope Stage (MIS) 3. Stable oxygen and carbon isotope ratios were determined at centennial resolution.

One of the drill cores shows episodic flowstone growth between the Last Interglacial (MIS 5) and MIS 3 (112 – 45 ka) with a mean constant growth rate of 10 μm/a from 60 to 46 ka. A second flowstone from the same hall exhibits growth from 132 ka to 50 ka. From 132 to 106 ka, the average growth rate is $>$10 μm/a. In the younger part (106 to 50 ka), growth interruptions between the warm Dansgaard/Oeschger (D/O) events cannot be excluded. A third flowstone from another hall of Cueva Victoria only recorded the time span from 86 to 48 ka including several growth interruptions. All three flowstones together cover main parts of MIS 5 to 3 including D/O events 28 to 12. Each D/O event is reflected by a remarkable decrease in δ^{18}O and δ^{13}C values (both up to 3 ‰) and is clearly detectable in the different records. The pattern is generally similar to the NGRIP ice core and sea-surface temperature records from the Iberian margin.

We interpret the changes to more negative values in δ^{18}O and δ^{13}C during D/O events as a shift to more humid conditions. Elevated sea-surface temperatures in the North Atlantic and the Mediterranean Sea result in increased moisture transport and precipitation on the SE Iberian Peninsula, which in turn leads to denser vegetation. However, changes in δ^{13}C values are partly less pronounced (e.g., D/O 19, 22, 23) in our record, probably due to the delayed behaviour of the in- and decrease in vegetation density.

This study, which is based on absolute ^{230}Th/U-ages even beyond the range of the ^{14}C-dating method, shows that climate variability on the northern hemisphere and sea surface temperature changes in the Northern Atlantic directly influence terrestrial climate in the Western Mediterranean. High resolution stable isotope measurements provide centennial-scale paleoenvironmental information for the period between the Last interglacial and MIS 3.