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# Marine Isotope Stage 5 Climate Variability in the Central Balkan Peninsula

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In this study we present results from two speleothems collected from Vernjikica Cave, situated in the central part of the Balkan Peninsula, at the fringes of the Carpathians and Balkan Mountains. The preliminary age models were determined by U-Th dating techniques that at present comprise 9 dates in stratigraphic order. The samples grew from approximately 63-113 ka BP and from 115-121 ka BP, spanning much of MIS stage 5 and the transition into MIS 4. Samples for $\delta$18O values were micromilled from each stalagmite along the growth axis.

Oxygen isotopic values of the younger sample, stalagmite V4-2, range from -9.9‰ to -6.3‰ while carbon isotopic values show an opposing general trend ranging from -8.8‰ to -3.0‰Over the growth period, $\delta$18O and $\delta$13C values show frequent simultaneous and distinct high-amplitude shifts towards more positive values that coincide with pronounced accumulations of denser and darker laminae. The strongest enrichment of $\delta$18O values is seen at approximately 107 ka and coincides with peaks of depleted oxygen values at Soreq cave, Israel, suggesting semiarid conditions at the study site at a time when sapropel layers formed in the Eastern Mediterranean. In regard to present isotopic compositions in rainfall in the study area, the V4-2 proxy record shows over its period of growth a change from more humid and warm to colder and drier environmental conditions. The distinct increases in stable isotopic ratios as seen at 107 ka reflect warm and dry intervals during which calcite precipitation is additionally affected by non-equilibrium conditions.

The overall trend in isotopic data mirrors both global climatic signals as seen in $\delta$18O variations from the NGRIP ice-core record, and regional climatic signals as seen in $\delta$18O from speleothems from Soreq Cave or in aeolian dust records from the Vojvodina in North Serbia. However, a prominent characteristic of the Vernjikica samples is the substantial variability in isotopic values over the growth period, potentially portraying a series of multi-decadal to centennial and millennial scale climatic changes. Especially in the period from 107 ka to 113 ka where sampling resolution yields an average of 10 years, rapid enrichments of 1.5‰ to 2.5‰ occur over few decades while more gradual depletions occur over a few centuries.