

# ***Interactive comment on “Constraining Holocene hydrological changes in the Carpathian-Balkan region using speleothem $\delta^{18}\text{O}$ and pollen-based temperature reconstructions” by V. Drăgușin et al.***

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We thank Frank McDermott and an anonymous reviewer for their comments, which were very helpful to improve the manuscript.

Changes made: Reviewer 1 made two types of comments – one about the error of our method and the calibration issue of calcite-water O-isotope fractionation, the other about possible climate mechanisms that may explain our results.

Rev 1, comment 1: we made appropriate changes to section 3.2 for clarification – essentially by providing a more thorough discussion on the off-set between farmed calcite and equilibrium values calculated from drip water  $\delta^{18}\text{O}$  using different calibration

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equations (Kim et al. 1997; Day and Henderson 2011, Tremaine et al. 2011). It was not our purpose to generalize on the accuracy of these equations, nor do the data allow it. For the discussion of relative change in calcite  $\delta^{18}\text{O}$ , the difference between the three calibration lines is no larger than 0.05‰ which is below analytical uncertainty. A general analysis of sources of error and their magnitudes – if they can be quantified – has been added to the appendix in a new paragraph (Sources of uncertainty for the calculation).

Rev 1, comment 2: Although the issue is difficult to deal with without the use of climate models, we have added a rudimentary discussion on possible mechanisms in Section 3.3.3. Temperature and hydrology-related changes in speleothem  $\delta^{18}\text{O}$  records from Romania and the Mediterranean basin.

Frank McDermott commented on potential contributors to the non-temperature aspects found to explain most of the  $\delta^{18}\text{O}$  change in speleothems from the Eastern Med and the Balkans, which we attributed to be most likely the result of a different relative contribution of Mediterranean moisture. In addition, ten specific comments were made on individual sections of the manuscript.

I. We use the term “climate-hydrology” and define it to include rainfall seasonality, moisture source, and moisture trajectories.

II. Changed as suggested

III. Changed as suggested

IV. We made the changes to figure 8 as suggested, by adding a stacked plot of all Romanian speleothem data. This resulted in two figures, 8a and 8b, the latter depicting the stacked speleothem data. The comment touched an aspect we realized after the original submission, i.e. that one might use the two records of Ursilor and V-11 cave in combination, so to expand the Ursilor record back in time. The two caves are very close to each other. We have added a data point in figure 9, which now shows the

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result for two cases: Ursilor alone and the combination of Ursilor and V-11.

V. The U-series dating and the age modeling did not bring any evidence for or against the existence of hiatuses. Nevertheless, we modified Fig. 5, adding arrows that depict the position of growth axis direction changes.

VI. Only a comment – no change requested

VII. Figure 1 now includes the site of V-11 and Stâna de Vale meteo station. In the original version they and Ursilor Cave were depicted by a single point due to their close location.

VIII. Corrected

IX. Corrected

X. The conclusion was rewritten to better accommodate our main findings

Other changes made: Some details of the discussion of events had to be corrected after a thorough review of the meaning of the position of the change in  $\delta^{18}\text{O}$  of the speleothem relative to the winter or summer end of the calculated pollen temperature-constrained range of expected  $\delta^{18}\text{O}$ , if only temperature had changed. In addition, a review of the pollen record of Lake Maliq revealed a possible chronologic discrepancy with marine records for the 3.2 ka BP event. The discussion has been modified to accommodate this uncertainty. None of the above modifications change the general conclusions of this study.

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