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Climate of the Past Discussions

Interactive comment on "Experimental evaluation of oxygen isotopic exchange between inclusion water and host calcite in speleothems" *by* Ryu Uemura et al.

Anonymous Referee #1

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General comments:

The paper experimentally investigates the post-depositional oxygen isotope exchange of fluid inclusion water. As an increasing number of laboratories are developing and applying techniques for fluid inclusion analysis, a sound understanding of the related isotope signals and potential limitations is urgently needed. The constraints provided by this study are therefore very valuable and show that in most cases also the fluid inclusion d18O signal may reflect the drip water at time of enclosure.

The paper is well structured and written. The used technique is clearly described, all necessary data for discussion are given, and the interpretation is based on the authors'

genuine data. The topic is well within the scope of Climate of the Past as it addresses an emerging proxy with high paleoclimatic significance.

Specific comments:

Introduction: -line 36-37: Cave dripwaters. . . usually close to the d18O of local rain. Is it? Or is it close to the infiltration-weighted mean of the rain? A literature reference may be sufficient (e.g., Baker et al., 2019, Nat. Commun.)

-line 42: . . .suggests a relatively stable value for the temperature dependence of d18Oca. . . I would be a bit more cautious here. Mühlinghaus et al. (2009) found that the change of the calcite d18O with temperature has a certain relation to the drip interval which is expressed differently at different cave temperatures. It is relatively limited at 10°C (-0.22 to -0.26 ‰°C), but quite substantial at 25°C (-0.21 to -0.35 ‰°C) for the modelled drip intervals.

Methods -section 2.1: Did you take the speleothem samples for fluid inclusions at the growth axis or off-axis? The position relative to the axis may have an influence on the water content and may also be interesting for the discussion section and Fig.3.

Results and discussion: -lines 137-138: you state that the observed increase is due to exchange between inclusion water and calcite. Could calcite dissolution or new calcite precipitation related to a change in the saturation state following the increased temperature also play a role?

-lines 144-145: Leakage may also be influenced by the fabric of the stalagmite and be different in inclusions with e.g., large columnar crystals compared to dendritic parts. What is the fabric of the investigated pieces of HSN1? Also the following statements in lines 148-152 should be rephrased considering potentially different behaviour of stalagmites with different fabric and micro-structure. Lacking larger data sets of various stalagmites I would be hesitant to generalize. Still the statements are ok for the analysed sample but should be written in a way that a generalisation for the leakage aspect

is avoided.

-lines 168-176: is the deuterium excess indeed a (better) indicator for oxygen isotope exchange compared to the closeness to the LMWL?

-lines 213-215: This sentence may be misunderstood and should be slightly rephrased. Whereas the rate constant of the isotope exchange reaction only varies with temperature, the number of transferred isotopes varies with the temporal evolution of the isotope ratios of the end members.

Fig.1: Please indicate in the figure where the samples were taken for the analysis.

Fig.4: Do you have d18O and dD values of modern drip water from the cave? Or could you alternatively calculate the infiltration-weighted mean of the rainfall? It may illustrate additionally the shift between the 105°C samples and the room-temperature reference that should be close to the dripwater.

Typos: -line 60: “These data suggest *an* isotopic exchange of ....” or just without the current “the” -line 131: “...of inclusion water *are* shown as deviation from ...” -lines 141-142: either “there is little hydrogen in the calcite” or “there is no significant hydrogen reservoir in the calcite”

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