

Clim. Past Discuss., author comment AC1
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Reply on RC1

David T. Liefert and Bryan N. Shuman

Author comment on "Expression of the "4.2 ka event" in the southern Rocky Mountains, USA" by David T. Liefert and Bryan N. Shuman, Clim. Past Discuss.,
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We thank the reviewer for constructive comments on our manuscript. Our responses and associated changes are copied below and will be included in any revisions.

Obviously your interpretation rests on $\delta^{18}O$ being weighted more towards the spring. You do justify this well using the conductivity data, $\delta^{18}O$ - $d^{13}C$ covariance, etc. Ideally you would have used sediment traps to establish when most carbonate is deposited in a year – maybe something to think about if you continue your work on this lake as then you'd be able to know with more certainty when carbonate precipitated.

Sediment traps would indeed help to clarify the timing of carbonate production in the lake and aid in interpreting the isotope record. Installing sediment traps over winter would be challenging because there is very little liquid water between the lake bed and overlying ice, and some carbonate production could occur within the bottom sediments rather than water column. However, measuring sediment in summer would be straightforward and informative. We added text to suggest these measurements in future work, as indicated below.

As I say above, if the $d^{18}O$ is just influenced by snowpack change, is "drought" really the best word to describe the 4.2ka event here? But anyway, clear some hydroclimate change going on, which is useful to know.

We agree that referring to the climate event described here as "hydroclimate change" would be accurate and broadens the scope of potential environmental changes that had affected our record, such as a reduction in snowpack. Because reduced snowpack is a type of drought (often referred to as a "snow drought"), the term "drought" also accurately portrays the type of hydroclimate change indicated by our record. Describing the event as a drought is also consistent with the interpretations and description of the nearby pollen-derived climate record in the Medicine Bow Mountains, WY, by Carter et al., 2018. To be transparent about our interpretations of the record, we have dropped the word "drought" from the title of the manuscript but continue to reference droughts throughout the text where it is supported by analyses of the specific hydroclimate changes and publications with similar conclusions.

I'm not really sure why you have plotted the age model and the LOI on the same graph.

Overlaying the age model and LOI helps to illustrate the relationships of sediment accumulation and carbonate production. For example, high rates of net sedimentation correspond with intervals of high carbonate flux into the lake, indicating that carbonate production may largely control sedimentation rates. The data shown in the first panel of Fig. 4 helps to clarify that this relationship is not true for carbonate content, which was both high and low through the fast-sedimentation interval. The age-depth model also controls the inferred timing of sediment and isotope changes, and overlaying the data helps to show that the model is well constrained within positive isotope excursion centered at around 4 ka when carbonate values were low but the carbonate flux was high.

You say "Ostracod tests were present in less than 10 of the 300 samples." Obviously these could have different $\delta^{18}O$ to endogenic calcite. Can you just briefly confirm that these aren't all around 4.2ka or something, to check they aren't responsible for the excursion at that time.

Ostracods and other materials were noted during sample preparation and later confirmed to not be found in this section of core. They are also unlikely to explain trends in the data because the sedimentation rate was very high at around 4.2ka, meaning that nearly 0.5 m of sediment accumulated during the positive isotope excursion, far more material than had contained ostracod tests throughout the entire length of the core (3.3 m).

Line 382 – just Shipley et al., 2008

Line 383: The citation has been corrected.

Line 480: We added the text "Installing sediment traps during the ice-free season could clarify the timing of carbonate production."

Best wishes,

David Liefert on behalf of all co-authors