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Climate of the Past Discussions

Interactive comment on "Aptian-Albian clumped isotopes from northwest China: Cool temperatures, variable atmospheric pCO_2 and regional shifts in hydrologic cycle" *by* Dustin T. Harper et al.

Anonymous Referee #2

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Harper et al. use pedogenic carbonates and paleosol elemental geochemistry to develop new temperature, precipitation, and pCO2 estimates of "mid" Cretaceous paleoclimate in northwest China. They use these records to confirm previous reconstructions, and to suggest that these conditions may represent examples of thresholds in shifting Hadley circulation at this time.

Overall this work contributes useful new data for the region and time period, but could benefit from a refocus of the work within geographic context and with additional discussion of regional climate and potential uncertainties. Below are some comments on

particular aspects of the work that could be improved or reevaluated before publication.

Comments and revisions:

1) Improve editing of the manuscript throughout (incorrect agreement, missing words, etc.).

2) Is the -8.23 per mil correction for δ13Ca reasonable for this period, given the existence of glendonites and the low temperatures and low pCO2? Cooler, low-pCO2 periods during the Cenozoic have substantially higher δ13Ca values (-5.5 to -6.5 per mil; Tipple et al., 2010), which may change your eventual pCO2 estimates (make them slightly higher?).

3) CALMAG is an elemental ratio, and should not be reported in % (e.g., Nordt et al., 2010).

4) These cathodoluminescence images are concerning. High luminescence indicates substantial Mn, Fe, etc. which is usually indicative of diagenesis (e.g., Driese & Mora, 1993; Budd et al., 2002), which appears to be what you sampled. Also, the final image (Figure 3, sample 6-042) is incorrectly illuminated and the bright region is just showing an incident beam from the CL (which is not calibrated across the surface). You may want to reevaluate your data to distinguish between samples selected from different regions of the carbonate nodules, and confirm that the presented data are from primary materials.

5) Why do you need Figure 6 showing different paleogeographies? Unless you add in simulations of MAT and δ18Omw as an overlay (e.g., Zhou et al., 2008; Hasagawa et al., 2012), this doesn't really contribute to the paper. Instead just rely on Figure 7 to show what you're arguing with respect to paleogeography, and perhaps expand the discussion of this point to match.

6) CALMAG values reported are different in the Results vs. the Discussion- does the version in the Discussion and in Figure 5 include non-B horizons? Check this and

revise (or specify) as needed. The CALMAG-derived MAP fit in Figure 5 is also overly smoothed- there are not enough data points for the level of smoothing (moving average I assume?), which results in data artefacts like the curve at $\sim$40m.

7) You are reporting false precision in δ18Omw and temperature (and raw data tables too)- edit this to reflect precision within reported uncertainties.

8) Your highest pCO2 values come from samples outside the "accepted" Δ13C range for this proxy (e.g., Cotton and Sheldon, 2012). As a result, perhaps all of your estimated values suggest low pCO2 for this period (<500ppm)? If so, does this mean C10 is non-unique, and that there is no reason to expect a shift in Hadley circulation during the mid-K? Also, why are you reporting partial uncertainties for pCO2 estimates instead of using error propagation for each component measurement (e.g., Retallack, 2009)?

9) How do your reported δ18Omw values show changes in hydrologic cycling during the Aptian/Albian? The relatively limited isotopic range (+/-2 per mil) matches the range reported from modern environments in the same region (c.f., Zhangye and Lanzhou), and MAP shows no clear trends through time (as well as a limited range of 600-1000 mm/yr). I don't see strong evidence for either changing MAP or δ18Omw across this interval (or a drop in pCO2) that would suggest a shift in Hadley Cell circulation. Are there other sites in the region to which you could compare (and perhaps make a spatial argument for the existence/location of cell boundaries; e.g., Hasegawa et al., 2012)?

10) What does Figure 1 show? The placement of your sampling sites relative to one another is inconsequential to this work. Could this figure be used more effectively to show relationships between White Pagoda and other studied sites in the region (e.g., for comparison in an evaluation of Hadley extent, as above)?

11) Something to consider, though maybe impractical for this work, is that most recent clumped isotope work suggests that <5 replicates is probably insufficient for appropriately constraining Δ47, and that 2σ are probably more realistic for compounded

uncertainties in paleotemperature estimates (e.g., Fernandez et al., 2017; Bernasconi et al., 2021).

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