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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.

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Response to Review 3 (Hilary Corlett)

Reviewer Commentary:

I was asked to provide a review focused on the reviewer comment below and Figure 3 from cp-2020-152.

The reviewer comment is: 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.

Please find my review below: I would agree that the images are concerning. They looked odd to me and when I read the text, the method of "Macroscale imaging through the 50 mm top window of the chamber was carried out using a 16 Mpx Canon EOS SL1 DSLR camera with a macro lens suspended over the CL chamber" may explain why the luminescence is not what you expect from a standard CL image. These images would normally be taken with a C-mounted microscope camera or C-mount DSLR, or if C-mount is missing, then you would use an ocular mounted USB microscope camera or DSLR. The luminescence in the photos may be exaggerated in some way, which may be why the reviewer is concerned. Also, the review is correct about the last image where it is showing the incident beam. This image should not be used. The cause of luminescence is Mn, and Fe is more of a quenching element. If these nodules formed under slightly reduced conditions, you would expect there to be some uniform, dull orange luminescence. In a pedogenic environment, you may expect there to be some luminescence because pore waters forming these nodules may be relatively Fe poor, if the Fe is oxidized, as is the case in these types of environments.

I wouldn't agree (with the reviewer's comment) that any luminescence at all means diagenesis. Given the fact that the zones indicated as "primary" have a uniform luminescence in the first two pictures, as long as the isotope data is fairly consistent (i.e. showing several data points in a narrow range), I wouldn't say these have been diagenetically overprinted. The third image has a more mottled appearance and therefore, may have experienced some diagenesis. It is impossible to say anything about the

fourth image because it is just showing the incident beam and causing one area to be more brightly illuminated than the surrounding. The best example here is the first image with a uniform orange/yellow luminescence of the nodule, marked as primary, and the fracture with mottled appearance marked as secondary.

The final word from me would be: 1) get rid of the last image, 2) mention that the method of photography used here may have resulted in overexposure of the CL images, and 3) only images 1 and 2 are convincing as "primary" formed from slightly reduced water, enriched in Mn. If the third nodule also resulted in isotope data that falls within the range of the first two, then this mottled appearance may just indicate this nodule has experienced minor diagenetic alteration or when it formed, it incorporated some of the matrix into the nodule, giving it a less uniform luminescence.

For context, I am a carbonate sedimentologist with a primary research focus on diagenesis. I am familiar with CL of carbonates but have not read the rest of the paper as I was only asked to provide this limited review. The review process required me to fill in the recommendations, but please note that my recommendation is limited to the CL imagery and interpretation. For all of my other recommendations, I defaulted to the median.

Hilary Corlett

Author Response:

We greatly appreciate the comments on our CL work and on the previous review of our CL work. The specific recommendations are clear and make sense. They will be implemented prior to our next manuscript draft submission. Specifically, we will:

1) Remove the last image and take new images which follow a more standard approach as Dr. Corlett describes.

2) If any previous CL images are included, we will mention the difference in methods which may have resulted in overexposure.

3) We appreciate and agree with Dr. Corlett's interpretation of "primary" luminescent material from Mn-enriched reduced water sources, and that the mottled appearance of nodule 3 (sample 3E-001) compared with samples 3-021 and 3A-097 is due to differences in matrix incorporation. This is bolstered by our isotope data for 3E-001 which falls within ranges of samples 3-021 and 3E-001, with comparable δ13C and δ18O standard deviations among multi-spot samples. We plan on updating the text to include these arguments and interpretations prior to the next draft submission.

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