

Clim. Past Discuss., referee comment RC1  
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## Comment on cp-2021-81

Anonymous Referee #1

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Referee comment on "Early Eocene carbon isotope excursions in a lignite bearing succession at the southern edge of the proto-North Sea (Schöningen, Germany)" by Olaf K. Lenz et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-81-RC1>, 2021

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This paper presents carbon isotope data of bulk organic matter ( $\delta^{13}\text{C}_{\text{TOC}}$ ), organic carbon content, and palynomorphs from an Early Eocene study site in Germany. The authors provide a new age model for the section and despite the variability in carbon isotope values, try to make educated interpretations to outline up to six potential negative carbon isotope excursions (CIEs). A full assessment of the intricacies of the lithological interpretations and stratigraphic framework is outside my area of expertise. That said, the paper appears to provide a lengthy description of observations.

One particular challenge is that there is a lot of variability in the  $\delta^{13}\text{C}_{\text{TOC}}$  values, which is a problem with relying on bulk organic matter to define carbon isotope excursion intervals. The authors do provide some context relative to other sections, especially with regards to the variability in the isotope values. I cannot help but wonder if others looking at the carbon isotope values would draw the same conclusions because of the variability.

It does seem like this paper is a helpful addition to constraining an additional study site of Early Eocene CIEs. This would be constructive for future work analyzing this area and for comparison to study sites in other regions to understand climate in the past. I think it's important to better note the level uncertainty in the results and age correlations to avoid oversimplification though.

Has any attempt been made to do compound-specific isotopes to help define the carbon isotope excursions? I think it would be worth mentioning this in the paper. For example, Ln 423 refers to work from the Bighorn Basin, where more recent work by Baczynski and others have provided evidence for how bulk organic matter carbon isotopes values can be distorted indicators of CIEs (as a function of a combination of organic matter sources, reworking of organic matter, and degradation). See for example, Baczynski et al. 2016 <https://doi.org/10.1130/B31389.1>

More specific comments:

Ln 99. The frequent changes between terrestrial and marine conditions and thus changes in TOC input type can be a challenge for sourcing. Mixed inputs would affect the  $\delta^{13}\text{C}$  of the bulk organic matter.

Ln 165. The figure number of the diagram needs to be specified.

Ln 276-281. How does the variability compare to other well-constrained CIEs and other sections with similar lithology changes as this section? In Ln 279, "comparatively high standard deviation" – what are the authors comparing to? What is causing the high variability, the "great range of  $\delta^{13}\text{C}_{\text{TOC}}$ "?

Ln 280. "significant decrease". On what statistical basis was this determined to be significant?

Ln 333. "values increase significantly" As above, are there statistics to attest to the significance?

Ln 342 "a weak CIE". Weak is a qualitative term, information on the magnitude of the excursion/time or depth interval/number of samples could help clarify the identification of this CIE.

Ln 389. I think the authors meant 1,000 years (1 kyr), not 1.000 years.

Ln 422. Can you provide and clarify the evidence that rules out reworking of organic matter? This is again stated in the conclusions, Ln 489, reworking is almost excluded within our seam. As far as I can tell, the logic may be that the rebound structure is consistent with the pollen and spore record...but that doesn't mean reworking couldn't also be a factor?

Table and Figure comments:

Table 1. What do the parentheses indicate vs. non-parentheses for the references? Also check for consistent spacing in the table between words.

Table 2. It would be useful to specify what stratigraphic positions (meter levels) were used for each of the identified excursions.

Figure 1. It looks like there is an extra space in the "Seam 7" label.

Figure 3. Is there any meaning between the different number of dots in the lines in the legend for global sea level curves?

Figure 6. I realize the authors may be citing the units used in the other publications, but it's unclear to the reader whether there is any meaningful difference between the types of organic matter. For example,  $\delta^{13}\text{C}_{\text{org}}$  "organic matter" versus  $\delta^{13}\text{C}_{\text{TOC}}$  "bulk organic matter".

Figure 7. Clarify is the carbon isotope data here from bulk organic matter?

Figure 8. TOC for the carbon isotope record should be subscript.