



EGUsphere, referee comment RC1
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Review

Eric Barefoot (Referee)

Referee comment on "Fluvio-deltaic record of increased sediment transport during the Middle Eocene Climatic Optimum (MECO), Southern Pyrenees, Spain" by Sabí Peris Cabré et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-891-RC1>, 2022

Synopsis

Using two new isotope and stratigraphic sections in the west-central Pyrenees, Cabré et al study the connection between the Middle Eocene Climatic Optimum (MECO) and sediment supply. Working in the Tremp-Jaca Basin, the authors collected geochemical and sedimentological data from two stratigraphic sections. These sections target two separate deltas, which were part of a common depositional system that deepened westward, created by subsidence in the Pyrenees foreland basin. The authors measured stable carbon and oxygen isotopes, trace and major elements, as well as organic matter composition and maturity. They synthesize these data into a new understanding of this basin during the MECO.

Their main findings are supported by two key observations:

- (1) The authors observe that the MECO coincides with two episodes of delta progradation in this basin. The authors assert that this is due to enhanced sediment supply due to changes in hydroclimate. They reject a suite of alternative hypotheses (enhanced uplifting, eustatic sea level, etc.)
- (2) The authors observe that patterns in stable isotopes of oxygen from their stratigraphic sections parallel patterns in the global ocean and other basins, patterns of carbon isotopes do not. Based on this observation, they assert that because the deltas are prograding into a restricted ocean basin, the carbon isotope signature is dominated by local effects (provenance, local chemistry) rather than a global input of depleted carbon. It is not made clear why oxygen isotopes are not affected by these processes. The authors assert that diagenesis effects have not altered their samples substantially.

Based on these main findings, the authors conclude that in the Iberian peninsula, climate-induced episodes of enhanced erosion are connected to transient warming and changes in hydroclimate. This bolsters similar findings from strata across the Pyrenees during the Eocene. The MECO is relatively long-lived (~ 500kyr) compared to its shorter counterpart hyperthermals during the EECO (e.g. PETM (~ 200kyr)). Given this, the authors suggest

that the MECO may be a good test case for understanding feedbacks between the carbon cycle, hydrological cycle, and other Earth systems.

Overall Comments

I read this paper with interest, and a fair bit of initial skepticism. The authors have identified a good case study for an important problem. In many stratigraphic studies like this one, there are major issues of resolution and timing. This is particularly a problem with Eocene hyperthermals, where the hypothesized duration of a climate "episode" or "event" is brief enough ($< 100\text{kyr}$) that it can be distorted, disguised, or destroyed entirely by sediment transport processes in the sedimentary basin. On the other hand, if a climate episode is very long ($> 1\text{Myr}$), then there are few terrestrial basins that can record the full length of the event without major issues of changing subsidence rates and basin filling, etc. This basin, and episode of interest, appears to lie in a kind of optimal middle ground, where the MECO is long-lived enough that one can be reasonably sure to capture the signal despite transport processes, and yet short enough given the basin size to ignore tectonic issues.

With the aid of this well-chosen field site, the authors have done a really nice job of constraining the problem. By leaning on a firm grounding in regional literature and collecting a comprehensive suite of data, the authors have persuaded me that their model is the most likely scenario. I found the observations to be appropriate, well-reasoned, and well-documented. The analysis of these observations is careful, and clearly articulated.

Overall, I think this is a very well-executed study, it will have substantial appeal to readers of *Climate of the Past* across disciplines. I expect it may spark some increased interest in studying the MECO, and may serve a touchstone for motivating studies that join the best insights of sedimentary geology and paleoclimate. I have a few minor comments and questions for the manuscript, but after those have been addressed, I think it would make a good contribution to CP.

For details, see the attached document that lists minor comments. The authors should feel free to reach out to me if they have any questions about my review.

Eric Barefoot

Please also note the supplement to this comment:

<https://egusphere.copernicus.org/preprints/2022/egusphere-2022-891/egusphere-2022-891-RC1-supplement.pdf>