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Science Editor
Prof. Shiling Yang
Climate of the Past

Topic: EGUSPHERE-2025-2619 Response to reviewers

Geneva, 10 February 2026

Dear Prof. Yang,

Thank you for handling our manuscript and for the opportunity to revise it. We have carefully addressed all comments from the reviewer and revised the manuscript accordingly.

We have added a paragraph discussing the unlikely Marine Authigenic Aluminosilicate Clay formation in the Rin section.

We hope these revisions fully address the reviewers' concerns and improve the clarity and robustness of the manuscript.

Please find below the point-by-point response to the reviewers' comments and queries.

Color coded:
Reviewer comment / Response and modification

On behalf of all co-authors,

Sincerely,

Rocío Jaimes Gutiérrez (she, her)
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Suggestions for revision or reasons for rejection

After carefully reading the response document from the authors, which answers my previous question, I found it generally solved most of my questions. One thing that I am still not fully convinced about is the contribution from marine authigenic alumino-silicate clays (MAACs), which is declared to be negligible to the bulk sediments. The authors suggest that MAAC formation is unlikely to happen in a coastal setting. However, researches have shown that MAAC formation predominantly happens in coastal settings, where supply of terrestrial Al- and Fe-bearing detritus is sufficient (**Geilert et al., 2023; Tréguer et al., 2021**). In my opinion, one argument that the authors could probably make is that although MAAC formation might been intensive in coastal setting, it is often masked by the large amount of terrestrial detrital, resulting in a contribution of less than 2% (mass fraction) to the bulk sediments (**Bernhardt et al., 2020; Presti and Michalopoulos, 2008**). Based on this, for example, the author could also do a mass-balance estimate, assuming a range of MAAC δ7Li, and times it with 2% (or some similar values), to quantify the potential influence of MAAC on the bulk sediment δ7Li. Another line of evidence that might help is from **Trapp-Müller et al. (2025)**, who suggested that MAAC formation is unlikely to happen in coastal settings under low continental weathering intensity, due to the delivery of cation-rich terrestrial materials, rather than cation-poor ones.

Added to main text, lines 472 to 489:

An influence from Marine Authigenic Aluminosilicate Clay (MAAC) formation is feasible in the coastal setting of the Rin section, but is unlikely to have been a significant driver of changes in the lithium isotope record given the dominance of continental inputs. In marine sediments, clay mineral assemblages dominated by kaolinite, illite, smectite, and mixed-layer illite/smectite are generally interpreted as mainly detrital in origin, reflecting continental weathering and fluvial transport rather than in situ marine precipitation (Thiry, 2000; Fagel, 2007; Velde and Meunier, 2008). Although the authigenic formation of these clay minerals is known to occur in marine environments, it is typically restricted to specific conditions or processes, such as the alteration of volcanic ash, or evaporitic or hydrothermal settings, and is therefore not expected to be significant in shallow, nearshore depositional systems with high terrigenous sedimentation rates (Środoń, 2001; Wise et al., 2001; Meunier, 2005). In contrast to glauconite or other green clays, which may form authigenically under low sedimentation rates, kaolinite and illite in coastal marine settings are widely regarded as inherited from continental sources (Thiry, 2000; Meunier, 2005; Fagel, 2007; Presti and Michalopoulos, 2008; Bernhardt et al., 2020). Given the dominantly continental depositional setting of the Rin section and the large detrital clay input inferred for the nearshore environment, any MAAC contribution is expected to have been minor relative to the terrigenous signal. MAAC form from isotopically heavy seawater or porewaters and are therefore expected to have δ^7Li values substantially higher than detrital clays (Pogge von Strandmann et al., 2021a). A simple mass balance indicates than even under extreme assumptions (i.e. 2 wt.% MAAC, 10‰ δ^7Li values), such a contribution would shift bulk values by <0.3‰, far smaller than the observed PETM excursion.

Also to mention is the observed increase in kaolinite abundance of the Rin section.
Note that two plausible explanations have been listed. If the former is the case, then it seems to contradict the interpretation of a declined weathering intensity.

Thank you for raising this point. Although kaolinite abundance increases during the PETM in the Rin section and δ^7Li show a positive excursion, this does not imply higher weathering intensity *sensu stricto*, because physical erosion and sediment export increased even more strongly, leading to a net decrease in W/D despite enhanced absolute clay production.

In the text, lines 572-587:

The Southern Pyrenees during the PETM was a relatively high-erosion regime, such that physical erosion dominated, increasing the sediment supply and exposing fresh minerals (Schmitz and Pujalte, 2007; Pujalte et al., 2015, 2016; Chen et al., 2018; Prieur et al., 2024, 2025). When erosion exposes fresh minerals, weathering rates increase with total denudation, albeit less strongly than the increases in erosion, consistent with shared controls on chemical weathering and physical denudation rates (Riebe et al., 2004; West et al., 2005). Even though high-relief regions produce weakly weathered sediments, their high sediment yields and moderate clay formation rates result in elevated weathering fluxes (Gaillardet et al., 1999). Therefore, we propose that the Southern Pyrenean floodplains record a shift from a high-weathering intensity regime to a moderate-weathering intensity regime during the PETM (**Fig. 7**). The pre-PETM conditions were characterised by a low reactivity of the parent lithology (Kump and Arthur, 1997; Caves Rugenstein et al., 2019), associated with the carbonate-rich, reworked sediments in the floodplain deposits, and hence low total weathering fluxes. The above scenario is also consistent with the "system-clearing" event documented in western North America (Foreman et al., 2012), where sediment transport surged in response to rapid climatic forcing, as well as with other Eocene warming events such as the Mid-Eocene Climatic Optimum, which saw a shift towards enhanced clay formation and a lower weathering intensity (Krause et al., 2023).

Some minor issues:

Line 263 and 264, the unit of 0.02 and 0.5-1.2 should be “°” and “°/min”
Corrected

Line 270, a typo in “the”
Corrected

Line 276, “2” in CO2 should be a subscript.
Corrected

Line 391, I think it should be dashed lines in panel A, not “grey bars”
Corrected

Line 540, the citation should be in parentheses.
Corrected