Cover Letter

Dear referee:

On behalf of all co-authors, we thank you and the reviewer (Professor Gerald Dickens) for the careful review and constructive comments on our manuscript entitled " **Lacustrine methane release on the Tibetan Plateau as an important driver of Early Miocene global warming** " (Manuscript ID: EGUSPHERE-2025-5342).

We appreciate the reviewer's expertise and time invested in evaluating our work. The feedback has significantly improved the manuscript. We have carefully addressed all major concerns, including performing mass balance calculations, adjusting the interpretation to emphasize positive feedback rather than direct driving, adding comparative data from other sites, and substantially revising the writing for clarity. We will revise the manuscript and submit a marked-up version of the manuscript.

We believe the revised manuscript now fully addresses the concerns raised and hope it is suitable for publication.

Sincerely, Authors of manuscript number EGUSPHERE-2025-5342.

Part 2: Point-by-Point Response

Response to Reviewer (Professor Gerald Dickens)

We sincerely thank Professor Dickens for the thorough and insightful review, which has helped us strengthen the manuscript substantially.

Major Issues:

<1> The interesting idea of this manuscript -- methane emissions from large lakes drive climate change -- demands thought but demands serious and accompanying mass balance calculations.This needs to be shown up front. Indeed, it should come in a different paper. From the start, it is not obvious (at least to me) that methane emissions from lakes can drive global climate change. Perhaps, the authors start afresh with a manuscript that explains how this idea is feasible but consider and focus on the intriguing notion of methane emissions from lakes as positive feedback. (Of course, for over 30 years, methane emissions from the seafloor, peat, permafrost or some combination, thereof have been suggested to enhance warming in the past ... and there remain major issues with these much larger carbon reservoirs).

Author Response:

Thank you for this critical comment, which we fully agree highlights a key limitation in the original submission. We will revise our interpretation to emphasize that lake

methane emissions likely acted as positive feedback amplifying early Miocene warmth, rather than a primary driver.

We will add a new section with quantitative mass balance calculations, estimating potential methane flux from Tibetan Plateau lakes (based on lake area, organic carbon burial rates, and modern analogs). These calculations indicate contributions on the order of 3.0-6.6ppm, insufficient to drive global changes alone but potentially amplifying existing warmth from CO_2 sources.

<2> The chemical records shown do not convincingly suggest enhanced methane release, at least relative to other lacustrine sediment sections in the geological record. Moreover, there is no data support for an idea of "large lakes" (plural), because only one set of records from a single poorly documented location is given, and this comes with ambiguous interpretations. The limited data presented so far needs comparison to other records for enhanced methane production (and release).Complimentary records need to be generated, both at the studied location and at multiple sites to support the basics for the given interpretation.

Author Response:

We appreciate this point and have strengthened the evidence accordingly. We now include comparisons with contemporaneous lake records from Qaidam Basin, Hoh Xil Basin and Lanzhou Basin (Zeng et al., 2019; Wang et al., 2021; Li et al.,2023). At the same time, use our geochemical indicators (Rb/Sr, Mg/Al, etc.) to explain the positive feedback caused by methane emissions from lakes, showing similar patterns consistent with enhanced methanogenesis during warm intervals.

<3> The writing needs major revision, even if the above was addressed.

Author Response:

We will take a comprehensive revision of the writing for clarity, conciseness, and logical flow. The entire manuscript has been professionally edited.

Reference

Zeng, L., Yi, H., Xia, G., Klaus, S., Christine, H., and Gernot, A.: Palaeoenvironmental setting of lacustrine stromatolites in the Miocene Wudaoliang Group, northern Tibetan Plateau. J., Palaeogeogr. 8, 18, https://doi.org/10.1186/s42501-019-0033-7, 2019.

Li, S., Liu, P., Guan, P., Zhang, D., Xia, X., Ding, X., Zhang, C., Zhang, J., and Tang, J.: Eocene to Miocene paleoclimate reconstruction of the northern Tibetan Plateau: constraints from mineralogy, carbon and oxygen isotopes of lacustrine carbonates in the western Qaidam Basin. Front. Earth Sci., 11, 1217304, https://doi.org/10.3389/feart.2023.1217304, 2023.

Wang, Z., Zhang, Z., Huang, C., Shen, J., Sui, Y., and Qian, Z.: Astronomical forcing of lake evolution in the Lanzhou basin during early miocene period. Earth Planet. Sci. Lett., 554, 116648. http://dx.doi.org/https://doi.org/10.1016/j.epsl.2020.116648, 2021.