Point-by-point responses (in blue) to the Editor and Reviewers' comments:

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Reviewer #1:

1. The methods are missing for how the authors "explored the effect of the orbital cycle on wildfires using long eccentricity" - Where are the values for long eccentricity orbital cycle variation (Fig. 5) derived from? And how was the relationship explored between long eccentricity orbital cycle variation and the data obtained in this study? It appears that the interpretation that orbital forcing is driving wildfire frequency is simply a visual observation (Fig. 5). Based on this, I think it is acceptable to interpret that wildfire frequency "may be related to the forcing of the long eccentricity orbital cycle" but to interpret this with significance - and include "orbital scale" as the beginning of the title requires a more quantitative astrochronologic model (comparing curves from Fig. 5 to the known long eccentricity orbital cycle variation from the Late Carboniferous).

Thanks for your suggestions. We have revised the wording to 'may be related to the forcing of the long eccentricity orbital cycle.' Due to the limited number of samples, we were unable to establish a quantitative astronomical orbital model. However, following your advice, we found an appropriate curve for the long eccentricity orbital cycle variations. Wu et al. (2023) reviewed Paleozoic cyclostratigraphy and established an astronomical time scale based on published paleoclimate proxy time series. By comparing our data with the quantitative astronomical orbital model under age constraints, we found that the results were consistent with our initial assumptions. Additionally, we are merely proposing a hypothesis, and further research will be conducted in this area in future studies. We also hope to spark interest among other scholars in studying the influence of Late Paleozoic orbital cycles on wildfire intensity.

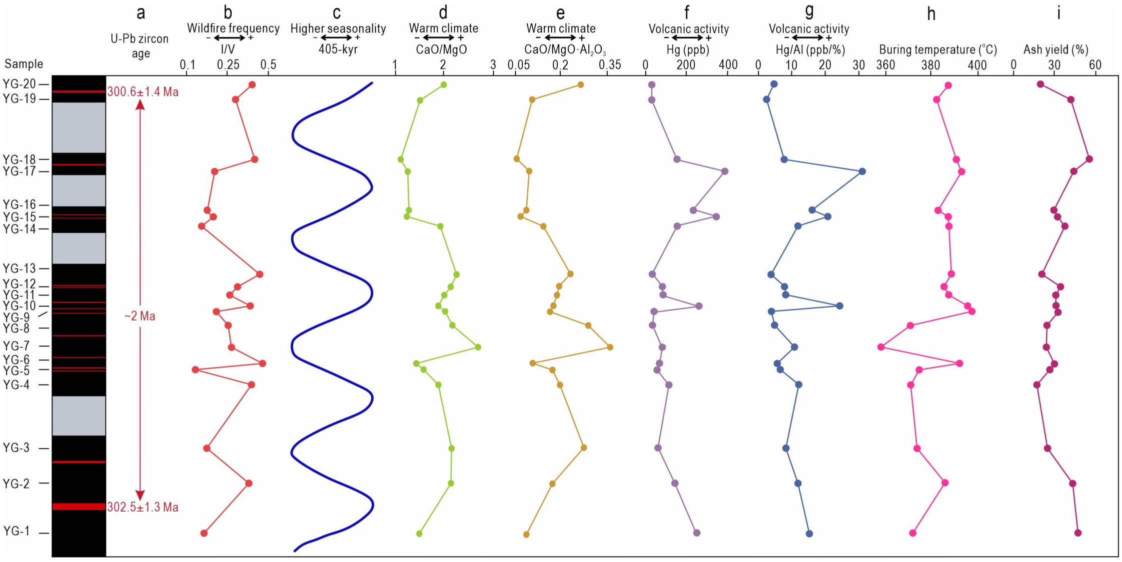

Fig. 5 Comprehensive analysis map of No.9 coal in Yaogou Mine. (a) Age of No. 9 coal, referred to Zhang et al. (2023a). (b) Inertinite/ Vitrinite variations in 20 coal samples. (c) Long eccentricity orbital cycle variation, referred to Wu et al. (2023). (d) CaO/MgO trends in 20 coal samples. (e) CaO/MgO • Al2O3 trends in 20 coal samples. (f) Hg content trends in 20 coal samples. (g) Hg/Al trends in 20 coal samples. (h) Combustion temperature trends in 20 coal samples. (i) Ash yield trends in 20 coal samples.

2. In this study, high (Ca/Mg)*Al during periods of greater wildfire frequency (YG #10-13) is interpreted to reflect a warm and humid climate, and low (Ca/Mg)*Al during periods of less frequent wildfires (YG #14-17) is interpreted to reflect a cold and dry climate. There are a few issues with this: (1) The relationship between I/V and (Ca/Mg)*Al (Fig. 5) even visually does not appear to be consistent. To make this point requires a crossplot with a trendline (and r2 value) showing this relationship rather than just listing YG #10-13 as high/hot humid and YG #14-17 as low/cold arid. Also (2) please consider that Ca and Al content can be influenced by changes in provenance and/or transport mechanisms as opposed to recording a signal of climate (cf., Demirel-Floyd et al., 2023; https://doi.org/10.1130/B36888.1). At first, this seems like it may not be as much of an issue given that these are coal deposits, but when I look at Figure 5 next to Figure 1, I notice a lot of variability in the Ca/Mg ratio within the same coal beds… It also in some places (e.g., the base YG #1-3 and top YG #19-20 of the section) it seems like the mineralogy (Al, Ca) may be responding to the influx of ash. Accordingly, it may be helpful to have a “j” column on Fig. 5 with the same red/black symbology from Fig. 1 to demonstrate which of these samples are from the same contiguous coal beds (separated by detrital influx) and where there are ash beds dispersed between them.

Thanks for your suggestions. We attempted a correlation analysis between I/V and (Ca/Mg)*Al, but the results were not ideal. As you mentioned, the concentrations of calcium and aluminum may be influenced by changes in source material and/or transport mechanisms. Zhang et al. (2023) already noted that there were frequent and intense volcanic activities in Coal Seam No. 9, and a certain amount of volcanic clastic material was present in the coal. Some of the Mg and Ca may have been affected by volcanic activity, leading to signal interference. As a result, the outcomes of the quantitative analysis were not ideal, and we were only able to conduct qualitative discussions.

3. There are several tonsteins directly within the study area that demonstrate the abundance of volcanic activity during this time… It might be worth mentioning that globally during the Late

Carboniferous there is evidence of anomalously frequent volcanism (see Soreghan et al., 2019) that complements the data presented herein and further supports the interpretation that Hg enrichment is driven more by volcanism than by wildfires during this time.

Thank you very much for your suggestion. The relevant content has been added to the manuscript.

4. It is not critical, but dating the interbedded tonsteins would strengthen the story about wildfire frequency derived from I/V ratios, and an astrochronologic model (if the authors decide to go in that direction).

Thanks for your valuable review. We appreciate your suggestion to date the interbedded tonsteins to strengthen our story. However, due to the focus of our current study and resource constraints, we have decided not to pursue this additional analysis.

5. It might be interesting to evolve the discussion in 5.3.2 to explicitly state how the (new) data fits into this regional/global framework, and also to acknowledge that the No. 9 coal of the Yaogou coal mine only records 2 Myr of climatic variation-It will be interesting to continue to test how these interpretations fit within the broader Gzhelian record/broader regional Gzhelian paleoclimate interpretations.

Thanks for your suggestions. The relevant content has been revised.

6. I suggest highlighting on Fig. 1 which of the tonsteins in the No. 9 coal seam constrain the age and maybe list the dates as well (from Zhang et al. 2023a?)

Thanks and done.

7. Missing a % sign on Line 181

Thanks and done.

8. In Table 1 the column titles maybe make a line break to differentiate what is in which category (organic vs. inertinite macerals)

Thanks and done.

9. In Table 1 is “total minerals” the ash yield?

Thanks for your suggestion. “Total minerals” is not ash yield. “Total minerals” indicates the inorganic minerals present in the coal sample.

10. Consider adding calculated V/I and Ro from each sample in either Tables 1 or 2 for easy reference.

Thanks for your suggestion. The relevant data have been added to Table 2.

Table 2

The I/V, R_o and chemical element data of 20 coal samples from the No. 9 coal seam of the Yaogou coal mine in the Ordos Basin. The Al_2O_3, TS, and TOC were from Zhang et al. (2023a).

Sample	I/V	R_o (%)	Hg (ppb)	Al_2O_3 (%)	TS (%)	TOC (%)
YG-1	0.18	1.59	255	16.33	0.23	27.82
YG-2	0.2	1.71	145	11.94	0.39	29.92
YG-3	0.4	1.61	63.2	7.67	0.44	47.30
YG-4	0.41	1.59	118	9.46	0.77	44.14
YG-5	0.14	1.62	58.6	8.96	0.32	48.07
YG-6	0.47	1.77	70.4	12.75	0.41	42.04
YG-7	0.31	1.48	85.1	7.44	0.57	44.72
YG-8	0.3	1.59	35.4	7.42	0.52	48.04
YG-9	0.24	1.81	43.5	11.87	0.45	41.17
YG-10	0.42	1.8	269	10.5	0.59	41.51
YG-11	0.31	1.73	88.5	10.53	0.48	38.10
YG-12	0.35	1.71	83.9	10.74	0.5	35.33
YG-13	0.46	1.74	34.5	9.57	0.48	46.26
YG-14	0.17	1.73	156	12.77	0.35	40.37
YG-15	0.23	1.72	352	16.48	0.42	32.35
YG-16	0.2	1.69	237	14.23	0.32	36.72
YG-17	0.24	1.77	393	12.42	0.36	29.26
YG-18	0.43	1.75	152	17.88	0.29	32.05
YG-19	0.34	1.68	29.5	13.53	0.3	37.95
YG-20	0.42	1.72	29.6	7.57	0.44	46.68

Reference

Wu, H., Fang, Q., Hinnov, L. A., Zhang, S., Yang, T., Shi, M., and Li, H.: Astronomical time scale for the Paleozoic Era. Earth-Science Reviews, 104510, https://doi.org/10.1016/j.earscirev.2023.104510, 2023.

Zhang, Z., Lv, D., Hower, J. C., Wang, L., Shen, Y., Zhang, A., Xu, J., and Gao, J.: Geochronology, mineralogy, and geochemistry of tonsteins from the Pennsylvanian Taiyuan Formation of the Jungar Coalfield, Ordos Basin, North China, International Journal of Coal Geology, 267, 104183, https://doi.org/10.1016/j.coal.2023.104183, 2023.