Principal criteria: Good

General comments

Thank you for the opportunity to review this work. This manuscript represents an interesting contribution within the scope of Climate of the Past, applying a novel combination of geochemical methods to a coal deposit in the the Ordos Basin (North China Craton) to interpret the frequency of Gzhelian wildfires in low latitude Pangea, and hypothesize about the potential orbital/climatic drivers. These questions are of broad interest to the paleoclimate community, especially those of us interested in deconvolving the complex drivers of the Earth's climate system evolution in the Late Paleozoic world. The scientific approach is clearly outlined, the combination of methods applied are creative/complementary, and the results are generally presented in a clean and well-structured way. However, I am not convinced about the relationship between wildfire frequency and the (CaO/MgO)*Al ratios, and I have some concerns about making interpretations about paleo-temperatures/humidities based on these proxies (specifics below). Additionally, I think it's acceptable to interpret loosely 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" in the title may require a more quantitative astrochronologic model.

Specific comments

- 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).
- 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.

- 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.
- 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).
- 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.

Technical corrections

- 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?)*
- Missing a % sign on Line 181
- In Table 1 the column titles maybe make a line break to differentiate what is in which category (organic vs. inertinite macerals)
- In Table 1 is "total minerals" the ash yield?
- Consider adding calculated V/I and Ro from each sample in either Tables 1 or 2 for easy reference.