Climate of the Past Discussions

Clim. Past Discuss., author comment AC2
https://doi.org/10.5194/cp-2021-108-AC2, 2021
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Reply on AC1

Peixin Zhang et al.

Author comment on "Low-latitude climate change linked to high-latitude glaciation during the Late Paleozoic Ice Age: evidence from the terrigenous detrital kaolinite" by Peixin Zhang et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-108-AC2, 2021

Detailed responses to reviewer #1's comments:

Reviewer #1:

- The paper is well written and presents interesting results concerning past climate conditions for North China. However I identified a fundamental issue requiring clarification. Indeed the authors investigate local climate conditions **without presenting and discussing the geological setting of the area**. In the absence of data highlighting the geological evolution of this site, most of statements presented in the discussion (4.2) remain too speculative to support authors' conclusions. I encourage the authors to resubmit their article after significant rewriting of the manuscript, with a full description of the continental environment and its temporal evolution (which explains why I recommend "rejected" rather than "major revision").

Response: We thank the reviewer for their comments here. We added the contents about the geological background and environmental evolution of the study area in section 4.2, and we have added additional figures to demonstrate this.

The details are as follows: "Changes in continental plate position, land-sea distributions, ice extent in Gondwana, atmospheric CO_2 and monsoonal rainfall are considered the main factors controlling climate change in low latitudes during the LPIA (Tabor and Poulsen, 2008; Cao et al., 2017). In the study area, local paleomagnetic data demonstrate that no large-scale plate motion occurred from the early to late Early Permian (Zhu et al., 1996). Through this time interval, the region remained in an equatorial humid climate zone (Zhu et al., 1996) on the southern margin of the North China Plate (NCP) in proximity to the sea (Fig. 9). Following regression of the epicontinental sea in the earliest Permian (Fig. 9a, b), sedimentary environments gradually developed from coastal tidal flat deposition to a series of shallow-water delta sedimentary systems comprising fluvial and tidally influenced offshore peat-bearing deposits (Zhu et al., 1996; Yang and Lei, 1987; Fig. 9). Fossil plants were widespread and abundant, comprising stable, tropical, ever-wet communities dominated by lycophytes, equisetophytes, marattialean ferns and pteridosperms (Zhu et al. 1996; Yang and Lei, 1987; Yang, 2006; Hilton and Cleal, 2007). Collectively, this information builds a picture of stability in continental plate position and land-sea distributions. The sedimentary record provides no evidence of monsoons. Consequently,

we consider that waxing and waning of ice sheets in high latitude Gondwana and changes in global atmospheric CO_2 were the main factors affecting climate change in the study area through the LPIA."

[Please see pdf for revised figure]

Figure 9. Lithofacies palaeogeograpy map from late Bashkirian to Wordian in the North China Plate (modified from Shao et al., 2014).

We collected palaeomagnetic data from the Dafengkou section in Yuzhou coalfield from early to late Early Permian. These data show that from the early to late Early Permian, the paleolatitude change in the study area is between 11.0°N and 11.4°N, that is, it is within the equatorial humid climate zone (Zhu et al., 1996).

Table 1 Permian ancient geomagnetic parameters and latitude in Dafengkou section

Period	sampling point	mean direction of magnetization	α95	stability valuation	Paleomagnetic pole position	Paleolatitude position
D (°)	I (°)	K (°)	Plat.(°N)	Plong.(°N)	Dp	Dm
P^2_1	6	143.2	-21.2	12.9	19.4	R
P^1_1	3	124.9	-22.0	82.1	13.7	R
P_1	9	136.9	-21.7	16.1	13.2	

[Please see pdf for revised figure]

Figure 11. Comparison of climate change, glaciations, $d^{18}O$, and pCO_2 records from the Gzhelian Stage of the Carboniferous to the Roadian Stage of the Permian. Age stratigraphic framework from Shen et al. (2019); **a,** Climate stages interpreted from the studied section; **b,** Interpreted climatic records with blue representing intervals of climate cooling while yellow represents climatic warming based on fluctuating climate signals from kaolinite content from the studied section, and climate type interpreted from the studied section. **c,** Records of glaciation events in Australia from Fielding et al. (2008), Frank et al. (2015), and Garbelli et al. (2019); **d,** Oxygen isotope values from Korte et al. (2005) and Grossman et al. (2008); **e,** Global pCO_2 concentration from Montañez et al. (2007), Foster et al. (2017) and Richey et al. (2020). Note: the red line from Foster et al. (2017), the black line comes from Richey et al. (2020). Abbreviations: Gzh. = Gzhelian; Sak. = Sakmarian; Cli. S. = Climate stage; Clim. type = Climate type; 2_1# = Coal 2_1 seam; Temp. = Temperature.

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