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Climate of the Past
Discussions
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Interactive comment on "Clay mineralogical evidence for mid-latitude terrestrial climate change from the latest Cretaceous through the earliest Paleogene in the Songliao Basin, NE China" *by* Yuan Gao et al.

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The manuscript reported a clay mineralogical record from the late Cretaceous to early Paleocene, especially across the dramatic K-Pg boundary with a high-resolution record, and concluded a novel climate change based on clay mineralogical proxies. The paper is generally well-written and organized. The scope of this manuscript is well-chosen and will meet the broad interest for geologist. I give moderate revision because I think some issues which are the base of interpretations need to be more discussed. The concerns are listed as follow:

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Response: We appreciate the helpful comments by Anonymous Referee #3.

1. The authors chose mudstones rather than sandstones to avoid the authigenesis during the diagenetic stage. However, how to prevent the influence of clay minerals from pedogenesis, which was widely developed throughout the SMF (in lines 152-153). In the pedogenic process, in general, clay minerals could form in solutions or transfer from other clays. The authors claim the clay minerals need to be primarily detrital in origin to use for paleoenvironmental reconstruction (Lines 240-241). However, two sources of smectite are discussed in the manuscript, in which in-situ formation is not excluded (Lines 264-265). It seems too simple to describe the factors affecting the interpretation of clay mineralogy, such as parent rock weathering, pedogenic formation, and differential settling on origins. (Lines 283-292).

Response: We rewrote section "5.1 Origin and paleoclimatic significance of clay minerals in the SMF of the SK-1n core" to better constrain the origins of clay minerals and the rationales of clay mineralogical indicators as paleoclimatic proxies. We consider weathering of parent rocks and pedogenesis as two main origins of clay minerals of SMF. In a wetter hydroclimate, with an intensified hydrologic cycle, increased chemical weathering on parent rocks and higher rates of transformation and neoformation in soil profiles are expected to generate more smectite versus illite, higher illite chemistry index, and more clay minerals versus clay-sized quartz. We also consider other sedimentary processes, such as differentially settling and sedimentary recycling, have little influence on our clay mineralogical records, because the Songliao Basin contained only small ponds or lakes and had a relatively flat morphology at the latest Cretaceous. Please see text for more discussions.

2. According to Lines 188-194, the authors seem to add random mixed-layer illite-smectite to smectite when semi-quantifying the abundance of smectite based on the 17 Å peak area. As a matter of fact, the random mixed-layer illite-smectite could be a very wide peak between 10-15.5 Å under air-dry XRD pattern, which will split into two peaks at _17 Å and 10 Å after ethylene-glycol solvation. From Figure 3, we can tell the

intensities of peaks at 10 Å enhanced after ethylene-glycol solvation besides the enhancements of peaks at _17 Å. From this point of view, the semi-quantitative amount of smectite could be questionable. Furthermore, the mixed-layer illite-smectite is an independent mineral phase, which could be the detrital phase from old strata or authigenic phase transformed from illite during pedogenesis. The amount of mixed-layer illite-smectite will likely affect the proportions of other clay minerals. Why the randomly ordered mixed-layer illtie-smectite and smectite have similar origin and paleoclimatic significance (Lines 253-254)?

Response: Actually, none of the panels in Figure 3 show the intensities of peaks at 10 Å enhanced after ethylene-glycol solvation, but all the panels show enhancements of peaks at ∼17 Å. This indicates smectite is the predominant mineral phase rather than I-S mixed layers. We consider the minor I-S mixed layers are also derived from weathering of feldspar, mica in parent rocks or transformation from illite during pedogeneis, similar to smectite.

3. In Figure 2, I suggest the authors add the age constrains, and then readers can know clay mineral trends and mutations along with the age.

Response: We revised Figure 2 following this comment.

4. I suggest the authors point out which pattern denotes what kind of treated slides in Figure 3. I can understand the black, blue, and red curves denote patterns of air-dry, ethylene-glycol solvation, and heating at 490 _C, respectively, which could not be the case for non-clay mineralogists. From the patterns of heating at 490 _C (Figure 3a, b, and f), we can read the peak at _14 Å could be chlorite. However, why the authors did not present patterns of heating at 490_C to further confirm having or having not chlorite in samples in Figure 3c, d, and e.

Response: We revised Figure 3 following this comment. If depth-adjacent samples have similar AD and EG curves, only selected samples were measured under heated condition. Therefore, patterns of heating were not present in Figure 3c, d, and e.

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5. The author claimed the stronger chemical weathering under more humid climate would produce more clays compared to quartz (Line 297-298). I think it is promising on condition that it happened in in-situ pedogenic profile. However, the grain-size distribution in this study could largely depend on sedimentary process.

Response: We consider in both weathering profiles and soils, stronger chemical weathering under more humid climate would produce more clay minerals compared to clay-sized quartz, as the latter is more likely to form through physical fragmentation. Paleosol layers are very common throughout the SMF of the SK-1n core, which is further promising for the use of the clay/quartz ratio as a paleoclimatic proxy in the current study.

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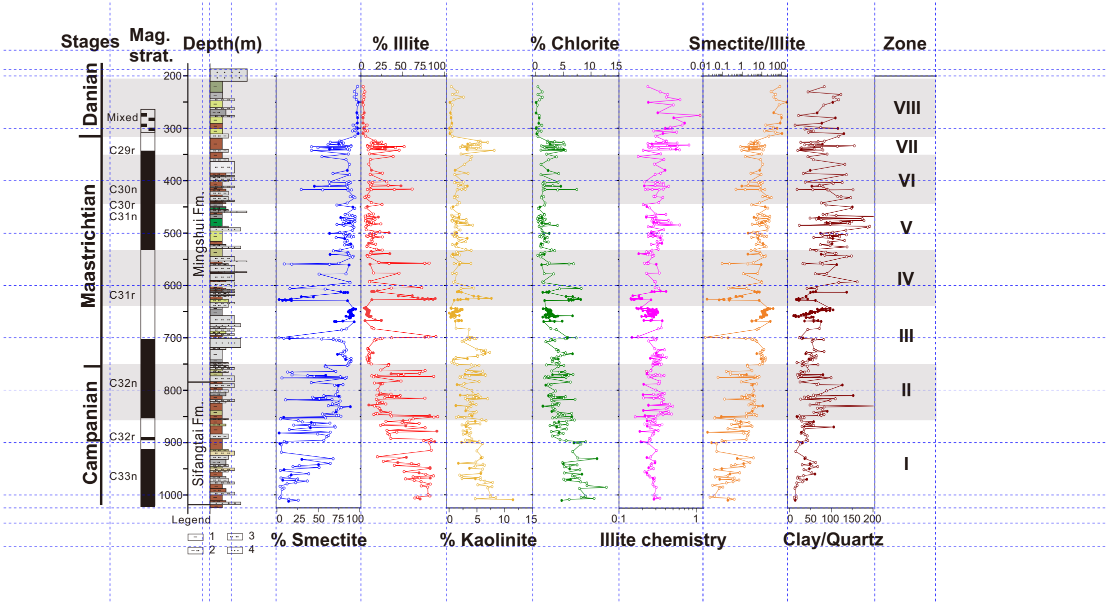

Fig. 1. revised figure 2

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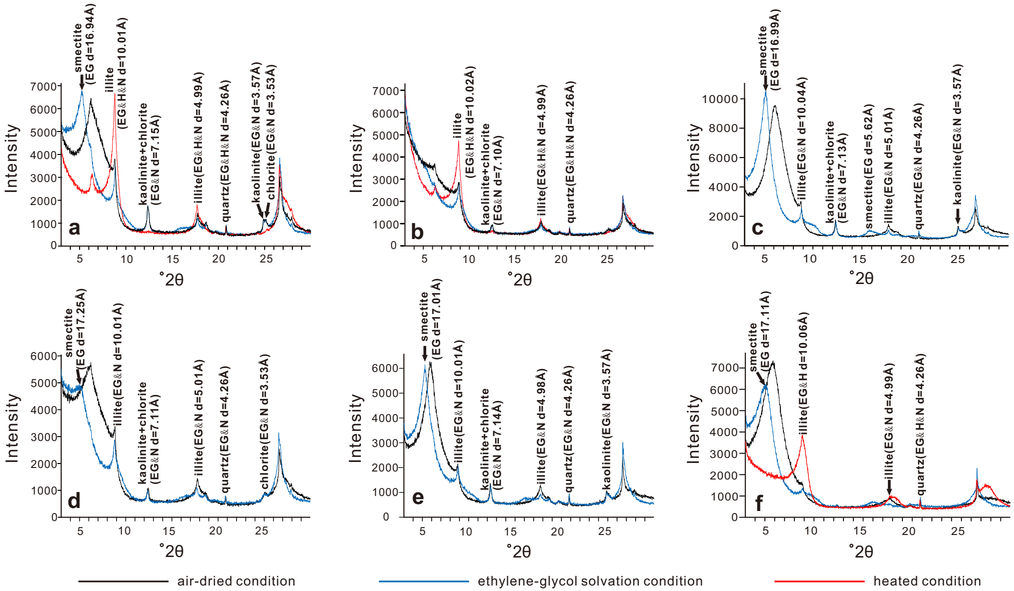

Fig. 2. revised figure 3