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Climate of the Past
Discussions

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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This manuscript reported the result from the SK-1n core. Authors tried to interpret the paleoclimate change using the clay mineral information. This is very important since the numerous data and the interprets from the oceanic sediments, but the study from the continent is very rare. The constraints are the difficult to obtain the complete and continuous samples. The SK-1n carried in a long-lived lake across late cretaceous to paleogene and satisfied the study of paleoclimate. It is of course very important and is consistent to the air of the journal. I recommend the accept of this mauncript.

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Discussion paper

Response: We appreciate the helpful comments by Anonymous Referee #1.

I have some suggestion for this manuscript, the detail is following. The methodology is right, but the reviewer is still worrying. The clay mineral was separated from the mudstone without the effect from diagenetic. This also means that the clay mineral was formed on continent, but we have not the idea about the weathering durations. I think authors might need to clarify how theses clay mineral can record the response from climate? It is nor like benthic foraminifera doing.

Response: 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. We estimate >100 kyr for in-situ clay formation in soil profiles and several hundred thousand years for clay accumulation in sedimentary basins. We rewrote section "5.1 Origin and paleoclimatic significance of clay minerals in the SMF of the SK-1n core" to clarify these questions.

The description of results is too simple and fail to give the necessary details. Such as the detail of the zone I to VIII. And the overall trends need to be clarified systematically.

Response: We expanded the "Results" section following this comment.

Line 202: crystallinity index of smectite and illite was calculated from a FWHM, the relation of CI and contents of mineral show a positive correlation, this might be misunderstood. The lower content of the clay mineral, the peak will be very weak and FWHM might be abnormal wider than the higher content ones.

Response: We agree that weak peaks in XRD diffractograms may cause abnormally wider FWHM. This actually interprets the scattering of datapoints in illite crystallinity at lower illite percentages (see plot in supplementary file). However, the peak areas of high-percentage smectite or illite samples are much larger than those of lowpercentage, which cause much wider FWHM in high-percentage samples. We therefore consider this to be the reason for a generally positive correlation between percentage and crystallinity, and did not use crystallinity as a proxy for paleoclimate.

Though the origin of the parent rock was deducted, it is too simple more support might be summarized from the published references. Line 261 “mafic volcanic”was mentioned, how the weathering of mafic volcanic produce smectite and illite? Illite was referred to the product of the physical weathering, but some reference suggested that illite was the strong chemical weathering of muscovite (muscovite was thought to be chemical stable mineral and widely spread in sandtone and mudstone)? Hence, the authors might think again about the physical weathering and chemical weathering of the clay minerals. Line 417-419, mentioned the chemical weathering origin of the illite.

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. In the provenance area of the SMF during the latest Cretaceous, both volcanic and granitic rocks were present. Illites of the SMF were primarily derived from the physical weathering and/or weak chemical weathering of granitoids in the Lesser Xing’an – Zhangguangcai ranges rocks. In lines 417-419 of original manuscript, we were not saying “chemical weathering origin of the illite”. Furthermore, we consider increasing illite chemistry index, but not illite content, suggests warmer and more humid climate with more intensive chemical weathering during the LME warming event.

Then, the trends from clay mineral might be delayed to some extents since its weathering from parent rock on the continental. Do authors find some abnormal trend might be affected by clay minerals?

Response: We added more discussion on the response time of clay formation to climate change in the last paragraph of section “5.1 Origin and paleoclimatic significance of clay minerals in the SMF of the SK-1n core”. In-situ formation of clay minerals in soil profiles may take 50-100 kyr under a mid-latitude, temperate climate. Several hundred thousand years may be needed for clay accumulation in sedimentary basins through transportation and deposition of weathering products. Therefore, clay mineralogical proxies are reliable to reflect climatic changes at million-year timescales, but may not respond well to climatic events at shorter duration.

The conclusion remark is not well documented. Lines 432-439 may be deleted since it is the repetition of the results.

Response: We revised the "Conclusions" section.

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