Referee 2

Dear Referee,

We very appreciate your helpful comments on our manuscript. We carefully revised our manuscript according to your comments. These comments help us to make our reconstruction more perfect and accurate. All detailed revisions and response are as below.

In this paper, Ma et al. proposed a new age model for this section and reviewed the paleoenvironment and paleoclimate changes during the K-Pg boundary interval. Overall, I commend the authors for applying new method on this topic and propose new ideas. However, the interpretations and conclusions need to be major modified before publication.

1. The authors claimed that the C30R and C31N was missing due to the covered strata. However, this is just the authors' speculation, and there is no further evidences. The authors also concluded that the age between the Zhenshui and Zhutian formations is ~71.5 Ma according to their new age model. However, this age is inconsistent with the biostratigraphic data they cited, which suggests the Zhutian Formation is lower Santonian-Campanian in age.

Response: The new chronological framework was constrainted by two established ages, one is radiometric age and another is palaeontological age (see section 4.1). We add more subtle discussions on the magnetostratigraphy: Although the calculated boundary age of the Zhenshui and Zhutian Formations is ~71.5 Ma according to the new age model, that is slightly differ from the biostratigraphic age (~72.1Ma, i.e. the boundary age between Maastrichtian and Campanian), the reasons probably are 1) the samples for biostratigraphic age were collected from the whole Zhutian Formation that is more than 1000m in depth, while the Zhutian Formation in Datang Profile is just the top part of the whole Zhutian Formation (Fig.1), and 2) the dereferences in sampling or time resolution between these two dating methods; therefore, it is reasonable to cause a little error between palaeomagnetic and biostratigraphic ages. If 72.1Ma (within C32N.2n) was regarded as the boundary age of the Zhenshui and

Zhutian Formations，then 30R (0.173 Ma), 31N (0.9 Ma), 31R (2.18Ma) and 32N.1n (0.24Ma) were missing due to the covered farmland, and thus only 45.2m sediments deposited during more than 3.4Ma, which seems unreasonable to have such a low sedimentary rate in this period.

2. The authors suggested that "the haematite was the dominant magnetic mineral in the red strata, and the variation trend of magnetic susceptibility was consistent with the oxygen isotope records from deep-sea sediments, which indicates that the pedogenic intensity was controlled by global climate". I can not understand the logic relationship in this sentence. Are their samples for magnetic susceptibility all collect from the palaeosls? Please clarify. In addition, if the age model is not valid, the consistency between the magnetic susceptibility and d18O would not exist.

Response: 1) Yes, we suggested that all the samples were collected from palaeosols, the difference is that moderately to fully mature soils with diagnostic characters such as Bk horizons, wormholes and root traces formed in sandy mudstone and muddy sandstone layers. No typical palaeosols were found in the coarse sandstone or conglomerate layers because of the lack of essential conditions for soil formation, but many root traces were preserved which can be called “weakly developed soils”. Please see more details in section 4.2. Haematite was generated during pedogenic processes, the relationship between χ and haematite content can be explained by the “pedogenic-plus hypothesis”: more haematite formed during warmer and wetter periods with stronger pedogenesis, and caused a higher χ, and opposite conditions yielded lower χ values. So we concluded that the pedogenic intensity indicated by the content of haematite (i.e. χ) was controlled by global climate. However, we would like to change this sentence to “the haematite was the dominant magnetic mineral in the red strata, and the variation trend of magnetic susceptibility was consistent with the oxygen isotope records from deep-sea sediments, which indicates that the content of haematite was controlled by global climate”, so as not to confuse the readers.

2) As age model, please see last response.

3. The authors classified the climate evolution into three stages. But the proposed

trend is similar to that established by other proxies and no substantial promotion, still qualitative.

Response: We agree with your comments that the constructed climate evolution revealed by magnetic parameters is still qualitative, however, it shows more details than other proxies or the marine record, such as the several sub-fluctuations during each stage, which probably indicates that the climate changes from 72 to 62.8 Ma were extremely instable with more fluctuations, and this needs our further work to provide quantitative and higher resolution results in the future.

However, we add more discussions in the revised manuscript on the potential mechanisms causing the described climate change that is not mentioned in previous studies: Hasegawa et al., (2012) found that the subtropical high-pressure belt was located between ca. 31 °N and 37 °N during the Late Cretaceous based on spatio-temporal changes in the latitudinal distribution of deserts in the Asian interior, thus the Nanxiong Basin (~20 °N, Scotese, 2014) was out of the area covered by subtropical high-pressure belt. Besides, computer simulation results revealed that the prevailing wind directions showed a remarkable seasonal variation over East Asia at 66Ma, which indicates a monsoon feature over East Asia at that time (Chen et al., 2013), and even more remarkable compared to the present day, this was supported by the geological evidences (Jiang et al., 2008), rainfall also showed a seasonal variation between dry and wet seasons corresponding to the monsoon (Chen et al., 2013). In addition, the root traces in Zhenshui Formation consisting of elongate gray mottles with red or purple hypocoatings (Fig. 7E) indicate a relatively well-drained soil condition (Krous et al., 2006), which is favourite for the formation and preservation of haematite. Therefore, the monsoon system already existed and the rainfall also showed seasonal variation across the Cretaceous–Palaeogene boundary, but the climate was more hotter and drier than present, so a great deal of haematite generated during pedogenic processes under well-drained condition, and thus recorded the global climate evolutions.