Discovery of millennial-scale climate change signals in the Cretaceous terrestrial sediments from the Songliao Basin, Northeast China

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Present paleoclimatic research on the Cretaceous greenhouse world focuses mainly on climate change events, e.g., oceanic anoxic events (FRIEDRICH et al., 2012) and sedimentary cycles attributed to orbital forcing (e.g., WU et al., 2014). Due to the lack of continuous and high resolution records, there are few studies that concentrated on millennial-scale climate fluctuations during the Cretaceous period. Recently, long and continuous terrestrial records have been recovered from the Songke SK-I core in the Cretaceous terrestrial Songliao Basin, NE China, and a precise and high-resolution chronostratigraphic framework has been built for Late Cretaceous to Early Paleocene strata of the basin (HE et al., 2012; DENG et al., 2013; WAN et al., 2013).These continuous Cretaceous records probably provides a unique opportunity for exploring terrestrial climate changes at millennial scale for the Cretaceous greenhouse world.

In this work, we investigate the potential for using high-quality elemental records, achieved by XRF core scanning, in the determination of millennial-scale climate changes in Cretaceous terrestrial records. Results suggest that ten elements (Al, Si, S, K, Ca, Ti, Fe, Mn, Rb and Sr) can be robustly detected from XRF core scanning. Multiple climate proxies suggest the presence of abrupt and short cold/warm transitions. Moreover, Spectral analysis of those climatic proxies reveals numerous millennial periodicities. When compared to millennial climate changes that occurred during the Quaternary, ~1500 year cycles discovered in the Songliao Basin are very similar to the period of the Dansgaard-Oeschger events. If this is correct, such similarities may provide new insights into the origins of millennial climate signals during the Cretaceous Period. We conclude that similar forcing factors, which were working during the last glacial period, have also been active during the Cretaceous greenhouse and controlling millenial-scale cyclicities recorded in SK-I, either precessional forcing at low latitude or solar activity changes.

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