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Periodicities of palaeoclimatic variations recorded by loess-paleosol sequence in China

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Palaeoclimatic periodicity recorded by Chinese loess-paleosol sequence has been investigated for a number of years. However, conclusions from previous investigations are still controversial, and interpretation of cycle evolution is quite equivocal. In this study, two typical loess-paleosol sequences (148 m and 191 m in thickness, respectively) in the central Chinese Loess Plateau are sampled (3872 samples total) and measured for grain size distribution and magnetic susceptibility in order to reconstruct the palaeoclimatic changes over the past three million years. On the basis of a new, sensitive proxy indicator of palaeoclimate and a newly developed independent time scale (not orbitally-tuned), two time series of Asian dust storm variations, which are highly related to the palaeoclimate system changes, are obtained. Wavelet and spectrum analyses indicate that there are approximately 400, 200, 100, 66, 57, 41, 31, 27 and 22 kyr cycles in these typical loess-paleosol records. Some orbital-driven cycles are weak and are not well presented in the new time series, while some non-orbital cycles are found. Since the eccentricity frequencies of the solar irradiance of approximately 400 and 100 kyr are preserved in these palaeoclimatic sequences, the lack of relatively short-time orbital cycles of 41-kyr-obliquity and 22-kyr-precession cycles in part of the two time series may be explained by the relatively low time-resolution of the loess-paleosol deposits. Through an astronomical estimate, the obliquity and precession cycles should leave stronger footprints on records of palaeoclimatic variations at the middle latitudes of the Northern Hemisphere. The presence of non-orbital cycles may be explained by unstable dust deposition processes and pedogenic processes in the paleosol units, which could misrepresent or obliterate the imprint of the solar irradiance frequency. This conclusion may indicate that one should be cautious when

investigating specific palaeoclimatic changes (e.g., at sub-orbital time scales) recorded in loess deposits, especially in the paleosol units.