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Magnetostratigraphic and rock magnetic evidences for Neogene paleoclimate variation and air-circulation rearrangement related to the Tibet uplift

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The loess-paleosol sequence which is transported by wind from the Asian inland deserts, is commonly regarded as the most complete, high resolution, terrestrial archives of paleoclimate and environmental changes during the Quaternary. In generally, the loess-paleosol is conformably underlain by reddish clay-silt sized sediments named red clay sequence. This sequence is well known for the wealth of mammalian fossils, especially Hipparion. So, it is also called Hipparion red earth. Recently, field observations, magnetostratigraphy and multi-methods such as geochemical, sedimentological, micromorphological analyses have demonstrate that the red clay was continuous accumulation during the Miocene-Pliocene and it was eolian in origin linked with drying of Asian inland and the evolution of East Asian monsoon due to the uplift of the Tibet Plateau. The thickness of red clay sections revealed in the central Loess Plateau ranges from tens of meters to over one hundred meter. It provides a good opportunity to reconstruct the paleoclimate changes.We report obtained data on magnetostratigraphy and rock magnetism of continuous 125m thick red clay section underlying the 175m thick Quaternary loess-paleosol sequence from the central Chinese Loess Plateau, to the east flank of Liupan Mountains (Mts.),

We collected orientated block samples for paleomagnetic measurements at 0.5∼1 m

intervals and also bag samples at 10∼20 cm intervals throughout this section. Our results indicate that the red clay in the central Loess Plateau started accumulate as early as 8.1 Ma. The appearance of wind-blown red clay implies a significant drying of Asian inland at about 8.1 Ma. The low-field susceptibility shift from low to high values at about 3.6 Ma in red clay indicates that a large change in magnetic mineral composition and concentration had occurred at that time. The dominance of hematite in earlier times was replaced by high proportion of magnetite later, suggesting a significant change in the source area. Such change of source area is most probably caused by an air circulation change. Moreover, the synchronous rapid increase in frequency-dependent susceptibility suggests that the pedogenesis and summer monsoon had some influence at that time.

The occurrence of red clay suggests the occurrence of the ca. 8.1 Ma tectonic event, which in one side terminated the development of the Ordos planation surface and on the other side led to the uplift of Liupan Shan. Similarly, the end of fluvial red bed and beginning of eolian red clay in Liupan Shan at about 3.6 Ma implies the second rapid uplift of Liupan Shan. Since Liupan Shan is physically connected with the northern boundary faults of the Northern Tibetan Plateau, the uplift events of Liupan Shan at 8.1 Ma and at 3.6 Ma may imply that the Tibetan Plateau had begun to rise at these times. Recent geomorphologic and sedimentological evidences from the northern margin of the Tibetan Plateau (Qilian Shan) demonstrate that the northern Tibet began to uplift at about 8.6 Ma, and then the uplift increased gradually. Since 4.9∼3.7 Ma, the Qilian Shan began to rapid uplift. Strong tectonic uplift of Southern Tibet and Himalaya at about 8 Ma are widely reported. Therefore, the significant drying of Asian inland at about 8.1 Ma and the change of air circulation and enhancement of the Asian summer monsoon at about 3.6 Ma might have been largely caused by the rapid/significant tectonic uplift of the Tibetan Plateau at these times.