Winter monsoon intensification during the last geomagnetic reversal in the Chinese Loess Plateau

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A link between geomagnetic field and climate is an unresolved long life research subject. Correlation between galactic cosmic rays (GCR) flux and low cloud cover can provide a theoretical rationale to this subject. Namely, the geomagnetic field intensity can change low cloud cover through GCR, and finally change the climate. The East Asian Monsoon (EAM) system significantly affects the climate in East Asia, including Japan. In order to clarify whether the EAM was influenced by geomagnetic field changes in the past, we analyzed loess paleosol deposits of the Chinese Loess Plateau (CLP) for the Marine Isotope Stage (MIS) 19 interglacial, during which the Matuyama-Brunhes magnetic polarity transition (MBT) accompanying a large field intensity decrease occurred.
For Chinese loess-paleosol deposits, magnetic susceptibility and frequency dependence are regarded as proxies of summer monsoon (SM) intensity, and grain size as a proxy of winter monsoon (WM) intensity. We collected samples from sections of about 7 m thick in Xifeng and 8 m thick in Lingtai, about 100 km south of Xifeng, in the CLP. Magnetic and grain size analyses were conducted at about 2.5~20-cm depth intervals. In both sites, the high-resolution paleomagnetic data reveal the detailed MBT with multiple polarity swings.
The SM and WM proxy curves, obtained from magnetic susceptibility and grain size data, show consistent variations well correlated the precessional sea level changes. The correlation shows that our data have an average resolution of about 120 yr. The SM intensity increases and WM intensity decreases during the MISs 19.3 and 19.1 seal-level highstands, and the opposite changes occur during the MIS 19.2 lowstand. This variation pattern is the same with the results of a number of previous studies. However, our high-resolution data reveal that the WM briefly strengthens around highstand MIS 19.3 which should be warm. The WM strengthening interval is partly overlapped with the MBT. According to the paleomagnetic intensity stack for the last 800 kyr (S-int 800), the WM strengthened when the geomagnetic field intensity decreased below one third of the present intensity, and also when the GCR flux increased to above 1.4 times, and about 2 times at maximum. The temporary WM strengthening occurred around highstand MIS 19.3 may be related to the climatic cooling observed in Osaka Bay, Lake Baikal, Israel, and Italy, probably caused by an increase in GCR due to the significant geomagnetic field decrease.

Keywords: Winter monsoon , Matuyama-Bryunhes boundary, Chinese Loess Plateau

