



A review of recent advances in red clay environmental magnetism on the Chinese Loess Plateau

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The late Miocene-Pliocene deposited red-clay sequence on the Chinese Loess Plateau is encoded with important information of past climate changes. However, in comparison to the overlying Pleistocene loess-paleosol sequence, it has received much less study. In this paper, we review recent progress in environmental magnetic studies of the red-clay sequence. Past studies reveal that there is no major difference in terms of magnetic enhancement mechanisms; i.e., magnetic enhancement in both the loess-paleosol sequence and the red-clay sequence are mainly caused by <100 nm magnetite or maghemite grains produced during pedogenesis. Recent studies also demonstrate that contrasting/comparing magnetic grain size proxy records from Chinese loess and red-clay sediments can resolve both the paleo-rainfall and paleo-temperature history of the CLP region. However, much is unknown about concentration variations and their formation mechanisms and magnetic transform routes of weakly magnetic minerals hematite and goethite in the red-clay sequence. Two contrasting formation mechanisms of hematite have been proposed. Classic viewpoints argue that the hematite forms by dehydrating ferrihydrites and thus high temperature and dry climate favor formation of hematite; whereas some authors propose that production of hematite results from aging of maghemite grains which are in turn produced by aging of ferrihydrites. In terms of paleoclimate implications, magnetic data suggest that during the late Pliocene, the East Asian Summer Monsoon (EASM) was stronger than early Pliocene periods. If future studies support this conclusion, then many proxies used to indicate the intensity of the EASM might be invalid. Obviously, future studies need to put more effort into understanding concentration variations of hematite and goethite in the red-clay sequence and their formation mechanisms. The paybacks would be a clear understanding of climate history during the Pliocene period, a possible analog for future warmer climate.