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Where is the Matuyama-Brunhes geomagnetic reversal boundary in marine sediments and Chinese loess/paleosol sequences?

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There is a longstanding controversy about the position of the Matuyama-Brunhes geomagnetic reversal boundary (MBB) because of observed differences in the position of this boundary compared to paleoclimatic proxies in marine and loess sedimentary records. Sedimentary paleomagnetic records are potentially displaced downward due to the combined effects of bioturbation in the surface mixed layer (SML; which is usually up to 10's of cm in thickness) and lock-in processes on the acquisition of the natural remanent magnetization (NRM). The exact displacement of the NRM remains controversial, which results in ambiguities in correlating paleoclimate proxies between the thick Chinese loess/paleosol sequences and marine sediments. We used two approaches to estimate the downward offset of the MBB. First, to avoid potential phase discrepancies among different paleoclimatic proxies and records from different marine settings, we compare benthic and planktonic oxygen isotope records separately. By correlating two benthic δ^{18}O records from ODP sites 982 and 983 (northeast Atlantic), and two planktonic δ^{18}O records from sites V28-238 and V28-239 (western equatorial Pacific), the MBB offsets for these two regions were estimated to be $\sim$23 and $\sim$21 cm, respectively. For comparison, we further constructed the relationship between the offset of the MBB and the total length of marine oxygen isotope stage (MIS) 19: the estimated offsets of the MBB are about 16 cm, which is lower than the estimate from the first approach. This suggests that sediments with much lower SAR may have different physical behavior (e.g., thicker SML). This second approach suggests a lower limit for the offset. Moreover, the dominant contribution to the NRM offset originates from the thickness of the SML. The NRM appears to be quickly locked-in below the SML. Correlations examined in this study unambiguously demonstrate the downward shift of the MBB recorded in marine sediments due to effects of the SML and lock-in processes. We conclude that the real stratigraphic location of the MBB is at the transition between marine oxygen isotope stages (MIS) 19/18, rather than at the mid-point of MIS19, and in the upper part of Chinese paleosol unit S8. We therefore directly correlate paleosol unit S8 to MIS19. Our results improve the chronological framework for both marine sediments and Chinese loess/paleosol sequences.