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Astronomical calibration of the Matuyama-Brunhes boundary: Consequences for magnetic remanence acquisition in marine carbonates and the Asian loess sequences

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Abstract

We have compiled 19 records from marine carbonate cores in which the Matuyama-Brunhes boundary (MBB) has been reasonably well constrained within the astronomically forced stratigraphic framework using oxygen isotopes. By correlation of the $\delta^{18}\text{O}$ data to a timescale based on astronomical forcing, we estimate astronomical ages for each of the MBB horizons. In all but one record the MBB occurs within Stage 19.

Most magnetostratigraphic sections in Asian Loess place the MBB within a loess interval. Since loess deposition is presumed to be associated with glacial intervals, loess horizons should correspond to even-numbered oxygen isotope stages. A glacial age for

the MBB is at odds with the results presented here, which firmly place the MBB within interglacial Stage 19. Inconsistency among the many loess sections and between the loess and the marine records suggests that the magnetic interpretation of loess sections may be more complicated than hitherto supposed.

The mean of the Stage 19 age estimates for the MBB is $777.9 \hat{\pm} 1.8$ (N = 18). Inclusion of the single Stage 20 age results in a mean of $778.8 \hat{\pm} 2.5$ (N = 19). The astronomical age estimate of the MBB compares favorably with an (unweighted) mean of $778.2 \hat{\pm} 3.5$ (N = 10) from a compilation of $^{40}\text{Ar}/^{39}\text{Ar}$ results of transitional lava flows. Combining the two independent data sets yields a grand mean of $778.0 \hat{\pm} 1.7$ (N = 28).

The new compilation shows virtually no trend in placement of the MBB within isotope Stage 19 as a function of sediment accumulation rate. We interpret this to mean that the average depth of remanence acquisition is within a few centimeters of the sediment-water interface.

Separating the cores into two geographic regions (an Indo-Pacific-Caribbean [IPC] Group and an Atlantic Group) results in a significant difference in the position of the mid-point of the reversal with respect to the astronomical time scale. The data presented here suggest a difference of several thousand years between the two regions. This observation could be caused by systematic differences between the two regions in sedimentation rate within the interval of interest, systematic differences in remanence acquisition, or by genuine differences in the timing of the directional changes between the two regions.



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Matuyama Epoch; Brunhes Epoch; paleomagnetism; time scales; magnetostratigraphy; remanence magnetization; loess

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