A new constraint for M-B boundary age based on U-Pb zircon dating and a high-resolution oxygen isotope chronology from the most expanded marine sedimentary record from the Chiba composite sectionn, Japan

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The youngest geomagnetic polarity reversal, the Matuyama–Brunhes (M-B) boundary, provides an important datum for sediments, ice cores, and lavas. Its still-frequently cited age of 780 ka is based on orbital tuning of marine sedimentary records, and supported by $^{40}Ar/^{39}Ar$ dating of Hawaiian lavas using a recent age calibration. However, post-depositional
remanent magnetization (PDRM) lock-in of the geomagnetic signal occurs below the sediment-water interface in marine sediments (e.g., Roberts et al., 2013; Suganuma et al., 2011), which then yields ages for geomagnetic events that are too old. This age offset is influenced by sedimentation rate, as records with higher sedimentation rates should minimize the temporal offset caused by PDRM lock-in. Indeed, younger astrochronological M-B boundary ages of 772–773 ka are given for high-sedimentation-rate records (Channell et al., 2010; Valet et al., 2014), with no PDRM lock-in delay being detected by Valet et al. (2014). These MBB ages are consistent with records of cosmogenic nuclides in marine sediments (e.g., Suganuma et al., 2010) and an Antarctic ice core (Dreyfus et al., 2008). Here, we report a newly obtained high-resolution oxygen isotope record from a continuous marine succession of the Chiba composite section of the Kokumoto Formation, Japan to provide a refined chronology for the M-B boundary. Our new chronology indicates that the M-B boundary locates in the middle of Marine Isotope Stage (MIS) 19, and yields an age of 771.7 ka for the boundary. This new M-B boundary age is consistent with those based on the latest orbitally-tuned marine sediment records and on an Antarctic ice core. Furthermore, a high-precision U-Pb zircon age of 772.7 ±7.2 ka from a marine-deposited tephra just below the M-B boundary in the Chiba composite section (Suganuma et a., 2015), coupled with a newly obtained high resolution oxygen isotope chronology yields a highly accurate MBB age of 770.9 ±7.3 ka. Because U-series dating is relatively free from standardization and decay constant issues, this U-Pb zircon age has a distinct advantage over $^{40}Ar/^{39}Ar$ dating. We provide the first direct comparison between orbital tuning, U-Pb dating, and magnetostratigraphy for the M-B boundary, fulfilling a key requirement for calibrating the geological timescales. In addition, there is no clear relationship between geomagnetic field intensity and climate observed in the paleomagnetic and paleoclimatic record from the Chiba composite section.

