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Radio-isotopic calibration of the Late Eocene – Early Oligocene geomagnetic polarity time scale

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The Geomagnetic Polarity Time Scale (GPTS) has been the subject of several revisions over the last few decades, with a trend toward increasing reliance on astronomically tuned age models over traditional radio-isotopic calibration. In the 2012 Geological Time Scale (GTS12) a comparison between radio-isotopic and astronomical age models for the GPTS yielded partially divergent results, with discrepancies of up to 0.4 Myr in the age of magnetic reversals around the Eocene – Oligocene transition (Vandenberghe et al., 2012). Radio-isotopic constraints on the age of Late Eocene – Early Oligocene magnetic reversals are available from two key sedimentary successions which host datable volcanic tuffs: the marine record of the Umbria-Marche basin in Italy, and the terrestrial White River Group of North America, however concerns have been raised regarding both the accuracy of dates obtained from these successions, and the reliability of their magnetic polarity records (Hilgen and Kuiper, 2009).

Here we present a fully integrated radio-isotopic and magnetostratigraphic dataset from the Late Eocene – Early Oligocene North American terrestrial succession with the aim of assessing the accuracy and precision of numerical ages derived from the GPTS. We developed a magnetic polarity record for two partially overlapping sections: Flagstaff Rim in Wyoming and Toadstool Geologic Park in Nebraska, which together provide coverage for the time interval between 36-31 Myr (C16n.2n – C12n) and calibrated this record using an age model based on 14 Pb/U weighted mean ID-TIMS dates obtained on zircons from primary air fall tuffs. The uncertainty of our age model includes random and systematic components for all radio-isotopic tie-points, as well as estimated uncertainties in the stratigraphic position of both the magnetic reversals and the dated tuffs.

Our Pb/U dates are 0.4 - 0.8 Myr younger than previously published Ar/Ar data (Swisher and Prothero,1990, recalculated to 28.201 Myr for Fish Canyon sanidine). This, together with the detection of a previously unreported normal polarity zone in the Flagstaff Rim section, correlative to C15n, greatly reduces previously reported discrepancies in the correlation of marine and terrestrial records of the Eocene – Oligocene transition. Our interpolated magnetic reversal dates have uncertainties of $\pm$ 0.05 – 0.10 Myr, are consistent with relatively constant spreading rates for the South Atlantic magnetic anomaly profile of Cande and Kent (1992), and are in good agreement with the astronomically tuned time scale of Paelike et al (2006). A comparison with the astronomically tuned GTS12 record reveals a systematic discrepancy of ca. + 0.3 Myr for Late Eocene reversals.

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