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Calibration of the Late Cretaceous to Paleocene geomagnetic polarity and astrochronological time scales: new results from high-precision U-Pb geochronology

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Reversals in the Earth's magnetic polarity are geologically abrupt events of global magnitude that makes them ideal timelines for stratigraphic correlation across a variety of depositional environments, especially where diagnostic marine fossils are absent. Accurate and precise calibration of the Geomagnetic Polarity Timescale (GPTS) is thus essential to the reconstruction of Earth history and to resolving the mode and tempo of biotic and environmental change in deep time. The Late Cretaceous – Paleocene GPTS is of particular interest as it encompasses a critical period of Earth history marked by the Cretaceous greenhouse climate, the peak of dinosaur diversity, the end-Cretaceous mass extinction and its paleoecological aftermaths.

Absolute calibration of the GPTS has been traditionally based on sea-floor spreading magnetic anomaly profiles combined with local magnetostratigraphic sequences for which a numerical age model could be established by interpolation between an often limited number of 40Ar/39Ar dates from intercalated volcanic ash deposits. Although the Neogene part of the GPTS has been adequately calibrated using cyclostratigraphy-based, astrochronological schemes, the application of these approaches to pre-Neogene parts of the timescale has been complicated given the uncertainties of the orbital models and the chaotic behavior of the solar system this far back in time. Here we present refined chronostratigraphic frameworks based on high-precision U-Pb geochronology of ash beds from the Western Interior Basin of North America and the Songliao Basin of Northeast China that places tight temporal constraints on the Late Cretaceous to Paleocene GPTS, either directly or by testing their astrochronological underpinnings. Further application of high-precision radioisotope geochronology and calibrated astrochronology promises a complete and robust Cretaceous-Paleogene GPTS, entirely independent of sea-floor magnetic anomaly profiles.