Astrochronology of the end-Permian extinction and the Early-Middle Triassic

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The timing of global carbon cycle perturbations and sea-level fluctuations during the end-Permian mass extinction and the Early-Middle Triassic can be established from astronomically controlled climate cycles recorded in continuous marine sedimentary sections. Astrochronology of the end-Permian extinction and subsequent prolonged recovery is established using astronomical-cycle calibrated spectral gamma-ray logs from marine sections at Meishan, Chaohu, Daxiakou and Guandao in South China. The integrated time scale for the Early-Middle Triassic is consistent with scaling of magnetostratigraphy from climatic cycles in continental deposits of the Germanic Basin.

This cycle-calibrated timescale allows a new assessment of the convoluted history of biotic recovery and paleoclimate change following the end-Permian extinction. This 10-Myr astrochronology projects the Olenekian-Anisian stage boundary at 246.8 ± 0.1 Ma and the Anisian-Ladinian stage boundary at 241.5 ± 0.1 Ma. The main marine mass extinction interval at Meishan is constrained to less than 40% of a 100-kyr cycle (i.e., <40 kyr) and the sharp negative excursion in $\delta^{13}C$ is estimated to have lasted <6 kyr. The positive shift in $\delta^{13}C$ from −2‰ to 4‰ across the Smithian–Spathian boundary at Chaohu was completed in 50 kyr. The middle Anisian warming event and humid phase occurred in ca. 244-245 Ma. This high-resolution astrochronology provides rates for the carbon- and oxygen isotope excursions and global sea-level fluctuations during the Early-Middle Triassic.