Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33563

Astronomically Tuned Orbital Forcing of Climate–Ocean Coupling During Late Permian Organic-Rich Shale Deposition in the Western Hubei Trough, South China

SHUAICAI WU[1] AND LEI CHEN[2]

[1]State Key Laboratory of Oil and Gas Reservoir Geology and Exploitation, Southwest Petroleum University
[2]School of Geoscience and Technology, Southwest Petroleum University

The Late Permian records a major transition from a long-lived icehouse to a greenhouse world, yet the depositional chronology of organic-rich marine shales in the Western Hubei (W–H) Trough, South China, and the orbital mechanisms coupling paleoclimate and paleoceanography remain poorly constrained. We apply cyclostratigraphic analysis to a natural gamma-ray (GR) record from late Wuchiapingian–Changhsingian shales. Astronomical tuning to the ~405 kyr long eccentricity cycle yields a high-resolution astronomical time scale (ATS) spanning 5.3 ± 0.1 Myr and constrains shale deposition to 257.3 ± 0.1–252.0 ± 0.1 Ma. To reconstruct environmental evolution during shale accumulation, we integrate geochemical proxies for weathering intensity, paleosalinity, and paleoredox conditions with a sedimentary-noise model. Relative sea-level change is phase-locked to Myr-scale long-period eccentricity cycles, indicating hydrological pacing via variations in moisture transport, precipitation, and aquifer storage. Eccentricity maxima correspond to higher relative sea level, more reducing bottom waters (elevated U_{EF}, Mo_{EF}, and C_{org}/P), intensified upwelling (Co (ppm) × Mn (%) < 0.4), and stronger connection to the open ocean (higher Mo_{EF}/U_{EF} and Mo/TOC); opposite conditions occur at minima. Near the Wuchiapingian–Changhsingian boundary (WCB), amplification of the ~405 kyr eccentricity signal covaries with B/Ga, Sr/Ba, S/TOC, and CIA, supporting orbital control on paleosalinity and continental weathering through the hydrological cycle. Integrating paleoclimate, paleosalinity, and paleohydrological indicators, we identify three stages of paleoenvironmental evolution in the W–H Trough: (1) late Wuchiapingian highstand with predominantly euxinic bottom waters, strong upwelling, and relatively open-basin conditions; (2) latest Wuchiapingian relative fall with dysoxic to euxinic, moderately restricted waters and weakened but orbitally paced upwelling; and (3) Changhsingian lowstand with restricted dysoxic conditions and only weak, short-lived upwelling. These results clarify Myr-scale sea-level variability and orbitally forced environmental change under non-glacial conditions, and provide a process-based framework for evaluating the heterogeneity and geoenergy significance of organic-rich sedimentary rocks as non-traditional subsurface resources.



