Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.25739

Long-term orbital eccentricity forcing of the Mesoproterozoic oxygenations

SHUICHANG ZHANG[1] AND XIAOMEI WANG[2]

[1]Research Institute of Petroleum Exploration and Development, PetroChina, Beijing 100083, China
[2]Research Institute of Petroleum Exploration & Development, PetroChina, Beijing, China

Million-year-scale orbital parameters have long influenced climate, environmental variations, and the carbon cycle, yet their role during the Precambrian remains poorly understood. Here, we established a ~21 Myr (~1413.2-1392.1 Ma) Mesoproterozoic astronomical timescale, revealing prominent ~6 Myr, ~2.2 Myr, and ~1.2 Myr cycles in the Al and K series of sedimentary rocks. By integrating these findings with other long-term records, we present the first evidence that the ~6 Myr eccentricity cycle has persisted throughout geological history. In addition, the g_4–g_3 term eccentricity transition from ~2.2 Myr to 1.5 Myr suggests a ~3.5 Myr long chaotic behavior of the solar system, which is the first evidence of the Mesoproterozoic chaos. Furthermore, the 6 Myr and 2.2 Myr long-term eccentricity maxima resulted in the intensified weathering, increased nutrient inputs, enhanced organic carbon burial, and a rise in marine oxygen levels. This synthetic process, coupled with volcanism, may have driven the local marine oxygenations and thus the evolution of eukaryotes during the Mesoproterozoic.