Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31434

Extreme nitrogen isotope fractionation during the Late Paleozoic Ice Age-evidence for rapid terrestrial turnover?

WENLI YANG[1,2], BENJAMIN J. W. MILLS[3] AND JITAO CHEN[1]

[1]Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences
[2]University of Chinese Academy of Sciences
[3]University of Leeds

Long-term secular variations in marine sedimentary nitrogen isotopic composition ($\delta^{15}N$) can be correlated with global climate shifts over geological time, and have been linked to gradual sea level fluctuations over greenhouse-icehouse cycles. However, the underlying drivers of a potentially extreme $\delta^{15}N$ apex during the Late Paleozoic Ice Age remain unresolved. Here, we present a high-temporal resolution $\delta^{15}N$ record from a continuously deposited carbonate slope succession in South China, integrated with existing records, which confirms the existence of a Permo-Carboniferous maximum $\delta^{15}N$ of up to ~18‰. We then use a modified version of the global climate-biogeochemical model SCION to evaluate key influences on nitrogen cycle dynamics. Our findings indicate that long-term sea-level variations may explain much of the Phanerozoic record, but are insufficient to drive the Permo-Carboniferous apex. These high values can however be resolved in our model by considering an enhanced riverine nitrogen input from coal forests. We conclude that the unique lycophyte coal forests, with intense growth and decay cycles, may have significantly amplified fluvial nitrogen fluxes, potentially instigating a substantial positive shift in the marine nitrogen isotope record during the Late Paleozoic Ice Age.