Sedimentary facies and carbon isotopes from South China shed light on late Paleozoic icehouse-to-greenhouse transition

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Reliable carbonate carbon isotopes ($\delta^{13}C_{carb}$) can reflect variations in global carbon cycling, and thus the paleoclimate and paleoceanographic

conditions. However, significant depositional hiatus in low-latitude areas occurred during the late Pennsylvanian to early Cisuralian.

Frequent subaerial exposures and stratigraphic discontinuities could have potentially altered the primary $\delta^{13}C_{carb}$ signals, which collectively hampered a valid global correlation at this time. Indeed, a global $\delta^{13}C_{carb}$ record is hardly established for chemostratigraphic correlation and global carbon cycle modeling.

Researchers led by Ph.D. student Yang Wenli and Prof. Chen Jitao from the Nanjing Institute of Geology and Paleontology of the Chinese Academy of Sciences (NIGPAS) have investigated sedimentary facies and high-resolution carbonate $\delta^{13}C$ on the Pennsylvanian and Cisuralian carbonate slope successions from the South China Block.

Their findings were published in *Global and Planetary Change* on Jan. 28.

The South China Block was located in the low-latitude region at the confluence of the eastern Paleo-Tethys Ocean and western Panthalassic Ocean during the Pennsylvanian and Cisuralian. Various sedimentary facies ranging from carbonate platforms to regional slopes and basins developed in South China during the Pennsylvanian to Cisuralian, which were well connected to open ocean waters, potentially recording a global seawater geochemical signal.

In this study, detailed sedimentary facies analysis and high-resolution $\delta^{13}C_{carb}$ time series during the late Pennsylvanian to early Cisuralian suggested that the $\delta^{13}C_{carb}$ recorded in slope carbonates of the Luodian Basin might represent a reliable proxy for global carbon cycling.

Across the Carboniferous-Permian transition, the well-coupled $\delta^{13}C_{carb}$, atmospheric pCO_2, and the inferred glacial records, showed a potential

linkage between increased rate of organic carbon burial and the apex of the Late Paleozoic Ice Age.

The decoupling between the $\delta^{13}C_{carb}$ and atmospheric pCO_2 during the middle Asselian to mid-late Sakmarian suggested that enhanced silicate weathering might have played a dominant role in drawdown of atmospheric pCO_2 and sustained glaciation.

The rapid negative excursion in $\delta^{13}C_{carb}$ coincided with the rapid rise of atmospheric pCO_2 and the substantial decrease in inferred glacial records, suggesting that the prolonged greenhouse gas accumulation potentially drove the transition from icehouse to greenhouse climate states.

More information: Wenli Yang et al, Sedimentary facies and carbon isotopes of the Upper Carboniferous to Lower Permian in South China: Implications for icehouse to greenhouse transition, *Global and Planetary Change* (2023). DOI: 10.1016/j.gloplacha.2023.104051

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