Evaluation of Organic Carbon Isotope Stratigraphy in Terrestrial Permian-Triassic Boundary Sections in South China

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Stable isotopes of inorganic and organic carbon are commonly used to correlate marine and terrestrial sedimentary sequences based on the assumption that the global signal dominates other sources of variability. However, relatively few studies have tested the fidelity of this approach. Here, $\delta^{13}C_{TOC}$ values in four terrestrial Permian–Triassic boundary (PTB) sections of Western Guizhou and Eastern Yunnan provinces in South China are compared to the $\delta^{13}C_{carbonate}$ curve of the GSSP Meishan section to evaluate the use of $\delta^{13}C_{TOC}$ as a reliable chronostratigraphic tool.

Detailed sedimentological, paleobotanical and palynological analyses on the four terrestrial PTB sections indicate that the sediments were deposited in a transitional setting dominated by alternating mudstone and sandstone units with paleosols and “coal seams”. The depositional environment transitioned from fluvial-lacustrine to coastal marine across the Xuanwei and Kayitou Formations. The $\delta^{13}C_{TOC}$ values for the studied terrestrial sections show a prominent carbon-isotope excursion that corresponds with the occurrence of fungal spores, characteristic of the extinction event, at the top of the Xuanwei Formation. Similar trends are observed in all four studied sections, however, the absolute magnitude of $\delta^{13}C_{TOC}$ values and the excursions vary from one section to another. For instance, $\delta^{13}C_{TOC}$ values change from -24‰ to -28‰ in the more proximal location at Chahe, and decrease from -26‰ to -29‰ in the more distal section at Mide. This indicates that depositional environment plays a role in determining the $\delta^{13}C_{TOC}$ values, but the overall changes in the $\delta^{13}C_{TOC}$ throughout the Permian-Triassic transition capture the atmospheric signature. Overall, the magnitude of the carbon isotope excursion recorded in these terrestrial sequences is about 3‰, similar to that reported in marine sequences. Thus, $\delta^{13}C_{TOC}$ is a potentially reliable tool for paleoclimatic interpretations and stratigraphic correlations between marine and terrestrial sequences.