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Constraining the origin of ^{13}C-depleted organic carbon isotope signatures during the Ediacaran-Cambrian transition on the Yangtze Block

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The Ediacaran-Cambrian (E-C) transition was an important period in Earth's history, characterized by significant environmental changes and biological evolution. The well-preserved continuous E-C strata on the Yangtze Block, South China, have been extensively studied over years to unravel the co-evolution of biota and environment. Previous studies have suggested heterogeneous and dynamic carbon cycling during this period, as indicated by the distribution of $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ across the Yangtze Block. Notably, most $\delta^{13}C_{org}$ values from the E-C Liuchapo Formation fall below -30‰ (reaching as low as -38‰), which is significantly lower than those from contemporaneous shallow-water facies and geological records from Phanerozoic anoxic basins. The enigmatic depletion in $\delta^{13}C_{org}$ is considered to originate from the increased proportion of secondary producers, such as chemoautotrophs or methanotrophs, below the chemocline.

To trace microbial communities utilizing various carbon fixation pathways, we apply the NanoSIMS *in-situ* $\delta^{13}C_{org}$ method. Specifically, we analyze the mixing pattern of different microbial communities within the Liuchapo Formation to elucidate the origins of the $\delta^{13}C_{org}$ anomaly and oceanic carbon cycle during this critical period. Our results provide insights into the mixing ratio, spatial distribution pattern, and paragenetic association of minerals of secondary producers, thereby enhancing our understanding of the formation environments prevalent during this period.