

Biogeochemical response to the Late Cambrian SPICE Event

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The Late Cambrian SPICE event (Steptoean Positive Carbon Isotope Excursion, 497-494 Ma) represents one of the most significant perturbations in the global carbon cycle during geological history, accompanied by marine biotic extinction, plankton revolution, and extensive organic carbon burial. This study systematically investigates the biogeochemical characteristics of the Upper Cambrian strata from the strata of shallow, slope, and deep marine facies in the Tarim Basin, NW China, to elucidate biological responses from varying depositional environments for this event.

The result showed that the shallow-water facies and transitional facies strata exhibit negative shifts in $\delta^{13}\text{C}_{\text{org}}$ and $\delta^{13}\text{C}_{\text{carb}}$, whereas no negative $\delta^{13}\text{C}$ shifts are observed in the deep-water facies (Figure 1), indicating that the shallow marine facies recorded the biotic extinction event at the end of the Miaolingian (i.e., end-Marjuman extinction). Both the shallow-water facies and deep-water facies strata document one positive $\delta^{13}\text{C}$ shift (i.e., SPICE), while the transitional facies strata exhibit two positive $\delta^{13}\text{C}$ shifts, representing a mixed carbon isotope signal derived from both shallow- and deep-water facies. These findings reveal the expansion of plankton from deep to shallow waters. The observed patterns of $\delta^{13}\text{C}$ variation in the diverse sedimentary profile are consistent with those identified in the SPICE strata from both the Missouri intrashelf basin in the United States^[1] and Southern Scandinavia^[2], suggesting that these characteristics represent a globally widespread phenomenon. This underscores the control of seawater depth gradients on marine biotic extinction and turnover during the Late Cambrian^[3].

