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The recovery of the Shuram anomaly and paleoproductivity balance

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The global Shuram anomaly records the longest and most negative carbonate carbon isotopic excursion in Earth history. It took place during the late Ediacaran (c. 570 – c. 551 Ma) with $\delta^{13}C_{carb}$values down to −12‰. In South China, Doushantuo Formation Member IV (c. 555-551 Ma) consists mainly of organic-rich black shales and records the recovery of this anomaly, with values going from –6‰ to +0.5‰. The origin of this anomaly is thought to be related to the existence of a vast pool of dissolve organic carbon (DOC) in the ocean that was episodically oxidized thereby providing a source of ^{13}C-depleted inorganic carbon. However, the main processes that ultimately drove to its recovery remain elusive. Here, we present new $\delta^{13}C_{org}$and $\delta^{15}N$ dataset along a shelf-to-basin transect of the Nanhua basin (South China) as robust organic proxies to reconstruct the spatial and temporal evolution of paleoproductivity at basin scale. In addition, Raman spectroscopy is used to assess the thermal maturity of the samples. These new results define areas of high primary productivity and suggest the existence of an oxygen minimum zone (OMZ) together with other reduced oxic areas. From base to top of Member IV, the observed increasing and covariant trends in $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$data together with a decreasing drift in $\delta^{15}N$ values in platform and mid-lower slope environments are interpreted as areas where primary productivity became the main source of organic matter. Conversely, decreasing trends in $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ data together with invariant $\delta^{15}N$ values in the upper slope and deep basin environments are interpreted as areas where reduced DOC dominated as the principal source or organic carbon. Based on that, we propose that a new balance was established between primary and secondary paleoproductivity, whereby the former succeeded to the latter as one of the principal contributors that led to the carbon isotope recovery in carbonates. This new model represents a plausible solution to the enigmatic negative $\delta^{13}C_{carb}$isotopic excursion of the late Ediacaran.