A change of carbon cycle in Early Cambrian: Evidence from the C-isotopic events, in Three Gorges area, S China.

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Carbon isotopic-records for carbonate carbon which fluctuate across the Precambrian/Cambrian boundary (Pc/C boundary) indicate the significant change of the carbon cycle. We have proposed a standard $d^{13}C$ curve for inorganic carbon ($d^{13}C_{carb}$) through the terminal Ediacaran to the Early Cambrian in the Three Gorge area, South China and have found the existence of large fluctuations in this period (Ishikawa et al., 2008). On the other hand, the $d^{13}C$ values for total organic carbon ($d^{13}C_{org}$) have rarely been reported with the $d^{13}C_{carb}$ across the Pc/C boundary mainly due to poorly contents of organic carbon in the carbonate sediments. Thus, we firstly report high-resolution d13Corg chemostratigraphy of drill core samples across the Pc/C boundary in the Three Gorge area, South China. This section extends from the uppermost Ediacaran dolostone (Dengying Fm.), through lowermost Early Cambrian muddy limestone (Yanjiahe Fm.) to middle Early Cambrian calcareous black shale (Shuijingtuo Fm.). As a result, in contrast to frequent large negative anomalies in $d^{13}C_{carb}$, the $d^{13}C_{org}$ values exhibit relatively invariant values averaged in -31 permil, with intermitted low values about -36 permil in the terminal Ediacaran to early Nemakit-Daldynian. This result means large fluctuations of the fractionation between $d^{13}C_{carb}$ and $d^{13}C_{org}$ in this period. These fluctuations are inconsistent with conventional, steady-state models of the carbon cycle, but similar to the non-steady dynamics of two reactive carbon pools in the Neoproterozoic (Rothman et al., 2003). We consider that the $d^{13}C_{org}$ of a larger organic carbon reservoir, relative to an inorganic reservoir or influx/efflux, would not be driven by the variation of input and output fluxes. Such a large organic carbon reservoir probably requires an anoxic condition, and when it is oxidized, isotopic 'light' carbons flux into the inorganic carbon reservoir. We therefore suggest that the significant negative $d^{13}C_{carb}$ anomaly across the Pc/C boundary resulted from the enhanced flux from the large organic carbon pool. Additionally, the fractionation between $d^{13}C_{carb}$ and $d^{13}C_{org}$ is invariant in the middle Nemakit-Daldynian through Tommotian to Atdabanian, indicating that the carbon cycle evolved into steady state. We estimated the fraction of burial organic carbon, and found that the organic carbon burial was enhanced in the late Nemakit-Daldynian and then it increased form Tommotian to Atdabanian after reduction in basal-Tommotian. Hence, we interpret that lowering pCO_2 and the subsequent global cooling resulted from the enhanced organic carbon burial in the late Nemakit-Daldynian. It possibly caused the global-scale regression in the basal-Tommotian (Ripperdan, 1994), and led to the low organic carbon burial in the early Tommotian.