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Post-Marinoan carbon circulation in the ocean recorded in the South China Block

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A series of drastic climate changes and biological evolution events during the late Neoproterozoic and early Cambrian have been intensively studied in the last decade. However, a deep mistily is still remained in the causal link between the climate change and the biological evolution. The linkage is enigmatic, and was unlikely straightforward because a severe cooling unlikely accelerated the evolution. A key to unravel the mystery is the oceanic condition that can be examined with the geochemical properties of the stratigraphic sections from different depositional settings.
This study selected two sections in South China Block and analyzed sedimentological characteristics, carbonate and organic carbon isotopic composition of the Neoproterozoic to early Cambrian sediments.
The Yangjiaping section exposes a thick sequence from the Xieshuihe Formation (lower Cryogenian) to the Shuichang Formation (earliest Cambrian). Depositional environment of this section was generally calm and reductive immediately after the Marinoan glaciation, and became high energy and shallow water throughout the following Ediacaran period. In Cambrian, the depositional environment transited to deep and was strongly influenced by clastic detritus. The stratigraphic framework of the Ediacaran strata was largely improved by the lithostratigraphy and chemostratigraphy. We recognized three negative excursions of inorganic carbon isotope recorded in the cap carbonate of the lowermost Doushantuo Formation, the upper Doushantuo Formation, and the PC/C boundary. The influence of upwelling was suspected for the second excursion. The isotopic records of the lower Dengying Formation appear the decoupling pattern. Then, the organic values indicate a decreasing trend, and appear the coupling with inorganic value in the upper interval. The carbon isotopic records of the Yangjiaping section are characteristic in terms of the generally high values and the parallel fluctuation pattern of the carbonate and organic values. The productivity was very high, and a thin water column was well-mixed in the very shallow setting.
The Wangchang section exposing the deeper facies of the Doushantuo Formation Sedimentary environment was anoxic as indicated by common occurrence of framboidal pyrite and abundance in organic matter. The isotopic decoupling between the inorganic and organic values had lasted through the lower to middle part of the Doushantuo Formation. These features were likely originated from the remineralization of the dissolved organic carbon (DOC) reservoir. Weakened decoupling and decreased Mn content in the upper Doushantuo Formation indicate the seawater become homogenized even in the slope setting likely due to the recovery vertical circulation.
Throughout the South China Block, the inorganic carbon isotope indicated different fluctuation patterns with different amplitudes depending on the depositional depths except for the cap carbonate in the lowermost Doushantuo Formation. The post-Marinoan ocean was stratified and reductive, where the DOC reservoir largely grew. Then, the DOC reservoir had been temporally and partly decomposed around the Doushantuo member II/III boundary, however the deep setting was still reductive. The recovery of ocean circulation occurred in the upper part of the Doushantuo member III, which was indicated by the decreasing trend of the inorganic carbon isotope values in

the shallow water sections. This reduced the depth gradient, and recalled the coupling pattern of carbon isotopic values. The decoupled isotopic pattern generally obscure during the depositional period of the Dengying Formation independent to the depositional depth. The DOC reservoir disappeared as reflected the isotopic records of the lower Dengying Formation in the Yangjiaping section.