Insights into the early Cambrian relations between marine productivity and redox fluctuations using Ba isotopes

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The start of the Paleozoic Era is marked by the so called "Cambrian Explosion", in which significant fluctuations in the global marine redox conditions and nutrient supply together with an overall increase in atmospheric O_2 are suggested to drive and promote the evolution of the first bilaterian fauna [1]. At this crucial geologic time interval, the direct linkage between organic matter cycling, O_2 and nutrient availability has been discussed to constrain the habitability of paleo marine ecosystems that possibly led towards greater animal diversity. However, how the redox fluctuations relate to marine productivity is not fully understood yet [2].

Recent developments in the understanding of the Ba cycle through its concentration and isotope compositions in seawater and marine sediments might allow us to explore this concern. We studied the Ba isotope compositions ($\delta^{137/134}$Ba) in carbonate leachates on the classic Early-Cambrian Xiaotan Section (545 Ma – 523 Ma, Yunnan Province, South China). Integrating existing carbonate U and C isotopic data with our Ba isotopic dataset [1][2][3], it has shown that Ba isotope compositions negatively correlate with U isotope compositions and positively correlate with C isotope compositions, respectively. The $\delta^{137/134}$Ba values increase from -0.1‰ in the early Fortunian to the maximum of +0.31‰ in the Cambrian Stage 2 (Dahai Member) during a time of marine anoxic aggravation. We suggest that significant marine redox fluctuation occurring in the eve of "Cambrian explosion" may be influenced by primary productivity changes as supported by the larger variation of $\delta^{137/134}$Ba in the period. The prolonged interval leading into oceanic anoxic events (OAEs) during Terreneuvian was resulted from a limited O_2 supply from atmosphere and an increasing marine production.

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