Nitrogen and sulphur isotopic records in black shale of the early Cambrian: implication for a stratified marine redox structure

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Nitrogen is an essential element for biological activity and nitrogen isotopes in black shale record significant information of both biological process and environmental evolution[1]. However, researches of N isotope in the early Cambrian are still sparse[3]. In this study, we use trace elements, sulphur isotopes and nitrogen isotopes of cherts, black shales and carbonaceous shales of a drill core at Daotuo, Songtao County in northeastern Guizhou Province, China, to reconstruct the redox structure of the early Cambrian seawater.

The Mo-U covariation of the black shales in the Daotuo drill core indicates that the Yangtze basin was weakly restricted and connected to the open ocean through shallow water parts. At the upper Liuchapo Fm (early Cambrian Fortunian), low Mo and U concentrations (<10ppm) and relatively high $\delta^{34}S_{py}$ (15.91‰) in the cherts and black cherts suggest an anoxic, but not euxinic condition and low sulphate concentration of the seawater. High $\delta^{15}N_{bulk}$ (>3‰) represents a relatively deep chemocline and mildly oxygenated surface seawater. The lower Jiumenchong Fm. (upper Cambrian Stage 2 and lower Stage 3) containing a polymetallic sulfide-rich layer, has the highest molybdenum concentration (>100ppm), the lowest $\delta^{34}S_{py}$ (-16.80‰) and lowest $\delta^{15}N_{bulk}$ values (<-3‰), suggesting the euxinic seawater caused by bacterial sulphur reduction (BSR) in the shelf margin area with increase of seawater sulphate concentration and a shallow chemocline with anoxic even euxinic photic zone after the widespread transgression event[2]. In the middle Jiumenchong Fm. $\delta^{34}S_{py}$ values return to the relatively high level (average 8‰) and $\delta^{15}N_{bulk}$ values are between -2‰ and 2‰, indicating anoxic seawater with the decline of BSR, which probably represents a biological negative feedback on environment as deposition of molybdenum and nutrient elements would reduce the primary production for sulphate reducedbacterias, leading to the depression of sulphidic seawater.

[1]Ader et al. (2014) *Earth Planet. Sci. Lett.* **396**, 1-13.

[2]Lenton et al. (2014) *Nat. Geosci.* **7(4)**, 257-265.

[3]Wang et al. (2015) *Precambrian Res.* **267**, 209-226.