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Cadmium concentrations and isotope composition of paleo-ocean during the Permian-Triassic transition in South China

Te Liu (2), Dong He (1), Lanlan Jin (1), Wei Guo (1), Li Tian (1), Jinnan Tong (1,2), Shenghong Hu (1,2)

(2) School of Earth Sciences, China University of Geosciences(Wuhan), Wuhan, China, (1) State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences(Wuhan), Wuhan, China

The distribution of Cadmium (Cd) in the ocean is similar to some major nutrients including phosphate, which is principally controlled by preferential consuming the light isotopes of Cd from phytoplankton cells at the surface water in modern oceans (Boyle et al., 1976; Bruland, 1980; Lacan et al., 2006). The distribution characteristic of Cd elemental concentration and isotopic composition and their validation as a proxy of productivity in the paleo-ocean are not clear. This paper examined Cd in the paleo-ocean during the Permian-Triassic transitions, in which the biggest biological crisis of the Phanerozoic occurred. High-resolution curves of Cd elemental concentration and $\delta^{114/110}\mathrm{Cd}_{NIST3108}$were reconstructed for four Permian-Triassic boundary (PTB) successions with varied paleo-water depths in South China. The analytical results showed that the average Cd concentrations was the successions increased with depth (0.05μg g^{-1}, 0.11μg g^{-1}, 0.12μg g^{-1}, 0.18μg g^{-1} from shallow to deep water section), and the shallower water sections display the larger Cd isotope fractionation effect ($\delta^{114}\mathrm{Cd}_{MAX} - \delta^{114}\mathrm{Cd}_{MIN}$ = 1.9‰ 1.7‰ 1.4‰ and 0.7‰ from shallow to deep water section, 2sd =±0.04, N=43), which is consistent with observation in modern oceans. The calculated results showed that a linear relationship (R $>$ 0.9) between the logarithm of Cd concentrations (ln[Cd]) and Cd isotope ratios (δ^{114}Cd) occurred at three shallow water sections at the main extinction horizon, which accorded with Rayleigh distillation and suggested the Cd isotope variations at the PTB were primarily controlled by biological activity. $\delta^{13}\mathrm{C}_{carb}$ and trace elements also confirm that. Phytoplankton decrease contributed to the rapid increase in Cd concentrations and the significant lighter Cd isotope composition exhibited at all three shallow water sections during the PTB main extinction. A revival of life in early Triassic led to a relatively heavier Cd isotope composition. In conclusion, Cd concentrations and Cd isotope composition display the similar pattern to that in modern oceans. And Cd concentrations and Cd isotope composition can be a great indicator of phytoplankton productivity in the paleo-ocean.

References

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