

Rise of ocean sulfate caused by oxidative weathering in the Ediacaran

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The sulfur isotope chemostratigraphy of sulfate and sulfide in the Doushantuo and Dengying Formations in South China is important to understand the sulfur cycling of the Ediacaran ocean. We conducted detailed sulfur isotope analyses of carbonate-associated sulfate (CAS) and sulfide throughout the Ediacaran using drill cores sampled from the Three Gorges area, South China. The sulfur isotope fractionation between the sulfate and the sulfide is negatively correlated with the $\delta^{34}\text{S}$ values of sulfides, suggesting the sulfide $\delta^{34}\text{S}$ values are mainly related to the degree of isotopic fractionation. The sulfide $\delta^{34}\text{S}$ stratigraphy exhibits two negative excursions in the Doushantuo Formation. The excursions coincide with positive excursions of $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of carbonate and negative excursions of $\delta^{13}\text{C}_{\text{carb}}$ values in the same drill core samples. Given existence of organic carbon pool in the ocean, the correlation between the $\delta^{34}\text{S}$ values of the sulfides, the $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, and the $\delta^{13}\text{C}_{\text{carb}}$ values indicates that enhanced sulfate input from continents by oxidative weathering increased the sulfate concentration in the ocean, likely causing the larger sulfur isotope fractionation and the negative excursions of the $\delta^{13}\text{C}_{\text{carb}}$ values in the Ediacaran ocean. In addition, the $\delta^{34}\text{S}_{\text{CAS}}$ values decrease in most sections from *ca.* 25‰ to *ca.* 17‰ when the $\delta^{13}\text{C}_{\text{carb}}$ values decrease from *ca.* 0‰ to *ca.* -10‰ at the beginning of the Shuram excursion. The globally decreasing trends indicate oceanic sulfate concentration increased enough to homogenize isotopic composition of oceanic sulfate. On the other hand, trends and values of the $\delta^{34}\text{S}_{\text{CAS}}$ before the Shuram excursion are highly varied among sections. Given the heterogeneity of $\delta^{34}\text{S}_{\text{CAS}}$ values and existence of organic carbon pool in the ocean, oceanic sulfate concentration before the Shuram excursion can be estimated as lower than 1 mM, probably lower than 21.5 μM . Those lines of evidence suggest oceanic sulfate concentration in early Ediacaran was μM level, and increased at the beginning of the Shuram excursion.