Large sulfur isotope fractionation during microbial sulfate reduction in maintenance metabolism of *Desulfoviburio desulufuricans*

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Sulfur isotope fractionation between sedimentary sulfate and co-existing pyrite is a proxy of Earth's surface oxidation and has exceeded 55‰ since Neoproterozoic. Microbial sulfate reduction plays a key role on sulfur isotope fractionation between sufate and sulfide, though the factor to increase the fractionation is not fully understood. Cell specific sulfate reduction rate is known to affect the fractionation and decreases when cells are in their maintenance phase, and/or when using high-energy electron donor like glucose. We carried out batch culture experiment of sulfate reducing bacteria (SRB) *Desulfoviburio desulufuricans* (DSM642) in 25°C, 30°C, and 37°C using glucose as electron donor, and studied sulfur isotope fractionation mechanism in both exponential phase and maintenance phase. The cell specific sulfate reduction rate during maintenance phase in 25°C, 30°C, and 37°C become 0.10±0.03, 0.03±0.02, and 1.02±0.36 fmol/cell/day, respectively. The cell specific sulfate reduction rates in 25°C and 30°C experiments are equivalent to that of present coastal marine sediments. Sulfur isotope fractionation during maintenance phase in 25°C, 30°C, and 37°C are 53±5‰, 107±63‰ and 48±3‰, respectively. The sulfur isotope fractionation during microbial sulfate reduction of the most popular SRB *Desulfoviburio desulufuricans* (DSM642) also exceeded 47‰ when glucose is used as electron donor, and the results of our study suggest that cell growth phase is important for considering the large sulfur isotope fractionation observed in natural environment. We compared the $^{34}\varepsilon$, $^{33}\lambda$, and $^{36}\lambda$ values derived from our expeimental results with a new CAS and sulfide analysis of Ediacaran section in the Three Gorges area, South China. The $^{34}\varepsilon$ values of Ediacaran samples ranged from -3‰ to 47‰ with an average value of 23‰, and the $^{33}\lambda$ and $^{36}\lambda$ values basically concentrated on 0.514 and 1.91 regardless of $^{34}\varepsilon$ value. The trend of $^{33}\lambda$ and $^{36}\lambda$ values are different from our culturing experiment of SRB. The difference suggest another process rather than microbial sulfate reduction played the major role in sulfur cycling during Ediacaran ocean.