Sulfur Cycling During Burial Diagenesis in Marine Carbonates

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Reduction of sulfate to sulfide plays a crucial role in global sulfur cycle. However, there is no comprehensive study has included the effects from both microbial sulfate reduction (MSR) and thermochemical sulfate reduction (TSR), in modulation of $\delta^{34}S$ signals. Here we report an occurrence of various types of sulfur-bearing components from the Cambrian-Ordovician carbonate system in the Tarim Basin, NW China, coupled with a well-established diagenesis framework. Our results indicate that most of the sulfur-bearing species possess $\delta^{34}S$ values slightly lower than the source sulfate and the sulfide generated by TSR, but substantially higher than the $\delta^{34}S$ values of sulfide that evidently is consistent with MSR. Hence, a mixing of sulfide from both MSR and TSR was a most plausible scenario. Building upon this hypothesis, a new sulfur diagenesis model was built for quantifying pooled H_2S from MSR and TSR, thus can help better determine the origin of sulfur-bearing species in many deep burial carbonate systems, and the Neoproterozoic super-heavy pyrite. Our results, further, invoke a deeper look at diagenesis to gain a better mechanistic understanding of the primary signals (e.g., $\delta^{34}S$ and $\delta^{13}C$) in marine carbonates, e.g., the Neoproterozoic ones deposited at the dawn of marine animal life.