

Large sulfur isotope fractionation occurs in microbial communities under low sulfate concentration

AL KURIHARA¹, MAYUKO NAKAGAWA¹ AND
YUICHIRO UENO^{1,2,3}

¹Institute of Science Tokyo

²Earth-Life Science Institute

³JAMSTEC

Sulfur isotope fractionation between sedimentary sulfide and sulfate ($^{34}\Delta$) increased in the Neoproterozoic. At that time fractionation factors ($^{34}\epsilon$) for microbial sulfate reduction may have increased in response to global oxygenation [1] with or without the aid of sulfur disproportionation [2]. However, the fundamental cause of this change remains unclear. Here, we report a new batch culture experiment of natural populations corrected from a low sulfate lake, using acetate as an electron donor. The results showed that the isotopic fractionation was large ($^{34}\epsilon = 60\text{‰}$; $^{33}\lambda = 0.5145$) when started from 1 mM sulfate concentration, whereas small ($^{34}\epsilon = 20\text{‰}$; $^{33}\lambda = 0.5190$) under higher sulfate concentration (7 mM). In the experiment with 1 mM sulfate, acetate decreased at a faster rate than sulfate, likely due to consumption by non-sulfate-reducing organisms that metabolize acetate faster than sulfate reducers (SR). This suggests that SR were outcompeted by other organisms, limiting their access to an electron donor and resulting in larger isotope fractionation under lower sulfate concentrations. Our findings indicate that the increase in the fractionation factor observed in the Neoproterozoic may not necessarily reflect elevated sulfate levels, but could instead be attributed to limitation of organic matter for SR caused by shifts in (micro)biological community structure.

[1] Fike et al. (2015) *Annual Review of Earth and Planetary Sciences*, 43, 593-622

[2] Canfield, D. E., & Teske, A. (1996). *Nature*, 382(6587), 127-132.