

6.7.P04

Using ^{33}S to differentiate biotic and abiotic sulfur isotope signaturesD.T. JOHNSTON¹, J. FARQUHAR¹, B.A. WING¹,
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We have measured $^{33}\text{S}/^{32}\text{S}$ and $^{34}\text{S}/^{32}\text{S}$ fractionations between sulfate and hydrogen sulfide for experiments with three dissimilatory sulfate reducers, two disproportionators that metabolizes sulfite and one disproportionator that metabolizes elemental sulfur. Our results indicate that the exponential factor that describes variations in $\delta^{33}\text{S}$ and $\delta^{34}\text{S}$ (λ [1,2]) is distinct for sulfate reducers and sulfur disproportionators (Fig 1.), even when the $^{34}\text{S}/^{32}\text{S}$ fractionations are similar. The values for λ produced by each of these metabolisms is also distinct from values that we have calculated for λ [3] that are produced by equilibrium sulfur isotope exchange, the process that is attributed as the cause for most geological isotope fractionations.

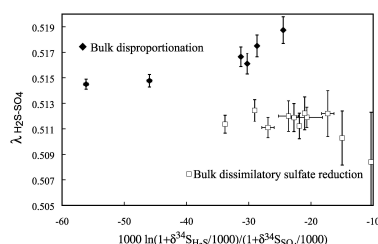


Figure 1: Plot of λ versus ^{34}S fractionation for hydrogen sulfide and sulfate from sulfur disproportionation and sulfate reduction experiments.

The λ values for $\text{SO}_4\text{-H}_2\text{S}$ pairs in experiments with the three dissimilatory sulfate reducers average ~ 0.5112 (range from 0.5117 to 0.5108). This is consistent with theoretical predictions of sulfate reduction (λ values of 0.512 [1]). The λ values for $\text{SO}_4\text{-H}_2\text{S}$ pairs in experiments with the three sulfur disproportionators ranged from 0.5145 to 0.5187. We interpret λ values more positive than 0.5145 to reflect forward and backward flow of sulfur intermediates along branches of the biosynthetic disproportionation networks. Published values of λ for $\text{SO}_4\text{-H}_2\text{S}$ equilibria range between 0.5141 at 0°C to a high temperature limit of 0.5159 [1,3].

Our results point to a new means to identify different mass-dependent biological and abiological sulfur isotope fractionation processes in the geological record, and suggest that relationships between λ and the $^{34}\text{S}/^{32}\text{S}$ fractionations can be used to study the biosynthetic networks in experimental studies.

References

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6.7.P05

Impact of the lightning discharge on chemistry of cometary atmosphere

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For the analysis of the substances and objects representing interest for astrobiology it is necessary to take into consideration both, process of their formation and the subsequent changes due to interaction with a surrounding medium. This especially concerns comets. Recent observations have shown that the chemical composition of the atmosphere of comets most likely does not correspond to the chemical composition of the nucleus [1]. If this is so, cometary substances participating in the formation of biochemical compounds, can substantially be determined by processes in the atmosphere.

The presented work discusses the capability for changes of the chemical composition of cometary substance (both gaseous components, and substances, which cover the surface of dust components) after a sublimation under effect of the electric discharges, presumably arising under certain conditions in near-surface layer of the atmosphere [2]. In this context it is interesting to note, that for an explanation of the chemical composition of the Jupiter and Titan atmospheres an explanation for the formation of some chemical compounds (HCN and acetylene on Jupiter, ethylene and nitriles on Titan) is suggested to take place under effect of the electric discharges [3]. In contrast to the lightning in dense atmospheres (Earth, Titan, Jupiter), discharges in gas-dusty cometary atmosphere will have following specialties [4]:

- presence of electrons of high energy ($\geq 1\text{eV}$)
- presence charged micron-size particles with charge $\approx 10^3\text{e}$.

These particularities give additional potential for synthesis of the organic compounds observed in atmospheres of comets.

References

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