

## A Model Study of Chamber Photochemical Experiments for S-MIF Under Reducing Conditions

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The Archean era is important for understanding the evolution of our planet and Earth-like exoplanets. Sulfur Mass-Independent Fractionation (S-MIF) has been widely applied as a geochemical tracer that can provide chemical and physical clues for the state of a given atmosphere. To understand thoroughly the enrichment processes of stable sulfur isotopes and the S-MIF photochemical mechanisms in chamber photochemical experiments under reducing conditions, a 1D photochemical model for the S-MIF generation mechanism inside a chamber was developed by using the Krome package<sup>[1]</sup>. All related chemical reactions to the chamber photochemical experiment of <sup>32</sup>S, <sup>33</sup>S, <sup>34</sup>S, <sup>36</sup>S isotope species were added to the model. Three main proposed mechanisms of S-MIF such as the wavelength effect, self-shielding effect, and intersystem crossing effect were also included. Experimental data<sup>[2], [3]</sup> were used for model validation. Although there are several issues with the Archean S-MIF sources and large differences between the experiment data and the rock record. This model can quantify the contribution of each reaction to the total S-MIF measured during experiments.

### References

- [1] T. Grassi et al., *Mon. Not. R. Astron. Soc.* **439** (3): 2386-2419, (2014).
- [2] Y. Endo et al., *Earth and Planetary Science Letters*, **453**, 9–22 (2016).
- [3] Y. Endo et al., *Geophysical Research Letters*, **46**, 483–491 (2019).