**THE MAGNITUDE OF ATMOSPHERIC SULFUR MASS-INDEPENDENT FRACTIONATION.** Mark W. Claire[1] and James F. Kasting Author[2], [1]Virtual Planetary Laboratory and UW Astrobiology Program (mclaire@astro.washington.edu) [2]Virtual Planetary Laboratory and Penn State Astrobiolgy Research Center (jfk4@psu.edu)

**Introduction:** Life on Earth is currently supported by cyanobacteria performing oxygenic photosynthesis at the bottom of the food chain. Their waste product, free oxygen, supports all complex life and has altered the atmosphere in a spectroscopically observable manner over interstellar distances. By contrast, Earth's atmosphere was drastically different prior to ~2.4 billion years ago, when it was chemically reducing with oxygen present as a trace gas. Understanding the details of how Earth's atmosphere has changed through time is thus vital to understanding the evolution of complex life and also informs the search for life elsewhere.

Anomalous fractionation in sulfur isotopes (MIF-S) in ancient rocks provides strong evidence that atmospheric chemistry was reducing in some portion of the Archean atmosphere [1,2]. Until very recently, we were unable to accurately interpret the magnitude of the MIF-S signal, due to our lack of knowledge of the precise formation mechanism. New high-resolution cross-section measurements [3] have proven that photolysis of isotopically substituted $SO_2$ yields MIF-S, and enable meaningful calculations of the magnitude of the fractionation as a function of wavelength. These new data have allowed for estimations of bulk abundances of absorbing gas concentrations in the Archean atmosphere, with biological OCS implicated as a major absorber [4] in a one-box model calculation.

Here we present results from a full 1-dimensional photochemical model of the Archean atmosphere, which has been modified to compute high-resolution radiative transfer through the isotopic species of sulfur. This represents an advance as the magnitude of MIF-S can be investigated as a function of height in a redox-stratified atmospere which a one-box model cannot simulate. The treatment of sulfur isotopes was developed in a similar manner to that in [2], although the photochemical model used [5] was developed specifically to work in both late Archean and early Proterozoic atmospheres.

We perform similar calculations to [4] in order to further investigate the suggestion that variations in the magnitude of the MIF-S signal may help constrain the presence of additional gases in the Archean atmosphere. The distribution of MIF-S between atmospheric species as a function of height in self-consistent steady state atmospheres will be described. Furthermore, we will attempt to link atmospheric deposition pathways with their potential for permanent storage in the geologic record.

**References:**

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