Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36902

Insights into Sulfur Mass Independent Fractionation in the Modern Stratosphere from Quadruple Sulfur Isotope Measurements in Polar Ice

ANDREA BURKE[1], ROBERT C. J. STEELE[1], ELIZA HARRIS[2], JAMES W. B. RAE[1], DR. JAMIE LEWIS, PHD[3], CHRISTOPHER D. COATH[3] AND TIM ELLIOTT[3]

[1]University of St Andrews
[2]University of Bern
[3]University of Bristol

The mass-independent fractionation of sulfur (S-MIF) in Archean sedimentary rocks has long been interpreted as indicative of low atmospheric oxygen, low ozone, and resulting photochemical reactions by ultraviolet (UV) radiation. In the modern atmosphere, S-MIF is preserved in volcanic sulfate deposited on polar ice caps, and it is assumed to come from the stratosphere at altitudes where UV radiation is present at levels to allow photochemical reactions such as photolysis or photoexcitation. This assumption has been informed by numerous photochemical laboratory experiments, but a number of challenges with this interpretation remain, including the mechanism of preservation of the S-MIF within an oxic atmosphere, the timescale of the photochemical fractionation process, and the striking consistency in fractionation across all volcanic eruptions despite differing volcanic locations, plume heights, and plume chemistries. Here we revisit the existing hypotheses for the mechanism of S-MIF in the modern atmosphere. Informed by new high temporal resolution $D^{36}S$ and $D^{33}S$ data measured by collision cell MC-ICP MS across a single volcanic sulfate peak in Antarctic ice, we speculate on a new mechanism for S-MIF in the modern stratosphere that may resolve the above challenges.