

SO₂光解離反応による硫黄同位体非質量依存分別の全圧依存性 Total pressure dependence of sulfur mass-independent fractionation by SO₂ photolysis

*遠藤 美朗¹、上野 雄一郎^{1,2,3}、生沼 美穂⁴、ダニエラチェ セバスチアン^{2,4}

*Yoshiaki Endo¹, Yuichiro Ueno^{1,2,3}, Miho Oinuma⁴, Sebastian Oscar Danielache^{2,4}

1. 東京工業大学地球惑星科学系、2. 東京工業大学地球生命研究所、3. 海洋研究開発機構、4. 上智大学理工学部

1. Department of Earth and Planetary Sciences, Tokyo Institute of Technology, 2. Earth-Life Science Institute, 3.

Department of Subsurface Geobiological Analysis and Research (D-SUGAR), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), 4. Faculty of Science and Technology, Sophia University

Sulfur mass-independent fractionation (S-MIF) in Archean sedimentary rocks is a useful proxy for atmospheric chemistry. Archean S-MIF signatures typically show that $\Delta^{36}\text{S}/\Delta^{33}\text{S}$ values are close to -1 . We have succeeded to reproduce the $\Delta^{36}\text{S}/\Delta^{33}\text{S}$ slope experimentally (Endo et al., 2016). Based on the experimental results, we suggested that Archean S-MIF can be explained by a combination of two effects: (1) self-shielding of SO₂ photolysis ($\Delta^{36}\text{S}/\Delta^{33}\text{S} \sim -2.4$) and (2) intersystem-crossing in excited SO₂ ($\Delta^{36}\text{S}/\Delta^{33}\text{S} \sim +0.7$). However, several results of previous photochemical experiments cannot be explained only by the two effects (Ono et al. 2013, Masterson et al. 2011). Total pressure may cause an additional effect on the S-MIF, though the mechanism is poorly understood. Here, we conducted SO₂ photolysis experiments under various total pressures from 0.1 bar to 1.7 bar and measured sulfur isotope fractionations. Measured $\Delta^{36}\text{S}/\Delta^{33}\text{S}$ values changed depending on total pressure. We discuss the mechanism of total pressure dependence of S-MIF by SO₂ photolysis in terms of pressure broadening effect (Lyons et al., 2018) and present an implication for the total pressure of the Archean atmosphere.

キーワード：太古代大気、硫黄同位体、非質量依存同位体分別、自己遮蔽効果

Keywords: Archean atmosphere, Sulfur isotopes, Mass-independent fractionation, Self-shielding