Isotopic effects on $^{32/33/24/36}$SO$_2$ UV Spectra measured by Dual Beam UV Spectrometer

□S. Danielache$^1$, D. Jensen$^2$, Y. Ueno$^1$, M. Johnson$^2$, N. Yoshida$^1$.

$^1$Department of Environmental Science and Technology, Tokyo Institute of Technology, Yokohama, Japan.$^2$Copenhagen Center for Atmospheric Research, Department of Chemistry, University of Copenhagen, Copenhagen, Denmark)

Sulfur dioxide (SO$_2$) is one of the many trace gases present in the atmosphere. The photodissociation reaction by UV light initiates a complicated oxidation process which its final product sulfates and sulfuric acid form aerosols. This chemical process is complemented by physical deposition which brings back sulfate aerosols to earth to become part of the soil and rocks. The photodissociation process is assumed to imprint a characteristic isotopic fractionation highly dependent on wavelength therefore the sulfates contained in rocks from different geological ages would have a characteristic isotopic fractionation of the atmospheric radiative conditions of that age. If the above assumptions are correct then by analyzing the isotopic fractionation of sulfates contained in rocks, information of the atmosphere at different geological ages can be obtained. Previously recorded UV absorption spectra of $^{32}$SO$_2$, $^{33}$SO$_2$, $^{34}$SO$_2$ (Danielache et al., 2008) have been used to interpret the geological record. Due to UV shielding, atmospheric concentrations of O$_2$, O$_3$, OCS, CO$_2$, H$_2$O, and SO$_2$ influence on isotopic fractionations and contribute to the mass independent fractionation (MIF) observed in rocks from the beginning of earth up to 2.4 billion years before present, also called Achaean MIF (Ueno et al., 2009).

Since the measurement of absolute absorption cross sections of isotopologues is a complicated task a dual beam spectrometer (DBS) was designed and built for the purpose of measuring ratio of absorption cross-sections of the isotopologues: $^{32}$SO$_2$, $^{33}$SO$_2$, $^{34}$SO$_2$ and $^{36}$SO$_2$ with high precision. All elements of the dual beam spectrometer, how they were used and tested for an optimal measurement of ratio of absorption cross-sections are presented. The spectrum of the $^{36}$SO$_2$ isotopologue measured and presented, is the first of its kind ever published.


Ueno et al., PNAS, 2009, accepted for publication.