

Source and reaction of atmospheric zinc in aerosols based on the isotope fractionation mechanism during the vaporization process

SACHIKA NATORI¹, MASATOMO FUJIWARA², PROF. MASAHARU TANIMIZU, PHD.³, MINAKO KURISU⁴, TSUYOSHI IIZUKA¹ AND YOSHIO TAKAHASHI¹

¹The University of Tokyo

²Hiroshima University

³Kwansei Gakuin University

⁴JAMSTEC

Presenting Author: snatori@eps.s.u-tokyo.ac.jp

Zinc (Zn) in aerosols plays important roles for biological activity because of its high-water solubility and amount in the atmosphere. In order to discuss the origin and behavior of atmospheric Zn and systematically understand the degree of isotopic fractionation associated with the vaporization of metal elements with different volatility, we conducted Zn speciation and isotope ratio analyses of atmospheric aerosol samples collected in Japan, and laboratory combustion experiments. Based on the results of Zn isotope ratios, atmospheric concentrations and speciation, three types of origin of Zn were estimated: (i) complete combustion origin (combustion of petroleum fuels such as gasoline with small isotope fractionation), (ii) partial combustion origin (combustion of fuels with solid phase such as coal and incorporation of their components into droplets with large isotope fractionation), and (iii) non-combustion origin (mineral particles and abrasive particles such as automobile tires without isotope fractionation). The results of indoor combustion experiments also suggested that the isotope fractionation effect in gasoline combustion was small compared to combustion of solid fuels. Isotope fractionation by combustion vaporization has also been studied for iron (Fe) [1,2,3,4], and it is expected that the difference in characteristics between Fe and Zn isotope ratio can be useful to identify the origin of aerosols. Unlike Fe, Zn does not need to be considered for isotope fractionation by redox reactions, and its isotope ratio may reflect historical change in atmospheric input from natural combustion sources such as volcanic activities.

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