

## Multiple sulfur isotope compositions ( $^{32}\text{S}$ , $^{33}\text{S}$ and $^{34}\text{S}$ ) of the dissolved sulfate in precipitation of Seoul from 2011 to 2015

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The multiple sulfur isotope compositions ( $^{32}\text{S}$ ,  $^{33}\text{S}$  and  $^{34}\text{S}$ ) of dissolved sulfate in precipitation of Seoul were analyzed to trace the source of sulfur from 2011 to 2015. The  $\delta^{34}\text{S}$  values of samples are ranging from 1.4 to 14.6‰ with no distinct seasonal variation. To exclude sea salt sulfate fraction, the  $\delta^{34}\text{S}$  values are converted to non-sea salt sulfur isotope values ( $\delta^{34}\text{S}_{\text{nss}}$ ). The  $\delta^{34}\text{S}_{\text{nss}}$  values ranges from -1.1 to 8.8‰, indicating that the fraction of sea salt sulfate (F) in most samples is less than 0.10 with two anomalies, 0.44 and 0.59. With backward trajectory models based on HYSPLIT by NOAA, it is considered that  $\delta^{34}\text{S}_{\text{nss}}$  values of samples can be classified by the origin and pathway of air masses causing precipitation. Considering the  $\delta^{34}\text{S}_{\text{nss}}$  of this study, the average sulfur isotopic values of coals used in china and the pathway of airmass, the combustion of coals in China is thought to be main source of the dissolved sulfate in the study area. The  $\Delta^{33}\text{S}$  values of samples range from -0.06 to 0.16‰. The measured anomalies ( $\Delta^{33}\text{S}$  values higher than 0.10‰) of this study (0.11-0.16‰) are small that it is not clear whether these values are derived from mass-independent fractionation.