

# Strontium isotopic and rare earth elemental compositions constraint on the provenance of solid particles in rainwater in the Kyoto-Osaka-Kobe area

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We determined Sr isotopic ratios ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) and concentrations of rare earth elements (REE) of solid particles (air dust;  $> 0.2 \mu\text{m}$ ) in monthly rainwater samples in order to elucidate the seasonal and regional variation in the provenance. We collected monthly rainwater samples at Kyoto city and Kyotanabe city in Kyoto, at Neyagawa city in Osaka and at Nishinomiya city in Hyogo from January 2010 to December 2011.

Monthly  $^{87}\text{Sr}/^{86}\text{Sr}$  of the dust ranged from 0.7081 to 0.7171 and tended to become high in spring, and low in summer and autumn. Kosa (Asian dust) events are frequent in spring and the maximum  $^{87}\text{Sr}/^{86}\text{Sr}$  of dust in spring was close to the  $^{87}\text{Sr}/^{86}\text{Sr}$  for loess in China. Moreover, the chondrite-normalized REE compositions in the dust samples with high concentrations of REE were similar to those of loess. The REE concentrations indicated positive correlation with  $^{87}\text{Sr}/^{86}\text{Sr}$  in Kyotanabe and Nishinomiya. These results indicate that the dust in spring were largely originated from Kosa (Asian dust). The maximum  $^{87}\text{Sr}/^{86}\text{Sr}$  in Kyotanabe city in 2010 was higher than those in 2011. Asian dust events in 2010 were more frequent than in 2011. These results demonstrate the influence of Kosa (Asian dust) on the dust was different depending on year.

The chondrite-normalized REE compositions of the dust samples showed negative Eu anomaly. It is likely that this is caused by the enrichment of weathered soil and clay minerals.

The dust samples contained more the light REEs than the heavy REEs and their chondrite-normalized REE compositions showed positive anomaly of Tb. This anomaly was large in summer and autumn in Kyotanabe, Kyoto and Neyagawa. The La/Sm ratios of the dust were high in Nishinomiya followed by Neyagawa, Kyoto, and Kyotanabe. Industrial waste incineration fly ash shows high concentrations of light REEs and Tb and the La/Sm ratio is considered the indicator of traffic-related pollution in previous studies. Therefore these results suggest that the dust were affected by anthropogenic substances depending on sites.

Keywords: rain water, dust, eolian dust, Sr isotope, rare earth elements