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Sr and Nd isotope compositions of atmospheric mineral dust at the summit of Mt. Sefuri, north Kyushu, southwest Japan

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Atmospheric mineral dust was collected for analyzing its provenance and seasonal variability from Sr and Nd isotope ratios beginning in 1998 from rainwater falling on the summit of Mt. Sefuri, North Kyushu, southwest Japan. The dust was composed of numerous unidentified fine particles as well as rare distinguishable minerals (<20 micrometer), which have been identified as quartz, plagioclase, K-feldspar, biotite, white mica (muscovite-phengite), magnetite, goethite, illite, and gibbsite. Such coarse grains were frequently observed in winter and following spring. During this period, the total mass of mineral dust generally increased in late winter, peaked in early spring, and then decreased. Inorganic materials sometimes increased somewhat from late summer to early autumn.
Sr isotope ratio of atmospheric mineral dust varied from 0.7096 to 0.7180, and epsilon-$Nd_{CHUR}$from -19.9 to -3.5. Sr isotope ratios were moderately correlated with Rb/Sr ratios and weakly with Nd isotope ratios. These variations were caused by fractionation of the airborne particles and by differences in source areas; therefore, the compositional characteristics can be used as an index to identify the sources of mineral dust. During heavy deposition periods, the dust had high Sr isotope ratios and low to middle Nd isotope ratios, respectively. These compositions varied within narrow ranges and are comparable to those of sand and loess in arid areas of Northeast China, Takla Makan and Western Beijing. Such particles were transported by westerlies from those areas to northern Kyushu in winter and spring. In summer and autumn, the isotopic compositions of the dust varied greatly; however, during light deposition periods, the Sr isotope composition was low. Contributions of soils derived from local weathered granite, and of south wind-transported volcanic ash, combined with a relative decrease in the amount of loess from the continent, caused Sr isotope ratios in the dust to shift to lower values in summer and autumn. Nevertheless, fine sandy desert particles and loess in general accounted for most mineral dust deposition in northern Kyushu year-round, even in summer. In greater or lesser amounts, the particles and loess, regardless of season, were major components of mineral dust carried by wind from northeast Asia. Local soils derived from weathered granite and volcanic ash were minor components only. In summary, Sr isotopic compositions reflected seasonal variations in mineral dust, and Nd isotopic compositions were useful for identifying the dust sources.
The net mass of water-insoluble inorganic matter in the collected mineral dust fluctuated from year to year; deposition on Mt. Sefuri was relatively large before 2001, decreased from 2002 to 20 05, and increased greatly in spring 2006. These year-to-year differences probably reflected changes in the strength of the westerlies and in climate conditions in the arid source areas.

Keywords: atmospheric mineral dust, Sr and Nd isotope ratios, seasonal variation, westerlies, loess