Geochemical features for aerosols, collected at north-western to central China: Isotopic characterization as tracer for Asian dust

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Introduction

Sr and Nd-isotope has been used as useful geochemical tracers to evaluate Asian dust contribution to aerosols and soils in Japan, sediments of the Pacific Ocean and dust in the Greenland Ice Core. In spite of a successful tracer study over Asian dust affected areas, geochemical data from possible source areas, i.e. inland Asia, are still very insufficient. Reported Sr and Nd-isotope data were mainly provided sporadically by the studies of long-range-transported areas of Asian dust.

We have been collecting aerosol samples at north western to central China by high-volume air samplers since spring, 2001. Aerosols, as well as size-segregated fine soils, are suitable for dust study, since they are Asian dusts themselves. We have analyzed Sr and Nd-isotope composition for bulk and silicate fraction (acetic acid residue) to clarify the geochemical features in source areas of Asian dust.

Result and Discussion

The $^{87}Sr/^{86}Sr$ and $^{87}Rb/^{86}Sr$ ratios of the aerosol collected over north-western and north central China were obviously higher in the silicate (0.7187-0.7205, 1.74-3.07) than the bulk fraction (0.7122-0.7149, 0.60-1.04). This is because the some carbonate components containing in Chinese surface soils are characterized by lower and nearly constant $^{87}Sr/^{86}Sr$ ratio (around 0.709). Enrichment of K-bearing minerals, such as illite or biotite (higher Rb contents) in a finer silicate fraction causes higher $^{87}Sr/^{86}Sr$ and $^{87}Rb/^{86}Sr$ ratios. In an Rb-Sr isotope diagram, both of the bulk and silicate fractions of Chinese aerosols were plotted around the field of Chinese loess. Although we could not find the close relationship to aerosols collected in Japan related to Kosa Phenomenon, there was a small diversity of the collecting sites.

On the other hand, $^{143}Nd/^{144}Nd$ ratios for silicate fraction of Chinese aerosols show almost constant (around 0.5122). In a diagram for $^{143}Nd/^{144}Nd$(_Nd)-$^{87}Sr/^{86}Sr$ ratios, Chinese aerosols are plotted in a distinct area of a few already reported data of inland Asia.

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Small scale heterogeneity near the top of the lower mantle around the subducted slabs

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Short period waveform data recorded at western US seismic array for deep earthquakes at north western Pacific show anomalous wave packets within several tens of seconds after the arrival of direct P wave (simply called "P" or "P wave"): We perform array analyses to locate the sources of the later phases. In the first step, we measure arrival time, slowness, back-azimuth, and amplitude of the later phases relative to P. In the second step, we compute composite semblance coefficients for the cases of P-to-P and S-to-P single scattering near the foci. The phases are usually best interpreted as S-to-P scattered waves generated near the focal regions based on three observations: (1) highest composite semblance values, (2) scatterer locations mutually consistent between different event groups with different focal depths, and (3) a reasonable amount of elastic property anomalies required. The scatterers are located near the bottom of the upper mantle to the top of the lower mantle, at depths from 600 to 900 km. They are unlikely to be horizontal or nearly horizontal discontinuities. The changes in elastic properties associated with these heterogeneous objects probably occur within several kilometers, according to their high efficiency at converting short period waves. They thus are likely to represent sharp chemical variations in major element composition. These objects tend to be located within thickened high velocity anomalies near the top of the lower mantle, which have been determined by previous seismic studies. A plausible tectonic interpretation of these objects is that they are fragments of former oceanic crust which are entrained in the Pacific slab impinging on more viscous lower mantle.