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Y. Iwasaka

Institute of Nature and Environmental Technology, Kanazawa University, Kotatuno, Kanazawa, 920-8667

Asian dust particles (KOSA) now attract great concern of many person since atmospheric dust particles have been recognized as important constituents controlling regional and global environment, and many international research projects were made since about 1995 to obtain better understanding of formation processes of asian dust storms, transport mechanism of dust, chemical-physical transform processes of dust particles, deposition processes of dust particles, and so on, and various new techniques were improved during those periods; networking of lidars and radiometer, usage of satellite, aircraft-borne instruments, ship-borne instruments, balloon-borne instruments.

We made measurements of aerosols including KOSA in 2001, 2002, 2003, and 2004 at Dunhuang (40°00'N, 94°30'E), China, which located east side of the Taklamakan desert, to understand nature of atmospheric particles, especially free tropospheric dust, over the desert areas in the Asian continent. Balloon-borne measurements with an optical particle counter (OPC) suggested that particle size and concentration had noticeable peak in size range of super micron in not only the boundary mixing layer but also the free troposphere (Kim et al., 2004). Thickness of the boundary mixing layer, from distributions of particle concentration, was in the range from about 2km (mostly in winter and fall) to about 4 km (mostly in summer), which suggests active mixing of particles near the boundary in summer. Vertical profiles of aerosol concentrations shows lots of sub-layers in the troposphere ,suggesting the structures of multi-layers which are possibly due to different sources and histories each other (Fig. 1).

Number-size distribution of particle frequently showed noticeable peak in the super micron particles size range in the mixing boundary layer and free troposphere, suggesting that dust particles are actively injected to the free troposphere not only in spring but also in other seasons. In winter strong inversion of atmospheric temperature was found in the height range from the boundary to about 3km and vertical distribution of particle concentration well corresponded with the temperature distribution.

The particle collection was tried in the free troposphere at Dunhuang with the balloon-borne particle impactor to make electron microscopic experiments of those particles (Iwasaka et al., 2003). It is shown, on the basis of analysis with an electron microscope equipped with an energy dispersive spectrometer of X ray (EDX), that major components of super micron particles were dust particles

having relatively clean surface (Fig. 2). The major component of fine mode particles (diameter smaller than 1μm) was sulfate particles. Therefore it is reasonable to consider that most of super micron particles observed by balloon-borne OPC is mineral dust particles. The surface state of the particles collected over Dunhuang shows large difference with the surface state of dust particles which were collected over Japan islands since most of dust particles had sulfate over their surface over Japan (Trochkine et al., 2003). This is strongly suggested that dust particles react with atmospheric sulfur during long-range transport from desert area of China to Japan.

Lidar measurements suggested the possibility that mixing of dust particles was noticeable from near the ground to about 6km heights even under the calm weather condition (Fig. 3). This showed well correspondence the profiles of coarse mode particle concentration observed by the balloon-borne OPC (Iwasaka et al., 2003).

The wind systems were estimated from analysis of the balloon-trajectory showed good agreements with the analysis by Sun (2002), and it is suggested that combination of wind system and geographical conditions is strongly controlling dust particle diffusions and transports (Iwasaka et al., 2003).

Background KOSA events, as suggested by Iwasaka et al. (1988) and Matsuki et al (2003), have been frequently found in spring and other seasons over Japan. It is suggested that the Tarimu basin including the Taklamakan desert functions as the dust particle pool from which always dust particles diffuse out (Iwasaka et a., 2004). The present observations strongly confirmed the suggestion that the Taklamakan desert was possible source of the background KOSA found in summer over Japan islands (Matsuki et al., 2003).

The measurements in 2001-2004 revealed the importance of Taklamakan desert as source of KOSA and suggested possible surface reaction on KOSA particle surface. Further observations and experiments made from the standing point of view of microphysics, to obtain better understanding on surface reactions on KOSA particles and their effects on environment in east Asia, are desired in future.

Climatology of background KOSA is important to understand contribution of KOSA particles on environment through radiative forcing and global/regional budgets of minerals. Advanced lidar networking will be effect to clarify behavior of background KOSA.

Chemical reactions on KOSA surface is important processes to discuss interaction between KOSA particles and atmospheric pollutants, and role of condensation nuclei. Intensive field measurements and laboratory experiments are desired.

Studies of contribution of atmospheric water vapor to surface reaction on KOSA also is necessary since some observations speculated that water vapor made important effects on surface reactions, and distribution of water vapor needs to discussed from view points of surface processes on KOSA

particles.

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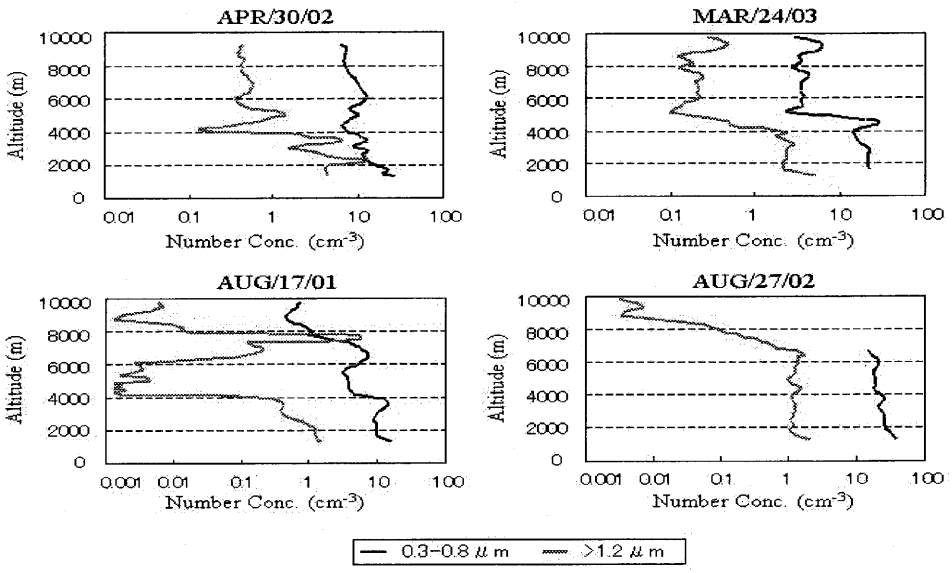

Figure 1 Number concentration of particles measured with the balloon-borne optical particle counter at Dunhuang, China.

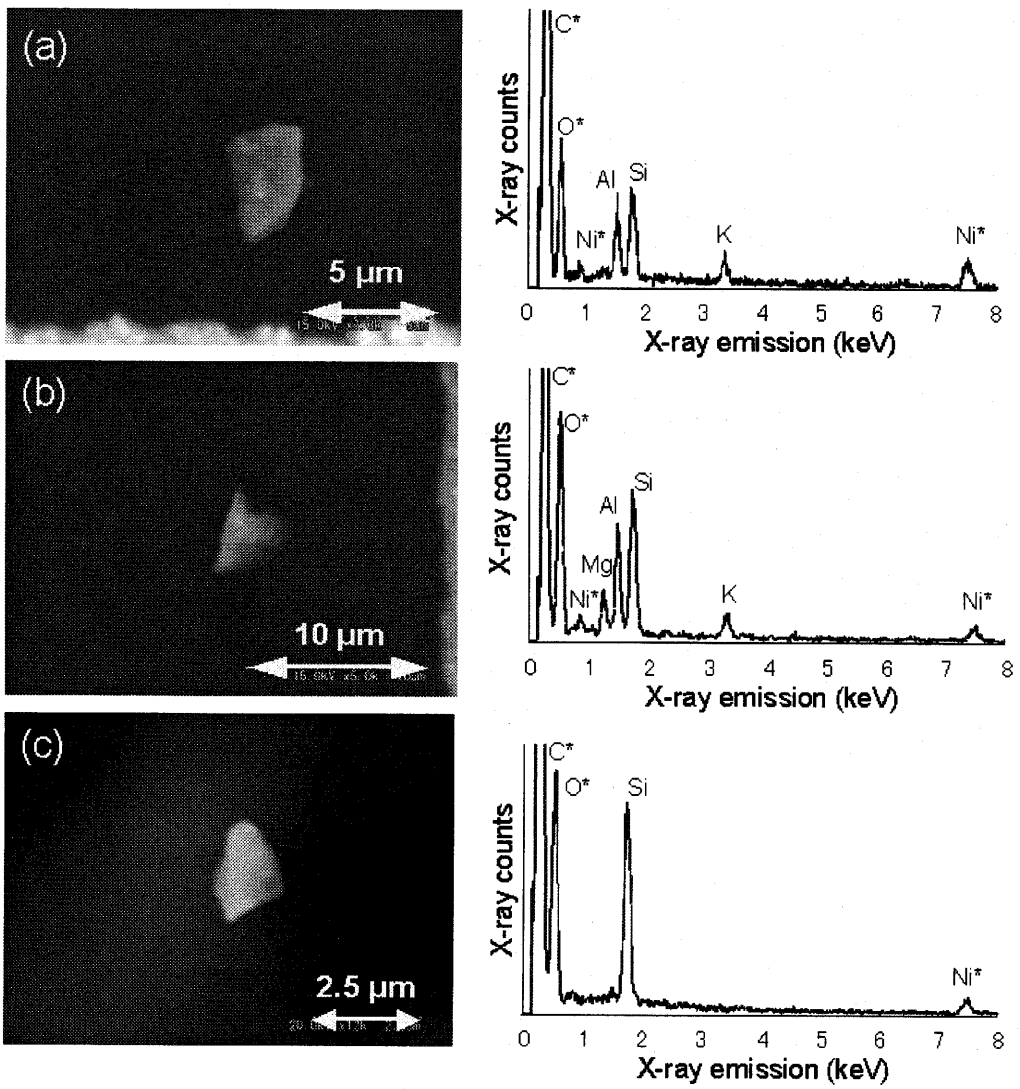

Figure 2 Example of electron microscopic picture and x-ray energy spectrum of the particles collected in the free troposphere over Dunhuang, China. Few coarse particles were detected in 5-8km in 28 August, 2002.

a: 28 August, 2002 (3-5 km)

b: 24 March, 2003 (3-5km)

c: 24 March, 2003 (5-8 km)

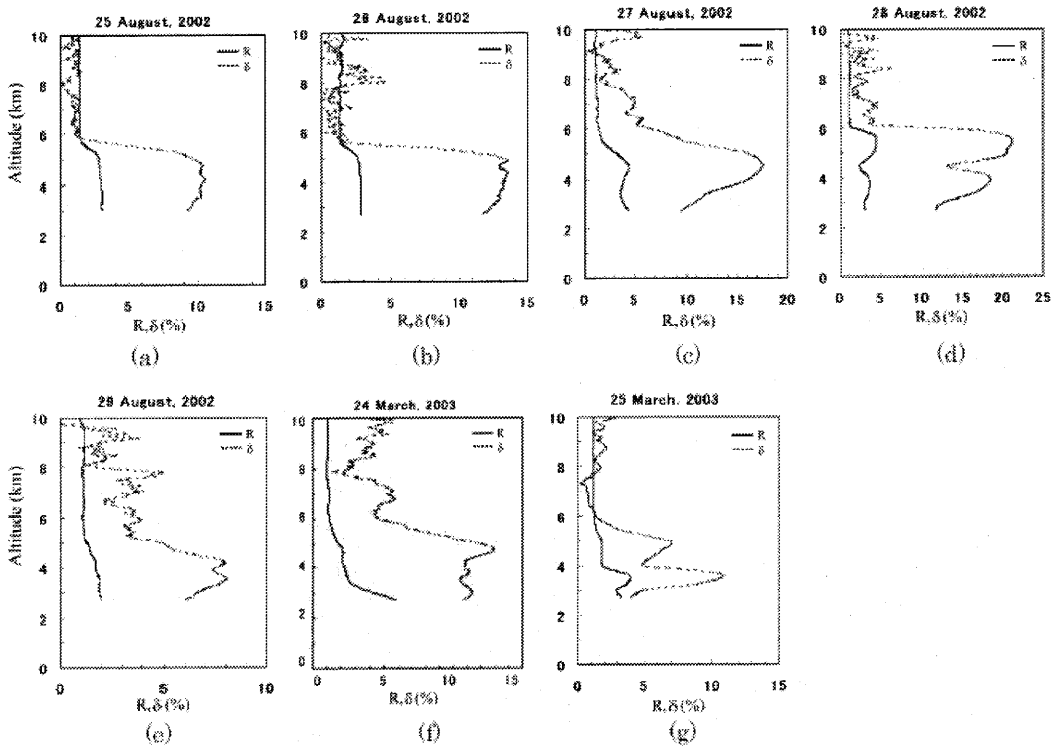

Figure 3 Scattering ratio and depolarization ratio of particles measured with lidar at Dunhuang, China. Decreases in scattering ratio and depolarization ratio is noticeable at about 5km.