2A1) Single-particle Characterization of Aerosol Particles Collected in Incheon, Korea, during Asian Dust Storm Event in the Fall of 2009

Shila Maskey · Hae-Jin Jung · Bo-Hwa Kim · Chul-Un Ro
Department of Chemistry, Inha University, Incheon, 402-751, Korea

1. Introduction

Asian Dust events usually occur in spring time, i.e., from March to May. However, an Asian Dust storm event occurred during 21-23 September 2009 as a distinctive event because Asian Dust events have rarely been observed in Korea during fall season. During the Asian Dust's long-distance travels, it can react with diverse chemical species and/or provide a reaction site for chemicals in the air. Therefore, Asian Dust can possibly carry other chemical species along with its original, mineral components. For example, it would react chemical species such as SO_x and NO_x so that the transport of modified Asian Dust to the East Asian region could result in the deposition of sulfate and nitrate, in addition to mineral dust, in this area. Hence, increasing attention has been devoted to the study on the modification of physicochemical properties of Asian Dust particles during long-distance transport. A single particle analytical technique, called low-Z particle electron probe X-ray microanalysis (low-Z particle EPMA), was applied for the characterization of aerosol samples collected in Incheon, Korea, during the Asian Dust event.

2. Materials and Methods

Five sets of Asian Dust samples (S_1-S_5) were collected during September 2009 on the roof of a campus building of Inha University, which is located in the Incheon (37°13′N,126°07′E), Korea. Particles were sampled on Ag foil using a three stage cascade impactor (PM_{10} Impactor, Dekati. Inc.). The particles of stages 2 and 3 of the impactor, corresponding to 2.5-10 μm (coarse fraction) and 1-2.5 μm (fine fraction) aerodynamic size fractions at a flow rate of 10 L/min, respectively, were measured using a JEOL JSM-6390-SEM equipped with an Oxford Link SATW ultra thin window energy-dispersive X-ray (EDX) detector. The net X-ray intensities for chemical elements were obtained by non-linear, least-squares fitting of the collected spectra using AXIL program. The quantitative analysis was performed by a modified CASINO Monte Carlo program (Ro et al., 1999). Based on SEIs data, elemental concentrations, and X-ray spectra, the individual particles were classified into different particle types.

3. Results and Discussion

A total of 2520 particles for 3 days samples (approximately 500 for each sample) were analyzed using the low-Z particle EPMA technique. Fig. 1 shows typical SEIs of individual aerosol particles collected during Asian Dust storm event. Major chemical species frequently encountered in the Asian Dust samples are aluminosilicate (denoted as AlSi), SiO_2, $CaCO_3$; AlSi+(N,S), reacted $CaCO_3$; genuine sea-salt, reacted sea-salt; carbonaceous species; and Fe-rich particles. The elevated secondary soil-derived particles in the sample collected during the storm event clearly indicate that Asian Dust particles experienced chemical modifications during long-distance travel over industrialized regions of China and the Yellow Sea. The sample (S_1) collected just after the rain and

at the beginning of the event showed the largest abundance of primary soil-derived particles (on average 37.9%, 24.2%, 17.4%, 14.7%, and 12% for samples S_1, S_2, S_3, S_4, and S_5 respectively) (Fig. 2). This result indicates that the particles of S_1 sample experienced less chemical modification because the air pollutants, i.e., SO_x and NO_x were washed out by rain. As the Asian Dust storm event progressed, abundances of primary soil-derived particles decreased.

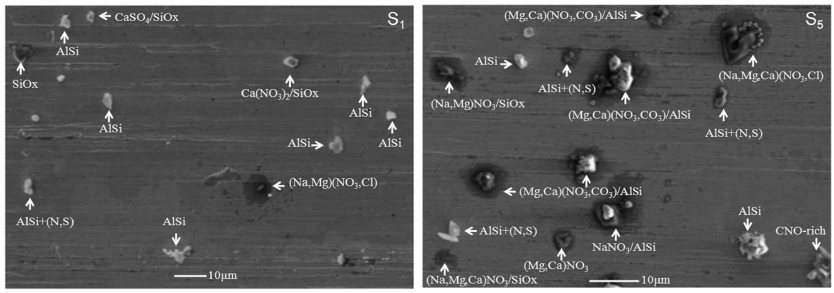

Fig. 1. Typical SEIs of individual aerosol particles collected during Asian Dust storm event.

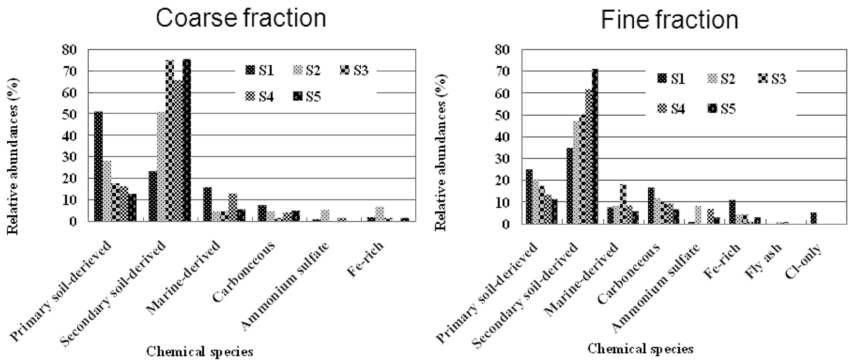

Fig. 2. Overall relative abundances of significantly encountered chemical species.

Reference

Ro, C.-U., J. Osàn, and R. Van Grieken (1999) Anal. Chem., 71, 1521-1528.