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Atmospheric aerosol particles collected above and below clouds along the pass of Mt. Fuji

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Size and composition of atmospheric aerosol particles can be altered by in-cloud process with absorption/adsorption and drying of activated aerosol particles as cloud condensation nuclei. To elucidate differences of aerosol particles before and after in-cloud process, we made four sets of observations along the pass of Mt. Fuji, Japan (3776 m a.s.l.) during July and August 2011 using a portable optical particle counter and an aerosol sampler. Number concentrations of dried particles selected for cloud interstitial particles using a fog-cut impactor were measured to quantify tendencies of cloud activation condition in cloud. Aerosol samples for analysis of elemental composition were obtained above, in and below clouds, by using a cascade impactor. After shadowing by evaporation of Pt/Pd, individual particles on the samples were analyzed using a transmission electron microscopy (TEM) equipped with energy dispersive X-ray analyzer.

Clouds under up-wind conditions without rain were identified at three of the observations; the cloud altitudes were from 1700 m to 3300 m on 15th July, from 1300 m to 3300 m on 3rd August and from 2000 to 2400 m on 11th August. Aerosol number concentration above the clouds was one order lower than that below the clouds on 3rd August, but was equivalent with it on 15th July and 11th August. The backward air trajectories for 3rd August were also not similar altitudes of above and below the clouds. We compare the samples (for 15th July and 11th August) above and below cloud aerosols to identify the impacts of in-cloud process. Most of particles (0.5?2 um diameter) were sea salt, containing Na with some S and Cl both for samples above and below the clouds. For Na-containing particles of 15th July, sample averages of atomic ratio of Cl/Na above and below the clouds were 0.00 and 0.30, respectively. In the atmosphere, NaCl in aerosol particles can be changed to Na_2SO_4 or $NaNO_3$ by substitution reaction. On 15th July, the ratio of S/Na above the clouds (0.20) was higher than that below the clouds (0.16), but lower than that of Na_2SO_4 (0.5), implying that Cl in the sea salt particles was replaced by SO4 and other components in the clouds. For 11th August, the ratio of Cl/Na was 0.00 above and below the clouds, while the ratio of S/Na above the clouds (0.31) was higher than that below the clouds (0.17). This result suggests that SO_2/sulfate components were absorbed or adsorbed onto sea salt particles after complete substitution of Cl.

Keywords: atmospheric aerosol particle, sea salt aerosol, in cloud process