Changes of dust particles due to sea salt and chlorine chemistry in the marine atmosphere

Daizhou Zhang
Prefectural University of Kumamoto, Japan

Asian dust particles have been studied in Japan since 2000 with electron microscopes. Mixture state of individual dust particles with sea salt, sulfate, nitrate and chloride were investigated. About 60–85% of dust particles were internally mixed with sea salt. Besides the coagulation of sea-salt and dust particles, chlorine could deposit onto dust particles through the absorption of chlorine-containing gases when the particles passed through the marine atmosphere between China and Japan. Quantitative estimation revealed that the chlorine deposition on many particles was not ignorant compared to sulfur deposition.

Mixing with sea salt can result in the growth of dust particles in size, which means that dust particles collected near the surface in downstream marine atmosphere are not the same as emitted in source areas and the whole particle has becomes larger than the mineral part. This is helpful to elucidate the fact that Asian dust particles during their trans-Pacific transport kept a constant size mode of about 3-4 µm for number distributions (particle number via particle size in per cubic unit of air) or a little larger for mass and volume distributions. As particles travel toward remote marine atmosphere, they grow in size due to mixing with sea salt. If they become larger than a certain size, they will drop to the surface rapidly, the result of which is a constant size mode at different sites along the dust transport route.

Analyses of dust samples with integrated samples cannot distinguish the re-deposited chloride. This will resulted in the underestimation of chlorine release from sea salt particles which is due to the absorption of acidic materials such as sulfuric acid and nitric acid in the marine atmosphere. Besides, chloride formation on the surface of dust particles is expected to enhance their ability of absorbing water vapor. This can, consequently, convert dust particles into aqueous droplets under remote marine atmospheric conditions, in particular when the concentration of hydrogen chloride exceeds that of other acidic species such as nitric acid.

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