

Hygroscopic Properties of Antarctic Sea Salt Aerosols Collected at King George Island

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Antarctica, having minimal influence from trade-winds is isolated from cross-continental anthropogenic aerosol sources. Hence, it is one of the few pristine sites ideal for studying natural sea salt aerosols (SSAs) processes (Maskey *et al.*, 2011). The different phases of natural SSAs significantly affect earth's radiative balance by scattering light and acting as cloud droplet or ice-nuclei (Ault *et al.*, 2013). So far most investigations are based on artificially generated SSAs. This study aims to present a systematic examination of the inter-dependence of hygroscopic properties and the chemical heterogeneity of natural SSAs collected at the Antarctic.

Aerosol samples were collected at a Korean scientific research station in the Antarctic: the King Sejong station (62°22'S, 58°78'W). Sea salt particles were collected on Al foils (Aldrich, 99.8% purity) using a three stage cascade impactor (PM₁₀ Impactor, Dekati Inc.). The impactor has aerodynamic cut-sizes of 10, 2.5, and 1 μm for stages 1, 2, and 3, respectively, at a 10 L min⁻¹ sampling flow. An optical microscopic technique was used to observe the phase transition and hygroscopic growth of sea salt particles (Ahn *et al.*, 2010). Secondary electron images and energy-dispersive X-ray elemental maps provide morphology and distribution of the elements within each particle.

In Figure 1, two exemplar natural SSA, their optical images at different RHs, SEIs, and elemental maps are shown. The particle (Fig. 1-A) dissolved at ~73.7 % RH lower than deliquescence RH (DRH) of pure NaCl. During dehydration process the particle effloresced at 47.6 % RH, comparable to pure NaCl efflorescence RH (ERH) even though small amount of magnesium, sulfur, and organic coating existed. On the other hand, the particle (Fig. 1-B) showed apparent liquid-liquid phase separation (LLPS). At 48.7 % RH, two apparently separate liquid phases (NaCl rich and organic rich phases) were observed (You *et al.*, 2013). At 74.7 % RH, the left part, which is NaCl rich (X-ray map, Fig. 1-B), showed deliquescence. The remaining part, which is MgCl₂ and organic rich, hinders absorption of water possibly due to surface organic layer and immiscibility with the aqueous part. Although droplets appear to crystallize at once (observed ERH = 49.4 %, higher than pure NaCl ERH), MgCl₂ and organic rich part gradually decreased in size

with decreasing RH. The heterogeneity of effloresced particle (Fig. 1-B) is well demonstrated through elemental maps.

Studies are in progress for elucidating hygroscopic properties of more SSA particles. Especially, the preference of the organic part to be associated with the Mg rich phase and the apparent LLPS would be a interesting observation made on natural SSAs.

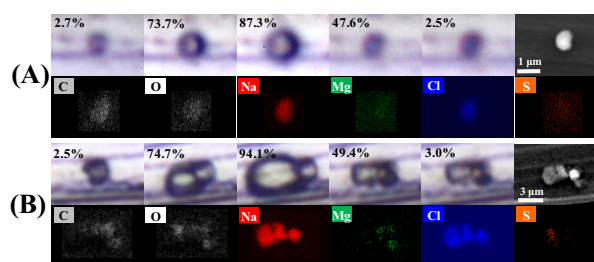


Figure 1. Optical images during humidifying and dehydration processes and elemental X-ray maps of crystallized particles with (A) mono-crystallized NaCl particle coated with organics and (B) fractionally crystallized particle (NaCl rich/MgCl₂ and organic rich).

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