Single-Particle Characterization of Aerosols Collected at King George Island, Antarctica

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Antarctica, a geographically isolated continent, is expected to be relatively clean with little influence from cross-continental air masses. Hence it is an ideal pristine site for studying characteristics and processes of natural aerosol. A previous study (Maskey *et al*., 2011) showed abundant sulfur-containing sea salt aerosols (SSAs), where the sulfur was originated from marine biogenic species. However, the relationship between seasonal biogenic activities and sulfur content of SSAs could not be established. In this work, Antarctic aerosols collected in the austral summer, winter, and spring seasons were investigated to identify the types of SSAs and the seasonal variation of sulfur to sodium ratio in SSAs, using quantitative energy-dispersive electron probe X-ray microanalysis, called low-*Z* particle EPMA (Ro *et al.*, 2000).

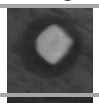
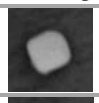
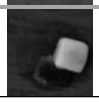
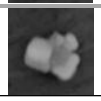
Samples were collected in different seasons from December 2011 to September 2012, at a Korean scientific research station in the King Sejong station (62°22′S, 58°78′W), King George Island, Antarctica. Aerosols were collected on Al foils (Aldrich, 99.8% purity) using a three stage cascade impactor (PM_{10} Impactor, Dekati Inc.) at a sampling flow rate of 10 L per min. 1000 individual particles from each of stages 2 and 3 (2.5-10 μm and 1-2.5 μm size fractions, respectively) for samples collected in the months of December (summer), July (winter), and September (spring) were analyzed.

From secondary electron images (SEI), four apparently distinct types of SSAs were observed in the stage 3 samples, such as mono-crystallized and fractionally crystallized particles containing major inorganics with or without organic species, as shown in Table 1. Dark shade around the crystallized SSAs represents the organic species. On the other hand, only fractionally crystallized SSAs without organic species were observed in the stage 2 samples for all three seasons.

The mono-crystallized SSAs in July and September samples showed the small amount of sulfur content whereas those in December showed quite high sulfur content. This observation is concurrent with the general trend of chlorophyll concentration data, which was higher in the summer than in the winter. It was reported that chlorophyll is an important indicator of biogenic activities (Minikin *et al*., 1998, Becagli *et al*., 2012). We are in the process of establishing some correlation between [S]/[Na] ratio in SSAs with chlorophyll concentration variation according to the season (Hara *et al*., 2012). Further, attenuated total reflection Fourier transform-infrared (ATR-FTIR) imaging of SSAs containing high [S]/[Na] can show signatures for intermediate and final stages in the formation of non-sea-salt sulfates from phytoplankton (Maskey *et al*., 2011). ATR-FTIR imaging of selected SSAs are under progress.

The complementary information obtained from both low-*Z* particle EPMA and ATR-FTIR imaging techniques is expected to provide a more fundamental understanding of the natural SSA processes that take place in the Antarctic region.

Table 1. Typical secondary electron images for 4 types of SSAs observed in stage 3

	With organic	Without organic
Mono-crystallized		
Fractionally crystallized		

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