

Individual particle analysis of marine aerosols collected over the Pacific Ocean and its marginal seas

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Sea-salt particles are produced by bubble bursting processes at the sea surface. Chemical compositions of sea-salt particles are modified when they react with acidic substances such as sulfuric acid (H_2SO_4), nitric acid (HNO_3) and methanesulfonic acid (MSA) in the atmosphere. The sources of acidic substances include anthropogenic pollutants, volcanic eruptions and dimethyl sulfide (DMS) from marine biota. If the acidic substances react with sea-salt particles, they are easily scavenged from the atmosphere. So the lifetime of acid substances in the atmosphere will be reduced and they are unlikely to be cloud condensation nuclei. Therefore cooling effect of clouds might be smaller than expected in the environment where sea-salt particles are abundant. In this study, difference in chemical compositions of sea-salt particles among ocean regions was revealed based on individual particles analyses of marine aerosols collected over the Pacific and its marginal seas. Additionally, source of acidic substances that modified sea-salt particles was discussed.

Sampling of marine atmospheric aerosol particles was carried out during KH-13-7 cruise (2013/12/11~2014/2/12) and KH-14-3 Leg2 cruise (2014/7/17~8/11) in the Pacific and its marginal seas. Individual particles were analysed using a transmission electron microscope and an energy dispersive X-ray spectrometer.

In most ocean regions, unmodified sea-salt particles accounted for more than 80% of the analysed particles. However, sulfate particles accounted for more than 85% in the sample collected around Guam islands. High concentrations of radon and number of aerosol particles, along with analysis of backward trajectories suggested that polluted air masses originated from the Asian continent came to the observation area. The aerosols collected around the Aleutian Islands included large number of sulfate and modified sea-salt particles. A Na-Cl-S ternary diagram indicates that sea-salt particles were modified with MSA produced from DMS oxidation or H_2SO_4 . Air masses from a volcano transported from the Kamchatka were also the potential source of H_2SO_4 around the Aleutian island.

Keywords: marine atmospheric aerosol, sea-salt, sulfate, volcano, dimethyl sulfide, methanesulfonic acid