Relations between Fractional Solubility and Trace Metals Species in Marine Aerosol

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Atmospheric depositon of trace metals (TM) is one of the important sources of dissolved TMs in the surface ocean [1]. However, controlling factors of fractional TMs solubilities have not been fully understood. One of the reasons is lacking of our knowledge about atmospheric TMs species which are an important controlling factor of fractional solubility. Here, we show Fe, Cu, Zn, and Pb species in marine aerosols determined by X-ray absorption fine structure (XAFS) spectroscopy and scanning transmission X-ray microscope (STXM). Size-fractionated aerosols were collected during meridional cruise in the Western Pacific Ocean (GEOTRACES, *R/V Hakuho-Maru*) by ultra-clean sampling for TMs [2].

Iron species in coarse aerosols (> 1.3 μm) were composed by natural Fe including Fe in aluminosilicates and (hydro)oxides. By contrast, submicron aerosol has Fe complexes with siderophore-like organic matters (Fe(III)-OM_{sidero}), even if Fe/Al ratio indicated that dominant source was also mineral dust. Iron(III)-OM_{sidero} was specific species in the marine aerosols because this species were ubiquitously found from submicron marine aerosols, while not detected in the continental aerosols. Iron(III)-OM_{sidero} was secondarily formed by mixing with sea spray aerosols, since OMs and Na were mixed on the surface of Fe particles. Copper, Zn, and Pb in submicron aerosols were composed of sulfate salts with a small amout of CuO, ZnC_2O_4/$ZnCl_2$, and PbC_2O_4, respectively. The reason for absences of OM_{sidero} complexes of Cu, Zn, and Pb is consumptions of OM_{sidero} by Fe and Al which were indicated by estimation of these metal species in the simulated atmsopheric droplet using equlibrium reaction model.

Fractional solubilities of Fe in submicron aerosols were consistent with fraction of Fe(III)-OM_{sidero} to total Fe. In addition, fractional solubilities of Cu, Zn, and Pb were similar to fractions of $CuSO_4$, $ZnSO_4$+$ZnCl_2$, and $PbSO_4$, respectively. Therefore, better understanding of TMs species and their formation processes leads to clarification of controlling factors of fractional solubilities of TMs in the marine aerosols.

[1] Jickells T.D., et al. (2015), Science, 308, 67-71.
[2] Sakata K., et al. (2018), Mar. Chem., 206, 100-108.