The fates of anthropogenic aerosol trace metals in the ocean

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The Western Philippine Sea (WPS), receiving tremendous amount of anthropogenic aerosols during winter and spring seasons, provides an ideal platform to investigate the fates of aerosol trace metals and their seasonal transformation in the Northwestern Pacific Ocean (NWPO). Two Taiwan GEOTRACES cruises were carried out in the WPS during July 2013 and March 2014, the low and high aerosol deposition periods, respectively. The trace metal composition in aerosols, seawater, size-fractionated suspended particles, and sinking particles were determined. The aerosol metal concentrations in March were 7-30 folds of the July. We found that the influence of anthropogenic aerosol deposition is mainly reflected in particulate pools but not dissolved pool. Eddy activities play an important role on deciding dissolved metal concentrations and elemental fluxes in the surface water. Using Fe as an example, total aerosol Fe deposition fluxes were 17 and 1.2 μmol Fe m^{-2} d^{-1} for the high and low seasons but dissolved Fe concentrations were comparable. In contrast to dissolved Fe, particulate Fe concentrations in the high season were 2 to 10 times of the low season in the top 100 m. In terms of size-fractionated plankton, trace metal quotas are 1 to 2 orders of magnitude higher than their intracellular plankton quota. The metal to Al ratios for most of the suspended particles, similar to metal composition observed in the aerosols, are also 1 to 2 orders of magnitude higher than their lithogenic composition. Our study demonstrates that Asian anthropogenic aerosol deposition has significantly increased trace metal concentrations in the suspended particles and plankton of the oceanic region.