DETERMINING THE FRACTIONAL SOLUBILITY IN SEAWATER OF ALUMINUM DERIVED FROM ATMOSPHERIC AEROSOLS

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ABSTRACT

In order to determine the atmospheric dust concentration and the fractional solubility of atmospheric aluminum (Al), aerosol samples were collected weekly on the windward side of Oahu, Hawaii between February and June 2002. Sampling was conducted using an automatic sector controlled aerosol sampling system to prevent pumping during times when winds would bring dust from nearby islands and local sources to the sampler. Aerosols were collected on 10 replicate acid cleaned Millipore 47 mm Polycarbonate filters with a pore size 0.4 μm at a mean pumping rate of 80 L/min.

Microwave acid digestion of a complete set of filters and their aerosol load followed determination of Al by flow injection analysis (FIA) yielded a precision (1σ) of 11% for the entire sampling and analysis process. Partial dissolution of the aerosols was determined by suspending a replicate filter in 60 mL of 0.2 μm filtered surface seawater at pH 8.3. 10 mL of this solution was then filtered (0.2 μm) and the amount of dissolvable Al was determined. In order to see changes in Al solubility with respect to time, samples were analyzed for Al at 24 hour intervals for 4 successive days. Another replicate filter sample was analyzed for major ions including Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_3^- and SO_4^{2-}.

During the sampling period, the atmospheric Al concentrations and atmospheric mineral dust concentrations observed above Hawaii were 1.2-56.1 (ng/m^3) and 15-700 (ng/m^3), respectively, assuming mineral aerosols are 8% Al by mass. Atmospheric dust concentrations at Hawaii increased shortly after an intense dust outbreak was observed in Mongolia in late March. Al fractional solubility varied from 0.087-14.3% with a mean value of 4.6%. Within the first 24 hours, Al in the aerosol samples appeared to dissolve

relatively quickly (first mode), then they continued to dissolve slowly over the next three days (second mode). The total dissolvable Al (1^{st} plus 2^{nd} mode) as well as the total charge of dissolvable non sea salt (nss) K^+, Mg^{2+} and Ca^{2+} was well correlated with the total charge of NO_3^- and nss SO_4^{2-} (R^2=0.78, R^2=0.84). These results indicate that the abundance of atmospheric (NO_3^- + nss SO_4^{2-}) acids is one of the major factors controlling the fractional solubility of atmospheric dust.