Solubility of iron in aerosol of volcanic origin with iron speciation analysis

A. MIYAHARA[1]*, H. FURUTANI[2], M. UEMATSU[2] AND Y. TAKAHASHI[1]

[1]Hiroshima University, Higashi-Hiroshima 739-8526, Japan
[2]Atmosphere and Ocean Research Institute, The University of Tokyo
(*m131704@hiroshima-u.ac.jp)

In high nutrient low chlorophyll (HNLC) region, growth of phytoplankton is limited by iron (Fe) concentration (Martin and Fitzwater, 1988). Moreover, it has been suggested that aerosol can be an important supply source of Fe to HNLC region (Jickells et al, 2005). Recent studies have also suggested that offshore deposition of airborne ash from volcanic eruptions is a way to inject significant amounts of bio-available iron into the surface ocean (Duggen et al, 2010). The solubility in ocean of Fe in aerosol depends on its chemical species, but the Fe species in aerosol have not been fully clarified. Therefore, the aim of this study is to determine the Fe chemical species and its solubility in aerosol of various sources including volcanic ash.

The results of backward trajectory analysis, Fe/Al ratio, and sulfate concentration showed that aerosol samples (Leg.1-5and Leg.1-6) collected from the western North Pacific during KH-08-2 cruise contained aerosols supplied from the eruption of the Okmok volcano. As a result of Fe K-edge XANES analysis, it was suggested that Fe species of volcanic ashes changed during the long-range transport. Moreover, the dissolution experiment by seawater showed that Fe solubility of the marine aerosol is larger than that of volcanic ashes, possibly due to the transform of insoluble Fe originally contained in volcanic ashes into the aerosols with highly soluble Fe content mainly due to the formation of iron(II) sulfate, highly soluble species, as shown by XAFS . This can explain why volcanic ashes which originally contained insoluble Fe changed into the aerosol with high soluble Fe content.

Although the average emission of fine volcanic ash (176-256 Tg/yr; Durant et al, 2010) into the atmosphere is less than that of annual terrigenous dust load (1000-3000 Tg/yr; Tegen and Schepanski, 2009) by a factor of 1/10, it was found that the soluble Fe content in the aerosol supplied as volcanic ashes should not be underestimated due to the very high soluble Fe content in the aerosol of volcanic origin.