Atmospheric processing of combustion aerosols as a source of soluble iron to the open ocean

AKINORI ITO[1*]

[1]Yokohama Institute for Earth Sciences, JAMSTEC, Yokohama, Kanagawa, 236-0001, Japan
([*]correspondence: akinorii@jamstec.go.jp)

The majority of bioavailable iron (Fe) from the atmosphere is delivered from arid and semiarid regions to the oceans because the global deposition of iron from combustion sources is small compared with that from mineral dust. Atmospheric processing of mineral aerosols by inorganic and organic acids from anthropogenic and natural sources has been shown to increase the iron solubility of soils (initially < 0.5%) up to about 10%. On the other hand, atmospheric observations have shown that iron in the aerosols can have a solubility more than 10%. Atmospheric processing of combustion aerosols may rapidly transform insoluble iron into soluble forms. Thus the mixing of the mineral dust with combustion aerosols can elevate iron solubility when aerosol loading is low. However, the dissolution of iron from combustion aerosols was not explicitly simulated in modeling studies.

Here, an explicit scheme for iron dissolution of combustion aerosols due to photochemical reactions with inorganic and organic acids in solution was implemented in an atmospheric chemistry transport model to estimate the atmospheric sources of bioavailable iron [1]. The model results suggest that deposition of soluble iron from combustion sources contributes more than 40% of the total soluble iron deposition over significant portions of the open ocean in the Southern Hemisphere. A sensitivity simulation using half the iron dissolution rate for combustion aerosols results in relatively small decreases in soluble iron deposition in the ocean, compared with the large uncertainties associated with iron solubility at emission. More accurate quantification of the soluble iron burdens near the source regions and the open ocean is needed to improve the process-based understanding of the chemical modification of iron-containing minerals.

[1] Ito (2015) *Environ. Sci. Technol. Lett.*, **2**, 70–75, doi: 10.1021/acs.estlett.5b00007.