Coupling of Redundancy Analysis with Geochemistry and Mineralogy to Assess the Behavior of Air Dust Arsenic as A Base of Health Risk Estimation in Dhaka, Bangladesh

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Abstract

Air dust suspended particle is a composite particulate matter originating from various sources such as airborne particles, emissions from industry and vehicles, they have significant influence on the pollution levels of urban environments as well as significant human health consequences. This study revealed that the exposure to air dust particles enriched with arsenic (As) is a significant health threat for populations living in Southeast Asian megacities. The mineralogical composition of air dust particles is the key factor that controls the retention and release of As. This study investigated the degree of metal(oid)s pollution (As, Ca, Fe, K, Ga, Rb, Sr, Ti, V, Y, and Zr) in air dust of Dhaka city, Bangladesh. Enrichment factor and geoaccumulation index suggested that the air dust was heavily enriched with As, which triggers a comprehensive investigation of its controlling mechanisms and potential health risks by combining physicochemical and mineralogical information with multivariate analysis and a simulated probabilistic risk estimation model. Alkaline air dust ($pH_{1:5}$ ranges from 8.02 to 10.34) in Dhaka city was found to have significant enrichment of As. Air dust alkalinity was possibly controlled by the presence of carbonate minerals, such as calcite. Quartz was identified as the dominant mineral phase followed by magnesium carbon arsenide ($MgCAs_2$). Carbonate mineral driven alkaline pH condition in air dust would potentially trigger the release and mobilization of As to the environment. However, organic complexation can stabilize As on particle surfaces. Monte Carlo simulation-based health risk forecast suggested that the probability of As associated cancer risk has greatly exceeded the threshold value of 1E-4 for adults and children, and children are more vulnerable than adults. According to sensitivity analysis, the concentration of As and exposure duration (ED) posed the most significant impact (> 58%) on risk estimation.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

MAP-AQ: Monitoring, Analysis and Prediction of Air Quality

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