

Chemical speciation of airborne mineral dust in the Middle East

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Background

On July 8, 1997, the U.S. Environmental Protection Agency (EPA) promulgated a new national ambient air quality standard (NAAQS) for particulate matter with an aerodynamic diameter less than 2.5 μm (PM_{2.5}). In response to the new NAAQS, EPA established two networks: the larger network monitors total mass to assess compliance with the standard. The second, smaller network, the PM_{2.5} Chemical Speciation Network (CSN) provides data to support attainment activities, and supplies a broad-based dataset to support human health studies and other research. RTI International has provided analytical services and other support to the chemical speciation network since early 2000.

Project Description

Desert Research Institute (DRI) contracted with RTI to provide analytical services for the U.S. Army's Enhanced Particulate Matter Surveillance Program (EPMSP), which began sampling in late 2006. The primary objective of EPMSP was to gather information on the chemical and physical properties of ambient PM in the Middle East. Ambient air samples were collected over a period of approximately one year at 15 sites, which included Djibouti, Afghanistan, Qatar, United Arab Emirates, Iraq, and Kuwait. Three particulate size fractions were sampled: PM_{2.5}, total suspended particulates (TSP), and particulate matter less than 10 μm (PM₁₀). Teflon, nylon, and quartz filters were used for sampling, and all filters were subsequently analyzed by RTI. Analyses included: trace elements (by X-ray Fluorescence Spectroscopy), anions and cations (by ion chromatography), total mass (by gravimetry), and elemental, organic, and carbonate carbon (by Thermal-Optical Transmittance).

Discussion

Because of the high levels of mineral dust found in the deserts of the Middle East, the levels of crustal elements found in the EPMSP samples were significantly higher than in CSN samples from the U.S., which posed some analytical challenges that will be discussed in this presentation.

Trace element geochemistry of soils in fluoride-rich shallow groundwater sites in Sri Lanka

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Higher groundwater fluoride is a controversial issue in dry zone of Sri Lanka. This study described the geochemistry of residual soil from higher (< 8 mg/L) and lower (< 1 mg/L) water fluoride sites in dry zone to identify possible sources for fluoride. Twenty two major and trace elements have been determined for seventy four soil samples by means of X-ray fluorescence. Results denote that soil fluoride is lower than upper continental crust and basement rocks in both higher (<411 mg/kg) and lower (<277 mg/kg) water fluoride sites. Negative linear correlation exists between fluoride in the soil and the water suggested that fluoride readily leaching to water rather than retaining in soils due to unconsolidated sandy clay loam texture. Weathering of heavy minerals such as zirconium, apatite, fluorite, monazite and garnet are the main source for the soil in high water fluoride area. Consequently, stable extent of Zr, Nb and Th and depletion of F together with CaO and P₂O₅ than basement is occurred, hence loss of CaO provides favourable condition to leach F to water. Conversely, lower water fluoride area soils show enrichment of TiO₂, Fe₂O₃, MnO, Cr, V and Sc denote the weathering of biotite, hornblende, garnet and pyroxenes in the basement. Primary minerals present in that soil is the main cause for the enrichment of those elements. Further, fluoride levels in the soil and subsequently in water show close link with magmatic differentiations along the geological formations. Thus soil geochemistry evident that meta-igneous rocks of the higher water fluoride area may have associate with a fluoride rich residual melt while lower water fluoride area associate with acidic meta-igneous rocks with concordant meta-sedimentary rocks.