Distribution of trace elements in the monsoon rainwater of south-western India: implication of human activity

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The south-west coast of India receives high rainfall (250-350 cm) during the summer. Owing to the abundance water resources and development of infrastructural facilities, the coastal region of Mangalore around 13° N latitude became a centre for rapid urban growth and industrialization. The suppression of rainfall as a result of atmospheric pollution has being noticed widely in recent years. In the light of this consequence, monsoon rainfall of Mangalore has been sampled, filtered and measured for trace elemental concentrations by ICP MS. The rainwater is generally enriched with Na^+, Cl^-, and NO_3^-, sea-salt and non-sea-salt Ca^{2+}, Mg^{2+}, K^+, SO_4^{2-}, but strongly depleted by H^+ as compared to high rainfall regions of the tropics, suggesting the potential input of sea-salt and mineral aerosol. The pH of rainwater is marginally lower when compared to most of Background Air Pollution Monitoring Network (BAPMoN) stations and other major cities of India implying that the study area is sensitive to acid deposition. Compared to average shale, trace elements measured in the particulate phase of the rain water are anomalously enriched by Ba, V, Cr and Co by factors 30-150, Cu and Ni by 400-450, and 1500-2000 (Zn, Ag, Cd and Pb), suggesting the impact of anthropogenic inputs from Mangalore Chemicals and Fertilizers Ltd. (MCF), Kudremukh Iron Ore Company Ltd. for manufacturing the iron pellets (KIOCL), steel smelters, Mangalore Refinery and Petrochemicals Ltd. (MRPL) as well as many other small scale industries. R-mode factor analyses of the trace elemental data suggests that the sea-salt aerosol, mineral component of local and long-range transported particles together with particles from anthropogenic origin are major controlling factors of the distribution of trace elements. The insignificant relationships of volatile trace elements with those representing crustal origin indicates the dominance of anthropogenic activity over natural processes.