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Example of environmental geochemistry research at the Anthropocene - Air PM pollution and human health. 2022 C.C. Patterson Award Talk

XIANGDONG LI

The Hong Kong Polytechnic University

Presenting Author: cexdli@polyu.edu.hk

Human activities have become a driving force that is changing many characteristics of our planet on local, regional, and global scales, *e.g.,* land use changes, agricultural practices, fossil fuel burning, traffic emissions, and the release of industrial and commercial products. Airborne particulate matter (PM) pollution, as a leading environmental health risk, causes millions of premature deaths globally every year. Enormous efforts are underway to identify toxic components and mechanisms associated with short-term and long-term adverse health outcomes. Recent decades have seen the development of state-of-the-art technologies in biogeochemistry and bioinformatics to address this challenge. Apart from modeling and simulations, laboratory-based chamber studies, *in situ* monitoring, and *in vivo* exposure models are also realistic approaches to investigating the influence of environmental conditions (*e.g.*, temperature, relative humidity, PM, and O_3) on the combined effects of chemical and microbiological agents on cells, organs, and the human body. Further investigations into the high-resolution monitoring of airborne pathogens relating to PM pollution for an integrated exposure-response assessment and mechanistic study are warranted. This is where environmental (bio)geochemists can particularly contribute their expertise to resolve the environmental pillar of the host-agent-environment triad. Such a framework encourages and requires multidisciplinary synergies to unravel the chemo- and biodiversity of what we breathe across spatiotemporal scales, exposure sequences of multiple hazards, and combined toxic effects that result in disease progression over time. Improving our understanding of the spatiotemporal features of toxic components and air pollutants, and translating scientific evidence into effective policies are vital to reducing the health risks and devastating consequences of global PM pollution.