It's been nano all along!: The occurrence, behaviour, and fate of natural and manufactured nano-minerals/materials in the environment

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Abstract
Clay mineralogists, soil chemists, and environmental geochemists have long recognized the unique properties of both crystalline and poorly ordered nanoscale phases ubiquitous in earth systems; however, widespread recognition of the occurrence and unique properties of these phases has only relatively recently emerged along with the commercial popularity of nanotechnology. The emergence of new powerful tools for examining nanoscale materials over the past one and a half decades has also spawned great interest in the occurrence, distribution, and properties of nanoscale mineral phases in terrestrial and aquatic systems and their role in facilitating/directing coupled biogeochemical processes that are critical for elemental cycling and contaminant fate and behaviour.

By conventions established by the U.S. National Nanotechnology Initiative and now more broadly by the European Commission, a nanomaterial is defined as "*A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm".* It has recently been suggested that the primary producer of the Earth's inorganic nanomaterials, in terms of mass abundance, is terrestrial weathering and mineral formation processes in soils, which has a contributed an estimated 10^7-10^8 Tg of mineral nanomaterials (Hochella et al., 2012). Even with the significant proliferation of products using manufactured nanomaterials over the past five years, estimates for manufactured nanomatieral production in the U.S. for five of the major (by mass) nanomaterials are on the order of ~40,000 T (Hendren et al., 2011). Thus, investigating the presence, transport, transformations, and ultimate fate of manufactured nanomaterials in complex environmental samples, such as soil is challenging.

This presentation will examine the composition and role of important naturally occurring and incidental nanomaterials on the transport and fate of contaminants in surface and subsurface environments, as well as the role of these materials and surface modified materials at controlling the surface chemistry in complex mineral assemblages. It will also provide an overview of the state of the science on the transformations, fate, and effects of manufactured metal and metal oxide nanomaterials in soil and terrestrial ecosystems based on advanced analytical, spectroscopic, microscopic, and molecular biological methods and approaches.

References

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