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**Incidental Environmental Nanoscience:
A Case Study of Worldwide Importance**
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Abstract

The field of nano-environmental science is advancing rapidly. Results from this kind of science can be highly impactful, when just a few years ago, we would have had little hope of this. Our best example to date started five years ago and unfolded very slowly. At that time we decided to study a coal ash accidental spill that occurred from an ash impoundment pond into the Dan River, North Carolina, USA. This damaging event provided us with an opportunity to study the significance and role of naturally occurring, engineered, and incidental nanomaterials associated with contaminant distribution (mostly arsenic at the time). During that study, we came across titanium oxide nanoparticles that we had never seen in natural environments before. They were non-stoichiometric titanium oxide nanoparticles (Magnéli phases) that at first seemed inconsequential. After two years of study, we conclusively determined that these Magnéli phases were incidental nanoparticles produced during industrial coal burning. We now have multiple lines of evidence that strongly suggest that these phases are distributed worldwide and that they may have deleterious human health consequences. For example, pulmonary mouse exposure to Magnéli phases in realistic concentrations result in significant macrophage abnormalities and decreased lung function.

Bionote

Michael F. Hochella, Jr. is an Earth scientist concentrating in the area of nano-bio-geo-environmental science on local, regional, and global levels. He is a University Distinguished Professor (Emeritus) at Virginia Tech and a Laboratory Fellow at Pacific Northwest National Laboratory. He received his B.S. and M.S. from Virginia Tech in 1975 and 1977, respectively, and his Ph.D. from Stanford University in 1981. He has been a professor, first at Stanford, and then at Virginia Tech, for a total of 30 years. He began a joint position with Virginia Tech and

Pacific Northwest National Laboratory in January, 2016. He has won many awards and honors, and he is a former President of both the Geochemical Society and the Mineralogical Society of America. He has served on high-level advisory committees at both NSF and DOE. He is the founder of the Virginia Tech Center for Sustainable Nanotechnology, and the Virginia Tech National Center for Earth and Environmental Nanotechnology Infrastructure funded by the National Science Foundation.