Fate of engineered nanoparticles: Challenges in informing human and ecological health risk assessments

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Nanotechnology is met with both excitement and scepticism. On the one hand there are tremendous technological opportunities through the exploitation of the unique properties of nanoparticles. On the other hand, there is concern that nanoparticles will have adverse effects on human and ecological health when they are released to the environment. Unfortunately, the risks of engineered nanoparticles (ENPs) to soil and subsurface environments are as yet unknown, limited, in part, by a lack of basic scientific understanding of their release from commercial products, as well as their ecotoxicity and subsurface transport. This study fills part of this data gap, investigating the subsurface transport of two emerging engineered nanoparticles, nanosilver (nAg) and carbon nanotubes (CNTs), of concern due to their potential negative environmental impacts. This presentation will focus on the impact of porous media grain size on the mobility of these engineered nanoparticles in saturated one-dimensional column experiments and their mobility in the vadose zone. An innovative method, utilizing the synchrotron at Argonne National Laboratory in Chicago, for quantifying in-situ nAg transport will also be discussed. In addition the numerical modeling phase of the study, investigating the mobility of CNTs at the field scale, will be presented. Results suggest that mechanisms in addition to those associated with colloid filtration theory need to be included in the numerical model to simulate observed behavior. Results also suggest that engineered nanoparticles are much more mobile in subsurface systems than currently assumed. Work of this nature is urgently needed by policy makers to make informed decisions related to the beneficial use of nanotechnology.