MAR12-2011-001387

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Nanominerals, Mineral Nanoparticles, and Earth Processes: Details on How Nanoparticles Work in the Environment

MICHAEL HOCHELLA, Virginia Polytechnic Institute and State University

Naturally occurring inorganic nanoparticles have been one of the principal catalytic components of Earth throughout its history. Yet these ubiquitous materials have largely escaped our close scrutiny until very recently. They are illusive and difficult to study. They have properties that change significantly with their exact size, shape, aggregation state, and surrounding environment. In the past, it has not even been clear how they accumulate, disperse, and move around the planet, nor even for sure what their major sources and sinks are. We have now compiled and derived a global budget for naturally occurring inorganic nanoparticles, including an assessment of their sources and sinks, as well as their fluxes between various Earth compartments (atmosphere, continents, continental shelves, and open oceans). In addition, these kinds of budgets provide a basis for fundamental understanding such as residence and transfer times between compartments. Specific findings include the following: 1) The primary producer of Earth's inorganic nanoparticles is soil through terrestrial weathering processes; 2) rivers, and to a lesser extent glaciers, bring 0.1% to 0.01% of the Earth's continental nanomaterial reservoir to the continental edge/ocean margins each year; 3) only about 1.5% of this material makes it to the deep oceans due to aggregation and settling in saline ocean margins; and 4) the airborne and waterborne inputs of nanominerals and mineral nanoparticles to the open oceans are very similar. These kinds of results, along with a much better understanding of the characteristics of naturally occurring inorganic nanoparticles via direct observation in the field coupled with laboratory studies, provide a useful foundation upon which to predict the behavior and fate of manufactured nanoparticles, many of which are very similar to naturally occurring varieties. Even when specific correlations between naturally occurring and manufactured nanoparticles cannot be made, important clues in manufactured nanoparticle behavior in complex environments can be obtain by observing natural systems.