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Changing Geosciences through Nanotechnology: 20 years of NNI

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Abstract

The first geoscience that had clear connections to nanoscience came about in the 1960's and 1970's. It was first realized that important geologic materials (silica in this case) exhibited much higher aqueous solubility when the particle sizes were reduced to the nanoscale. Geochemists also realized that the normalized rate of mineral-aqueous solution reactions increased with the size of mineral particles in the nanoscale range. However, this work was rare, and it was not until the 1990's and earliest 2000's when nanogeosciences was more widely recognized. In the last 20 years, the number of nanoscience-geoscience papers has increased by well over an order of magnitude, and the number of geo-nano-researchers has seen similar growth. Twenty years ago, nanoscience and technology in the Earth sciences were becoming sophisticated for studies at the atomic and molecular level. At the time, it was predicted that these newly discovered nano-interactions could have regional and global implications. Now, in the past two decades, through the time of the NNI, Earth and atmospheric scientists have shown specific examples of how nano-processes are in fact affecting the planets character and behavior. Two examples given in this presentation include 1) the realization of the role that naturally-occurring nanothin semiconducting Fe- and Mn-(oxyhydr)oxide-mineral coatings having on regional to global photon-induced redox chemistry; and 2) the discovery that coal burning results in the massive production and global distribution of otherwise rare Magnéli phases (titanium sub-oxides), and that these Magnéli phases show both *in vitro* and *in vivo* human lung toxicity behavior.