Why Nanoscience Should Be Embraced by Earth and Environmental Scientists: How It Provides a Better Understanding of Earth, Space, Life, and Nearly Everything Else

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Just as the industrial revolution changed the world, so too has the information technology (IT) revolution. And the molecular biology revolution is in the process of doing the same. Now, we are beginning to clearly recognize the nanotechnology age as a revolution that will one day be comparable to the impact of the industrial, information, and molecular biology ages. The growth of nanoscience and nanotechnology over the last 15 years is truly staggering. Research publications currently number in excess of 80,000 annually. Worldwide, government sponsored research in nanoscience exceeds $8 billion annually. Even more is spent in industrial research. Important nanoscience and technology conferences are found somewhere in the world on a weekly basis. Nevertheless, for various reasons for which I can only speculate, the Earth and environmental sciences lag behind this fervor. In part due to this, the very large Next Generation National Nanotechnology Infrastructure Network, funded by the US National Science Foundation, has specifically stipulated that the Earth and environmental sciences should be involved. For those who are already involved in nanogeoscience and nanobiogeoscience, as well as the technological aspects of these fields, results have so far been promising to compelling to revolutionary. One can start with the fact that all matter in the universe, except most of the H and the noble gases, has at some time existed in a one-, two-, or three-dimensional nanomaterial. A good example is the Eagle Nebula, only 6,500 light-years from Earth, which consists of pillars of gas and dust several light-years in length. Here, stars are born each with an accompanying disk-like cloud of dust and gas (mostly hydrogen) that will eventually form a solar system. The dust contains a vast assortment of nanomaterials as determined by astronomical observations. On Earth, throughout the continents, atmosphere, and oceans, nanomaterials abound, move, react, and influence all things. They behave differently than their bulk equivalents, often dramatically differently. This large piece of the Earth's puzzle will slowly be filled in over the next several decades.