Understanding nanogeochemistry of radionuclide reaction and migration in subsurface environments

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Nanogeochemistry - a newly emerging research field - attempts to understand geochemical reactions and mass transfers at nanometer scales, especially with regards to the formation of nanostructures in geochemical systems, emergent properties of these structures, and their controls on geochemical processes. The research also includes use of nanotechnology to design new materials and engineering approaches for effective natural resource extraction and environmental management. At the core of this new research field is the concept that, as the size of a material is reduced to nanometers, novel physical or chemical properties of the material may emerge that can be drastically different from those of the corresponding bulk phase and the material properties then become size-dependent. Nanostructures, which frequently occur in geologic materials, may directly control mineral phase stability, mineral-water interface chemistry, geochemical reaction kinetics, geo-fluid migration and transport, and even global biogeochemical cycles as a whole. This presentation will focus on recent progress in nanogeochemical research, specifically on two general types of nanostructures - nano solid phases and nanopores (nanofluids) – with an emphasis on the occurrence of each nanostructure in natural environments, the associated emergent properties, and the potential geochemical implications, especially in the context of radionuclide reaction and transport in a natural or an engineered subsurface system.

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