Microbial Uranium Immobilization: Could it give a solution for controlling radionuclide dispersal for Fukushima Daichi Nuclear Disaster?

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It is becoming increasingly clear that microbes play key roles in transformation of mobile uranium into its immobile forms via bioreduction, biosorption and intracellular uptake at natural and contaminated settings [1]. In addition to direct interactions between microbes and uranium, microbial uranium immobilization is known to occur via incorporation and/or agglomeration into calcium phosphate and calcium carbonate [2]. The latter processes lead to the long-term and stable sequestration of uranium at near-surface and subsurface settings.

By integrating microbiological, molecular biological, geochemical and mineralogical techniques, naturally occurring and incubated microorganisms were subjected to characterize microbial processes involved in uranium immobilization. *Arthrobacter* sp. isolated from uranium mine soils was found to accumulate uranium intracellularly with polyphosphate granules, whereas *Deinococcus radiodurans*, the most radiation-resistant organism, was inactivated by uranium toxicity [3]. In uranium mine sediments, naturally occurring and incubated microorganisms were observed to form nanoparticles of uranium oxide with a diameter range of ~2 nm [4]. Bioreduced uranium nanoparticles were concealed in fractures filled with calcium carbonate for ~one million years after the nanoparticle formation [2].

These microbial processes are artificially stimulated in the environment where human activities are physically restricted such as the subsurface and Fukushima Daichi Nuclear Reactors. As the latter is accessible by robotic technology, extremely radiation-resistant microorganisms are potentially stimulated to immobilize uranium and its fission products after opening of the reactor lid for debris retrieval.

References

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