Advances in The Recovery of Uranium From Seawater: Studies Under Real Ocean Conditions

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ABSTRACT:

Considerable effort is being spent within DOE's Fuel Cycle Research and Development Program on the design and testing of new adsorbents for the extraction of uranium from seawater. This proposal builds upon these efforts by offering an infrastructure and expertise for marine testing of these sorbents, moving from the lab to field tests to quantify sorptive properties and uranium uptake in real ocean conditions. There is a big gap between detailed lab studies and potential large scale applications of these technologies, and the next step requires expertise in ocean geochemistry and the selective extraction of radionuclides from large volumes of seawaters. The PI and his lab have extensive experience in the development and testing of adsorbents for the extraction from seawater of dissolved cesium, thorium, plutonium and radium isotopes. During this project, we will study the effectiveness of the U adsorbents using different field testing designs working with DOE partners who have already made progress in testing several polymer fibers in controlled lab settings.

Specific objectives include: 1) to test the extraction efficiency of the U adsorbents under changing environmental conditions in a controlled laboratory setting and then in the field (at the WHOI dock); 2) to collect and measure radium extracted onto manganese oxide coated fibers to quantify the volume of water passing through the uranium adsorbents ("exposure volume"); 3) to determine by field-tests the most efficient methods for collecting (pumping vs. passive) and the best platform (mooring type, sorbent material: ropes, sponges, fibers) to expose, in high current regimes, these new fibers to the optimal extraction conditions; and 4) to design a mooring contingent on the findings in objective 3 that will be amenable to scaling up small batch extraction of U to these new large volume in-situ methods.

As an outcome of this effort, DOE will gain vital field data on the behavior of the U adsorbents now being developed under prior funding by this program. It does no good if the best adsorbents, as optimized in the lab, cannot be adapted or effectively used in the field due to fouling, structural weaknesses and natural processes that might interfere with U extraction (pH, temperature, DIC, DOC). We might find in fact that a fiber of lower extraction efficiency is preferred if the extraction is reversible and there are fewer problems with bio-fouling or ligands competing for sites where U is sorbed. Such information will have a major impact on the direction of the Program and feasibility of this approach to be scaled up in the future. By the end of the 3 year project period we should have a prototype, or at least a mooring design that could be scaled for deployment in other locations, depths, geochemical conditions, and a clearer idea of the strengths and weaknesses of the feasibility of our ability to extract uranium from seawater.