

Determination of Geochemical Partitioning of Uranium and Transuranic Elements in a Marine Sediment by the Application of Sequential Chemical Extractions

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The primary concerns associated with artificial radionuclides in the environment are: (1) migration through natural systems; and (2) bioavailability to organisms via the food chain. It is well known that ionizing radiation in sufficient doses can affect a variety of biological processes in higher organisms. The mobility and/or bio-availability of radioactive elements in the environment is dependent upon the element's physico-chemical form, referred to here as the element's partitioning within the soil or sediment matrix. These physico-chemical forms include the geochemical associations of radionuclides in soils, sediments, and groundwaters and are thought to be key factors in the understanding of the migrational behavior and bioavailability of trace metals and radionuclides. One popular approach to identifying the partitioning of a given radionuclide within a specific soil or sediment is by the application of sequential chemical extractions or "fractionation" approach. This type of technique facilitates the prediction of an element's eventual fate in the environment by the application of operationally-defined chemical treatments to analyze selectively one part of the complex mixture of geological components of soils and sediments. Carefully designed and applied sequential extraction experiments can be useful in discerning "readily available" contaminants from more refractory ("less available") contaminant/sample geochemical associations. Thus, sequential extraction experiments can be applied to the development of remediation strategies by indicating sites of greatest concern. Considering the large number of radiologically-contaminated sites, the successful development of such an approach for identification of priority areas is highly desirable.

Although sequential extraction techniques have been used extensively for several decades, their use as a tool for determining the distribution of nutrient elements, transition metals, radionuclides, and other components within different sample matrices has stirred considerable controversy. From a geochemical viewpoint, sequential extraction procedures are criticized for both non-selectivity of the target phase(s) and unquantified re-adsorption of analyte during the reaction period. Although proponents of sequential extractions maintain that each reagent phase attacks a specific geochemical fraction of the sample, these minerals may not be uniquely attacked by the reagent. Secondly, a chance exists for redistribution of the species to other mineral phases during the procedure, thereby producing ambiguous results.

The work to be presented will show the results of a comparison of three variations of a sequential extraction technique, including variations in the order of selective extraction, all on one well-characterized standard. We will also present the results of experiments specially designed to address adsorption effects during sequential extractions.