Exploiting new advances in micro-extraction to improve the detection and quantification of environmentally relevant radionuclides

Dominic Lariviere,[1,*]

[1]Radioecology laboratory, Chemistry department, Laval University, Quebec City, Quebec, Canada

* *e-mail: dominic.lariviere@chm.ulaval.ca corresponding/presenting author*

Recent developments in microextraction techniques have significantly enhanced the analytical capabilities for detecting and quantifying trace levels of environmentally relevant contaminants. These techniques have gradually found increasing application in radiochemistry in recent years. This work presents the application and optimization of a sub-category of microextraction, cloud point extraction (CPE) and related micelle-based systems, for the selective preconcentration of actinides and other radionuclides from complex matrices.

This presentation emphasizes overcoming key challenges such as maintaining micellar integrity under acidic conditions, optimizing ligand–analyte interactions, and ensuring compatibility with both mass spectrometric (e.g., ICP-MS/MS) and radiometric (e.g., alpha spectrometry, LSC) detection methods. The study demonstrates the effectiveness of surfactant-mediated extraction systems, including the use of non-ionic surfactants such as Triton X-114 and specialized ligands like bis(2-ethylhexyl) methanediphosphonic acid (H_2DEH[MDP]) and diglycolamide analogs, for the efficient recovery of isotopes such as plutonium-239/240 and polonium-210.

Analytical figures of merit, including preconcentration factors, method detection limits (MDLs), and matrix-specific recoveries, are reported for various environmental and biological samples. The results underscore the potential of advanced microextraction strategies to improve throughput, sensitivity, and selectivity in radiochemical analysis, supporting not only routine monitoring and emergency response applications, but also the production of rare radioisotopes.