

Recent advances in the detection of specific natural organic compounds as carriers for radionuclides in soil and water environments, with examples of radioiodine and plutonium

Santschi, P.H.,^{1*} Xu, C., Zhang, S.,¹ Schwehr, K.A.,¹ Lin, P.,¹ Yeager, C.M.,² Kaplan, D.I.³ Hatcher, P.G.⁴

123

¹ Texas A&M-Galveston, Galveston, TX USA

² Los Alamos National Laboratory, Los Alamos, NM USA

³ Savannah River National Laboratory, Aiken, SC USA

⁴ Old Dominion University, Norfolk, VA, USA

Among the key environmental factors influencing the fate and transport of radionuclides in the environment is natural organic matter (NOM). Understanding NOM-radionuclide interactions at the molecular level remains a challenge. Sensitive techniques are required for the detection of organic radionuclide species at ambient concentrations. Gas chromatography and accelerator mass spectrometry techniques are reviewed here that aim to assess how two radionuclides, iodine and plutonium, form strong bonds with NOM by entirely different mechanisms; iodine tends to bind to aromatic functionalities, whereas plutonium binds to N-containing hydroxamate siderophores at ambient concentrations.

While low-level measurements are a prerequisite for assessing iodine and plutonium migration at nuclear waste sites and as environmental tracers, it is necessary to determine their in-situ speciation, which ultimately controls their mobility and transport in natural environments. More importantly, advanced molecular-level instrumentation (e.g., nuclear magnetic resonance (NMR) and Fourier-transform ion cyclotron resonance coupled with electrospray ionization (ESI-FTICRMS) were applied to resolve either directly or indirectly the molecular environments in which the radionuclides are associated with the NOM.