Bioavailability, Uptake, Bioaccumulation, and Biomagnification of Per- and Polyfluoroalkyl Substances in Sediments

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Background/Objectives. Per- and polyfluoroalkyl substances (PFAS) are organic chemicals which are emerging contaminants: chemicals that have previously not been considered a risk to humans or the environment. PFAS include thousands of different chemicals with diverse, useful properties due to the unique chemistry of their strong, stable carbon-fluorine bonds. Some types of PFAS are persistent in the environment and can bioaccumulate in living organisms. The U.S. Environmental Protection Agency (EPA) and Department of Defense (DoD) have identified PFAS ecological risk characterization as a "clear and immediate information gap." DoD's Strategic Environmental Research and Development Program (SERDP) has included PFAS ecological risk characterization in its FY 2019 Core Solicitation Statements of Need. This presentation will provide a brief overview of our current knowledge regarding bioavailability, uptake, bioaccumulation, and biomagnification of PFAS in sediments and discuss knowledge gaps that inhibit our understanding of site-specific risk assessment needs.

Approach/Activities. This presentation will summarize what is known about sediment PFAS and provide references relating to:

- Fate and transport, including accumulation and spatial distribution of PFAS in sediment;
- Available PFAS ecotoxicity data and alternative approaches to evaluate ecotoxic effects;
- PFAS bioconcentration factors and biota-sediment accumulation factors for primary producers such as aquatic plants, substrate algae, periphyton/biofilm, and benthic organisms;
- Trophic transfer and magnification: the cumulative risk of sediment PFAS bioconcentration.

Results/Lessons Learned. Understanding site-specific risk assessment needs will first require researchers to identify which PFAS to investigate. Currently, the choice is driven by (1) preliminary studies of human and ecological health risks and (2) the availability of calibration standards for instrumental analysis. Some of the sediment risk assessment activities that are needed to inform additional research include:

- Identifying the physical and geochemical factors affecting PFAS sediment bioavailability;
- Understanding the relationship between bioavailability, uptake, bioaccumulation, and biomagnification and PFAS chain length, functional group, and degree of fluorination;
- Determining the rate and extent of PFAS uptake from sediments by lower-trophic level organisms;
- Understanding the uptake and excretion rates of PFAS by different organisms, including competitive uptake and selective bioaccumulation at different trophic levels;
- Understanding the biotransformation of polyfluoroalkyl substances to perfluoroalkyl substances;
- Assessing preferential PFAS distribution throughout a food web, including potential modeling approaches.