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Monitoring polycyclic aromatic hydrocarbon (PAH) attenuation in Arctic waters using fluorescence spectroscopy

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ABSTRACT

As oil exploration in the Arctic grows, the risk of crude oil exposure to the environment through spills and leakage increases. Polycyclic aromatic hydrocarbons (PAHs) are a toxic component of crude oil that are highly insoluble and persist in the environment. Much is known about PAH degradation through abiotic and biotic factors and remediation strategies in temperate climates; however, little is known about the degradation of these compounds in the Arctic where cold temperatures and sea ice predominate and remediation strategies differ greatly. In this study, excitation-emission matrix (EEM) fluorescence spectroscopy was used along with parallel factor analysis (PARAFAC) to analyze concentrations of PAHs, associated hydroxylated metabolites, and microbial biomass (as based on the protein-like indicators: tryptophan and tyrosine) in surrogate solutions to develop a correlation between PAH biodegradation and native microbial growth. EEMs generated from solutions of 16 EPA-listed priority pollutant PAHs, metabolites, tryptophan, and tyrosine were characterized. Based on maximum emission wavelength peak intensity ($EM_{\lambda max}$), PAHs were found to best categorically group, in an effort to determine which PAHs would serve as effective indicators in comparison to bioindicators (microbial

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