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Application of Compound Specific Stable Isotope Analysis in Mapping Hydrocarbons Along the St. Lawrence Waterway

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Crude oil and petroleum products are continually being introduced into the environment during transportation, production, consumption and storage. Source identification of these organic contaminants proves challenging due to a variety of factors; samples tend to be complex mixtures of highly altered aliphatic and aromatic compounds, and chemical composition and biomarker distributions can be altered by weathering, aging, and degradation processes. The aim of our research is to optimize a molecular and isotopic (δ^{13}C, δ^{2}H) method to fingerprint and identify petroleum contaminants in sediment matrices, and to trace the temporal and spatial extent of the contamination event. This method includes the extraction, separation and analysis of the petroleum derived hydrocarbons. Sample extraction and separation is achieved using sonication, column chromatography and urea adduction. Compound identification and molecular/isotopic fingerprinting is obtained by gas chromatography with flame ionization (GC-FID) and mass spectrometer (GC-MS) detection, as well as gas chromatography coupled to an isotope ratio mass spectrometer (GC-IRMS). A modelling approach based on these isotopic and molecular fingerprints will be used to apportion the different hydrocarbons between natural and contaminant sources. This method will be used to assist the Centre d'Expertise en Analyse Environnementale du Québec to determine the nature, sources and timing of contamination events as well as for investigating the residual contamination involving petroleum products. Preliminary data will show carbon isotope signatures of a range of n-alkanes and select polycyclic aromatic hydrocarbons from sediments collected along the St. Lawrence Estuary and Gulf.