Forensic Fingerprinting of Alberta Oil Sands Bitumen and Oilsands Contaminated Environmental Samples

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Increasing mining, production, transportation and usage of the oil sands has driven rapid economic growth in Alberta and in Canada at large. This growth, however, has become a concern due to its possible impacts on water quality, health of aquatic biota, and on the environment as a whole. A forensic chemical fingerprinting methodology via GC-MS and GC-FID has been developed in the ESTS Oil Research Lab of Environment Canada to characterize and differentiate pyrogenic and biogenic hydrocarbons from petrogenic hydrocarbons in oil sands-contaminated environmental samples. The characterized target hydrocarbons by GC-MS included hydrocarbon groups, *n*-alkanes, the oil-characteristic target alkylated polyaromatic hydrocarbon (PAH) homologous series and other EPA priority unsubstituted PAHs, biomarker terpanes and steranes, bicyclic sesquiterpanes, and diamondoids. This study investigates and compares the chemical fingerprints of Alberta oil sands bitumen, bitumen products, conventional crude oils, and various environmental samples collected from the oil sand impacted regions, It is found that hydrocarbons in these environmental samples (sediments and waters) were most likely from four sources: (1) Oil sands bitumen hydrocarbons; (2) Biogenic compounds; (3) Hydrocarbons of other fuel oils: such as Cn-N series from diesel and diluents used for diluting heavy bitumen oil; (4) Pyrogenic PAH compounds generated from combustion processes.