

Aliphatic hydrocarbons in dated sediment cores from Imo River, Nigeria: Environmental implications

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Four recent sediment cores (0-30 cm long) from Afam (AF), Mangrove (MG), Estuary (ES) and illegal Petroleum refinery (PT) sites of the Imo River, Southeastern Nigeria were analyzed in order to characterize the sources and distribution of aliphatic hydrocarbons, as well as examine their historical trends of deposition and assess human-induced changes in the last ca. 5 decades. Radionuclides ²¹⁰Pb and ¹³⁷Cs were used to assign approximate dates to each section of the cores. Evaluation of proxy parameters such as carbon preference index (CPI, 2.01 - 2.19), carbon number maximum (C_{max}, 29, 31) and atomic C/N (16.51-31.32) for the most recent top layers (0-5 cm) revealed greater wash-in of land-derived organic matter (OM), attributable to the recent rise in water height/flood following intense rainfall occasioned by climate change. The bottom layer (PT1, 25-30 cm,) of the PT core deposited ca. 1964-1972 exhibited a CPI of 0.97 and pristane/phytane (Pr/Ph, 3.75), suggesting that oil bunkering/illegal refinery activity had begun in the region ca. 8 years after the first commercial discovery of oil in Nigeria in 1956. The non-detection of petroleum biomarkers (e.g. αβ-hopanes) in the bottom layer (MG1, 25-30 cm; 1964-1972) of the MG core revealed a period of relatively pristine depositional environment and the occurrence in high abundance of heptadecane (C₁₇) in the middle layer (ES4, 10-15 cm) of the ES core almost corresponded with the period of eutrophication that blocked the waterway in the late 1980s. Measurement of a marked unresolved complex mixture (UCM) at the near-top layer (AF5, 5-10 cm) of the AF core indicated that the heaviest contamination by petroleum hydrocarbons occurred at ca. 1997-2005. This time frame coincided with the period of intensive bunkering and oil pipeline vandalism by Niger Delta militant groups who campaign for fair allocation of oil revenue in the oil-rich region.