

Use of Forensic Methods to Identify Sources of Elevated PAH Concentrations in Sediments from Urban Tidal Waterbodies

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Background/Objectives. The purpose of this study is to identify sources of PAHs to urban tidal waterbodies. Gowanus Canal and Newtown Creek are two Superfund dead-end waterbodies in the New York City that have a long history of industrial activities. These two sites are selected for this evaluation to represent urban tidal waterbodies that exhibit highly elevated concentrations of polycyclic aromatic hydrocarbons (PAHs). The two sites differ in the extent and type of influence of industrial activities that existed along the waterbody. Newtown Creek is impacted by various industrial activities, such as former manufactured gas plants (MGPs), petroleum-handling facilities, refineries, pipelines, and bulk terminals, aluminum plants, and other industrial facilities. Gowanus Canal, in contrast, is mainly impacted by three former MGPs. Surface sediments from both sites are impacted by ongoing transport of non-aqueous phase liquids (NAPL) from subsurface sediments via ebullition, through oil seeps from uncontrolled upland sites, groundwater and other releases. Both sites also receive impacts from common urban sources, such as discharges from combined sewer overflow (CSO), storm water, and tidal exchange. This study is to understand the relative importance of urban CSO discharges and NAPLs to the elevated PAH levels in sediments through geochemical evaluation and forensics analysis.

Approach/Activities. Available data on parent and alkylated PAH compounds in sediments, ebullition-transported NAPL, NAPL seep from upland sites, and CSO solids collected for the two sites by various entities including USEPA, were used to assess the sources of PAHs to these sites. The relative impacts from various NAPL sources and CSO solids to sediment PAHs were evaluated by comparing the concentrations and compositions of PAHs in NAPL, CSO solids and sediments. Changes of PAH composition and sources in surface and subsurface sediments were discussed using PAH source diagnostic ratios, principal component analysis, PAH pattern comparison, and other forensic approaches.

Results/Lessons Learned. Concentrations of PAHs and its spatial variations in surface sediment indicate that the elevated concentrations of sediment PAHs cannot be explained by on-going municipal discharges from CSOs. Ebullition-transported NAPL and NAPL seep from upland sites contain PAHs at levels several orders of magnitude higher than CSO solids, and is a likely mechanism for contaminating recent sediments in the two waterbodies. The PAH forensic analysis suggest that elevated PAH levels in sediments from Gowanus Canal is mainly impacted by coal-tar from former MGPs. Whereas, the impacts from NAPL and contaminated groundwater to the sediments from Newtown Creek are likely diluted by solids from East River and municipal inputs. The results highlight the importance of an in-depth characterization of different sources to a waterbody for a robust forensic evaluation of PAHs in sediments.