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A Mixing Model for Polychlorinated Dibenzo-*p*-Dioxins and Dibenzofurans in Surface Sediments from Newark Bay, New Jersey Using Polytopic Vector Analysis

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Abstract. The identity and relative contributions of various sources of polychlorinated dibenzo-*p*-dioxins (PCDDs) and dibenzofurans (PCDFs) to recently deposited sediments collected in Newark Bay and its major tributaries were determined using polytopic vector analysis (PVA), a multivariate statistical technique relatively new in the chemometric literature. The concentrations of 2,3,7,8-substituted PCDD/Fs were assayed in eighty-one surface and near-surface sediment samples collected from the Passaic River, Hackensack River, Arthur Kill, Elizabeth River, Kill Van Kull, Port Elizabeth, and Port Newark navigation channels and Robins Reef, which is located in New York Harbor. PVA modeling revealed five predominant 2,3,7,8-substituted PCDD/F fingerprint patterns in geographically plausible distributions throughout the estuary. This was consistent with the current understanding of hydrodynamic and sedimentation conditions reported in the literature for Newark Bay. Three patterns contained 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD), which is alleged to originate from a single industrial source on the lower Passaic River. One of the fingerprints containing 2,3,7,8-TCDD was present in moderate proportions (10–20%) in surface sediments near the site, but was generally observed in low abundance (<5%) elsewhere in the estuary. A fingerprint pattern characteristic of PCDD/F profiles in effluents from municipal sewage and waste water treatment plants was widely distributed in the estuary, but reached its highest relative proportions in the Elizabeth River. A third fingerprint pattern was highest in the Arthur Kill and lower Passaic River and closely matched the residue patterns found in several types of combustion sources. A fourth fingerprint pattern in Hackensack River and lower Passaic River sediment matched the PCDD/F profile reported in PCB Aroclor® formulations. A fifth fingerprint pattern matched the profile in recycled pulp and paper mill effluents and was highest in Kill van Kull and upper Passaic River sediment. The majority of PCDD/Fs in sediment from Reaches B, C, and D of Port Newark and Port Elizabeth were attributable to sediments transported via the Arthur Kill and the Kill Van Kull. These results are consistent with those previously reported using principal components analysis, which indicated that 2,3,7,8-substituted PCDD/F patterns in the sediments of Newark Bay are consistent with discharges from multiple sources.