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Sources and fate of polycyclic aromatic hydrocarbons (PAHs) in settling particulate matter from deep basins of the northeastern Mediterranean Sea

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This study investigates the composition, abundance and vertical export of polycyclic aromatic hydrocarbons (PAHs) across three deep basins of the northeastern Mediterranean Sea (NEMS) over one year. Sinking particles were collected using sediment traps and PAH analysis was conducted via gas chromatography-mass spectrometry. PAH fluxes varied significantly, peaking in the north Aegean Sea due to meso-trophic conditions, nutrient-rich riverine and Black Sea water inflows, and maritime inputs (Fig.1). The fluxes were highest in winter (477 ng m^{-2} d^{-1}) and lowest in fall (38.5 ng m^{-2} d^{-1}). In the Cretan Sea, petrogenic sources (~70%) dominated, driven by water circulation, with higher fluxes in spring (93.9 ng m^{-2} d^{-1}) and lower in winter (9.49 ng m^{-2} d^{-1}). The Ionian Sea exhibited lower fluxes, peaking in summer (71.4 ng m^{-2} d^{-1}) and decreasing in fall (5.48 ng m^{-2} d^{-1}). Atmospheric deposition seems to be the main transport pathway of pyrolytic PAHs in this site, while its high-water column depth (4300 m) compared to the other sites presumably enables extended degradation of organic constituents during particle settling. PMF identifies four key sources: low-temperature combustion (31%), high-temperature combustion (30%), petrogenic inputs (22%), and low-molecular-weight fossil inputs (17%), highlighting the dominance of combustion-derived PAHs. PCA further elucidates the mechanisms driving PAH export, with biogenic particle fluxes (PCA-PC1, 57.7% of the total variance) playing a central role, enhanced by elemental carbon inputs from atmospheric deposition (Fig. 2). The association of combustion-related PAHs with soot and char particles, suggests atmospheric deposition as a critical vector for high-MW PAHs, while fossil-related low-MW compounds are efficiently transported via organic-rich biogenic particles. Overall, PAH fluxes in the NEMS reflect the complex interplay of pollution sources (e.g., degraded petroleum, unburned fossil fuels, combustion emissions) and transport pathways, including maritime activities, atmospheric deposition and freshwater inputs. Spatio-temporal variability underscores the determinant role of biogeochemical processes and circulation dynamics in shaping PAH distribution across the NEMS deep basins.

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