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Vertical fluxes of organic contaminants in the Ligurian Sea.

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High resolution temporal series of hydrological and biogeochemical parameters have been monitored throughout the SO-DYFAMED program, aiming at better understanding the response of the ocean to anthropic and climatic disturbance.

The present contribution addresses fluxes of organic semi-volatile contaminants and of biogenic lipids associated with marine sinking particles. Sediment trap samples were collected at the DYFAMED station (Ligurian Sea, NW Mediterranean Sea) from December 2000 to July 2002, at a depth of 200m and 1000m, and with a time step of 2 to 3 weeks. Polycyclic Aromatic Hydrocarbons (PAHs) and Non-Aromatic Hydrocarbons (NAHs) were investigated to characterize the levels of contamination and the fluxes of contaminants transferred from the upper marine waters to intermediate waters. Specific lipids of phytoplankton, terrigeneous matter and faecal pellets were also determined, aiming at better understanding biogeochemical processes that may impact on pollutant transfer toward deeper marine horizons.

Up to 36 PAHs were identified. The 13 parent compound levels ($\sum PAH_{13}$) varied from 564 to 4156 ng.g^{-1}, with highest concentrations corresponding to winter months. The molecular profile was dominated by low molecular weight PAHs and higher abundance of alkylated homologues over parent compounds. This characteristic, together with diagnostic molecular ratios attribute the main part of PAHs to a petrogenic origin. Aliphatic hydrocarbons were largely dominated by an UCM (Unresolved Complex Mixture), accounting for ca. 91 % of NAHs, which further confirms the dominant petrogenic origin of hydrocarbons.

Fluxes of $PAHs_{13}$ and NAHs varied from 0.29 to 0.422 and from 0.4 to 19.0 μg.m^2.d^{-1}, respectively. Alike concentrations, PAH fluxes were higher than those reported in other open Mediterranean locations, revealing that the study site is under a stronger anthropogenic influence. Various inputs of contaminants at the study site may be pointed out: riverine inputs, ship traffic and likely ship ballasting.

Temporal variations of PAH and NAH fluxes show highest values in late winter - spring. Mass fluxes appear to exert the main control on the downward transfer of PAH/NAH contaminants. High fluxes in late winter-spring months are linked to intense mixing and onset of primary production. Fluxes and concentrations of long-chain alkenones and unsaturated alkenes, biomarkers of Haptophyte algae, showed higher values in April-May and July-October, reflecting the seasonal variation of Haptophyte productivity. Organic carbon (OC) flux, describing the overall productivity of the ecosystem, also described spring and fall maxima.

OC and biogenic lipid fluxes decreased between 200m and 1000m deep samples. Surface spring and fall maxima of OC fluxes were poorly recorded at 1000m, revealing strong mineralization of the biogenic material during sinking. In contrast, PAHs and NAHs fluxes recorded at both depths were of the same order, suggesting no significant degradation and/or desorption of contaminants from sinking particles. Thus, despite consistent changes in the nature and composition of the particles during sinking, the pollutant load originating from the surface is efficiently transferred to the deep marine environment, which may act as a sink of organic semi-volatile pollutants.