

Spatio-temporal variations of organic matter along the Seine estuary (France)

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Organic matter (OM) in aquatic systems plays an important role in water quality and biogeochemical processes. It is thus essential to characterize OM, especially in estuaries which are the place of the transport and the reactivity of natural and anthropogenic compounds. However, the characterization of OM in estuaries is complex due to its heterogeneity and variability in addition to specific features of these environments (salinity, turbidity...). Two types of aquatic OM, namely particulate (POM) and dissolved (DOM) are commonly distinguished by filtration. Due to its low concentration in estuaries (few mg/L), DOM has to be concentrated prior to its molecular (or structural) analysis. However, this step also induces the concentration of salts which are predominant (several g/L) in coastal environments. To overcome this issue, DOM has been isolated by a combination of reverse osmosis and electro dialysis. This method is more efficient than classical ones (ultrafiltration, solid phase techniques) in the isolation of representative DOM material. As a result, DOM can be characterized just as POM and sedimentary OM.

The aim of this study is to characterize the spatiotemporal variability of DOM, POM and sedimentary OM along the Seine estuary (France) so as to understand its role in the functioning of this ecosystem.

To this end, 5 sampling campaigns were performed in the Seine estuary between January 2015 and April 2016, during which large water samples (100 L) and sediment cores (10 cm) were collected. These campaigns covered the whole estuary. The three OM pools were analyzed through (i) elemental and isotopic analyses (Elemental Analysis-isotope ratio Mass Spectrometry, ^{14}C ages) and (ii) structural analyses (^{13}C solid state nuclear magnetic resonance, pyrolysis coupled with gas chromatography and mass spectrometry and ultrahigh resolution mass spectrometry), allowing to obtain both bulk and molecular information.

The combination of these chemical characterization and statistical analyses shows that the 2 main factors driving the composition of OM in the Seine estuary are the OM pool (DOM, POM or sedimentary) and its origin (marine vs freshwater) whereas seasonal variations appear less pronounced. Indeed, OM exhibits higher C/N ratio and is richer in aliphatic and alkoxy carbons than POM and sedimentary OM. The latter share the same elemental and isotopic composition but POM is enriched in aliphatic carbons with respect to sedimentary OM. These results confirm the higher hydrophilic nature of DOM when compared to POM and that the sedimentary OM in the Seine estuary is close to POM. Moreover, the dating of OM shows that DOM and POM are recent (> 1950 AD) contrary to sedimentary OM. When going downstream along the estuary, DOM is depleted in aliphatic carbons and enriched in alkoxy carbons, the reverse trend being observed for POM. Both are enriched in $\delta^{13}\text{C}$.