INFLUENCE OF BIOTURBATORS ON THE QUALITY OF ORGANIC MATTER IN THE NORTH INTERTIDAL MUDFLAT OF THE SEINE ESTUARY (FRANCE)

A. Huguet¹, J. Lebrun-Thauront¹, J. Maubert¹, C. Anquetil¹, J. Morelle², F. Orvain², M. Sourzac², E. Parlanti³

¹UMR METIS, Sorbonne Université/CNRS/EPHE, France ²UMR BOREA, Univ. de Caen, France ³UMR EPOC, Univ. Bordeaux/CNRS/EPHE, France

Intertidal mudflats play a key role in the ecological functioning of estuaries, as they represent the main feeding area of numerous fishes and birds and are inhabited by benthic organisms. They are strongly linked to the estuarine hydrosedimentological dynamics and play a key role in the biogeochemical processes taking place in estuaries.

Over the last decades, the Seine Estuary (NW France) – one of the major French estuaries characterized by a strong anthropogenic pressure – was largely altered by and for human activities. Even though intertidal mudflats are still present along this Estuary, their surface was divided by 3 since 1975. The Seine Estuary was indeed subjected to drastic modifications due to port constructions, leading to the disappearance of mudflats and benthic organisms living there. Maintaining the vegetal productivity, mainly related to benthic algae, is essential to improve the quality of these habitats and their availability for the organisms feeding on plankton. It is especially important to relate the morphological and sedimentological conditions of intertidal mudflats to (i) the qualitative and quantitative properties of the organic matter (OM) and to (ii) the nature and activity of benthic communities in such settings.

The aim of this work was to characterize the OM in sediments and interstitial waters of the North intertidal mudflat of the Seine Estuary – the largest of the estuary (320 km²) – and to determine its properties and sources in relationship with the presence of benthic organisms inhabiting this ecosystem. Two bioturbating species are predominant in this mudflat: the annelid worm Hediste diversicolor and the bivalve Scrobicularia plana. The influence of these bioturbators on the OM quality was tested in situ by using 4 different treatments in separate plots: (i) enrichment of the mud in H. diversicolor, (ii) enrichment in S. plana, (iii) artificial defaunation of the mud and (iv) control plot. These treatments were made in triplicates. As the type of sediment can also have an influence on the biogeochemical processes occurring in sediments, these experiments were performed in two different zones of the mudflat separated by a hundred of meters and differing by the granulometry of the sediment (silty/sandy). These experiments were repeated in February and October 2018 to take into account the seasonal variability of the mudflat functioning. Sediment cores of 10 cm-diameter and 20 cm-depth were collected in each treatment plot and divided into 6 slices: 0-1 cm; 1-2 cm; 2-3.5 cm; 3.5-5.5 cm; 5.5-7.5 cm; 7.5-10 cm. The effect of (i) the sediment granulometry and (ii) the presence of bioturbators on the quality of the OM was investigated by analyzing lipid biomarkers (e.g. n-alkanes, fatty acids, alcohols, GDGTs) in the different sediment layers. In addition, dissolved organic matter (DOM) present in the corresponding interstitial waters was analyzed by excitation-emission matrix (EEM) fluorescence spectroscopy.

The samples collected in February 2018 did not reveal any obvious differences in terms of lipid distribution between surficial (0-1 cm depth) and deepest (7.5-10 cm depth) sediment
whatever the treatment or sampling zone (silty vs. sandy sediment). Thus, odd long chain n-alkanes (> C25; Fig. 1) and even long chain alcohols were predominant in all samples, suggesting that these compounds are mainly derived from terrestrial plants in this mudflat. In contrast, fatty acids were dominated by even short chain (<C20) homologs implying that they mainly have a microbial/algal origin. Altogether, these preliminary results suggest that, whatever the type of sediment, bioturbators do not have a major influence on sedimentary OM properties, which may be due to the low biological activity in winter.

Regarding interstitial DOM, qualitative and quantitative differences with depth and between silty and sandy sites were observed. An increase of fluorescent DOM intensities was observed with depth with a global trend to an increase of DOM degradation. However, specific sediment layers were pointed out by optical indicators of biological activity at various depths depending on site and sampling date.

Analysis of OM in the sediment and interstitial water samples collected in October 2018 is currently performed and should allow determining if there is a seasonal influence of bioturbators on the OM characteristics taking place in the North intertidal mudflat of the Seine Estuary. All the data will be used to develop a model of microphytobenthic primary production taking into account the hydrosedimentological and biogeochemical processes occurring in intertidal mudflats.

**Figure 1.** Average chain length distribution of n-alkanes in surficial (0-1 cm) and deep (7.5-10 cm) sediments of the silty and sandy sites. Data of the different treatments were combined.