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Towards A Sediment-Based Epidemiology?

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Settling basins found in sewage networks mostly collect coarse particles [1]. This material accumulates prior to more or less regular cleaning, and one can consider that the particles accumulated between each cleaning, although coarse, record a molecular signal that reflects the contamination of the wastewater.

With the very strong recent development of wastewater-based epidemiology, which consists in estimating the uses and health states of the population based on the wastewater chemical composition, the aim of this study is to consider these sediment accumulations as archives of the latter.

Several sediment cores were collected by gravity coring before cleaning in decantation tanks in Orléans and Paris, France, in combined sewer networks. A total of 12 cores, sub-sampled into 200 samples, were recovered.

Samples were characterised by various methods to assess particle size distribution, total organic carbon and elemental composition. In addition, they were extracted with methanol by accelerated solvent extraction to recover the moderately polar organic molecules adsorbed on the particles. Analysis through liquid chromatography coupled with tandem mass spectrometry was used to detect 60 molecules (mostly pharmaceuticals and illicit drugs), 54 of which were quantified at least once.

The analyses highlighted the very significant geochemical heterogeneity of the samples, within the same core, with 2 main types of facies, very coarse and mineral facies, and organic and less coarse facies [2]. These two facies can be explained in particular by the two types of wastewater at the origin of these deposits, rainwater in the case of the former, and black and grey waters in the case of the latter.

This sedimentological heterogeneity also has an impact on the evolution of organic molecule content, with very distinct levels between organic and mineral facies. These rapid and abrupt changes in content make direct interpretation of usage arduous.

Two trends have been observed, with (i) neutral or negatively-charged molecules whose content is strongly correlated with total organic carbon, and (ii) positively-charged molecules whose content is uncorrelated [3]. Therefore, before considering using this typology of sedimentary archives to retrospectively estimate the state of health of populations, and in particular healthcare practices, some corrective work remains to be carried out. While for non-cationic molecules, normalization to organic carbon seems particularly promising, for cationic molecules, the combined role of organic and mineral surfaces seems to play an important role in their affinity with particulate material, making this normalization more difficult to achieve to reveal the full potential of these archives of everyday practices in the areas collected.

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