

Ecole Doctorale des Sciences Fondamentales

Title of the thesis: FROM MACROPLASTICS TO MICROPLASTICS: FROM RIVERS TO OCEANS

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Summary :

The discovery of the presence and accumulation of plastic wastes in the seas and oceans has given rise to a great number of scientific studies and reports about this major environmental concern. We are far from knowing everything about the real impact on human life. Nevertheless, it is now known that macro-waste plastics abandoned in the environment will undergo **fragmentation during their aging** generating then particles of increasingly small sizes (microplastic and nanoplastic). In addition to this fragmentation process, they interact and fix persistent organic pollutants (POPs), which makes them potentially toxic to human health as they may be ingested by marine species, entering thus in the human food chain. Finally, it is also known that the vast majority of these microplastics originate from lands and not from coastal or maritime areas.

More recently, the presence of microplastics has been demonstrated in freshwaters (rivers and lakes), serving as transport routes from the lands to the seas.

Freshwater microplastics are very interesting to study because they are at origin of a process that will transform a plastic macrowaste (with a low concentration of POPs) into a microparticle with an increasing amount of fixed polluting molecules. Several questions remain to be elucidated:

- What is the average duration of this process: land → River → Sea?
- At which step of the process do the microplastics fix persistent organic pollutants?
- What is the impact of the aging?

We are carrying out researches on freshwater microplastics with a dual approach. The first part consists of simulating in the laboratory the different conditions of aging (UV irradiation in dry state, in freshwater environment, in salt water environment). The second is a field approach within the PLASTICCAGE project which is developed in real fluvial environments (Allier River). The methodology adopted consists in attempting to a full screening as complete as possible both for the liquid phase (IR spectroscopy, chromatography (gas and liquid)) and the solid phase (IR, rheology).

The applicant will have skills in analytical techniques. He / she will have to carry out chemical analysis methods and protocols on both laboratory and field experiments. In particular, he / she should focus on developing studies on the transfers and the interactions of chemical molecules from the aged polymer to the aqueous medium. He will have to develop precise methodology for collecting microplastics both from sediments and river water. A main challenge will be to try to get an idea of the age of these materials by measuring the level of aging.