Titre

Speciation in marine radioecology, contribution and limitation

Environnemental chemistry of the radionuclides and radioecology emerged in response to problems from radioactive fallout associated with nuclear weapons testing in the cold war period. But to date the mechanisms of dissemination of radionuclides resulting from an accidental release in the environment is still a scientific but above all political and social issue. Hence, the need for managing the risk, for controlling the environmental fate and transport of radionuclides, and for preventing human exposure through direct contact and indirectly through the food chain is essential. Among the environmental compartments, seawater represents the largest proportion of the hydrosphere, it covers by itself about 71% of the earth’s surface and it is often considered as the final repository of pollution. It is therefore crucial to understand the transfer and accumulation mechanisms of radionuclides in marine ecosystems. Speciation is poorly described in seawater systems but also more generally in the environment because of its complexity and large dilution factors that most often preclude direct speciation. Therefore, in order to shift from descriptive to mechanistic approaches the use of speciation tools in model ecosystems must be tuned up.

In 2012, we started to work on the mechanisms of contamination of several actinides (uranium, neptunium, americium and surrogate europium), fission products (cesium) and activation products (cobalt) on marine species (sponge, sea urchin, mussels) in well-controlled marine systems. By describing the speciation of the above metallic radionuclides, we explored the occurrence of soluble and insoluble species in seawater leading to potentially bioavailable and bio-transferred species. We have answered this question by doping natural seawater with the metallic radionuclides of interest in order to be able to perform direct spectroscopic investigation and thus to decipher their molecular form. In parallel, the uptake of metallic radionuclides has been monitored in vivo. Sea urchin Paracentrotus Lividus known as a possible sentinel species for heavy metal accumulation has been selected to further address ecotoxicological questions. To do so, we have combined several spectroscopic techniques mostly based on X ray Absorption Spectroscopy (XAS) in bulk mode and spatially resolved mode (imaging); together with electron microscopy images, speciation modeling and quantum chemical models.

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Cordiale invitation à toutes et à tous !

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