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Bioaccumulation and speciation of europium in sponge A. Cavernicola

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The fate of radionuclides in the marine environment remains a major concern in our modern societies[1], specially after the recent event of Fukushima in 2011. Among the environmental compartments, the hydrosphere is ubiquitous and can transport compounds or elements over long distances. Among the radionuclides of concern, actinides are the heaviest elements involved in nuclear activities. Surprisingly, very little is known about the speciation of actinides in sea water[2] and their accumulation in marine organisms. Improving knowledge on the interaction between actinides, sea water and marine organisms is therefore essential to better understand the transfer mechanisms from the hydrosphere to the biosphere and to evaluate their global impact on the environment. Marine sponges have already been identified as hyper-accumulators of several trace elements and are proposed in this case as model biomonitor organisms[3].
To address this question, we have focused the present study on americium (III), an actinide with a relatively simple RedOx chemistry compared to plutonium or uranium. Yet because of the relatively high specific radioactivity of americium, europium (a stable lanthanide with chemical properties very close to that of americium) was also used as a chemical surrogate.
The use of speciation calculations conforted by the X-ray Absorption Spectroscopy (XAS) allowed to study the speciation of europium and americium (III) in the sea water. The europium is assumed to interact with carbonates and humic substances. A similar behaviour seems to be observed for americium. In a second step, the accumulation of europium (III) was investigated in the Mediterranean sponge A. Cavernicola. This sponge is commonly found in the caves off the coasts of the Northwestern Mediterranean and previous studies have shown that it has a substantial capacity for metal accumulation[3]. The amount of europium integrated in sponges exposed to the radiotracer 152Eu was monitored using a high-purity Ge gamma spectrometer. Despite the relatively low levels of accumulation, the X-ray Absorption Spectroscopy (XAS) spectra at the europium LII edge showed a specific phosphate interatomic distance. This phenomena could be explain by an interaction with the bacterial membrane. Furthermore, the use of STXM (Scanning Transmission X-ray Micrsoscopy) showed that the europium in the sponge is located where the bacteria are.

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