

1 Master thesis in (environmental) Radiochemistry

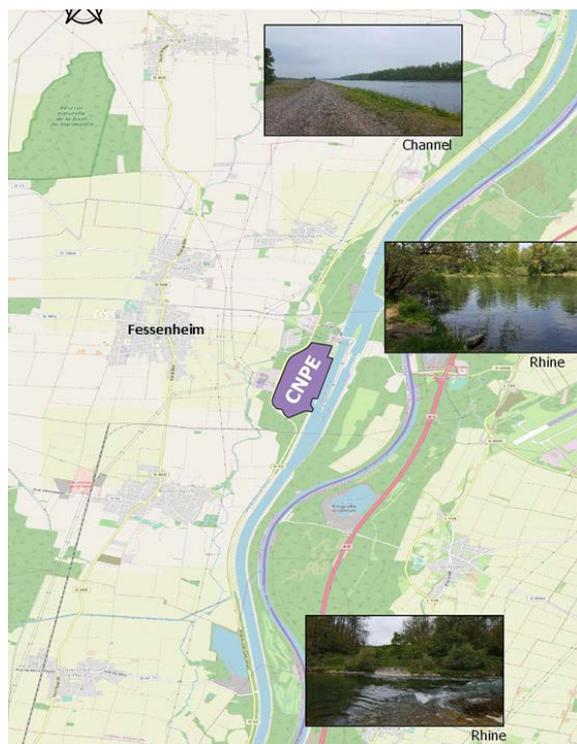
Topic

Characterization of (micro)pollutants and their (in)organic nanovectors around a decommissioning site: Application to the Grand Canal of Alsace and the Old Rhine (Fessenheim, Alsace, France)

Background

Over the last decades numerous human activities have emitted and released to terrestrial and aquatic ecosystems around urbanized and industrialized territories various metallic (micro)pollutants including radioactive isotopes (called hereafter more generally metallic trace elements, MTEs). This is a main environmental issue due to their variety, their potential toxicity and the complex mechanisms controlling their fate in the environment. Thus, an emerging scientific challenge at international level is to identify and to model the interactions between the MTEs and the main vectors of their aquatic mobility, i.e. the organic matter (OM) and the (in)organic nanoparticles (NPs).

These issues also arise in the context of the decommissioning of nuclear facilities as the potential conversion of these industrial areas to other types of land use calls for a comprehensive methodology to assess the site and its status. In this context, a scientific in-depth analysis based on the use of modern ultrasensitive analytical methods is required for the assessment of the environmental impact caused by decommissioning operations *before, during and after*.



In the frame of the European Campus EUCOR, we have initiated a project involving three partners: the INE (KIT, Germany), the IPHC (University of Strasbourg, France), the ENSCMu (University of Haute-Alsace, France). The objective is to initiate a cross-border expertise center (*via* the pooling of the specific expertise and advanced analytical techniques) to study and better understand the MTEs dynamic in natural aquatic biotopes.

The aim of our project and of the present Master thesis is to gain data providing valuable information at hitherto not available sensitivity and quality on the environmental status of a specific region. It refers presently to the Rhine aquatic biotope (limited to the Upper Rhine region and the Grand Canal of Alsace, see Figure), thus close to the future decommissioning site of Fessenheim (France).

Work description

The entire work is distributed into several tasks between the partner institutes. For this specific part, the work will be done at **KIT/INE (Karlsruhe, Germany)**. Travel and accommodation expenses will be covered by the EUCOR project. In the frame of the cross-border student training, students from IPHC and ENSCMu are greatly encouraged to apply.

The Master thesis (open in February 2021) will consist in application of Gamma-Spectrometry and AMS:

- (i) Analysis of radioactive MTEs, namely ^{137}Cs , ^{60}Co , ^{236}U , ^{237}Np , ^{239}Pu and ^{240}Pu ,
- (ii) Dedicated sample preparation for ^{137}Cs and ^{60}Co determination with Gamma-Spectrometry and successively for ^{236}U , ^{237}Np , ^{239}Pu and ^{240}Pu with AMS,
- (iii) AMS measurements with beamtime allocation at the Vienna Environmental Research Accelerator (VERA), University of Vienna, Austria,
- (iv) Identification of the source of radioactive contamination, i.e. global fallout and possible releases from Nuclear Power Plants, by using the isotopic ratios of the investigated actinides as well as the measured activity of ^{137}Cs and ^{60}Co ,
- (v) Study of the environmental behavior of the radioactive MTEs in the Rhine aquatic biotope close to the future decommissioning site of Fessenheim, France.

Methods:

- Sample collection and preparation
- Radiometric technique (Gamma-Spectrometry)
- Ultra-trace analysis (AMS)

Publications

Quinto F., Blechschmidt I., Garcia Perez C., Geckeis H., Geyer F., Golser R., Huber F., Lagos M., Lanyon B., Plaschke M., Steier P., Schäfer T. *Multiactinide Analysis with Accelerator Mass Spectrometry for Ultratrace Determination in Small Samples: Application to an in Situ Radionuclide Tracer Test within the Colloid Formation and Migration Experiment at the Grimsel Test Site (Switzerland)*. Anal. Chem. **2017**; 89, p. 7182–7189.

Quinto, F., Golser, R., Lagos, M., Plaschke, M., Schafer, T., Steier, P., Geckeis, H. *Accelerator Mass Spectrometry of Actinides in Ground- and Seawater: An Innovative Method Allowing for the Simultaneous Analysis of U, Np, Pu, Am, and Cm Isotopes below ppq Levels*. Anal. Chem. **2015**, 87, p. 5766–5773.

Quinto, F., Steier, P., Wallner, G., Wallner, A., Srnecik, M., Bichler, M., Kutschera, W., Terrasi, F., Petraglia, A., Sabbarese, C. *The first use of ^{236}U in the general environment and near a shutdown nuclear power plant*. Appl. Radiat. Isot. **2009**; 67, p. 1775–1780.

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