# Multiscale study of radionuclides variability near former french uranium mines

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Accumulations of radioelements occurred in the area near former uranium mines, due to preferential direction of stream water that collects run-off and water from the mine (Vera Tomé *et al*, 2002). Some riverbed sediments show enhanced radioactivity due to wastewater discharges from mining and milling works (Barth *et al*, 1998, Carvalho *et al*, 2007). Environmental contamination is larger in areas where the radioactive ore was chemically extracted (Carvalho *et al* 2007). The aim of this study is to investigate the distribution of radioelements from U-Th decay chains in the environment of French uranium former mines. In this work, we investigate two different former French uranium mines: Bertholène and St Alban sur Limagnole. At Bertholène, ore was treated with *in situ* heap leaching in order to pre-concentrate uranium. In St Alban mine, the ore was extracted but not treated. A study was carried out in the environment near the both sites up and downstream of the mine area. We combine a radionuclide map using a mobile gamma-spectrometer associated with discrete soil sampling in order to determine the radionuclide activities and disequilibrium along soil profiles. XRD, SEM-EDS and BCR Sequential Extraction were performed to determine radionuclide repartition and forms. Activities of radionuclides from the head chain of $^{238}U$ can be as high as 21000 Bq $Kg^{-1}$ in riverbank soils contaminated by annual winter floods. Based on the sequential extraction, we show that uranium is mainly associated with Fe and Mg oxydes.

[1] Barth *et al* (1998) *Wat.Sci.Tech*. **37**, 6-7, 257-262 [2] Vera Tomé *et al* (2002), *J. Environ. Radioact*, **59**, 41-60 [3] Carvalho *et al* (2007), *J. Environ. Radioact*, **96**, 39-46